CITY OF DALLAS

INTERIOR LEVEE DRAINAGE STUDY

WEST LEVEE – PHASE II

VOLUME 2 of 2 – PUMP STATION ASSESSMENTS

January 2009

Prepared for:

The City of Dallas, Texas

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Large Able (LAX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. LARGE ABLE PUMP STATION (LAX)

600 South Industrial Blvd.
Dallas, TX 75207
Mapsco 43D

Year Built: 1953

Current Design Pumping Capacity: 3 – Peerless 48" 500 hp, 505 rpm, 46,667 gpm vertical pumps for 140,000 gpm. 1 – Low Flow Aurora pump 16" 100 hp, 1200 rpm, 6,000 gpm.

Overhaul Program: Pumps #2 & #6 currently pulled and sent in for overhauls. Switchgear replaced and SCADA installed 1990/91.

Photo 1.1 – Large Able (LAX)

2. MAINTENANCE PROGRAM

The current contract between the City of Dallas and the US Army Corp of Engineers (USACE) dictates a condition level that can only be met by an overhaul of equipment. This contract should be reviewed and revised to reflect new technologies that could provide significant repair cost savings to the City of Dallas.

Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. Metering equipment would allow personnel to determine a unit's efficiency, which can be affected by many mechanical conditions. Vibration analysis can determine, among other things, improper alignment, bad or worn bearings, soft foot, impeller wear or in-balance, and shaft problems. Additionally, thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues.

A monitoring program would enable personnel to diagnose potential problems prior to failure which would translate to a savings to the owner. Such a program could provide better assurance of reliability than performing overhauls periodically on a schedule or upon a breakdown.

3. LAX ASSESSMENT

Interviews were conducted with management and maintenance staff to gain a better understanding of current practices, conditions, concerns and suggestions. An inspection of the site was conducted to evaluate and assign a condition rating of the station and its equipment.

3.1 OPERATIONS

This station is controlled and monitored by the Supervisory Control and Data Acquisition (SCADA) System located in Flood Control's main office at 2255 Irving Blvd. This system allows an operator to monitor and control multiple stations from one location. More detailed information on what information and controls the SCADA System provides is included in the SCADA section.

In the event of SCADA System failure, personnel are able to manually operate this station from the cabinet at the south end of the switchgear by switching controls from remote to local and selecting the start or stop switch. (Photo 3.1)

Photo 3.1 – LAX Switchgear and Pump Controls

Indicator lights, trip relays and labeling provide the necessary information to an Operator. An operational chart presents guidelines as to when each unit is to be put on-line or off-line.

Approximately ninety percent of this division's man-hours are used maintaining equipment and facilities, grounds keeping and special projects. The remaining ten percent required to perform operational duties does not allow for a separate operational staff, as is used in other departments within the City of Dallas. This division has training and testing programs to train personnel to operate the Flood Alert System, Pump Stations, and SCADA System.

At the time of this report, units #6 and #2 have been removed for scheduled overhauls. Unit #6 is the low flow unit for the Able site while unit #2 is one of the main storm water pumps.

The Large Able Station (LAX) has three main vertical pumping units and one low flow unit. All can be operated within the station, but normal operations are executed and monitored by means of the SCADA System located in Flood Control's main office at 2255 Irving Blvd. This station has been designed with very little work area. Though the area meets the three foot minimum clearance required by code, the distance between electrical switchgear and pumping units is small and this tight area makes it difficult to roll out and remove the electrical gear in the cabinets.

Concerns and Issues

The layout of the station is a concern as it is a compact area with little room to work. The clearance between the pump and switchgear could prove to be unsafe for employees rolling out the switchgear for maintenance activities. (Photo 3.2) When equipment is pulled, its removal leaves a dangerous opening in the floor. (Photo 3.3) This opening needs to be barricaded to prohibit stepping over. Additionally, a temporary

handrail system able to prohibit entry and stable enough to withstand a person falling into it would provide more safety. As another option, a steel plate with enough strength to support walking traffic could be provided to cover the entire opening.

There are no emergency lights or lit exit signs for personnel that might be in the building at the time of a power outage. The designated emergency should be equipped with a kick or panic bar. Also, there should be an emergency exit at both ends of the building.

The City of Dallas should consider modifying or replacing this station in order to provide a more safe work environments for their employees.

Photo 3.2 - LAX Walk Space

Photo 3.3 - LAX Unit Two Pulled

3.2 EXTERIOR EQUIPMENT

LAX is located to the South of the original Small Able Station (SAX). Both LAX and SAX share operational importance. SAX is included in the pumping sequence, rather than being utilized as a back-up station, as seen at the Baker and Hampton sites. This site location has a shared sump area and the screens for both stations are affixed side by side. There is not any physical damage to the LAX screens, however the rakes are out of alignment. SAX rakes adjoin the LAX screens and do not have an automated rake system. It appears that personnel are required to move debris from SAX to LAX for removal as there is no other suitable method available. Because the LAX rakes were not designed to convey debris from both LAX and SAX, the added load from SAX may exceed the capacity of the LAX rake system. (Photo 3.4)

Photo 3.4 - LAX AND SAX Screens, Rakes on LAX Out of Alignment

Photo 3.5 - SAX Sump Inflow from the North

Photo 3.6 - SAX Sump Inflow from the South

As mentioned above, the screens do not show any damage. However, this site is more vulnerable to impacts by large objects due to the flow pattern of incoming flood water maintaining some velocity. (Photos 3.5 & 3.6)

This sump area has a large amount of trash floating into the screens such as cans, plastic bottles, and paper. The rakes are not designed to pick up this type of debris resulting in trash blowing up onto the levee property and personnel spending hours removing it by hand. A row of troughs added to the rakes could provide a solution for this problem that could possibly be designed in-house. The total debris from all flood water stations averages 36 to 72 cubic yards per 1.5" rain event and as much as 240 cubic yards when rainfall exceeds 2.0".

The LAX conveyor system is operational, but maintenance intensive. (Photo 3.7) According to system mechanics, every conveyor system at each station is different, and all of them are labor intensive. The conveyors create the majority of their workload. Having different equipment at each location prohibits the standardization of the parts inventory which leads to higher costs for maintaining inventory, both in parts required and space to store them. Storage at this station is also a major problem.

Photo 3.7 - LAX Conveyor System

There are numerous businesses and their adjacent parking areas located near the station and any waste coming from these areas flows directly into the sump's channel. The possibility of hazardous waste coming from these businesses is not currently monitored. The debris coming into the site is hauled to a pubic landfill. There are restrictions on what may be deposited at these landfills, and if hazardous material is being spilled into the sump's channel, additional costs could be incurred to properly dispose of this waste. Additionally, all flood waters are discharged into the Trinity River which could cause another potential health concern.

Photo 3.8 - SAX & LAX Channel to Sump Area

The extent of the monitoring of the waste from local business is not currently known, but the City of Dallas has recently created a new Environmental Department and is actively involved in environmental management. It is recommended that the Environmental Department look into this waste to prevent possible envinronmental repercussions.

Photo 3.9 - Able Site's Security Fencing

The fencing around the perimeter of Able's site and the gate at the entrance is ineffective as a deterrent to trespassing and vandalism. (Photo 3.9) The gate across the driveway entrance is not intended to stop foot traffic. The gates on the chain link fencing surrounding the site have been pulled off their hinges and left open. In order to maintain the safety of the equipment and personnel, these gates should remain operational.

There is adequate lighting around the site. Additional lighting is needed along the driveway leading to the site. This would provide additional safety to employees as they unlock and enter the entry gate.

Vandalism has occurred at the pump stations and vagrants are commonly living within the levee area. For the safety of intruders, employees and equipment, it is recommended that security and lighting in and around the site be upgraded per the recommendations above.

The turning radius of the driveway on the south end of the site (Photo 3.9) is very confining for large vehicles. The location of the transformer yard makes it difficult to increase the turning radius to accommodate larger vehicles. Pumps and motors are removed from the west side of these stations and may not pose a problem as long as the south end drive is long enough for turning around.

Photo 3.10 - LAX roof Vent Cover, Equipment Hatch and flashing

The roof is poured concrete with a membrane cover and rock overlay. There are no internal signs of leaks from the roof, but the flashing around the roof's perimeter is showing a heavy build-up of corrosion that does require attention. (Photo 3.10) There does not appear to be any physical damage to the metal, however a close inspection from the rooftop was not done.

The two vent covers and three equipment hatches are not showing any signs of corrosion. The equipment hatches are raised several inches above the roof, which prevents standing water from entering the station. This is the most important consideration when altering the hatches on the roof at any facility.

The brick work appears to have been re-grouted in the recent past. There also appears to have been repairs or replacement of brickwork on the roll-up door on the west wall. There is a crack running down the exterior of the south wall on its east corner. The crack runs downward through several courses in a straight line breaking bricks in its path, then shifts over a half course, and then continues straight downward again breaking additional bricks along that line in its path. This crack runs over several more courses and down half the height of the building before ending. (Photo 3.11) Though the crack appears minor, but it is recommended that a structural engineer look at the problem to insure there are not any structural problems and to determine what repairs (if any) might be required. No other areas with this type of damaged were observed. This crack could be the result of the hammering and drilling required for mounting the security camera and its related conduits and junction boxes.

If this building's bricks were not re-sealed at the time of re-grouting, it is recommended that this work be added to the next available contract.

Photo 3.11 – LAX Brickwork on South Wall, East corner

Concerns and Issues

- The sump area needs an access road down into the area for ease of maintenance and a safer work environment for personnel.

- The conveyor system needs to be modified to accommodate floating debris and the additional loading that is taking place on the north set of rakes.

- The City of Dallas should investigate the type of waste and debris coming into the sump and into the station. This may already be included in their environmental work being conducted with the City's new Environmental Department.

- Every station needs a storage area. The stations at the Able site are smaller than most and there is not any room for materials or parts storage. A portable building would not provide the fortification required unless fenced as this is an isolated area where ongoing vandalism is a concern. The north end of this building has a parking area within the fence that could be used for storage purposes.

- Fence repairs are required to improve security. The gates need to be installed to secure the site. If these gates are a nuisance to maintenance and/or operations, the fence line could be moved to better accommodate activities. The City of Dallas has a price agreement in place for fence repairs and new installation.

- The flashing around the roof needs to be cleaned and sealed to eliminate the ongoing corrosion.

- There is damage to the brickwork on the south wall at the east corner. This should be looked at by a structural engineer to determine if repairs are necessary.

3.3 INTERIOR EQUIPMENT

LAX is a poorly laid out pump room with little available space for working on its equipment. As mentioned above, the pumping units are very close to the switchgear. Personnel attempting to carry tools and/or equipment would have to be careful not to bump into either unit while walking between them. There are three main pumping units and one low flow pump. Two units are out of service and sent in for overhauls. There is nowhere to store the removed parts, making an already cramped space more hazardous. (Photo 3.12)

Photo 3.12 - LAX Pump Room, #2 Removed

Chemical containers, some not marked, are routinely stored in pump rooms. Depending on the contents of these containers, it is possible that some may require special cabinets and may not be permitted to be stored inside the building. This situation should be investigated by the part division's team assigned to the ecology program. (Photo 3.13)

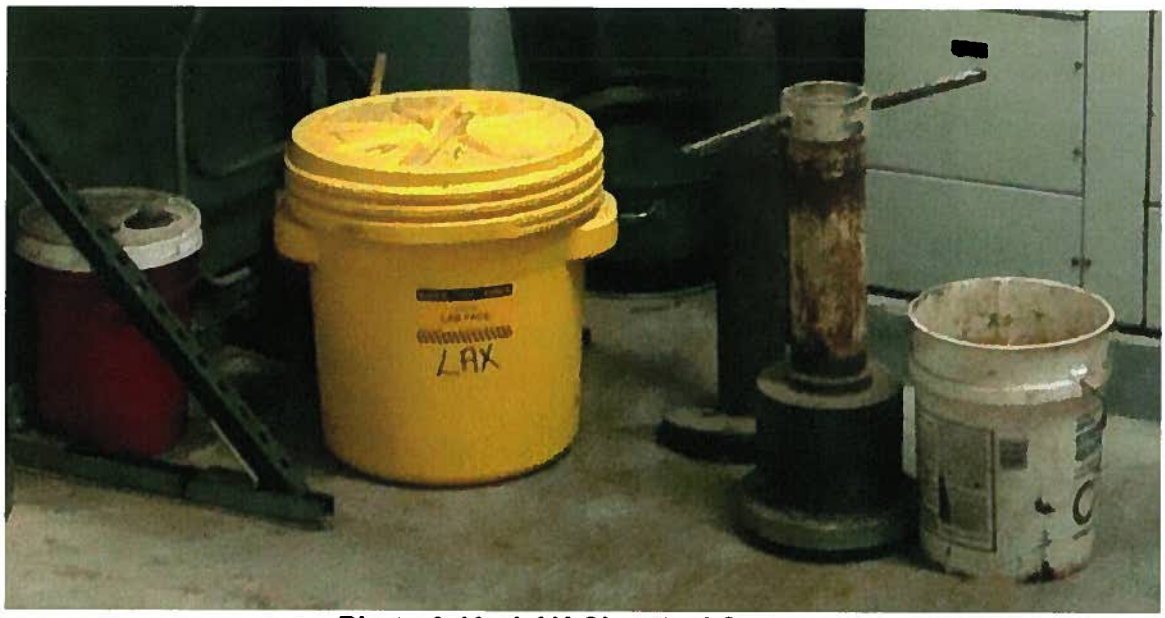

Photo 3.13 - LAX Chemical Storage

No Material Safety Data Sheets (MSDS) were observed in the station. It is suggested that each building with any chemicals on-site have a MSDS book with an up-to-date listing of all chemicals on the premises. This MSDS book should be clearly displayed and readily available to all employees.

Photo 3.14 - LAX Pump Room

The age of these pumping units is at or past their normal service life. They can continue to be serviced and used, but the cost should be looked at and determined at what point newer more efficient units would be more cost effective. Unfortunately this problem would be compounded cost-wise, because of the limited space and the fact that other stations built in the same time frame will also have aging units. These stations were not designed for future changes or expansion. (Photo 3.14)

There is not any type of emergency lights or exit signs. These are needed and can be connected to an Uninterrupted Power Supply, (UPS) emergency generator, or batteries.

Lighting in the pump room is adequate but could be improved with additional ceiling mounted fluorescent fixtures. These lamps are a little difficult to reach due to the ceiling's height, but a step ladder can be used to install/replace light fixtures. However, the previously discussed limited space does present a challenge. (Photo 3.15)

The roofing structure is poured in place concrete, sealed with paint. There are no signs of leakage. The equipment hatches are raised, with a bi-fold a hatch cover. (Photo 3.15)

Photo 3.15 - LAX Lighting, Hatches & Crane

The pump room has a manually operated rail and dolly with an electrically operated 10-ton crane (Photo 3.15) used to pull and install equipment. The bridge travels north – south and the dolly, east – west. All equipment in the main pump room is accessible to the crane. It is in working order and inspected by division personnel. The extraction of a pump requires a rental mobile crane that pulls the units through the roof's equipment hatches. (Photo 3.15)

Photo 3.16 - LAX Farval Lubrication System

The Farval lubrication system (Photo 3.16) provides each pump with a measured amount of lubrication at prescribed times. The transfer of grease from the storage container to the Farval's main cylinder has experienced some problems with air pockets. The delivery of grease to the farthest pump is also experiencing some intermittent

difficulties. There are alarms in place that prevent a pump from starting or that take the pump off line if the Farval system fails to operate correctly. These alarms transmit to the SCADA, informing the operator of the problem.

Photo 3.17 - LAX Switchgear

The electrical switchgear is located on a solid raised concrete base and mounted against the east wall. (Photo 3.17) The line of cabinets runs parallel to the pumping units, with a distance of +/- 3 feet between the pump motor and the front of the cabinets. The operator's controls are located on the south end of the pump's switchgear. The switchgear itself is in good operational order, but as in other stations, its age makes acquiring parts difficult and the protection devices are the old mechanical type and are not calibrated. Current personnel do not have the equipment or experience to calibrate these relays. (Photo 3.18 & 3.19) The information transmitted to the SCADA reflects these discrepancies, which are then altered within the SCADA to read, "what is believed to be correct". The City of Dallas has a price agreement that covers electrical switchgear. Calibration may also be covered under this contract.

This equipment is at or past its expected service life. Its alarm relays are minimal, requiring on-site personnel to set and reset alarm flags. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc.

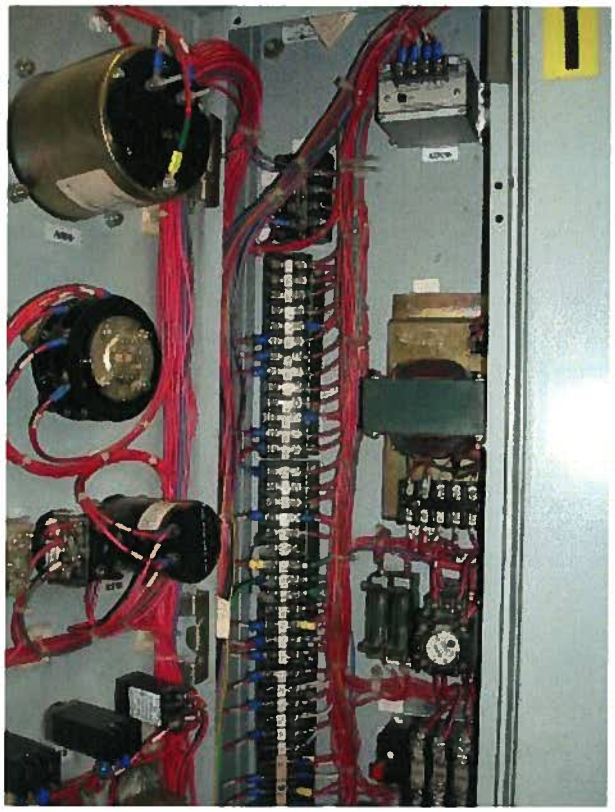

Photo 3.18 - LAX Switchgear

Photo 3.19 - LAX Switchgear

Division's electrical staff is responsible for maintaining and repairing electrical equipment, the majority of which is switchgear. All switchgear is inspected and serviced twice a year. Very minor discrepancies were noticed while inspecting random cabinets.

Ventilation of the main pump room is provided by two wall-mounted exhaust fans with exterior louvers. The air is pulled through the grates surrounding the motors. The two roof-mounted exhaust vents can release heated air, but are not motorized and may cause the exhaust fans to short circuit by pulling air from the ceiling instead of the floor grates. A smoke test would be beneficial to determine if air circulation is working correctly.

Concerns and Issues

- The overhead cranes require proper inspections along with proper documentation. To be in compliance with OSHA STANDARD 29 CFR 1926.550(a)(6), the crane requires an annual inspection to be completed before it may be operated in the United States; it states:

    - *A thorough, annual inspection of the hoisting machinery shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The employer shall maintain a record of the dates and the results of inspections for each hoisting machine and piece of equipment.*

A competent person, as defined in 29 CFR 1926.32(f), is *"one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them."*

- This building does not have any lightning protection other then the lightning arrestors within the switchgear. This has not caused any outages in the past at this location. Newer facilities are including this protection in their design.

- The Fire Department recently underwent changes in requirements for fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed but is not required to be tied into the fire department's alarms if someone is monitoring the system in-house at all times. There must be an external alarm to alert passers-by. It is recommended that the City verify whether these changes are grandfathered.

- There are three access points into this building. The south entrance is a hinged double door that has no latching hardware for the exterior. The interior is secured with a wood beam. On the west wall there is a roll up equipment access and on the North wall is the station's normal point of entry and exit. The South entrance should be refurbished or replaced with a new set of doors. Doors with safety glass would allow some much needed natural light to enter the building. Hardware should include an emergency panic bar (kick bar). This type of hardware should also be added to the north entrance. Both entrances should have a lit emergency exit sign above them.

- Every station needs emergency lighting. It is recommended that battery operated fixtures be mounted on the walls at a height that permits routine checking. These fixtures need to emit enough light to permit personnel to see the way to an exit.

- Every station needs a storage area. Personnel are placing parts and materials wherever there is room at most locations. Lockable enclosures can be installed along with shelving to provide on-site parts and materials storage

3.4 LEVEE & OUTFALL

As at other stations, there is no foot traffic access to the top of the levee. This is a steep irregular grassy surface which employees climb to check equipment at the outfall structure.

The east side of the levee facing the station is well maintained with the slope even and smooth. There is excellent grassy ground cover throughout the east side of the levee. Trash seems to be a problem at this site, both from the trash blowing in from the sump area and from the vagrants that frequent the area. (Photo 3.20) The road on top of the levee ends prior to reaching this site but there is a road at the bottom on each side of the levee to the north. These routes provide Flood Control personnel access to other areas of responsibility.

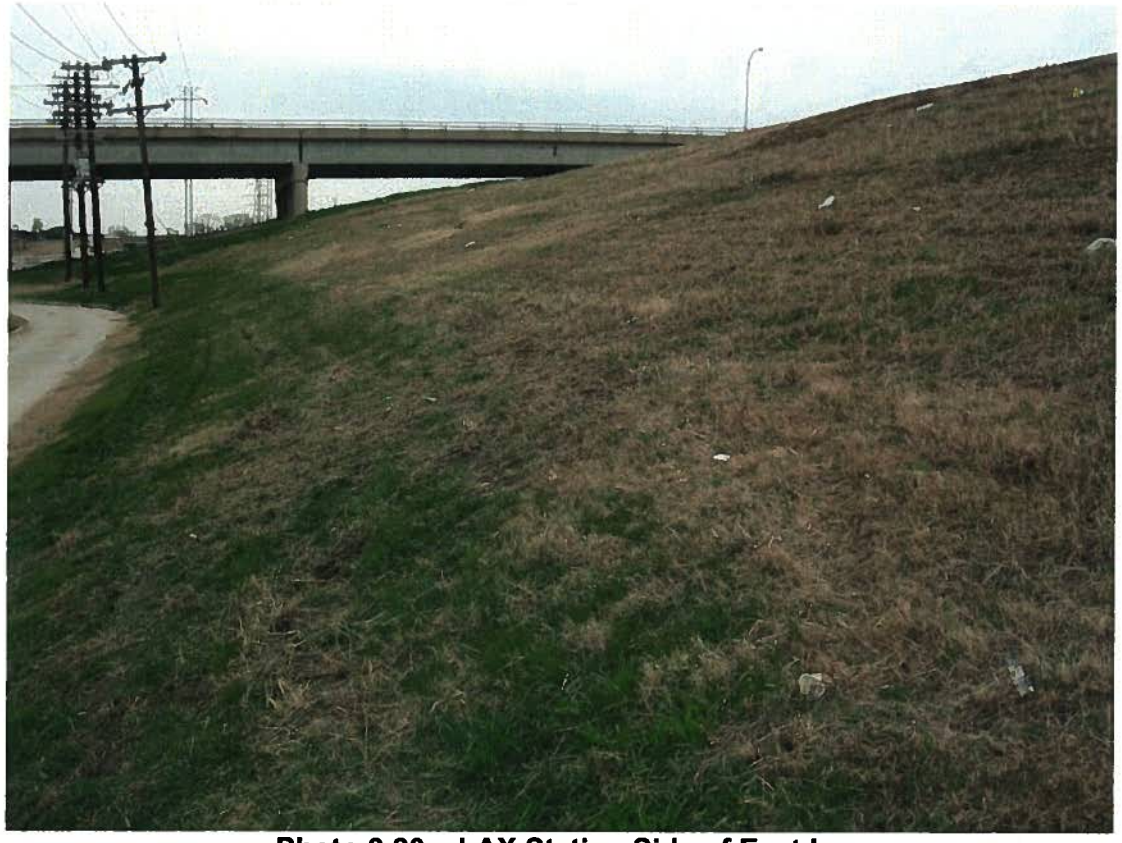

Photo 3.20 – LAX Station Side of East Levee

The west or river side of the levee to the north is in good condition. There is vegetation coving most of the slope, but vegetation is sparse in areas lacking full sunlight. (Photo 3.21) To the south, a concrete apron covers the slope beneath the bridge crossing the levee and the vegetation is growing up to the edge of the apron. (Photo 3.22)

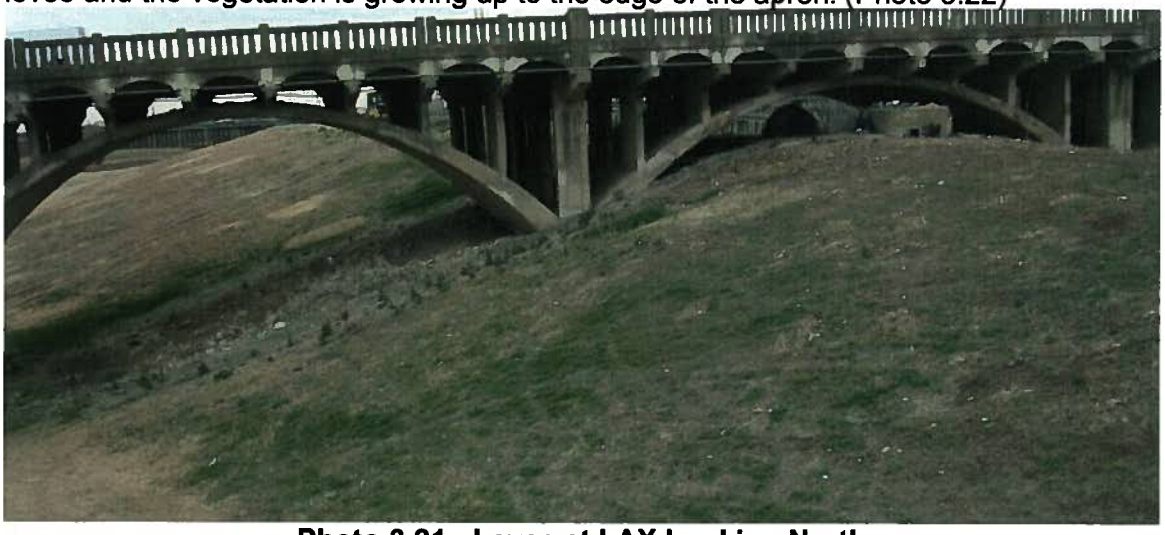

Photo 3.21 - Levee at LAX Looking North

Photo 3.22 - Levee at SAX Looking South

The slope is covered in shallow ruts that were caused during mowing, probably because the ground was wet at the time of mowing. These should level out over time.

Photo 3.23 - LAX Standpipes

The valve vaults on top of the levee are in excellent shape. (Photo 3.23) Access to these vaults should be considered a "confined space" when working within. It is not the depth but the limited entrance and confining area within that would define these valve vaults as "confined space".

Photo 3.24 - LAX Outfall structure Shared with SAX

The area surrounding the outlet structure is lightly vegetated dropping off to loose soil just above the structure. (Photo 3.24) There are no signs of previous rip-rap. Although there had not been significant rainfall at the time of observation, there were signs of water leeching from the soil above the structure. The loose soil appears to be very unstable and it is likely to continue washing down in front of the structure into the outfall area until the area is stabilized. The outlets are beneath the water's level and the water is too murky to determine any existing conditions below the water line. The exposed portion is in excellent condition.

Photo 3.25 - SAX Outlet Pond and Channel

The circular pond of water at the structure's discharge shows heavy silting on the Northwest portion of this area. (Photo 3.25) It appears this could be the soil that washed down from above the outfall structure. It is recommended that the area surrounding this structure be graded down and replaced with the appropriately sized rip-rap.

The banks along both sides of the outfall channel make a smooth transition to the water's edge with excellent vegetation growing within a couple of feet of the water's edge. (Photo 3.25) The channel to the river was clear of obstacles.

Concerns and Issues

- It is suggested that this site be considered for adding appropriately sized rip rap to surround the Outlet structure as a measure to stabilize the area.

- Personnel have no safe access up or down the levee. A stable pathway should be added.

- The addition of lights and GFI outlets installed on the valve vault of LAX would be helpful to personnel required to inspect the vaults and work on its equipment.

Small Able (SAX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. SMALL ABLE PUMP STATION (SAX)

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Dallas, TX 75207
Mapsco 43D

Year Built: 1932

Renovations: Pumps replaced with current units in 1967, SCADA added in 1991, switchgear replaced 1990/91

Current Design Pumping Capacity: 2 – Peerless 42" 300 hp, 503 rpm, 40,000 gpm vertical pumps for 80,000 gpm.

Overhaul Program: Both units scheduled for overhaul the first quarter of 2008

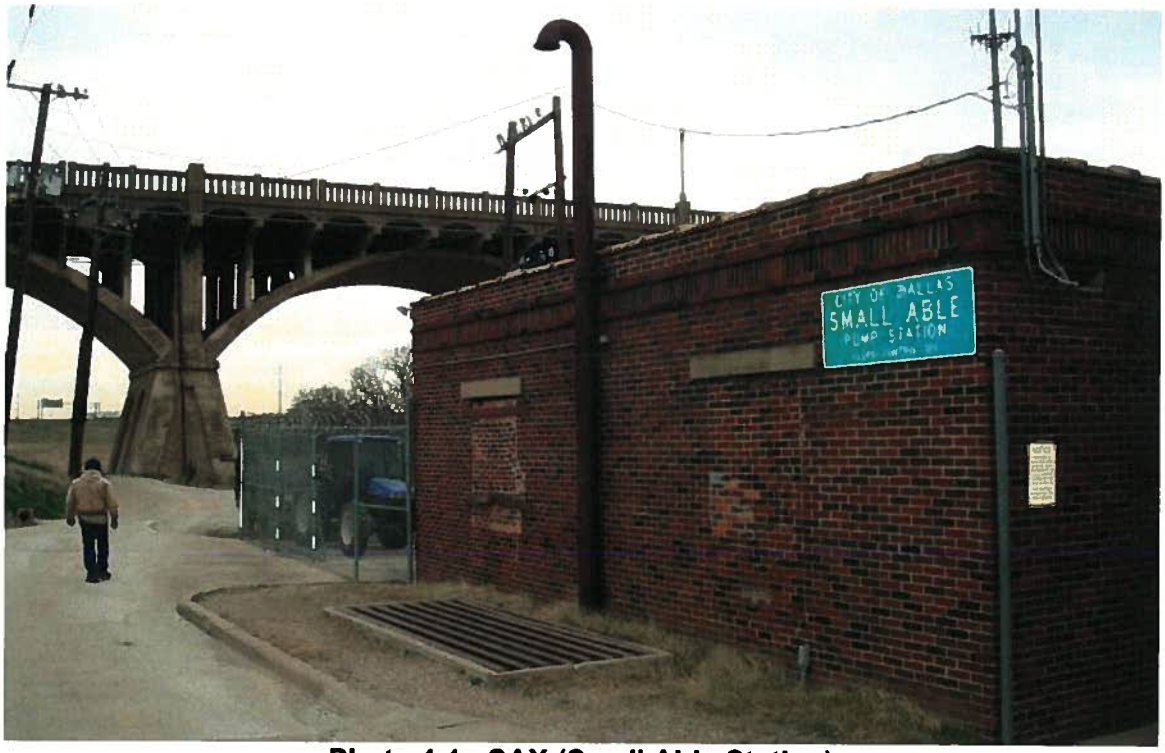

Photo 1.1 - SAX (Small Able Station)

2. MAINTENANCE PROGRAM

The current contract between the City of Dallas and the US Army Corp of Engineers (USACE) dictates a condition level that can only be met by an overhaul of equipment. This contract should be reviewed and revised to reflect new technologies that could provide significant repair cost savings to the City of Dallas.

Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. Although these stations do not generate enough revenue to require accurate metering, meters would allow personnel to determine a unit's efficiency which can be affected by many mechanical conditions. Vibration analysis can determine, among other things, alignment, bad or worn bearings, soft foot, impeller wear or in-balance, and shaft problems. Additionally, thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues. This monitoring would enable personnel to diagnose potential problems prior to failure which would translate to a savings to the owner.

3. SAX ASSESSMENT

The interviews with management and maintenance provide a better understanding of current practices, conditions, concerns and suggestions. As a result of the site inspection and interviews, an evaluation is made and a condition rating is assigned for this station and its equipment.

3.1 Operations

This station is controlled and monitored by means of the Supervisory Control and Data Acquisition (SCADA) System located in Flood Control's main office at 2255 Irving Blvd. This allows an operator to monitor and control multiple stations from one location. Detailed information on what information and controls the SCADA System provides is included in the SCADA section.

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Photo 3.1 - SAX Manual Controls on Switchgear

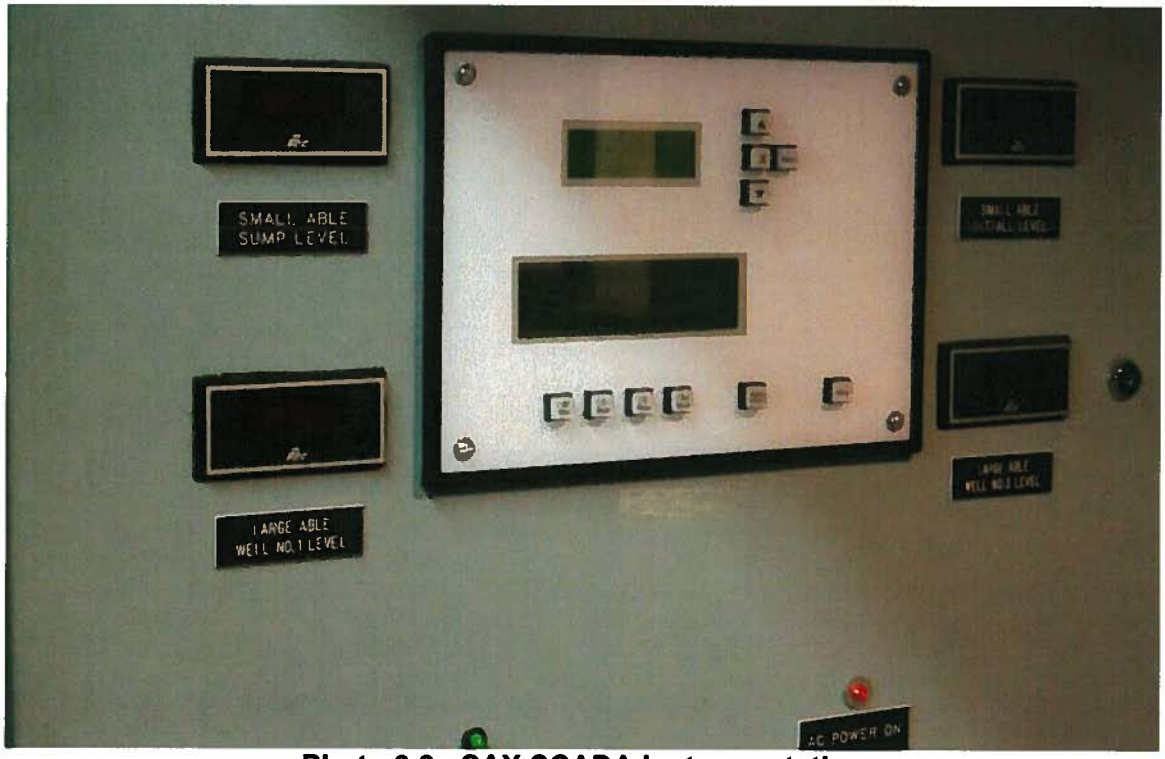


Photo 3.2 - SAX SCADA Instrumentation

The original Able Pump Station was completed in 1932. This was the same time period that OBX, CX and DX were added along the east and west levees. Able was renamed

Small Able (SAX) in 1953 when a new larger station was built on the south portion of the site, named Large Able. (LAX) The pumps at SAX were updated in 1967 and this station remains in a routine operational sequence, unlike OBX and OHX which are used only in a back-up capacity or secondary role.

The operational duties of employees in the Flood Control Division are minimal, and do not justify having a separate operational staff. This division has separate training classes to train personnel to operate the Flood Alert System, Pump Station and SCADA System and also tests its personnel prior to allowing them to perform operational tasks.

All equipment in SAX is in service and fully operational. The division has set an aggressive schedule to overhaul pumping units before the rainy season begins. At the Able site, one of the main units in LAX has been removed as part of the maintenance program. The two units at SAX are scheduled for overhaul the first quarter of 2008.

There has not been any recordable rainfall up to the time of this report. All sites will be revisited during a rain event to witness the units while running. Condition assessments will be made, based on physical inspection of each unit. This information will be documented and provided in spreadsheet format with comments.

Concerns and Issues

- There are not any safety precautions or training for those personnel required to work on clearing the screens. This is hazardous work when the station is online. A strong current to the screens is caused by the pumps. Anyone falling into the water in this area would be placed in a life-threatening situation.

- The station is located in an area frequented by vagrants, making security and safety of the site and personnel questionable. This site is open to foot traffic and only a bar crosses the driveway entrance. The fencing at the site is not secure.

3.2 Exterior Equipment

The SAX is located to the North of LAX and shares the same sump area (Photo 3.3). There was no visible damage to the screens, but some of the rakes at LAX had serious misalignment on the section closest to SAX. This could mean the incoming debris exceeds the lifting capacity of the rakes. SAX does not have a trash crane or mechanical rake system. Debris must be manually cleared with long handled rakes. There is no access to the SAX screen's landing to remove the debris. Raking the debris over to the LAX rakes would explain the overloading of the rake system's design.

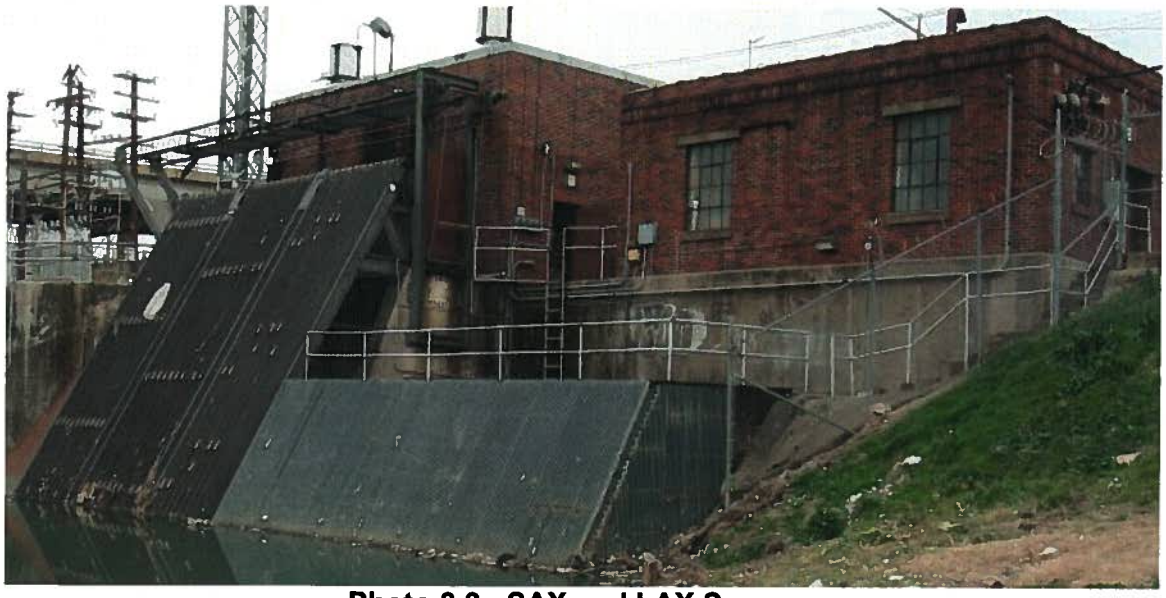


Photo 3.3 - SAX and LAX Screens

This site has a large accumulation of manmade debris around the sump area. This site is the furthest South on the east levee and closest to downtown industrial areas. Many of these industrial businesses are built right up to the banks of the channel feeding into the sump. (Photo 3.4)

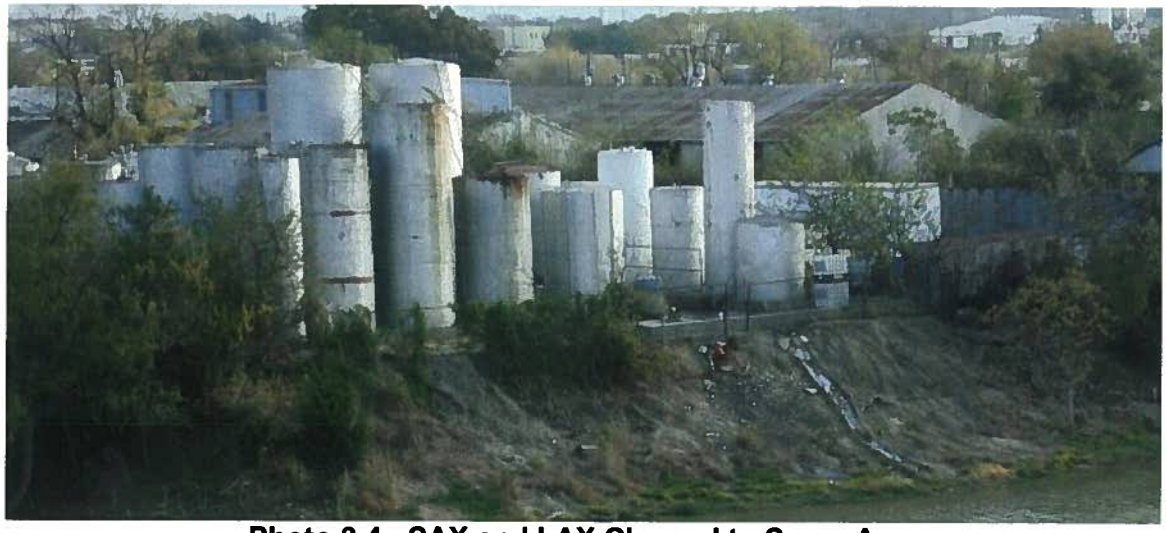


Photo 3.4 - SAX and LAX Channel to Sump Area

There are numerous businesses and their adjacent parking areas located near the station and any waste coming from these areas flows directly into the sump's channel. The possibility of hazardous waste coming from these businesses is not currently monitored. The debris coming into the site is hauled to a pubic landfill. There are restrictions on what may be deposited at these landfills, and if hazardous material is being spilled into the sump's channel, additional costs could be incurred to properly dispose of this waste. Additionally, all flood waters are discharged into the Trinity River which could cause another potential health concern.

The extent of the monitoring of the waste from local business is not currently known, but the City of Dallas has recently created a new Environmental Department and is actively involved in environmental management. It is recommended that the Environmental Department look into this waste to prevent possible envinronmental repercussions.

As mentioned above, the screens do not show any damage, but this site is more vulnerable to impacts by large objects due to the flow pattern of incoming flood water maintaining some velocity. (Photos 3.5 & 3.6)

Photo 3.5 - SAX Sump Inflow from the North

Photo 3.6 - SAX Sump Inflow from the South

The freeform concrete apron on the north end of the screen structure has begun to crack and shift. It has an imbedded drainage line discharging into the sump. This apron also

carries off drainage from the North side of the structure. This is not a structural concern but should be replaced in the next available contract. (Photo 3.7)

Photo 3.7 - SAX Drainage on North End of Screens

There is adequate lighting around the site. Additional lighting is needed along the driveway leading to the site. This would provide additional safety to employees as they unlock and enter the entry gate.

The fencing around the perimeter of Able's site and the gate at the entrance is ineffective as a deterrent to trespassers. (Photo 3.8)

Photo 3.8 - Able Site's Security Fencing

The gate across the driveway entrance is not intended to stop foot traffic. The gates on the chain link fencing surrounding the site have been pulled off their hinges and left open. In order to maintain the safety of the equipment and personnel, these gate should remain operational.

The SAX station has glass windows across the east wall facing the sump area. Although high on the wall, it would not be difficult to break and enter. The control center has intruder alarms but the center is not manned 24/7. The alarms do forward to on-call personnel.

Vandalism has occurred at the pump stations and vagrants are commonly living within the levee area. For the safety of intruders, employees and equipment, it is recommended that security and lighting in and around the site be upgraded per the recommendations above.

Photo 3.9 - SAX Brickwork and Capstones

The building as a whole appears to be in excellent condition, with only minor repairs needed. The brickwork is in excellent condition, with no signs of cracking or movement, and there are signs that the joints were re-pointed. The joints of the capstones surrounding the roof are poorly grouted and in need of attention. (Photo 3.9)

There are signs of the roof leaking on the northeast interior of the building that is also mentioned below in the section covering the interior inspection. The roof is concrete, designed with a large equipment hatch above each pumping unit to allow crane access. (Photo 3.10) These hatch penetrations do not have a sufficient lip height above the roof's surface to prevent water from entering the pump room if the roof does not drain properly. This may be part of the problem. The south hatch has a large amount of corrosion in a circular pattern, indicating the possibility of ponding. This can be seen on the southwest corner of the building's roof, which can be seen in Photo 3.10.

Photo 3.10 - SAX Roof, South End

There is minor corrosion on the North equipment hatch, but only on the edges. Cleaning and painting is all that would be required. The scupper or downspout may be partially blocked and is also leaking at its point of penetration. The roof's surface is clear of any debris and there are no dark areas indicating a ponding problem on the remainder of the roof.

There are also three roof penetrations for ventilation. Two of these are just vent penetrations that are original to the building, and are in excellent condition. The newer is an exhaust fan with an aluminum cover. The cover is in excellent condition, but the fasteners are corroding and should be changed out before they become a problem.

Photo 3.11 - SAX Vandalized North End of Building

Vandals had broken out safety glass panels on the north side of the building. Although these are walled over inside, the broken glass is a safety hazard. There are glass windows on the east wall which have not been vandalized. It is suggested that both areas utilize panes of Lexan glass to eliminate future concerns. Placing a solid panel in

front of the windows on the east wall would offer protection to the existing panels. (Photo 3.11)

Concerns and Issues

- Renovations and new construction should include a paved surface to the screen area to allow access to remove debris. A mechanical method of removing debris from the SAX screens is also needed to replace of the use of manual rakes. The design should take into account the amount and type of manmade debris coming into this location. The rake system's design at LAX is not able to lift soda cans, plastic bottles and other forms of small floating objects.

- The sump area needs an access road down into the area for ease of maintenance and a safer work environment for personnel.

- Every station needs a storage area. The stations at the Able site are smaller than most. There is not any room for materials or parts storage. A portable building would not provide the fortification required, unless fenced. This is an isolated area where ongoing vandalism is a concern. The north end of this building has a parking area within the fence that could be used for this purpose.

- Re-pour the north apron attached to the screens.

- Fence repairs are required to improve security. The gates need to be installed to secure the site. If these gates are a nuisance to maintenance and/or operations, the fence line could be moved to better accommodate activities. The City of Dallas has a price agreement in place for fence repairs and new installation.

- Although walled off, broken window panes on the building should be repaired to prevent potential injuries. The use of a Lexan type product would prevent future breakage.

- The equipment hatch penetrations do not extend above the roof's surface sufficiently and allow leakage into the pump room, in the event the roof does not drain properly. A modification extending the lip a minimum of 4" above the roof's surface is suggested. This could be accomplished by adding an internal collar, welded or bolted with a sealant added between the existing and new surfaces.

3.3 Interior Equipment

Photo 3.12 - SAX Pump Room's Interior

The electrical cabinets are raised off the floor slab and mounted against the wall. (Photo 3.12) Electrical service enters the building through the upper northeast corner of the building. The electrical service enters the switchgear from the top. Only the motor leads exit from the lower sides of the cabinets, while the remaining runs exit the top of the cabinets through wall-mounted conduits to the circuit panels and breakers. All appear to be in excellent shape. This station was a well laid out design for its day.

The switchgear itself is in good operational order. (Photo 3.13) As in other stations, its age makes acquiring parts difficult and the protection devices are the old mechanical type and meters are out of calibration. The relays are minimal, requiring on-site personnel to see and reset alarm trips. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc. The switchgear was replaced in 1990. Now is a good time to consider the future role of this station before equipment is at or past its expected service life.

Photo 3.13 - SAX Switchgear Interior view #4 Unit

The units can be operated within the station, but normal operations are executed and monitored by means of the Supervisory Control and Data Acquisition System (SCADA) located in Flood Control's main office at 2255 Irving Blvd.

The Remote Terminal Unit (RTU) that controls this station on-site is located in a room within the pump room. This was built in-house to protect the equipment. (Photo 3.14) The walls of this room are stained from water entering the station. This could be through the equipment hatch, ventilation shaft, the penetration around the roof's drain line or the opening in the upper west corner of the south wall. Someone has placed a panel on top of this room to direct the water away from the room suggesting this is a known problem. The City of Dallas' EBS Department maintains and repairs roofs on city owned facilities.

Photo 3.14 - SAX RTU Room, Roof Leak in This Area

There is nowhere in the stations to store parts or equipment. This station is an older design and would not be considered cost effective for renovation to increase its pumping capacity. It would lend itself for an addition on the north end. Extension of the building or adding another structure, would be feasible and an excellent location for a small storage area.

There has not been any technical analysis conducted to determine levels of efficiency or vibration on any of the units other than what was performed by the contractor at the time of the last overhaul. Each location will be revisited when the units are able to run. This will be to determine the condition based on a physical inspection only. A vibration analysis and thermal imaging should be added to the division's routine maintenance program.

Preventative maintenance and most repairs on electrical switchgear and equipment are performed by the Division's Electrical section. As seen in above Photo 3.12, this equipment has been well maintained. Each component is inspected and cleaned twice a year. All technical sections within the division make routine inspections and perform related preventative maintenance which is recorded in weekly reports.

There are two exhaust fans in this station. One very small wall mounted unit on the North wall and one Large Roof mounted unit. The roof mounted unit is large enough for a station this small. Air enters through the floor grates surrounding the motors. This is an old station with windows. When built, these were opened in the summer to allow additional ventilation. AC is recommended for new or refurbished electrical switchgear areas to increase its service life.

The lighting system has been upgraded with fluorescent fixtures and provides adequate light and is easily maintained. Windows along the east wall provide excellent lighting during day light hours.

SAX does not have an overhead crane. Equipment is removed by means of a mobile crane. This works well for the pumps and motors. For other pieces of equipment not accessible to the equipment hatches, it is recommended that a small roll-around lift, be provided for personnel to use.

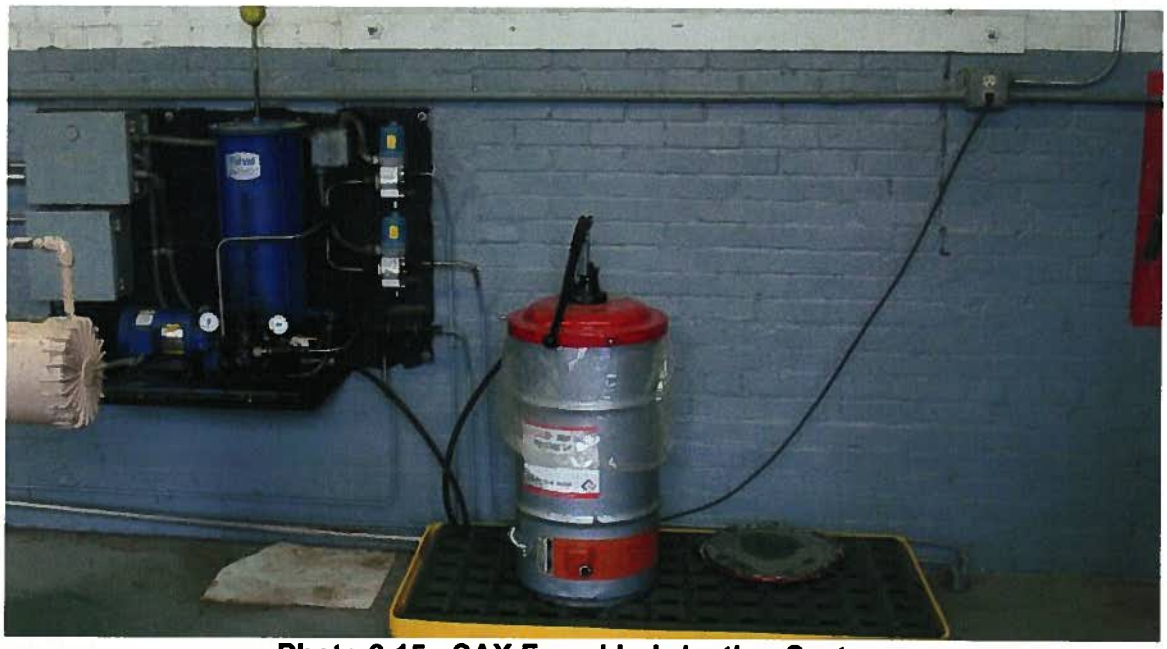


Photo 3.15 - SAX Farval Lubrication System

The Farval lubrication system (Photo 3.15) provides each pump with a measured amount of lubrication at prescribed times. The transfer of grease from the storage container to the Farval's main cylinder has experienced some problems with air pockets. If the Farval system fails to operate correctly, there are alarms in place that prevent a pump from starting or take the pump off line. These alarms transmit to the SCADA, informing the operator of the problem.

Concerns and Issues

- The roof leak over the RTU room needs to be repaired as soon as possible to prevent damage to electronic equipment. There is also a wall penetration in the south wall in the upper west corner that needs to be sealed to prevent driving rain from entering from this opening.

- The building does not have any lightning protection other then the lightning arrestors within the switchgear.

- Neither vibration analysis nor pump testing are performed to evaluate these units. Vibration analysis alone could warn of pending bearing failure, misalignment, soft foot, impeller wear and numerous other conditions before they cause a failure of the unit. This would also be a tool to lower repair costs. The units at this location operate during every rain event. Early diagnosis allows for in-house repairs on many of these listed conditions and minimizes catastrophic failures. Thermal imaging should also be considered. This provides personnel with images that locate hot spots in electrical equipment and can also be used on mechanical equipment such as bearings, packing or mechanical seals, couplings, etc. This is an available service on price agreement or the better solution would be to invest in a unit for the division.

- The Fire Department recently underwent changes in requirements for fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed but is not required to be tied into the fire department's alarms if someone is monitoring the system in-house at all times. There must be an external alarm to alert passers-by. It is recommended that the City verify whether these changes are grandfathered.

- There are two access points into this building. The South entrance is a hinged door. This entrance needs to be fitted with a kick bar for emergency exit. The access on the north end of the building is a large equipment slider. Consideration should be given to changing it to a double hinged door so it too could be utilized as an emergency exit. Lighted exit signs should also be added above these doors.

- Every station needs emergency lighting. Mount battery operated fixtures on the walls at a height that permits routine checking. Provide enough light to permit personnel to see the way to an exit.

- Every station needs a storage area. The building is too small for any type of storage, but there is space outside at the north end of this building to add a small storage building that could be secure inside the site's fencing.

3.4 Levee and Outfall

As at other stations, there is no foot traffic access to the top of the levee. This is a steep irregular grassy surface which employees climb to check equipment at the outfall structure.

The east side of the levee facing the station is well maintained with the slope even and smooth. There is excellent grassy ground cover throughout the east side of the levee. Trash seems to be a problem at this site, both from the trash blowing in from the sump area and from the homeless that frequent the area. (Photo 3.17) The road on top of the levee ends prior to reaching this site but there is a road at the bottom on the station side which extends south. This route does provide Flood Control personnel access to other areas of responsibility.

Photo 3.16 – SAX Station Side of East Levee

The west or river side of the levee to the north is in good condition. There is vegetation coving most of the slope, but vegetation is sparse in areas lacking full sunlight. (Photo 3.17) To the south, a concrete apron covers the slope beneath the bridge crossing the levee and the vegetation is growing up to the edge of the apron. (Photo 3.18)

Photo 3.17 - SAX Levee Looking North

Photo 3.18 - SAX Looking South

The slope is covered in shallow ruts that were caused during mowing, probably because the ground was wet at the time of mowing. These should level out over time.

The elevated bridge and valve vault appear to be in excellent condition. There are not any noticeable signs of the concrete structure moving or cracking. The metal bridge and its concrete walkway are also in excellent condition. (Photo 3.19)

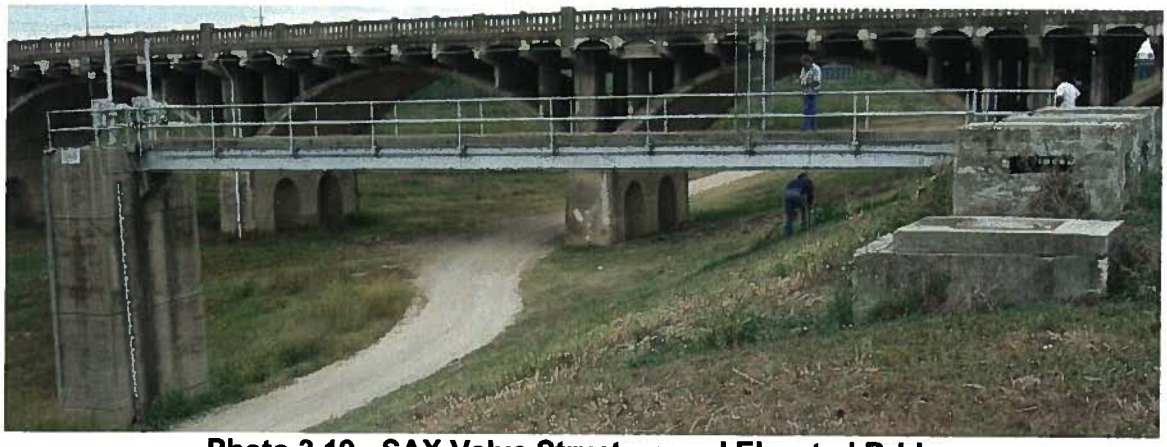


Photo 3.19 - SAX Valve Structure and Elevated Bridge

There are two electrically operated sluice gates at the end of the structure. Their operators and upper valve stems are well maintained. The north gate is locked and tagged out of service. The shafts extending down into the vault are straight but have visible corrosion show along their lengths. The wall mounted shaft supports appear to be secure but are also showing signs of corrosion. It is suggested that the nuts and bolts be changed out during the next maintenance period. (Photo 3.20)

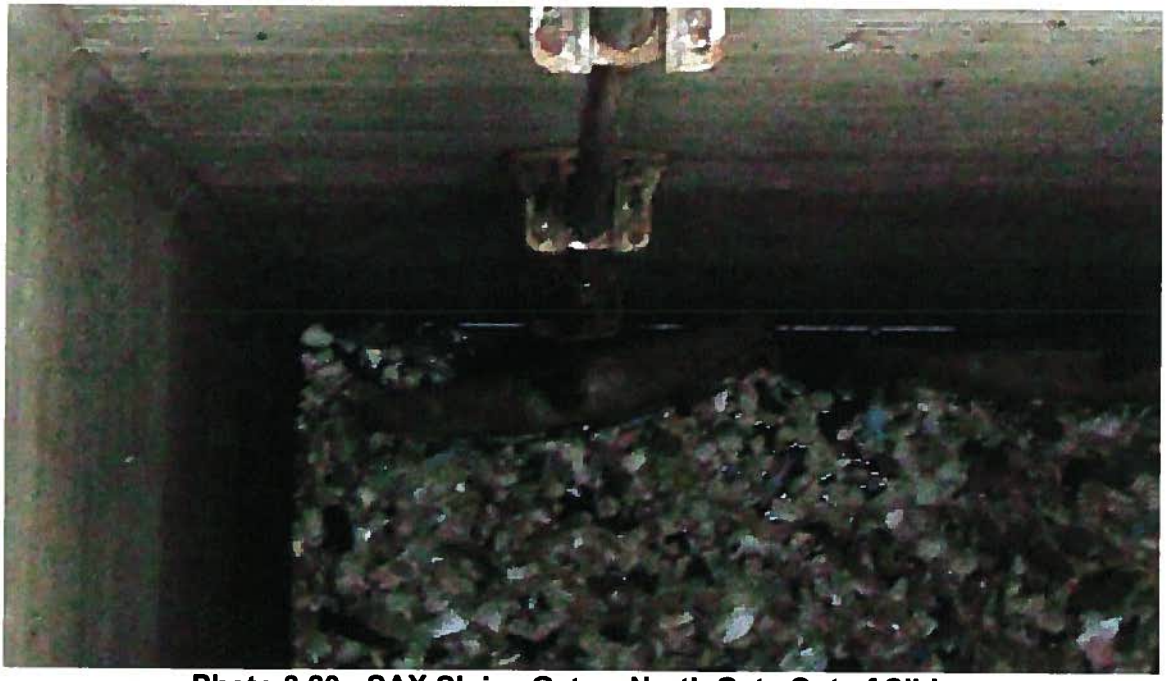


Photo 3.20 - SAX Sluice Gates, North Gate Out of Slides

The north sluice gate has pulled loose from its slide (Photo 3.20) and is the reason this valve is currently tagged out of service. This prevents the station from isolating itself from the river. This presents a serious problem if the pumps fail from breakdowns to power outages during a flood event. This would allow the river to flow back through the station and flood the areas normally requiring this station to keep it from flooding.

Closing this gate as a temporary fix would limit the station's pumping capacity. This valve should remain open until repairs can be made. Repairs should be completed as soon as possible.

This area should be drained as soon as possible. This would allow access to the valve to evaluate damages and make necessary plans for repairs. While down all parts that are corroded such as nuts, bolts and pins, should be replaced where possible to shorten the required repair time by eliminating hidden potential problems. Once achieved the area should be refilled until parts are on hand and repairs can be started.

On the opposite end of this structure, the landing at the levee end of the bridge has dropped on the east end about two inches. This does not affect the bridge or its supports. This landing is a separate element. It is suggested that no attempt to re-level be done at this time. It should be watched to see if the conditions changes. (Photo 3.21)

Photo 3.21 - SAX Bridge Landing

The area surrounding the outlet structure is lightly vegetated dropping off to loose soil just above the structure. There are no signs of previous rip-rap. Although there had not been significant rainfall at the time of observation, there were signs of water leeching from the soil above the structure. The lose soil appears to be very unstable and likely to continue washing down in front of the structure into the outfall area until the area is stabilized. (Photo 3.22) The outlets are beneath the water's level and the water is too murky to determine any existing conditions below the water line. The exposed portion is in excellent condition.

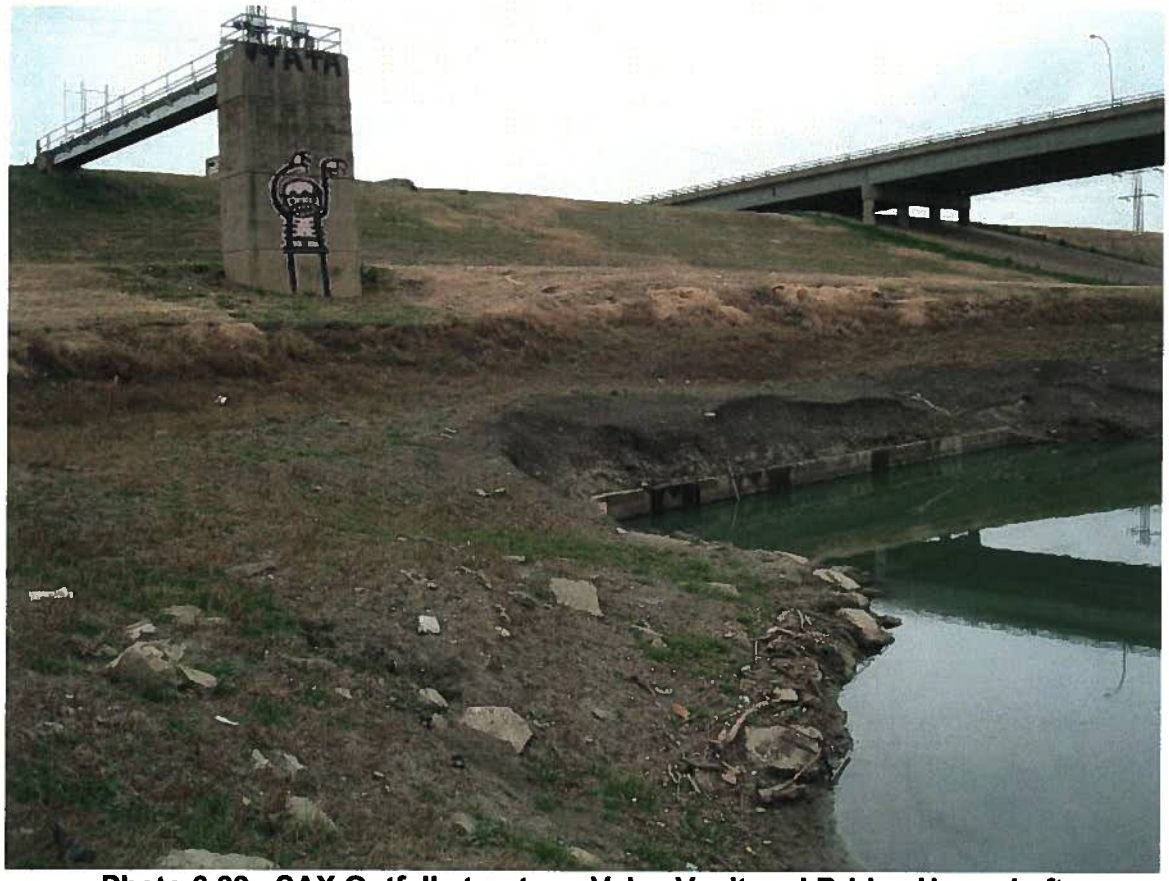


Photo 3.22 - SAX Outfall structure, Valve Vault and Bridge Upper Left

The circular pond of water at the structure's discharge shows heavy silting on the Northwest portion of this area. (Photo 3.23) This could be the soil that washed down from above the outfall structure. It is recommended that the area surrounding this structure be graded down and replaced with the appropriately sized rip-rap.

Photo 3.23 - SAX Outlet Pond and Channel

The banks along both sides of the outfall channel make a smooth transition to the water's edge with excellent vegetation growing within a couple of feet of the water's edge. (Photo 3.23) The channel to the river was clear of obstacles.

Concerns and Issues

- It is recommended that the City of Dallas expedite repairs needed on the North sluice gate.

- This site be considered for adding appropriately sized rip rap to surround the Outlet structure as a measure to stabilize the area.

- Personnel have no safe access up or down the levee. A stable pathway should be added.

- The addition of lights and GFI outlets installed on the valve vault would be helpful to personnel required to inspect and work on its equipment.

Old Baker (OBX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. OLD BAKER PUMP STATION (OBX)

2255 Irving Blvd.
Dallas, TX 75207
Mapsco 44F

Year Built: 1929

Renovations: 1945 – current pumps and motors, 1955 – current switchgear added, 1988 - new dual electric service, 1990 Automated with SCADA

Current Design Pumping Capacity: 4 - 52,000 gpm Fairbanks Morse pumps

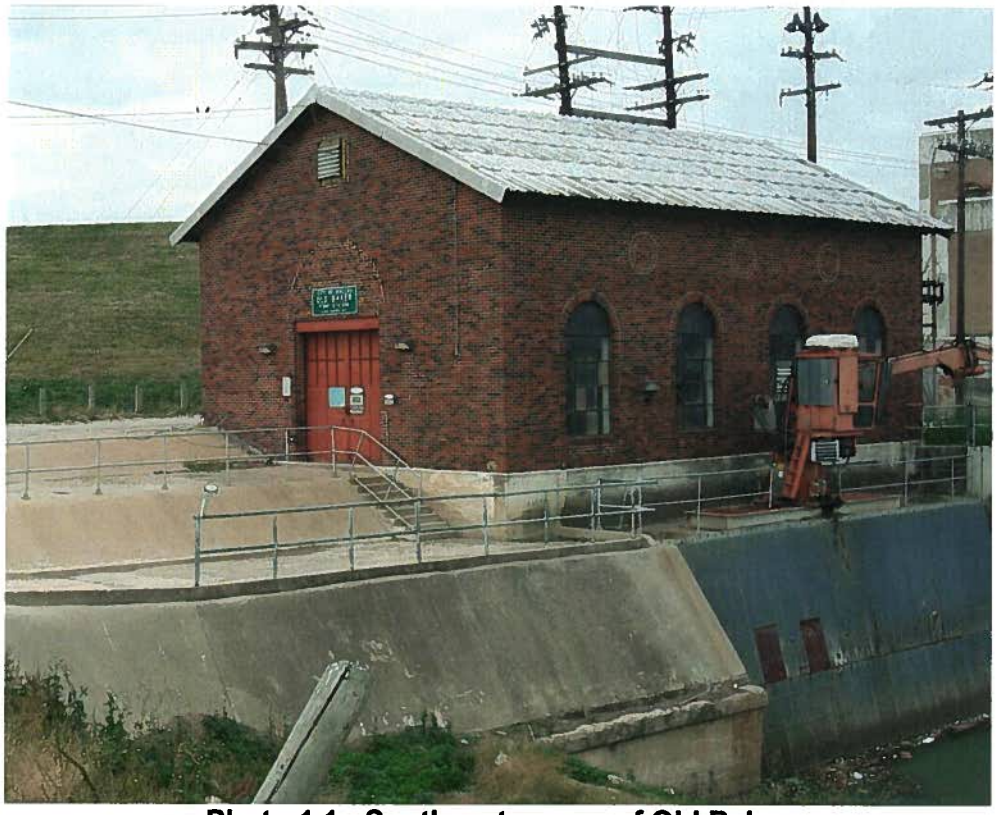


Photo 1.1 - Southeast corner of Old Baker

2. OPERATIONAL COSTS

The current contract between the City of Dallas and the US Army Corp of Engineers (USACE) dictates a condition level that can only be met by an overhaul of equipment. This contract should be reviewed and revised to reflect new technologies that could provide significant repair cost savings to the City of Dallas.

Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. Although these stations do not generate enough revenue to require accurate metering, meters would allow personnel to determine a unit's efficiency which can be affected by many mechanical conditions. Vibration analysis can determine, among other things, alignment, bad or worn bearings, soft foot, impeller wear or in-balance, and shaft problems. Additionally, thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues.
This monitoring would enable personnel to diagnose potential problems prior to failure which would translate to a savings to the owner.

3. OBX INTRODUCTION

Interviews were conducted with management and maintenance staff to gain a better understanding of current practices, conditions, concerns and suggestions. An inspection of each site was conducted to evaluate and assign a condition rating of the station and its equipment.

The Old Baker Station (OBX) is one of the original pump stations built as part of the East Levee System in the late 1920's. It is downstream from the Old and New Hampton stations (OHX and NHX) and upstream from the Small and Large Able Stations (SAX and LAX).

OBX is of brick masonry construction on a concrete foundation (Photo 1.1). The bar screen located on the East façade, is mechanically cleared with a manually operated trash crane mounted to the top of the screen structure. Debris is dumped in a container placed at the Southeast corner of the station.

The only access to this building is located on the South wall. It is a double wide sliding door used for both equipment and personnel. This door leads into a small landing (Photo 3.1) with a stairway down to the pump room floor. An overhead rail and crane system is used to move equipment from the landing to the pump room or outside (Photo 3.2).

Photo 3.1 - OBX landing

Photo 3.2 - OBX overhead cranes

The building equipment consists of four horizontal pumps and motors; a priming system consisting of two vacuum pumps, an air compressor and pneumatically operated valves attached to a header system to carry off the priming system's wastewater; four large gate valves for isolating the pumps; switchgear, motor controllers, circuit panels, electrical conduit running throughout the structure to the equipment, one abandoned in place oil lubricating system and one active automated grease lubricating system. (Photo 3.3) Open area and workspace is very limited, making removal of equipment difficult and hazardous.

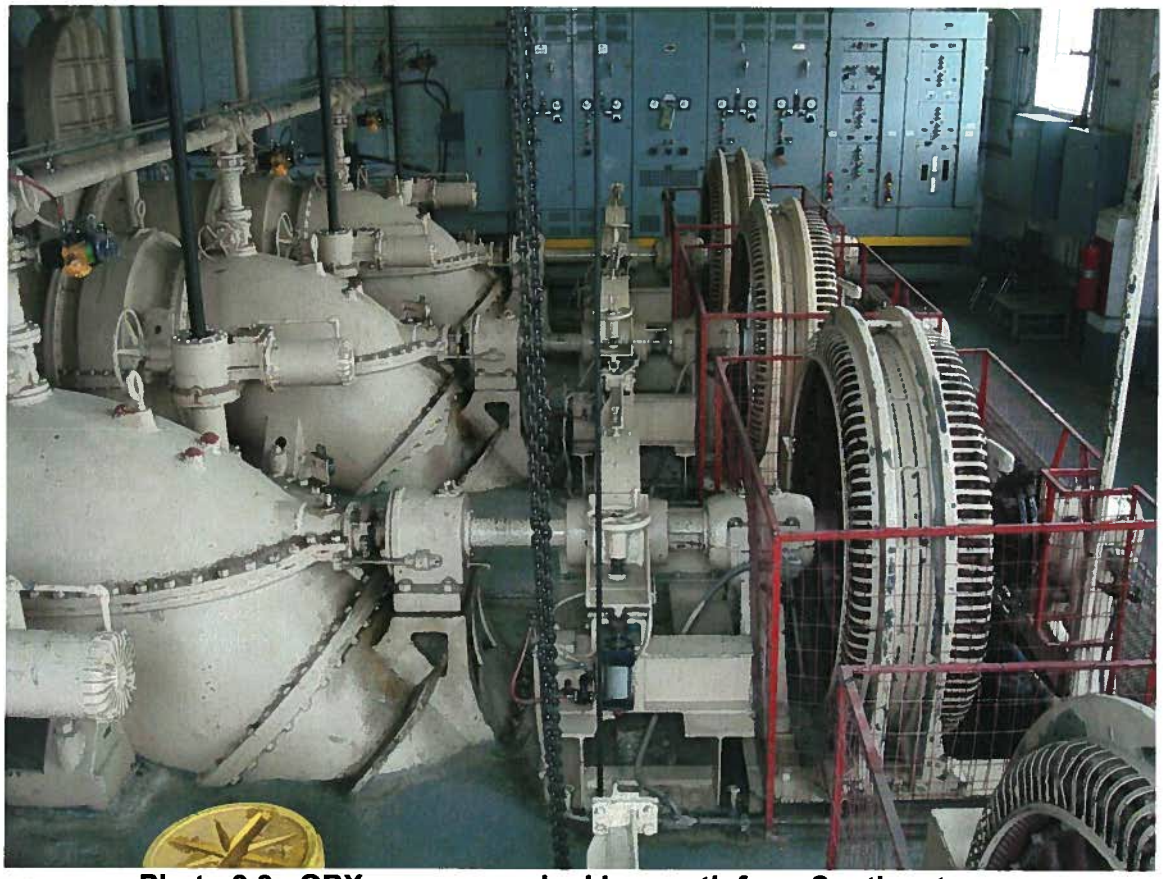


Photo 3.3 - OBX pump room looking north from South entrance

3.1 Operation

All stations are intended to be operated remotely through the Supervisory Control and Data Acquisition System (SCADA) located in Flood Control's main office at 2255 Irving Blvd. Because OBX has a priming requirement, automating this system proved to be complex and not as reliable as required. As a result, this station is routinely manned for start-up. Once online, it is monitored from the main office.

The station's equipment can be operated by personnel by placing controls in the local mode. This is only a back-up to the SCADA system should it fail. The station, once online, is reliable, but is only used when rainfall exceeds New Baker's (NBX) capacity. Ideally, the motors at OBX are designed for long continuous run times. The vertical pump and motor configurations used at all other stations are a better design for this application.

Equipment Out of Service
At the time of this report the station had no operational restrictions. Out of service equipment listed does not affect the station's ability to run all flood water pumps.

- #1 "C" gate and #3 Outfall gate valves are broken in the open position
- Gravity flow gates are operational but the silt build-up prohibits their use
- #2 vacuum pump is removed for repairs. #1 is operational

3.2 Equipment Assessment

The switchgear and motor controllers are in excellent operational condition for their age but protective relays are minimal by today's standards.

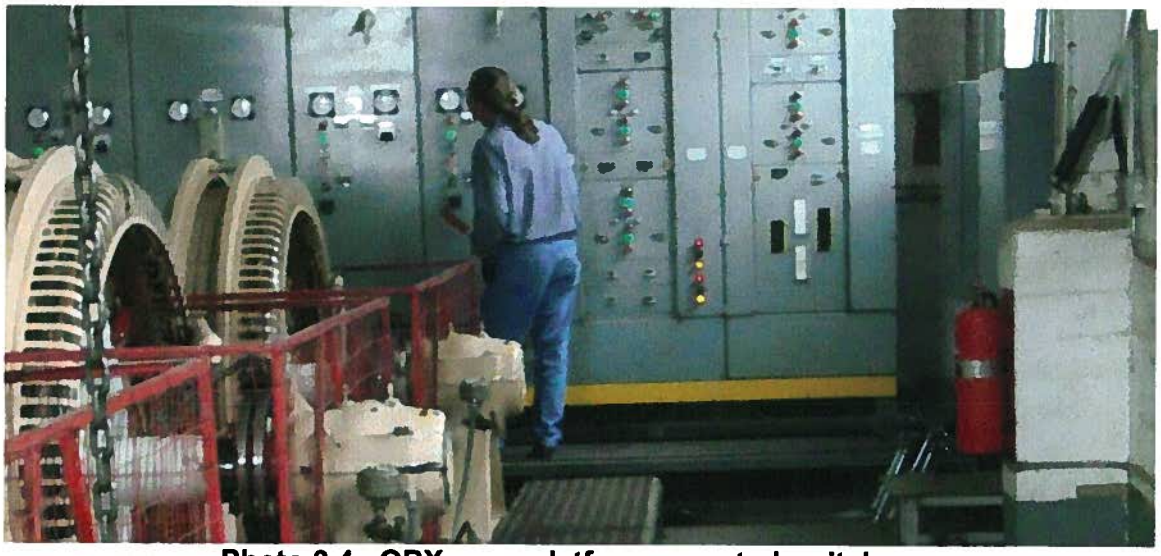


Photo 3.4 - OBX open platform mounted switchgear

The cabinets are mounted against the North wall (Photo 3.4) on an open framed platform. The electrical service enters the station through the North wall with exposed buss bars (Photo 3.5) running down the wall into the top of the gear. These busses are surrounded with a wire cage in plain view. Electrical conduits exit the bottom and are routed along walls and floor to equipment and breaker panels.

Photo 3.5 - OBX Buss bars on North wall

Lighting is excellent in this building during daylight hours. This is provided by 4 large windows along the East wall. There are ceiling mounted Metal Halide lights providing good work lighting for nights and foul weather.

Maintenance

There has not been any analysis conducted and the Division's Technical personnel have no available means on hand to determine levels of efficiency or vibration on any of the units, other than what was performed by the contractor at the time of an overhaul. A "Price Agreement" setup with vendors is being used by the Flood Control Division for all major repairs and overhauls. Mechanics and Electricians are responsible for disconnecting and loading the equipment on the vendor's truck. The City employees are also responsible for reinstallation and alignment. Units are sent in for an overhaul on a 5 year rotation. The units are to be refurbished to meet or exceed "Original Equipment Manufacturer" (OEM) standards. This contract also requires the vendor to contact management for approval on work and parts not included in the original estimate. The estimated out of service period for the overhaul process is 55 days.

All technical sections within the division make routine inspections and perform minor repairs and preventative maintenance. These activities are recorded in weekly reports. Preventative maintenance is flexible and normally planned during traditional dry periods.

The Division's "Availability Report" indicates that the 3 year average for overall availability of the station's units was 75.6%. The division's maintenance overhaul program has one unit out of service for +/-60 days each year for an availability of 83.6% or 8% less downtime.

The current schedule calls for one additional unit overhauled this fiscal year. The #3 unit was returned to service in November 2007. With three out of four units overhauled and the remaining unit not exhibiting any signs of potential failure, the availability status should improve.

Concerns and Issues

- One major drawback to this station's configuration is the inability to maintain a suction prime when the units are off line. The priming system has been modified to provide control through the SCADA system. This has not proven to be reliable, thus requiring an employee be on location to facilitate start-ups. Operationally, this station is used only when conditions exceed the capabilities of the newer Baker Station, an average of two or three rain events per year.

  The complexity of the vacuum priming system will not allow the reliability needed, making this station a weak link. The system consists of two vacuum pumps (#2 out of service), the air compressor and priming valves and the isolation valves on the pump's discharge. Every pump start requires the unit to be started first, the vacuum pump is then started and the priming valve is opened along with the isolation valve. The sequence has to be timed right or a prime is not obtained and the unit shuts down.

- The automated lubricating system has experienced problems with air pockets in the feeder lines. Employees have lowered these types of incidents by keeping the grease warm, which allows the air pockets to dissipate before entering the system. New installations should consider this problem during design.

- Age of pumps and motors - The station's four horizontal units, with its synchronous type motors, have a very old and outdated configuration with exposed slip rings, brushes, rotor, stator and braking system on the coupler. (Photo 3.6) To operate safely and efficiently, these exposed slip rings require a clean and polished surface or the brushes vibrate, causing arching, which in turn causes pitting of the rings. This pitting and arching escalates. Left unchecked, this will cause destruction of the slip rings, motor failure and fire. The bearing surfaces of any horizontal unit not routinely run will develop flat spots, resulting in vibration and ultimate bearing failure. This type of motor is best suited for long and continuous run times, where maintenance and/or operation staffs are available to monitor the units in operation and keep exposed slip rings clean. These units were not new when delivered. They were acquired from New Orleans, Louisiana in 1945. Although they are operational and reliable, their age is well beyond their useful life expectancy. Large synchronous motors were beneficial for keeping electrical cost down. Induction motors fitted with capacitors are now commonly being used to gain the same electrical cost benefits associated with synchronous motors.

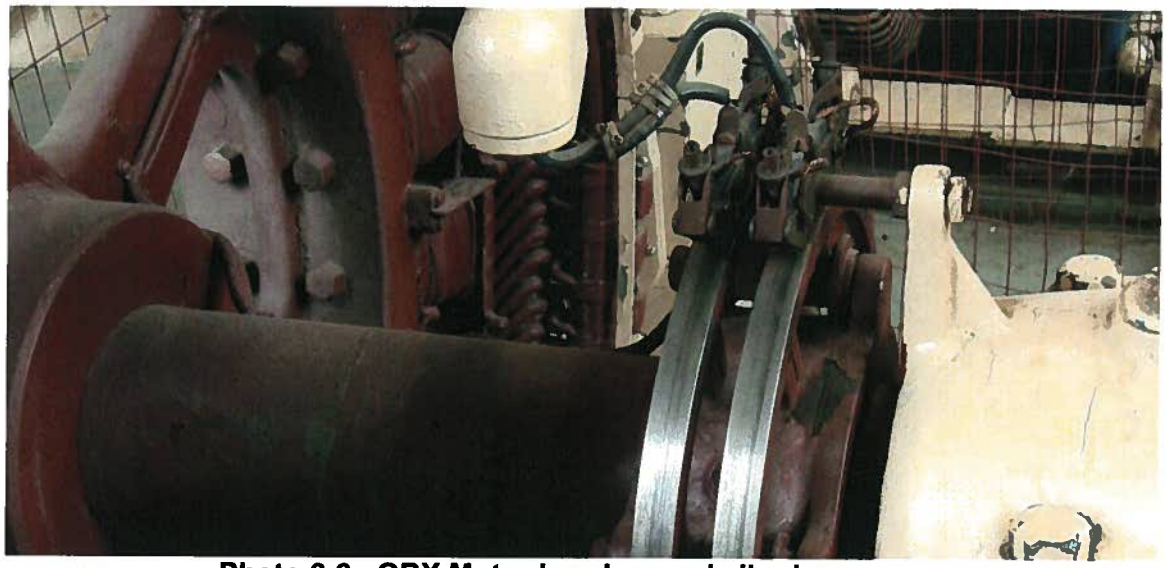


Photo 3.6 - OBX Motor brushes and slip rings

- All valves are cycle operated once a year, but the current practice is to open/close one-fourth the valve's number of turns. This will not sufficiently keep internal parts and areas clear of build-up. If possible, all valves should be fully cycled open and/or closed while water is flowing through them to flush and clear any internal debris.

- Equipment ingress/egress and crane in use – This station is very confined with heavy equipment filling all but a minimal walk space. This equipment requires removal and reinstallation when repairs and overhauls are required. The landing area is inadequate and workspaces are confined and limited.

- The overhead crane has not been properly inspected or properly documented. To be in compliance with OSHA STANDARD 29 CFR 1926.550(a)(6), the crane requires an annual inspection to be completed before it may be operated in the United States; it states:

    - *A thorough, annual inspection of the hoisting machinery shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The employer shall maintain a record of the dates and the results of inspections for each hoisting machine and piece of equipment.*

  A competent person, as defined in 29 CFR 1926.32(f), is *"one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them."*

- Ventilation - the building has one gable-mounted exhaust fan on the South peak and louvers on the North peak. It is only designed to carry away accumulated heat across the roof's interior. There is not any ventilation taking place at the pump room level. Air circulation should flow cross the motors to carry heat away from the unit. Due to heat generated by equipment, this station exceeds outside

temperatures and should be a concern during hot weather for both equipment and personnel.

- A large cylinder mounted high in the South wall was part of an oil lubricating system. This system is no longer in use and needs to be removed. It appears to be unattached resting on its frame. This should be removed for safety concerns.

- The building does not have any lightning protection other then the lightning arrestors within the switchgear. This has not caused any outages in the past at this location. Newer facilities are including this protection.

- As mentioned above, no vibration analysis or pump tests are performed in-house to evaluate these units. Most units have minimal run times and are operated only during rain events. The five year overhaul cycle currently in use could be eliminated. With the ability to make proper diagnoses, bearing failures and alignment problems could be eliminated before catastrophic failures occur.

3.3 Structure

The building's foundation shows minimal structural deficiencies. The masonry construction is sound with no visible breakage. The mortared joints show signs of recent maintenance and are in good condition; paved surfaces surrounding the station are also in good condition

The building's roofing system on the interior requires only minor maintenance with rust removal and painting of the metal supports (Photos 3.7 & 3.8).

The exterior of the roofing system appears to be in excellent physical condition. There were no broken tiles noticed and all shingles were overlapped properly. There is staining discoloration (as seen in Photos 3.7 & 3.10) that appears to be rust. This could be a sign that water has leached under the surface, corroding the fasteners that hold the roofing system in place. As a precaution, this should be inspected and verified by a roofing contractor or the City of Dallas' Building Services.

Photo 3.7 - North Interior Roof Peak

Photo 3.8 - South Interior Roof Peak

Photo 3.9 - East Roof exterior

Photo 3.10 - East Roof Exterior Close-up

Concerns and Issues

- Rolling concrete drives are around the perimeter of the pump station. (Photo 3.11) The routine use of heavy equipment at this location without any warnings of an uneven road surface has the potential of vehicle's wheel catching an edge and veering over into the station or personnel. If the driver attempts to compensate by pulling back the load could roll off and could also cause injury or damages. Marking the pavement areas with rubber traffic poles, street reflectors or paint would provide drivers better visibility, especially during foul weather and at night. The installation of permanent barricades is recommended. As an alternate, a removable barricade system would provide added protection.

Photo 3.11 - Rolling surfaces

- The entire site's handrail system should be improved to meet current OSHA standards. Kick plates along the bottom edge on existing handrails would provide better protection for employee's work areas.

- The flood elevation of this station is alarming. Current staff members have witnessed a rain event where heavy rainfall over a two hour period exceeded the capacity of both OBX and NBX. All pumps were online and water levels at Baker's sump area continued to rise, stopping only when the rain ended.

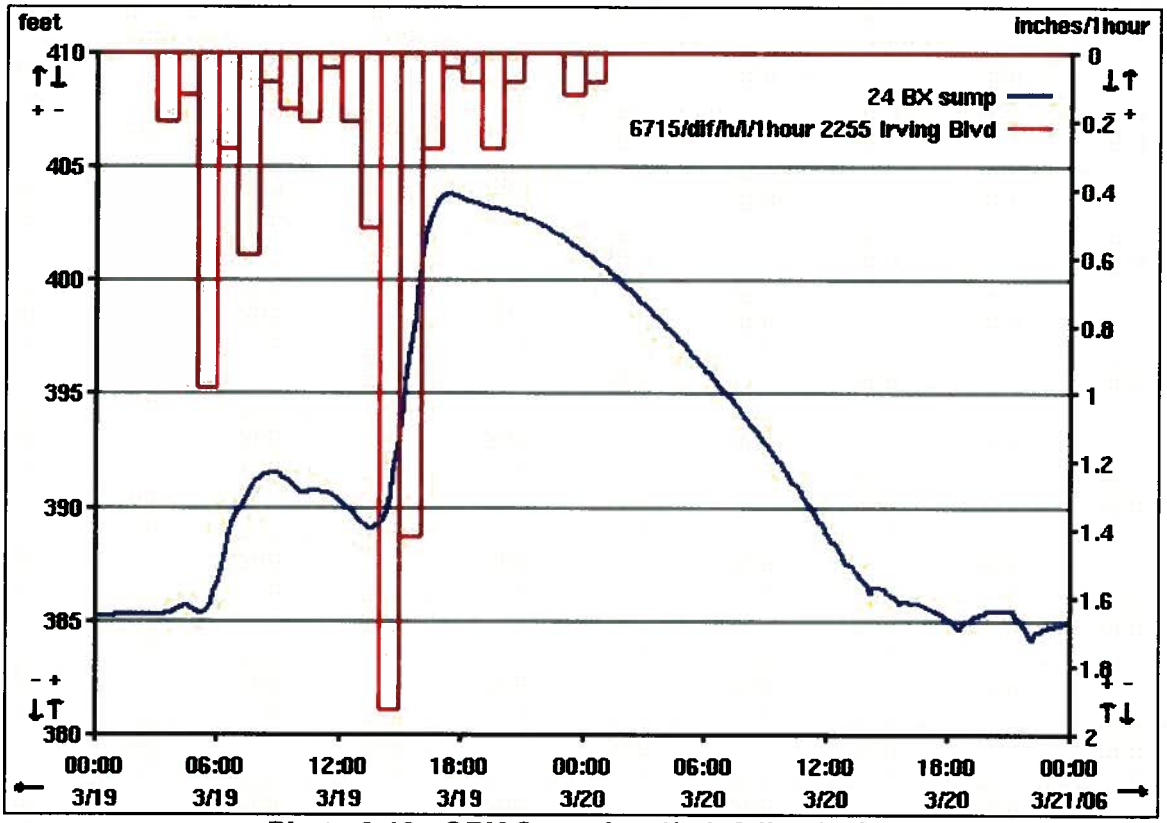


Photo 3.12 - OBX Sump level/rainfall 03/19/06

The graph in Photo 3.12 shows water levels reached at or above 404.0 msl. This station could be lost to flooding if rainfall exceeds the event of March 19, 2006. The employees reported that the water level was above the bottom of the Irving Blvd. Bridge, shown in the upper left corner of Photo 3.13. The station has several 2" holes core drilled through the floor to remove standing water. These holes are secured with threaded stoppers during high water incidents. During the period mentioned, even though the drainage holes were plugged, water was observed seeping through small cracks in the pump room floor. The entrance to the station (Photo 3.11) had to be sandbagged as water levels threatened the station. The pump room floor is even with the bottom of the staircase, also seen in Photo 3.11. With a water level at the station's only point of entrance and exit, the station would be flooded with over four foot of water instantly submerging motors and switchgear. Any personnel in the station could be easily injured, drowned and/or electrocuted, with fatalities a very real possibility.

Dallas' development and construction activities have increased the percentage area covered with paved surfaces and buildings, which in turn has caused increased runoff of rainfall to all Flood Water Control sites.

- Although not the property of the City of Dallas, the railroad bridge west of Irving Blvd. (Photo 3.13) is a concern. The supporting timbers capture a large amount of debris, creating a restriction to the flow of water and increasing the potential to damage the bridge. The City of Dallas and the railroad might both benefit if a new bridge structure was built. A low water weir with a sluice gate built into the new bridge would provide a way to isolate the sump area from inflow for maintenance activities. This would be would be much easier and safer than the use of sandbags, which is the current practice.

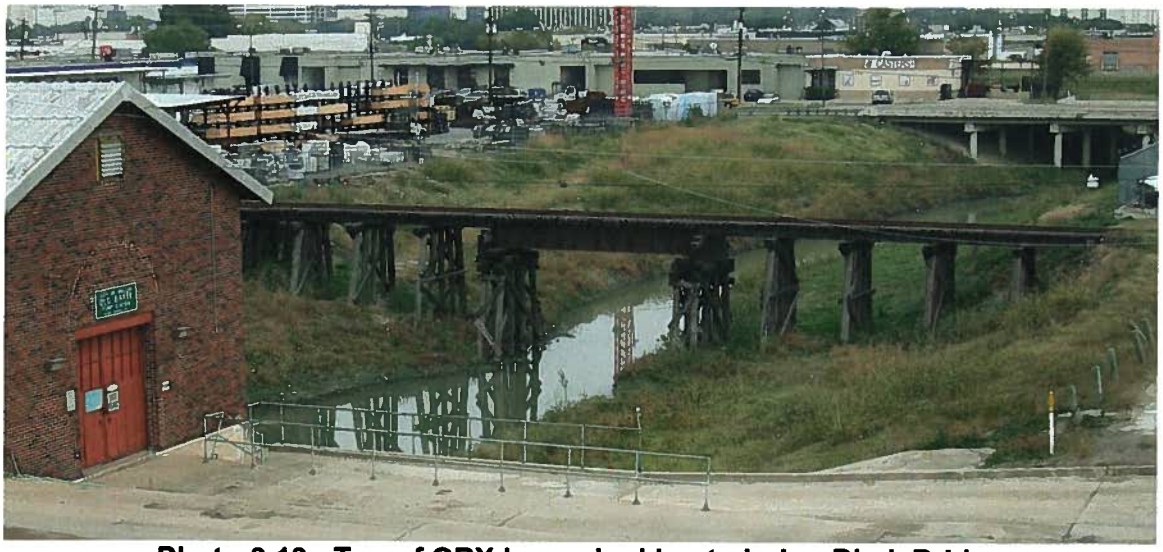


Photo 3.13 - Top of OBX Levee looking to Irving Blvd. Bridge

3.4 OBX Levee and Outfall

Grounds maintenance on the levee area of OBX is excellent. The surface slope on the East bank is at a smooth even grade, with a few very minor irregular surface areas. Personnel on foot do not have a practical way to climb the levee for access to the outlet structures. With the surface smooth and grassy, footing is very poor, and a safety hazard exists for both going up and coming down either side of the levee. (Photo 3.14)

The slope on the outfall side has a good even slope that is molded to meet the outfall structure. The surface is not quite as refined as the East bank but well within the excellent range.

The road running along the top of the levee is used daily for accessing stations and structures along the length of the East and West levees. Both light and heavy vehicles travel this road and the division's personnel do an excellent job of keeping it maintained. The road is well compacted and free of ruts or potholes. (Photo 3.15)

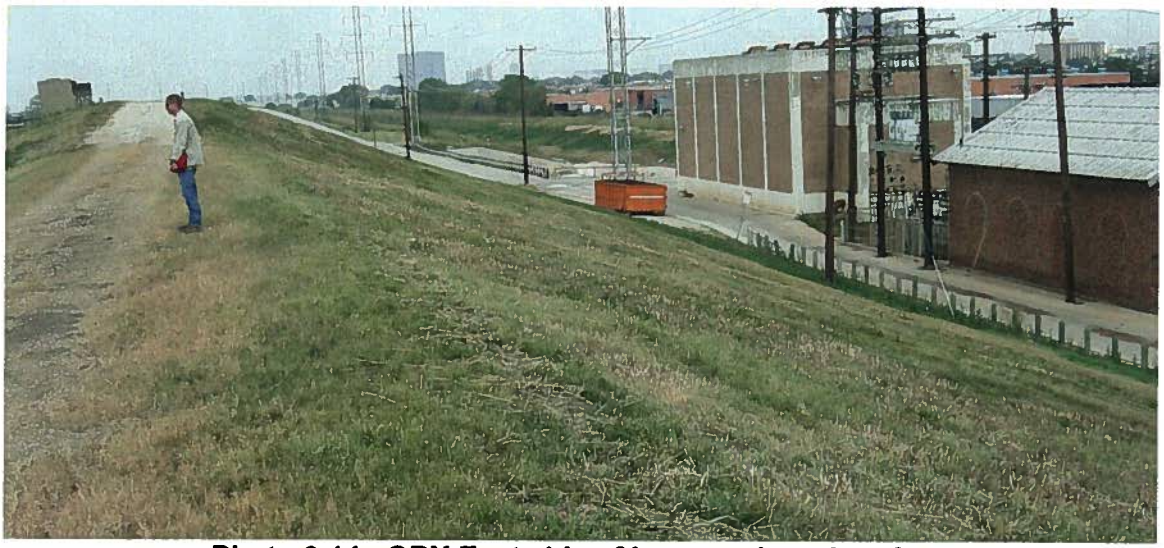


Photo 3.14 - OBX East side of levee and road surface

Photo 3.15 - OBX - West side of Levee

Concerns and Issues-Levee

- The levee has poor pedestrian access. Climbing to the top of the levee is a safety hazard. (Photo 3.16) The only safe method for accessing the outfall structures on foot is to walk the road intended for vehicular traffic +/- 500 yards north and then back +/- 500 yards to the outfall structure. Employees climb the slope for routine inspections. This is difficult in good weather conditions but these stations are only in operation in foul weather, and when it becomes necessary to check the outfall, it would be nearly impossible. I recommend a safety measure to improve the staff's accessibility by designing an acceptable pathway that would not interfere with grounds maintenance. A slightly recessed narrow stairway with removable rails has been used at other City of Dallas locations with success.

Photo 3.16 - OBX Levee access to Outfall Structures

The concrete structure has no evident defects in the main body. There does seem to be an ongoing problem with the bridge. The alignment of the bridge has a noticeable shift at the landing structure on the levee's end. On the outfall structure's end there is minor spalling at the landing's support. It appears to have been patched but failed to adhere. The area is small and repairable but, it is recommended that a structural engineer be called in to evaluate this and provide a professional opinion and method of repair.

The outfall gates were in the fully open position, with the threaded portion of the shaft protected by a slotted metal sleeve (Photo 3.17). The slot provides a visual indicator for the valve's position. It also allows a visual inspection of the threads. The threads were clean with no signs of any build up of grease or dirt. Each shaft is properly coated with a light application of grease.

The portions of shafts extending down through the structure (Photo 3.18) to the gates were also clean and greased. Employees operated and performed maintenance on these valves the week before inspection. Each shaft was visually observed while the shafts rotated with no out of true movement. The braces holding the shaft did not show any movement while the shaft was in motion. The base of the Operator showed no signs of being separated from its foundation. This can be caused by over torque.

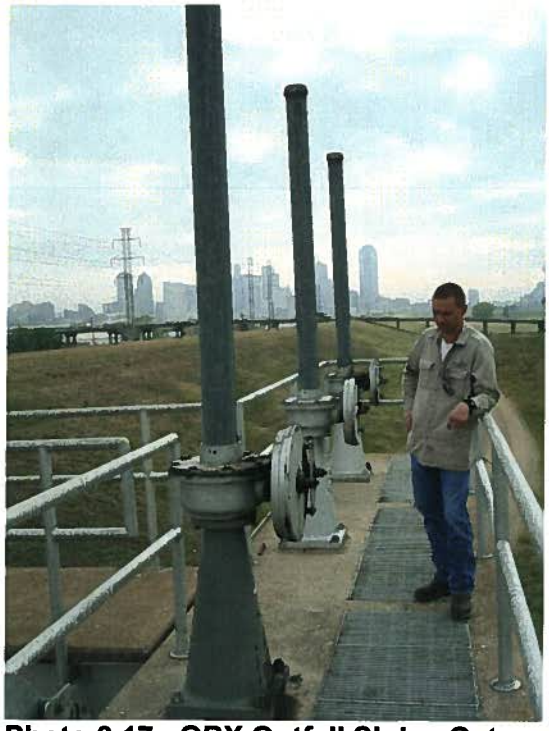


Photo 3.17 - OBX Outfall Sluice Gates

Photo 3.18 - OBX sluice gate shaft in Outfall Structure

An internal inspection of the outflow pipe from the discharge point back to the pump station is not possible without de-watering the Outfall area. This would require sandbagging off the sump area into the station and pumping out the entire outfall channel. This discharge pipe was originally installed in 1929. The most common pressure pipe material used for water at that time was cast iron with lead joints. The discharge piping was extended in 1957 with some type of concrete pipe. It is not known if any type of protective coating or concrete encasement was provided during construction to protect the outside of the pipe. The pipe passes through the levee and carries the weight of the soil overburden of the levee. The soil of the Trinity River flood plain is known to be very corrosive. The pipe is 80 years old, and a failure of this pipe during a flood event could lead to a catastrophic failure of the levee. The discharge pipe should be inspected from the inside to check for potential problems, including visual defects, deflection due to overburden, cracks and missing mortar lining.

Concerns and Issues-Outfall

- The outfall structure (Photos 3.19, 3.20 & 3.21) has one visible structural defect on the Northwest point where the bridge anchors to the main structure. This appears to have been patched in the past. There is a slight misalignment being caused by movement between the structure and the landing on the levee. Because of the weight bearing down on this support and the fact that this is a reoccurring problem, it would be advisable to have a structural engineer inspect this and determine what action is needed.

Photo 3.19 - Old Baker Outfall Structure

Photo 3.20 - OBX Bridge Support

Photo 3.21 OBX Support Closeup

- The Outfall channel has a slight build-up of silt with heavier build-up at the junction where the channels of the two stations intersect. (Photo 3.22) OBX does not run very often, averaging only 2 or 3 times annually. This is not a problem at

the current time but the channel should be dredged when time and equipment become available.

- There is some very minor slippage along the South bank of the outfall channel that needs to be monitored. It does not require any action at this time.

Photo 3.22 - OBX and NBX Outfall channel to of the Trinity River

New Baker (NBX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. NEW BAKER PUMP STATION (NBX)

2255 Irving Blvd.
Dallas, TX 75207
Mapsco 44F

Year Built: 1975

Renovations: Addition of S.C.A.D.A., Farval Lubricating System, Security Cameras

Current Design Pumping Capacity: 5 – Johnston 54" 1250 hp, 395 rpm, 80,000 gpm vertical pumps for 400,000 gpm. 1 – Low Flow Johnston 16" 125 hp, 1180 rpm vertical pump for 6000 gpm.

Overhaul Program: Overhauls on Pumps #1, #2, #5 & #6 took place in 2003, #4 in 1999, #3 in 2005.

Photo 1.1 - New Baker Southwest corner

2. MAINTENANCE PROGRAM

The current contract between the City of Dallas and the US Army Corp of Engineers (USACE) dictates a condition level that can be met only by an overhaul of equipment. This contract should be reviewed and revised to reflect new technologies that could provide significant repair cost savings to the City of Dallas.

Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. Although these stations do not generate enough revenue to require accurate metering, meters would allow personnel to determine a unit's efficiency which can be affected by many mechanical conditions. Vibration analysis can determine, among other things, alignment, bad or worn bearings, soft foot, impeller wear or in-balance, and shaft problems. Additionally, thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues.
This monitoring would enable personnel to diagnose potential problems prior to failure which would translate to a savings to the owner.

3. NBX ASSESSMENT

The interviews with management and maintenance personnel provide a better understanding of current practices, conditions, concerns and suggestions. As a result of the site inspections and interviews, an evaluation is made and a condition rating is assigned for this station and its equipment.

3.1 Operations

This station is controlled and monitored by means of the Supervisory Control and Data Acquisition (SCADA) System, located in Flood Control's main office at 2255 Irving Blvd. This allows an operator to monitor and control multiple stations from one location. Detailed information on what information and controls the SCADA System provides is included in the SCADA section.

In the event of a SCADA System failure, personnel are able to manually operate this station from the switchgear cabinet by switching controls from remote to local and selecting the start or stop switch. (Photo 3.1) Indicator lights and trip relays along with labeling provide the necessary information to an Operator. An operational chart provides guidelines for when each pump unit is to be placed on-line or off-line.

Photo 3.1 - NBX Switchgear and Pump Controls

Approximately ninety percent of this division's man-hours are used maintaining equipment and facilities, grounds keeping and special projects. The remaining ten percent required to perform operational duties does not allow for a separate operational staff, as is used in other departments within the City of Dallas. This division has training classes to train personnel to operate the Flood Alert System, Pump Station, and SCADA System and tests its personnel prior to allowing them to perform operational tasks

At the time of this report, all units are in-service. Only a small amount of run-off was coming into the station, limiting the testing of the units. The number 8 unit ran for a short period. An unusual amount of vibration was detected. Vibration analysis should determine the level and provide information on where the vibration is being generated. Though no testing has been completed, it is hypothesized that the vibration is coming from the pump section, possibly due to impeller damage or an object trapped in one of the vanes, knocking the unit out of balance.

All sites should be revisited during a rain event to provide the time and opportunity to cycle through all units at all locations. This information will be documented and provided in spreadsheet format with comments.

3.2 Exterior Equipment

The New Baker Station (NBX) is located to the North of the original Baker station, (OBX) and shares the same sump area (Photo 3.2). NBX is the primary station at the Baker site. OBX is only used when incoming floodwaters exceed the capacity of NBX.

The screens at NBX are downstream of OBX and are shielded from major impacts. A 90-degree turn located in front of OBX directs the flow by the screens instead of directly into the screens, as is the case with NBX. Large floating objects in the channel cannot plunge directly into the NBX screens.

This 90 degree turn causes a silt build-up on the inside corner, and debris not caught by the screen system accumulates in the sump area. The sump area's concrete base and

apron surrounding the Baker site facilitates access of heavy equipment for cleaning and repairs.

Photo 3.2 - NBX Sump Area and Screens

Photo 3.3 - NBX Area behind Screens Where Debris is Cast Off

The NBX screen and rake system is in excellent operating condition. This station does not have a conveyor system to carry trash to bins as some other pump stations built during the same period do.

The rakes drop the debris directly behind the screens onto a paved surface where a small skidsteerer then removes it, placing it into a dumpster. (Photo 3.3) This area is very narrow and restrictive for the driver, resulting in minor scrapes to the building and screens.

Outdoor lighting is adequate for personnel to conduct operations during foul weather or night conditions. Existing handrails and barricades do not meet current O.S.H.A. standards.

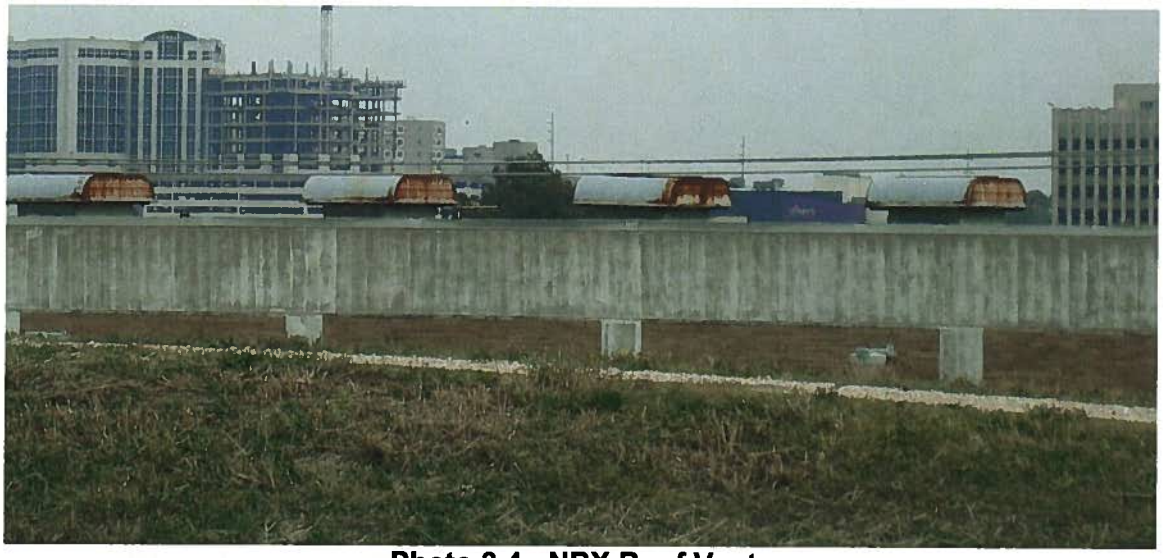


Photo 3.4 - NBX Roof Vents

The only pump station within the scope of this project with an access to the roof is Pavaho. A bucket truck or very long extension ladder is required to gain access to the roof at the other pump stations. Some observations can be made of a station's roof from the top of the levee, but the roof's surface at NXB is too high for this. This also prohibits routine inspections. All of these facilities have their original roofing system and are at or past the roofing system's expected service life. City of Dallas' Building Services has been required to make repairs at these locations, which is an indicator that replacements should be a concern. Rust on the ventilation cap's north and south surfaces can be seen from the ground, and painting should be done before there is damage to the metal. There are no signs of blockage to the roof's drainage system (Photo 3.4).

Concerns and Issues

- NBX and OBX share a sump area and all concerns mentioned under OBX apply to NBX in this area. In addition, there is not safe access to the sump area for foot traffic. Although surfaced with concrete, there is not a designated point of entry provided for personnel. A handrail coupled with a stairway or a textured ramp would resolve this problem.

- The grout work on the building's exterior brickwork needs to be re-pointed and sealed.

- The seam between the east apron and north wing wall (Photo 3.5) of the gravity bypass structure has moved slightly, pulling the sealant loose and allowing water to enter. There is potential for movement or washout should the area behind the apron become saturated for any length of time.

- The guardrail along the West sump wall has obvious damage (Photo 3.6). The rail is slightly bent, but reusable. The split bollard is not repairable. Due to the location, a larger bollard post composed of steel and concrete is recommended.

Photo 3.5 NBX North Wing Wall Sealant Failure Bollard

Photo 3.6 - NBX Bent Rail and

Photo 3.7 - NBX Grates Behind Screens

- The grates covering the drain holes behind the screen and rake system have been damaged. The resulting damage to the grates makes them a trip hazard and unusable. (Photo 3.7) Removal of the grates by the workers then creates even more

of a trip hazard. Replace damaged grates in high traffic areas to prevent potential injuries.

- The stairway and the handrail at the South entrance to the screens are out of alignment. (Photo 3.8) This requires the use of a crane or other heavy equipment to move it back into its original location. The steps then need to be pinned in place and handrails welded together.

Photo 3.8 - NBX Stairway to Screens

- The east apron wall of the sump area has a minor crack running north to south across the entire length. Signs of ground water seepage are present along sections of this crack. (Photo 3.9) A Structural Engineer should inspect this crack and make a recommendation.

Photo 3.9 - NBX East Apron of the Sump Area

- Soil has washed out the area around the Southwest corner. There is no soil supporting the section of the foundation, which serves as a support for the low flow pipe. (Photo 3.10) This should be backfilled and compacted to reduce the potential for damage to the pipe or foundation.

Photo 3.10 - NBX Low Flow Pipe Southwest Corner of Building

3.3 INTERIOR EQUIPMENT

NBX's main pump room is a large open structure designed only to house the five vertical floodwater pumps and related electrical and electronic equipment (Photos 3.11 & 3.12). The vertical pump's impellers are located at the lowest point of the casing. This casing extends down into a suction well that is lower than the incoming water level. This allows all water entering the sump area to gravity flow into the suction well, giving the pump station the ability to pump the sump area dry.

Photo 3.11 - NBX Pump Motors

The elevation of vertical pumps relative to the suction well creates a positive suction head, eliminating the need to prime the pumps at startup.

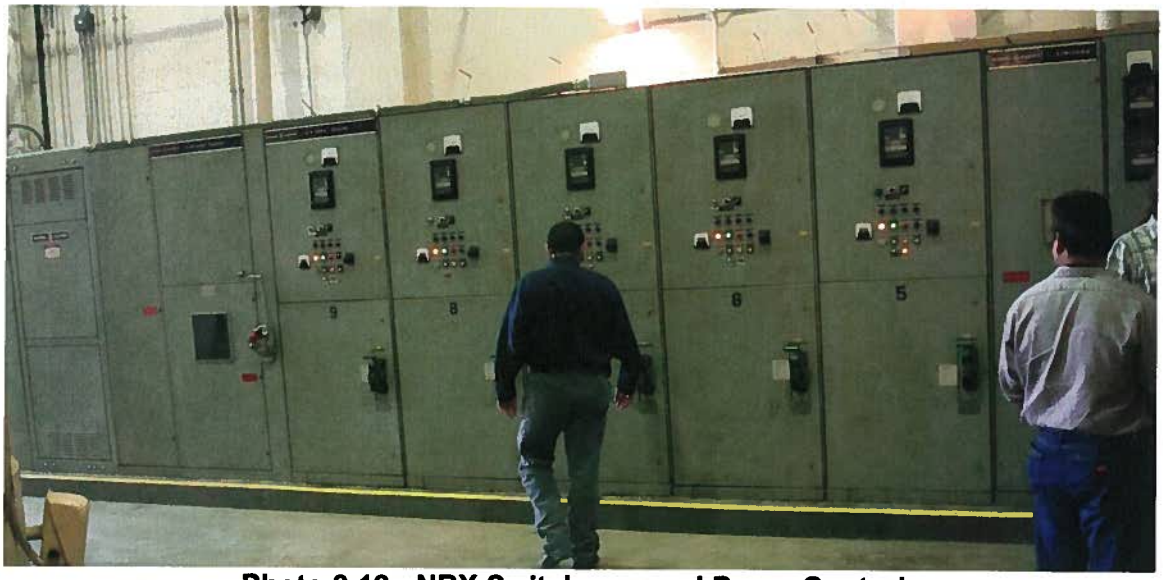


Photo 3.12 - NBX Switchgear and Pump Controls

The equipment layout in this building is excellent. There is adequate room for an entire crew to work on any piece of equipment. All cable runs are below floor level while grates allow for drainage and air circulation. Lighting is adequate. However, storage is a concern. There is no dedicated place within the building to store parts or equipment.

This station's design does not allow for further build-out. There is not adequate space for any additional pumps and switchgear. Any expansion at the Baker location or replacement of OBX will require new construction.

Photo 3.13 NBX Exhaust Fans

The roofing structure is concrete inverted "U" beams that are sealed and painted. Spacing between beams is uniform with no visible signs of leakage at the seams. The exhaust fans mount internally to the beams (Photo 3.13) with the exhaust vent penetrating the beam and roofing system. There are no signs of leakage at these penetrations. The lighting system also has ceiling-mounted fixtures. These require personnel to ride the overhead crane to change bulbs or make repairs.

The main pump room has an electrically operated 20-ton crane used to pull and install equipment. The bridge travels north – south and the dolly, east – west, making all equipment in the main pump room accessible. The extraction of a pump requires the motor to be detached and lifted off separately before pulling the pump. This is due to the pump's length and the overhead crane's height restriction. This is a common practice for vertical units and is not a problem. Division personnel inspect the crane and report that it is in working order.

The Farval lubrication system (Photo 3.14) provides each pump with a measured amount of lubrication at prescribed times. The transfer of grease from the storage container to the Farval's main cylinder has experienced some problems with air pockets. The delivery of grease to the farthest pump is also experiencing some intermittent difficulties. When the Farval system fails to operate correctly it sends the alarm state to the SCADA. The SCADA then prevents that unit from starting. If the unit is running, the SCADA will send the unit a stop command. This alarm condition is sent to the operator's workstation informing the operator of the problem.

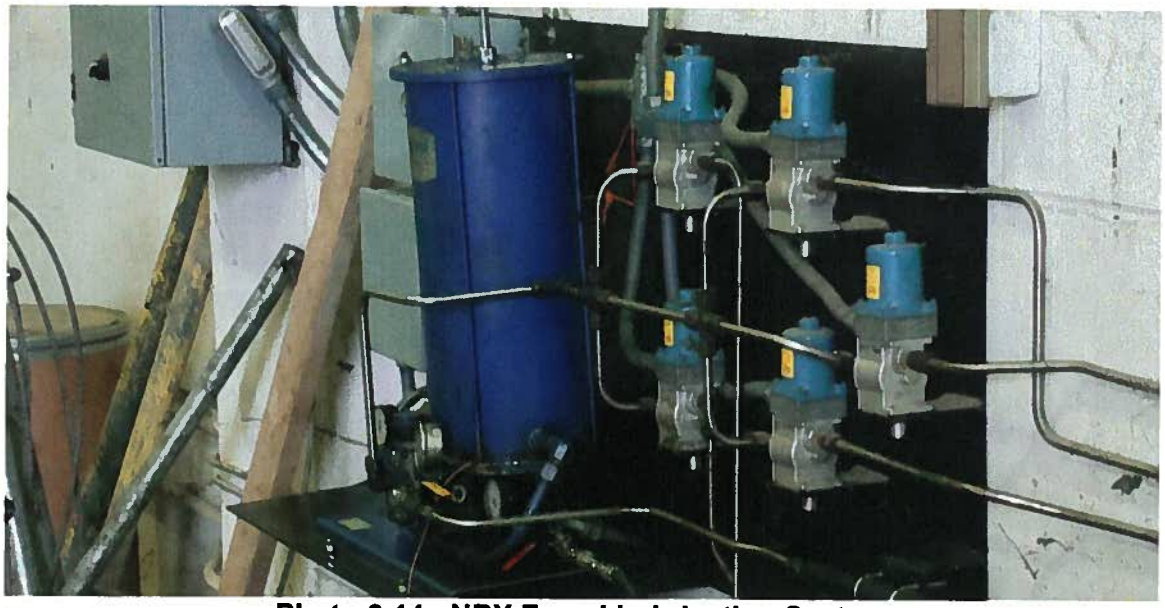


Photo 3.14 - NBX Farval Lubrication System

Photo 3.15 - NBX Switchgear on Raised Base

The electrical switchgear is located on a solid raised concrete base. (Photo 3.15) The line of cabinets runs parallel to the pumping units, with a distance of 6 feet between the back of the cabinets and the east wall. Personnel have walled-in this area to store electrical parts and access is by key. However, this area could also be accessed by climbing over the wall which is a code violation. Removal of these walls is required as soon as possible. The switchgear itself is in good operational order, but as in other stations, its age makes acquiring parts difficult. The protection devices are the old mechanical type and appear to not be calibrated. Personnel do not have the equipment or experience to calibrate these relays. The information transmitted to the SCADA reflects these discrepancies, which are then altered within the SCADA to read, "what is believed to be correct". This equipment is at or past its expected service life. The alarm relays on this switchgear are manual, requiring on-site personnel to see and reset alarm

flags. The alarms provide minimal information. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc.

Controls for the Gravity Sluice Gates are mounted on the east wall in a separate steel cabinet. The switches and indicator lights are easily accessible for operation. The position of each switch is transmitted to the SCADA where they are normally controlled. The panel also allows local operation in the event the SCADA system fails. At the time of this report, gate #5 was tagged "out of service" which should not affect normal operations.

Ventilation of the main pump room is provided by seven interior roof-mounted exhaust fans and louvers opened by the pressure differential created by the exhaust fans. The louvers are not operating freely as required for proper air movement. Another concern was the location of the louvers. The motors are located along the west wall, while the louvers are on the east wall behind the switchgear cabinets. The exhaust fans are located along the centerline of the building's ceiling north to south. It is likely that an air flow test would probably show that no air movement reaches the area of the motors. An improvement would be to isolate and install HVAC in the switchgear area to maintain a lower humidity and controlled temperature. Tests have shown this can double the switchgear's service life. The existing intake's louvers should be eliminated and new intakes placed where they can provide circulation to the motors. Although heat rises and this pump room has a high ceiling carrying heat up and away from the motors, having air circulate across each motor would be more beneficial. If air entered below the pump room floor, passing through the grates surrounding the motors and exhausted upward through the exhaust system, this would be a much improved air circulation. A less costly method would be to install wall-mounted louvers inline with each motor. Directional vanes would be required to direct air towards the motors and to the exhaust fans.

The south end of the building has a separate room extending the width of the station, east - west with an exterior door on the east wall. The area contains a low flow-pumping unit, a small 3-ton hand operated overhead crane to pull the low flow unit and a framed enclosure (built in-house) that contains a Remote Terminal Unit (RTU) that transmits and receives data to and from the SCADA.

City staff installed an air conditioning unit in the main pump room and vented it to the enclosure to cool it and the electronic equipment. The unit failed and will not be repaired or replaced per division staff. Remove this equipment and dispose of it properly as it contains Freon.

Concerns and Issues

- The area behind the switchgear cabinets should not be enclosed or used as a storeroom. This area must be clear of any obstacles and have no barriers. Appropriate storage areas are non-existent at this location. Each station needs a secured area such as a cage, with appropriate shelving to store parts and materials.

  The overhead, 20 Ton, electric operated crane in the main pump room and the manually operated 3-ton overhead crane is in the South room need to be properly inspected as outlined under OSHA regulations. The overhead cranes require proper

inspections along with proper documentation. To be in compliance with OSHA STANDARD 29 CFR 1926.550(a)(6), the crane requires an annual inspection to be completed before it may be operated in the United States; it states:

- *A thorough, annual inspection of the hoisting machinery shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The employer shall maintain a record of the dates and the results of inspections for each hoisting machine and piece of equipment.*

A competent person, as defined in 29 CFR 1926.32(f), is *"one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them."*

The required documentation was not available or non-existent.

Photo 3.16 - NBX Motor Jack Bolt and Motor Leads

- Jack bolts, used during alignment, are in conflict (Photo 3.16) with other items associated with the motor. This problem exists on several units at this station. The example shown could become a serious problem if vibration causes the bolt to wear through the conduit into the motor leads. It is recommended that the jack bolt be removed once alignment is completed and the motors are bolted in place, or install a new reshaped piece of conduit for the motor leads and widen the hole through the grates to allow the conduits to be routed away from Jack Bolts.

- The building does not have any lightning protection other then the lightning arrestors within the switchgear. This has not caused outages in the past at this location. Newer facilities include this protection in their design.

- Neither vibration analysis nor pump testing are performed to evaluate these units. Vibration analysis alone could warn of pending bearing failure, misalignment, soft foot, impeller wear and numerous other conditions before they cause a failure of the

unit. This could also be a tool to lower repair costs. The units at this location operate during every rain event. Early diagnosis allows for in-house repairs on many of these listed conditions and minimizes catastrophic failures.

- There is no access to the roof. This roof system may not allow an adequate size opening cut through to allow internal access, which is preferred for security and minimizing exposure while climbing. A second method is to install an exterior ladder starting ten feet above the ground that is permanently mounted to the structure. The remaining portion of the ladder could be stored within the building.

- There is no safe method of changing light bulbs or repairing the fixtures mounted on the ceiling. Personnel are required to use the overhead crane by balancing themselves on the crane while performing these tasks. The same problem exists with the exhaust blowers when repairs or maintenance is required. The surface area within the building appears to provide enough room to allow the use of a man lift device.

- The Fire Department recently underwent changes in requirements for Fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. A fire alarm system should be installed, but it is not required to be tied into the fire department's alarms if it is monitored in-house at all times. There must be an external alarm to alert passers-by. It is recommended that the City verify whether these changes are grandfathered.

- There are two access points into this building. The North entrance is a large sliding door designed for heavy equipment vehicles with a hinged personnel entrance built into it that is padlocked from the outside. The second entrance is in the low flow pump room's east wall, which is at the opposite end of the building, and is secured with a deadbolt lock. There is a third door separating the low flow and main pump rooms that locks with a deadbolt. There are no emergency exits in this building. No natural light can enter the building and there are no emergency exit signs or a fire alarm system. There needs to be kick bars installed and lighted exits signs placed at the exits.

- Every station needs emergency lighting. There needs to be battery-operated fixtures mounted on the walls at a height that permits routine checking. These fixtures need to provide enough light to permit personnel to see their way to an exit.

- Fasten down the grates surrounding the motors. Replace damaged grates to eliminate trip hazards. Access grates down into the pump pit area should be hinged and equipped with drop down handles. This would help to prevent back injury or accidents when dropping them into the pit.

- The installation of ladder-up devices on the pump pit's ladders would make it easier and safer for worker ingress and egress.

- Every station needs a storage area. Personnel are placing parts and materials wherever there is room at most locations. Lockable enclosures can be installed along with shelving to provide on-site parts and materials storage.

3.4 LEVEE, OUTFALL STRUCTURE AND GRAVITY FLOW GATES

The discharge lines leaving the pumps at NBX follow the Levee's contour up, over and back down to the outlet structure. A "T" connection at the peak of each discharge line has a steel Standpipe extending above the levee's peak, (Photo 3.17) providing an air gap between the station and the outlet structure.

Photo 3.17 - NBX Standpipes

Station plans show all discharge pipes leaving the station to be made of steel. The steel on the standpipes has protective wraps exposed at ground level that are rapidly deteriorating. (Photo 3.18) The soils in the area are assumed to be corrosive and were the reason for the installation of these protective wraps. Test sections of all piping need to be uncovered and inspected to determine the condition of the pipe to check the extent of corrosion or other damages.

Photo 3.18 - NBX Corrosion on Standpipe

The station side of the levee is in excellent condition, with excellent groundcover and no signs of any irregular areas. The riverside of the levee (Photo 3.19) has equipment tracks, sparse vegetation, and all vegetation is gone where the levee bottoms out to the lower road. This area could wash out if not protected. City staff monitors this area daily and intend on taking action to remedy this.

Photo 3.19 - NBX River's Side of Levee

The area surrounding the NBX outfall structure is level with the top of the structure within a 12 to 15 foot perimeter. (Photo 3.20) The edges of this perimeter show signs of erosion from past rain events. There is no path to this area and footing is hazardous. This is an area not normally requiring access, but even a crushed rock path would be useful in maintaining safety for personnel.

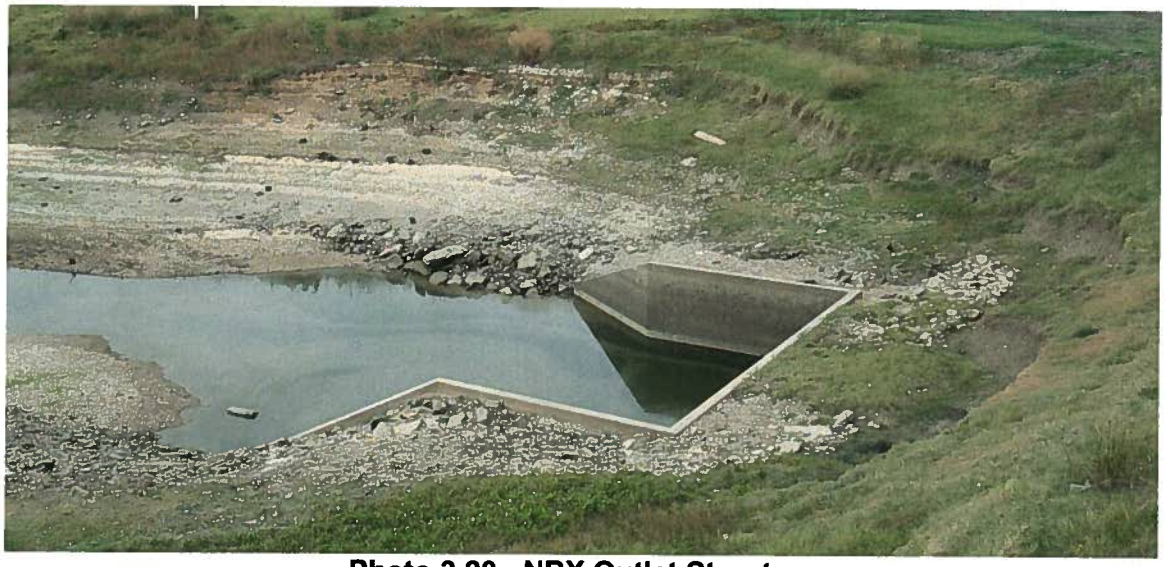


Photo 3.20 - NBX Outlet Structure

The outflow discharge piping is underwater. This is a normal occurrence as there is water coming into the station's sump area most of the time and the low flow pump discharges often enough to keep the outflow full. The water is too murky to see much below the water line, but the exposed area had no cracks or spalling. There appears to be only minor pitting and staining.

At the time of inspection there had been no recent rain events and therefore the sides of the channel should have been dry. However, when inspected the south side areas close to the edge felt spongy. The area on the north side felt more stable and dry.

Photo 3.21 also shows that silting is more prevalent on the south edge of the outfall, but the entire channel has noticeable build-up in areas. City personnel indicate that the channel routinely requires clearing. As mentioned in the OBX report, NBX and OBX outfall channels join before reaching the river. The NBX flow has caused silting at their junction.

The gravity flow gates and outfall channel are located to the north of NBX. These six gates are the only thing creating a separation between the channels feeding into the sump and the outfall channel to the Trinity River. This would normally be open during low flow conditions and minor rain events. (Photo 3.21)

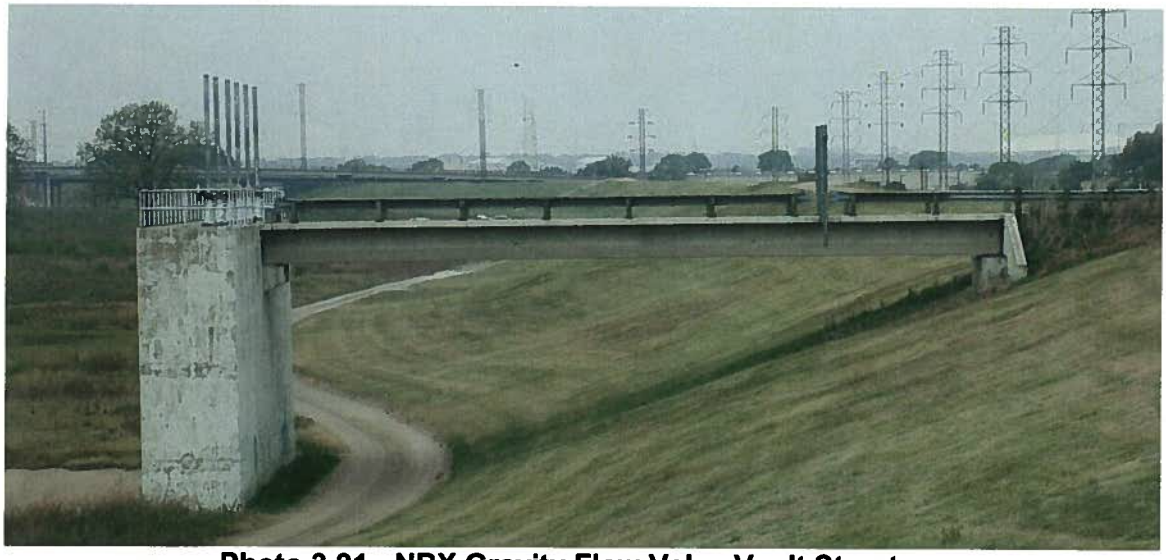


Photo 3.21 - NBX Gravity Flow Valve Vault Structure

The area under the bridge structure on the levee is sparsely vegetated for the upper third of the levee surface, where a minimal amount of sunlight is able to reach. This area will always be difficult to maintain with any form of ground cover. A concrete apron would remedy this problem and reduce maintenance upkeep. The main valve structure appears to be in excellent condition. The six gate stems are covered and all shafts are clear of debris. The six mains are each 10 feet square with manually operated sluice gates. At the current time, silt has blocked the western two thirds of the channel (Photos 3.22 & 3.23) resulting in standing water.

Photo 3.22 - NBX Gravity Gate Structure, Notice Silted Up Completely to River

Photo 3.23 - NBX Gravity Gates Channel Silt Build-up

Concerns and Issues

- Plans show that discharge pipe from NBX is steel. There are concerns for potential corrosion and metal loss.
- Corrosion on the Standpipes is serious enough to justify having the area surrounding these pipes excavated to determine how much corrosion damage there is below grade.
- Add a concrete apron or rip-rap under the heavily shaded areas of the structures in the outfall area.
- Add heavy rip-rap to the area surrounding the outfall structure to prevent further soil erosion.
- Add a footpath to the Outfall area.
- Remove silt in the channel between the Gravity Gates and the river.

Charlie (CX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. CHARLIE PUMP STATION (CX)

600 First Street
Dallas, TX 75207
Mapsco 45W

Year Built: 1932

Renovations: SCADA 1990/91, Low Flow Pump 1963, Farval Lubricating System, Service disconnect 2007

Current Design Pumping Capacity: 2 – Peerless 42" 300 hp, 503 rpm, 40,000 gpm vertical pumps for 80,000 gpm, 1 – Aurora Low Flow 16", 100 hp, 880 rpm, 6,000gpm
Overhaul Program: #1 Unit is at the vendors for scheduled overhaul, #2 unit is scheduled for September 2008 and Low Flow Unit #3 is scheduled for November 2008.

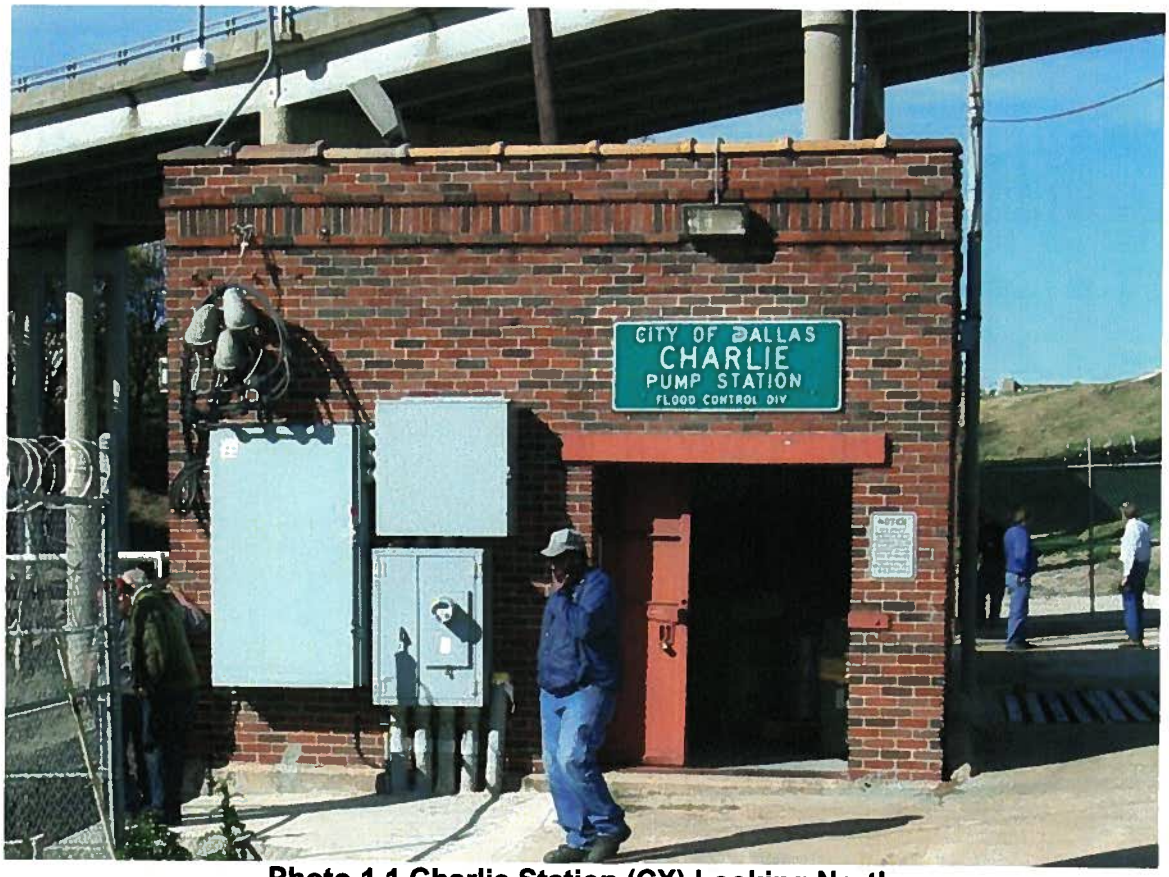


Photo 1.1 Charlie Station (CX) Looking North

2. MAINTENANCE PROGRAM

Flood Control Division does not have access to their budget on at a level allowing a cost analysis for operation and maintenance. The division has recently had a change in management. The new staff began an aggressive overhaul schedule of pumps and motors. The current contract between the City of Dallas and the Corp. of Engineers dictates a condition level that can only be met by an overhaul of equipment.

This contract should be reviewed. Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. This would enable personnel to diagnose potential problems prior to failure at a savings to the owner. It also better assurance of reliability than having an overhaul upon breakdown or on a five year schedule.

Vibration analysis can determine alignment, bad or worn bearings, soft foot, impeller wear or in-balance, shaft problems, etc. Thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues. Although these stations are not providing revenue requiring accurate metering, a meter would allow personnel to perform pump tests to determine a unit's efficiency that is affected by many mechanical conditions such as worn wear rings, damaged or worn impeller, horsepower to pumpage ratio, etc.

If the contract with the Corp. of Engineers can be re-negotiated where they accept and agree to a condition assessment level, the City of Dallas should be able to cut repair costs substantially.

3. CX ASSESSMENT

Interviews were conducted with management and maintenance staff to gain a better understanding of current practices, conditions, concerns and suggestions. An inspection of the site was conducted to evaluate and assign a condition rating of the station and its equipment.

3.1 Operations

This station is controlled and monitored by means of the Supervisory Control and Data Acquisition (SCADA) System located in Flood Control's main office at 2255 Irving Blvd. This allows an operator to monitor and control multiple stations from one location. Detailed information on what information and controls the SCADA System provides is included in the SCADA section.

In the event of a SCADA failure, personnel are able to manually operate this station from the switchgear cabinet by switching controls from remote to local and selecting the start or stop switch. (Photo 3.1) Indicator lights and instrumentation provide the necessary information to an Operator. An operational chart provides guidelines when and which unit is to be put on line or taken off.

Photo 3.1 - CX Manual Controls on Switchgear

Charlie pump station (CX) is located on the west levee and completed in 1932. This was the same period that OBX, SAX and DX were added along the east and west levees.

The operational duties of employees in the Flood Control Division are minimal and do not justify having a separate operational staff. This division has training classes for personnel to qualify in three areas of operations, Flood Alert System, Pump Station Operation and SCADA System Control. Employees must pass an exam prior to operational assignments and may only operate the system once they have completed and passed all three courses.

Both main flood water pumps are scheduled for overhaul this FY 07/08. Unit #1 is currently pulled and at the vendors for overhauling on both the pump and motor. Work is to be completed and installed by late March. #2 unit is scheduled for overhauling in September and the low flow pump, #3 in November, which will be FY 08/09. The

division has set an aggressive pace to get back on the original overhaul schedule for all their stations.

There has not been any recordable rainfall up to the time of this report. The stations will be will re-visited during a rain event to witness the units while running. Condition assessment will be made based on physical inspection of each unit and this information will be documented and provided in spreadsheet format with comments.

Concerns and Issues
The station is located in a remote area with industries located to the west backing up to the sump area. Security is better at this location with the fencing surrounding the station's facilities.

3.2 Exterior Equipment

The CX screens are much narrower (Photo 3.2) than the screens at the larger stations. It was also the first screen to have an automated rake system and is unique from the other stations. A hydraulic motor powers the rakes.

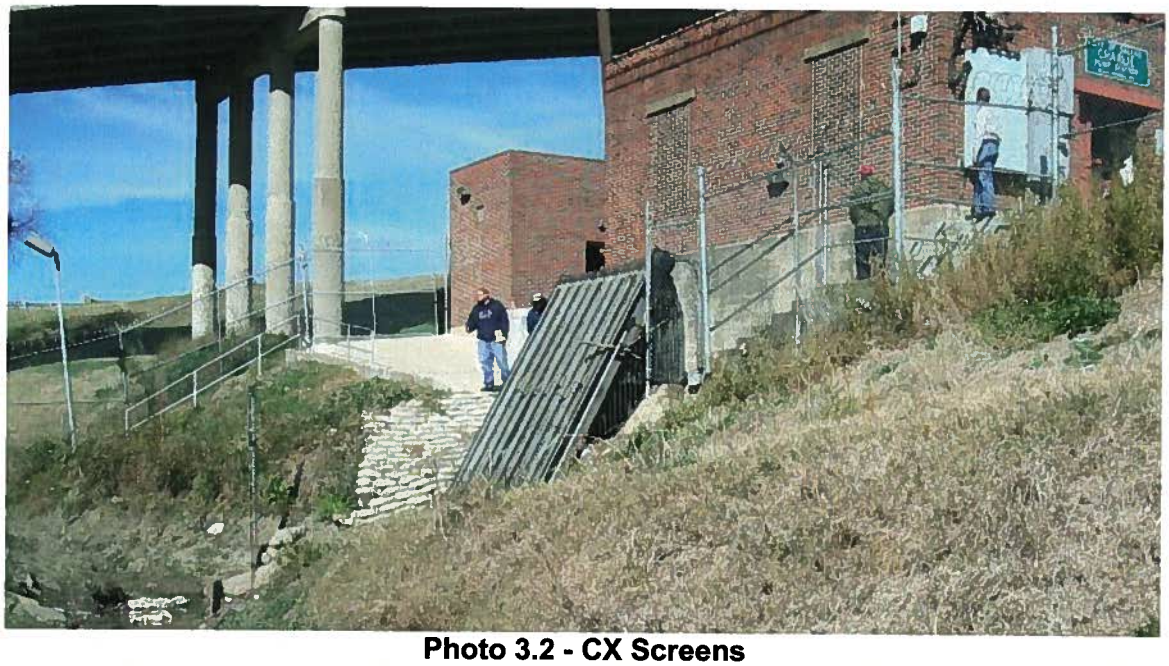


Photo 3.2 - CX Screens

A hydraulic pump sends pressurized fluid to a motor mounted on the screen's rake system. Temperature changes affect the viscosity of hydraulic fluid. This can require seasonal adjustments to compensate for changes to the motor's speed. The hydraulic lines require insulation, must be able to handle pressure and temperature variations and their fittings are prone to leakage. This may be the reason that later designs went to electric motors.

Photo 3.3 - CX Sump Channel Looking South

The channel feeding the sump area is very narrow, not more than six feet across and a three to four feet deep drop-off. This is sufficient for light rain events and the everyday runoff from various sources. Above the drop-off, the channel spreads outward +/- 20 feet on each side in a gradual grade. (Photo 3.3)

Photo 3.4 - CX Narrow Lower Section of Sump's Channel

Heavy vegetation covers the upper wider portion of the channel preventing slippage. This tapers at a gradual slope before making an almost vertical three foot drop off into the primary channel. Although this is a severe drop off, there are no signs or indications of erosion or recent slippage. (Photo 3.4)

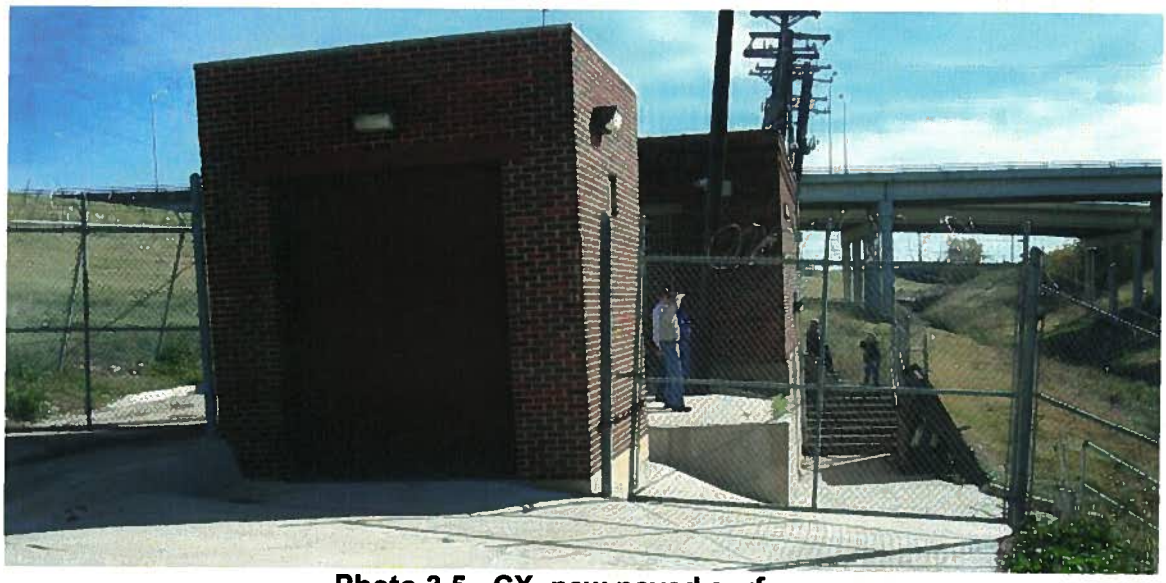


Photo 3.5 - CX, new paved surfaces

The area surrounding the CX site experienced drainage problems with water coming off of the western slope of the levee. The division's personnel were able to pave around and between the two stations to eliminate most of this problem. Addition of handrails are needed for personnel safety and curbs added to prevent vehicles from rolling off into the sump or the drop off between the buildings. (Photo 3.5)

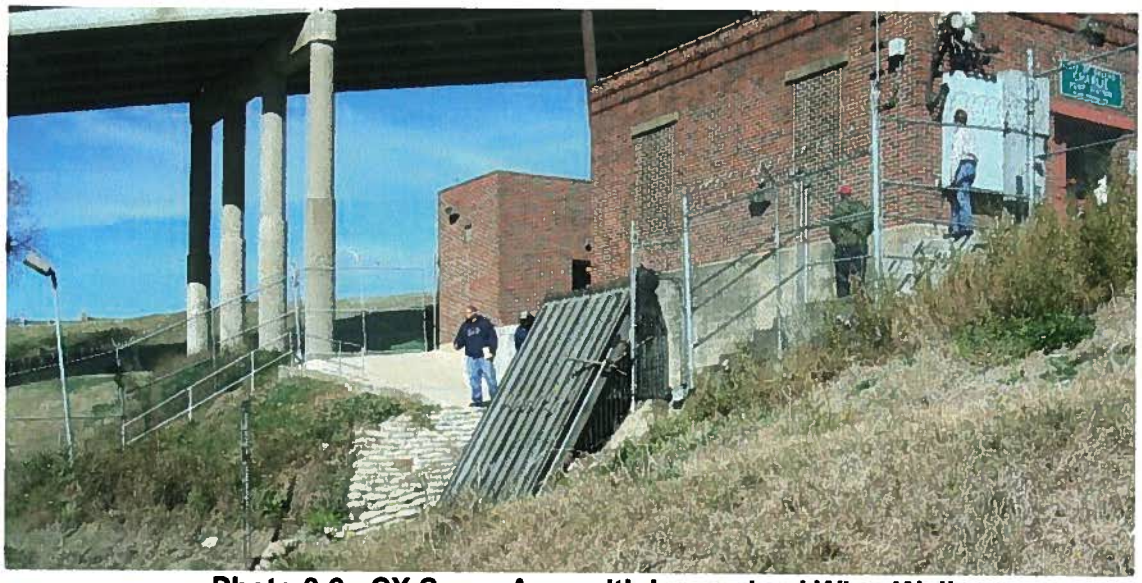


Photo 3.6 - CX Sump Area with Improvised Wing Wall

An improvised wall made out of concrete filled bags was placed on top of the existing wing wall. (Photo 3.6)

Photo 3.7 - CX South Stairway to Screens

Run-off was also a problem on the south end of the main pump station. The stairway leading down to the screens is unsupported for a height of +/- two feet where soil has washed out. It appears that new paving is covering old, re-directing the run-off but the soil needs to be replaced and compacted correctly. A concrete apron on both sides of the screens may still be required to eliminate problems in this area. (Photo 3.7)

There was no visible damage to the screens but noticed that one rake was missing on the north end. This is minor and something that the maintenance staff can repair as part of their normal duties.

The channel's west bank has industrial sites built right up to the bank. This appears to be a potential problem. Whatever washes from these sites goes directly into the channel. The possibility of hazardous waste coming from these industries is not currently monitored. The debris coming into the site is hauled to a pubic landfill. There are restrictions on what may be dumped at these landfills and this could become a costly problem. All flood waters are discharged into the Trinity River, another health concern.

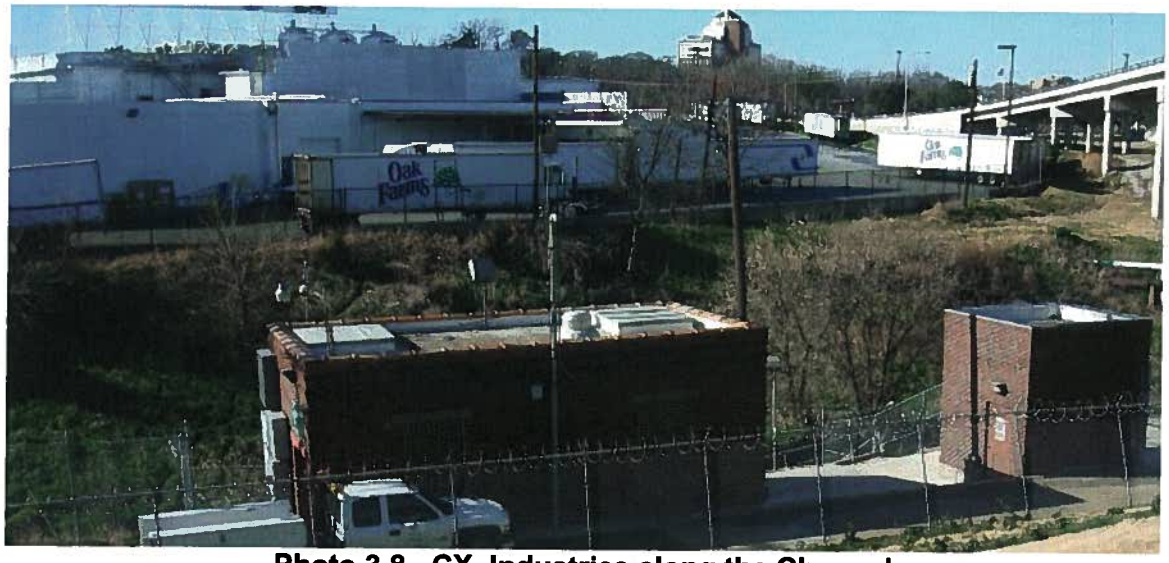


Photo 3.8 - CX, Industries along the Channel

The current accountability in place for the industries is not known or if it is being monitored and recorded. The City of Dallas is actively involved in environmental management, having created a new Environmental Department that both the Streets and Water Departments are heavily involved with the pilot program. (Photo 3.8)

There is adequate exterior lighting for personnel to perform their required tasks. The fence surrounding this area is in good repair and a deterrent against vandalism. (Photo 3.9)

Photo 3.9 - CX Security Fencing

This facility has a stairway down to the low flow suction inlet for cleaning. This type of access should also be built to the area where the channel enters the sump area for access to the lower section of the screens. A curb added along the east side of the driveway might re-direct some of the run-off problem around the site and prevent it from washing out the area on each side of the screens

The building has signs of possible structural problems. Numerous cracks can be seen more readily on the painted walls inside. Mortar has separated from the brick in patterns

suggesting movement. There is a more serious concern with the brickwork at both the north and south ends of the building that supported an overhead crane. There is external separation extending internally as if something too heavy was lifted. (Photos 3.10 and 3.11) A thorough inspection by a Structural Engineer would be advisable to see what repairs may be needed.

Photo 3.10 - CX Brickwork above Exhaust Fan North Wall

Much of the decorative band around the upper exterior wall requires re-grouting. A few of the joints on the capstones surrounding the roof also need attention. (Photo 3.10) When having the re-grouting done it is also advisable to apply a sealant to the brickwork. Moisture appears to be causing the paint on the interior wall to fail.

Photo 3.11 - CX Interior North Wall and Overhead Crane's Rail above Exhaust Fan

There are no signs of the roof leaking on the main pump Room Building. The roof is concrete and appears to have a membrane with rock topping. There are no signs of ponding or leakage inside or out. A large equipment hatch is above each pumping unit to allow crane access. (Photo 3.12) These hatch penetrations have an excellent lip height above the roof's surface to prevent water from entering the pump room, should the roof not drain properly. The hatch on the north has minor damage along the seam

that may allow very minor amounts of rain to seep into the building. A small amount of leakage is normally not a concern, but this is directly above an electric motor and should be monitored during a rain event to see if repairs are necessary. There is a third roof penetration for ventilation that shows no signs of leakage.

Photo 3.12 - CX Main Pump Room's Roof

The roofing system on the Low Flow building does not show any signs of leakage internally, but the roofing system shows signs of wear that will need repair or replacement in the near future. The sealant or painted area has cracked where the walls and roof meet. This is normally the first area to fail and should be monitored. This appears to be a membrane type of roofing system, but there is not any rock covering the roof's surface area, this is usually placed over a membrane for its protection. (Photo 3.13)

Photo 3.13 - CX Low Flow Pump Station

Concerns and Issues

- Hydraulics used for the screen rakes present several concerns. Depending on the type of fluid used, a broken line can create a hazardous spill that requires hazmat clean-up. Hydraulic systems are temperature sensitive and can affect the equipment's operation. With a hydraulic system, you are dependant on both electrical power to the pump and hydraulic pressure to the motor for the rakes to operate.

- The screen needs a stairway down into the area where the sump enters the screens for ease of maintenance and a safer work environment for personnel.

- A concrete apron is needed on both sides of the screens from the existing wing walls to the paved area surrounding the west side of the site. Run-off has caused damage in the past and is the reason for the extensive paving. The addition of a concrete apron will prevent any additional run-off from damaging the banks to the screens.

- The power poles to this location are also showing signs that the east bank is shifting. They are leaning towards the channel but not to the degree where additional support is required.

- The area under the south staircase leading down to the screens is severely undermined by erosion and needs to be repaired as soon as possible.

- There is damage to the brickwork that extends through the walls to the interior that indicate movement. The brickwork on the north and south walls has damage around the area where the overhead crane's rail was supported. A Structural Engineer's inspection of the site and its buildings are advised.

- The brickwork on the main pump room's exterior needs to be re-grouted in areas that have fallen out. The application of sealant to the brickwork should lessen the paint failure problems inside the pump room.

- Newly paved areas around the station are not well marked and lack any safety provisions for personnel and vehicles. The new driveway has no curb to redirect run-off and there is a vertical drop off along the western edge of the driveway into the sump. Bollards installed along the drive would provide drivers a visual clue and some protection from going off the edge. Handrails or bollards with a rail between the buildings need to be added. There is an unsafe drop-off between these buildings on the west side.

- Have Equipment and Building Services (EBS) inspect the roof on the Low Flow Pump Room to determine when and if repairs or replacement of the roof is necessary. Also, inquire if a rock cover is appropriate for this roof system.

3.3 Interior Equipment

The units can be operated within the station but normal operations are executed and monitored by means of the Supervisory Control and Data Acquisition System (SCADA) located in Flood Control's main office at 2255 Irving Blvd.

The division's electricians have installed a service disconnect at this station. This allows the division to shutdown power at the station without having to call out the service provider to pull or restore power for the station's electrical maintenance activities. Charlie and Delta are currently the only stations where a service disconnection has been installed. The division will be adding this to all stations as time and money permits.

The electrical cabinets are raised off the floor slab and mounted against the wall. (Photo 3.14) Electrical service enters the building through the upper portion of the south wall on the west corner and enters the switchgear from the top. The motor leads exit from the lower sides of the cabinets in a large flexible conduit to the motors. The remaining

conductors exit the cabinets through wall mounted conduits to the circuit panels and breakers.

Photo 3.14 - CX Main Pump Room West Wall

Photo 3.15 - CX Main Pump Room East Wall

The switchgear itself is in good operational order. As in other stations, its age makes acquiring parts difficult, the protection devices are the old mechanical type, and meters are out of calibration. The relays are minimal, requiring onsite personnel to see and reset alarm trips. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc.

Preventative maintenance and most repairs on electrical switchgear and equipment are performed by the Division's Electrical section. This equipment has been well maintained. Each component is inspected and cleaned twice a year. All technical sections within the division make routine inspections and perform related preventative maintenance that is recorded in weekly reports.

There are two manually operated sluice gates and two motor operated gates in the pump room. All are operational and well maintained. The manually operated valves have only half of the exposed threaded shaft covered. (Photo 3.14) A full length cover would provide better protection by keeping contaminates from bonding to the grease used on the threads. If clear covers were not available from this manufacturer, a longer section of PVC with a small slot cut up the length would provide the coverage while allowing visual inspection of the stem's position. The electrically operated valves have the full cover suggested. (Photo 3.15)

The Remote Terminal Unit (RTU) receives commands from the SCADA and sends status and data to the SCADA is located in a room within the pump room. This was built in-house for an office area that also serves to protect the electronic equipment. (Photo 3.16)

Photo 3.16 - CX RTU Room

There has not been any technical analysis conducted to determine levels of efficiency or vibration on any of the pumping units. The only tests performed are by the contractor/vendor at the time of the unit's last overhaul.

An inspection will be scheduled at all location when the units are able to run. This will be to determine the condition, based upon a physical inspection only. Vibration analysis and thermal imaging should be added to the division's routine maintenance program.

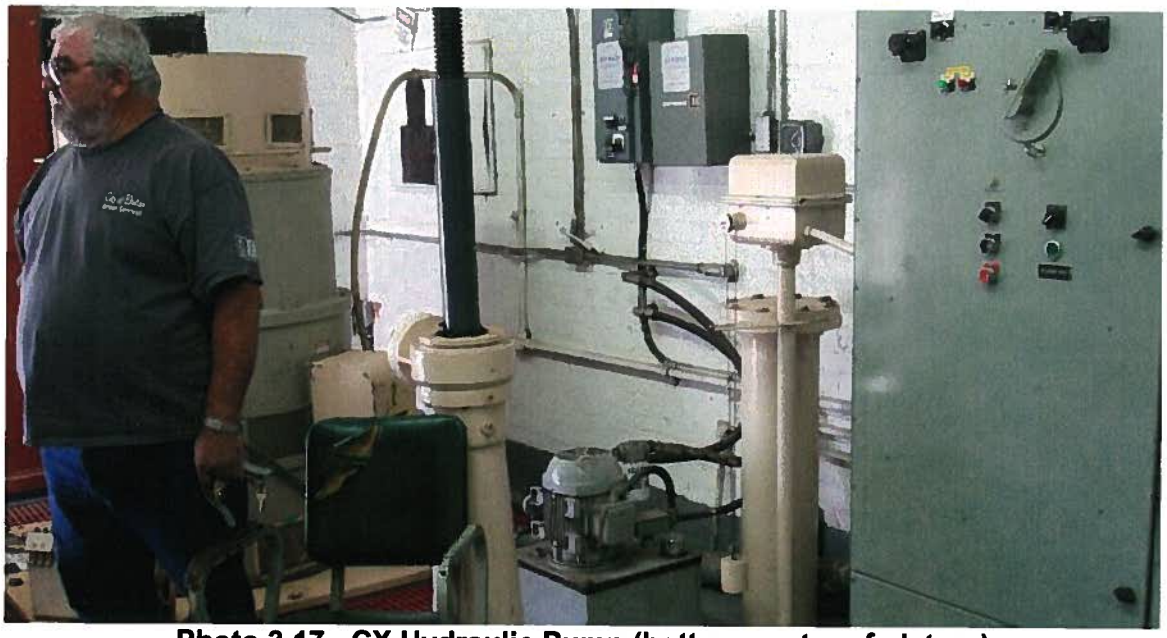


Photo 3.17 - CX Hydraulic Pump (bottom center of picture)

The hydraulic pump for the screen and rake system is mounted on the floor between the #2 pump, the switchgear panel, the south manually operated sluice gate and the sump level tube. (Photo 3.17) Although this is operating correctly, The choice of hydraulics in this application is questionable. There are no obvious benefits and there are several liabilities. Electricity is still required to run the hydraulic pump and there are pressurized lines that can break and spill hydraulic fluid. If this goes into the sump, there is a possible hazardous spill to deal with. There are connections that will leak at some point, hydraulics are affected by temperatures, etc. As mentioned in the Exterior Equipment Section, there is a problem with the structure's brickwork and a Structural Engineer should be called in to see what action should be taken. Inside the pump room there are numerous areas where the paint has popped off the brick, which may indicate that moisture is leaching through the brick causing this problem. Bricks are porous and may require a sealant on the exterior surfaces.

There is no space available within the stations to store parts or equipment. This station is an older design with minimal floor space. Renovation would be difficult and the downtime required would be impractical. If there are long range plans for replacement, the new structure should include an area for storage.

There are two exhaust fans in this station. One is a very small fan mounted on the north wall and the other is a large roof mounted unit. The roof mounted unit provides enough circulation for a station this size. The supply air was designed to come into the building from the grates surrounding the pumps. The old pump station originally had windows that could also be opened in the summer to allow some ventilation. AC is recommended for new or refurbished electrical switchgear areas to increase service life.

These windows were bricked up to provide better security. This eliminated a natural light source. The lighting has been improved by adding fluorescent fixtures, which provide adequate light and are easily maintained.

Photo 3.18 - CX Rail at South Wall

The overhead rail that was used for the hoist in this station may not be properly sized for this building's structure. The original design of hatches above the main units was to

allow a mobile crane to pull equipment through the roof hatches. If the overhead hoist's rail running north/south the length of the building is original, its purpose was to handle auxiliary equipment or possibly removal of the motor from the pump. The supporting walls have some damage around both contact points. The original hoist may have been replaced at some point with one having a larger capacity or the motors now in place weigh more that the supports were designed to lift safely. Although no longer used for lifting the damaged areas on the walls should be checked. (Photo 3.18)

Photo 3.19 - CX Farval Lubrication System

(Photo 3.19) The Farval lubrication system provides each pump with a measured amount of lubrication at prescribed times. The transfer of grease from the storage container to the Farval's main cylinder has experienced some problems with air pockets. The delivery of grease to the farthest pump is also experiencing some intermittent difficulties. There are alarms in place that prevent a pump from starting or take the pump off line if the Farval system fails to operate correctly. These alarms transmit to the SCADA, informing the operator of the problem.

The low flow pump is located in a separate building, north of the main pump station. Power to this building is routed through the main station, exits through the main station's lower north wall where it elbows into the ground and is a buried cable to the low flow station where it enters through the floor into the bottom of the station's switchgear. (Photos 3.20 & 3.21)

Photo 3.20 - CX Low Flow Switchgear

Photo 3.21 - CX Low Flow Pump

Photo 3.22 - CX Low Flow Pump Station's North Equipment Entrance

The building is just large enough to house the pumping unit and switchgear comfortably.
Equipment is removed through the north roll up door. (Photo 3.22)
Normal foot traffic enters through a hinged door on the south wall. (Photo 3.23)

Photo 3.23 - CX Low Flow Pump Station's South Entrance

As mentioned in the comments for the main station, the hinged door should be equipped with a kick bar for emergency exit and a lit exit sign unless the fire marshal approves the existing hardware.

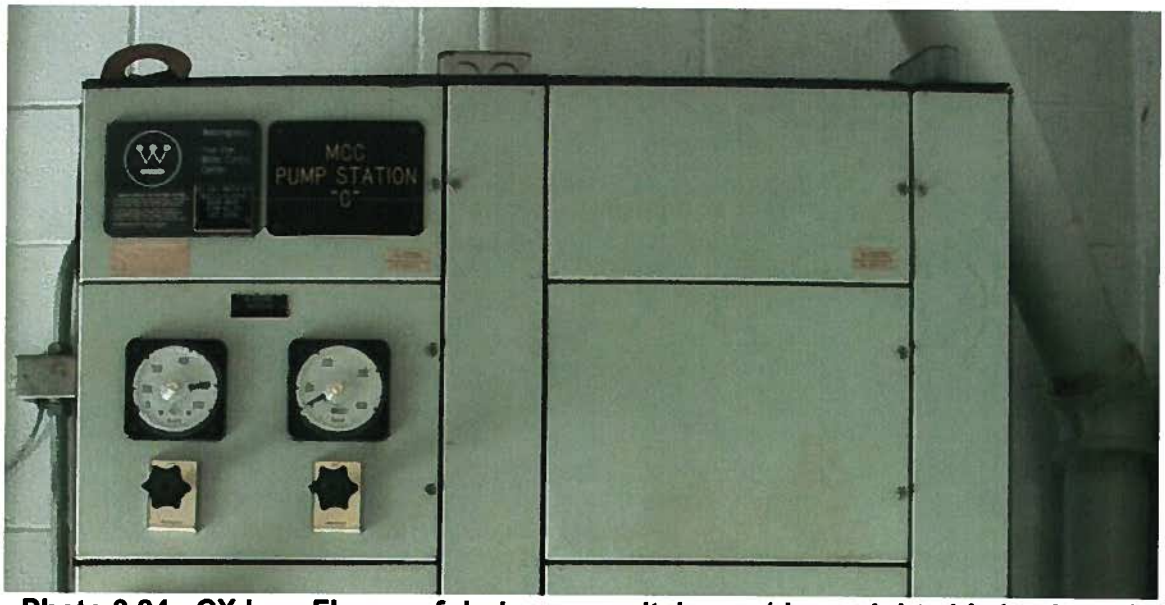


Photo 3.24 - CX Low Flow roof drain over switchgear (down right side in picture)

The roof drain of this building is directly above the switchgear and the drain line runs through the station rather than outside the station. (Photo 3.24) This may not be a code violation but the penetration in the roof for the drain is a potential leak on to medium voltage gear. It is a good design practice to keep water outside the building when possible. The roof should have scuppers with drainpipes down the outside walls to eliminate this concern.

Concerns and Issues

- The building does not have any lightning protection other then the lightning arrestors within the switchgear.

- Neither vibration analysis nor pump testing are performed to evaluate these units. Vibration analysis alone could warn of pending bearing failure, misalignment, soft foot, impeller wear and numerous other conditions before they cause a failure of the unit. This would also be a tool to lower repair costs. The units at this location operate during every rain event. Early diagnosis allows for in-house repairs on many of these listed conditions and minimizes catastrophic failures. Thermal imaging should also be considered. This provides personnel with images that locate hot spots in electrical equipment and can be used on mechanical equipment such as bearings, packing or mechanical seals, couplings, etc. This is an available service on price agreement or the better solution would be to invest in a unit for the division.

- The Fire Department recently underwent changes in requirements for Fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed but is not required to be tied into the fire department's alarms "IF THERE IS SOMEONE INHOUSE MONITORING IT 24/7". There must be an external alarm to alert passer-bys. Verify that these changes are or are not grandfathered.

- There is only one access point into the main building. The entrance is a sliding door that needs to be changed out to a hinged double door and fitted with a kick bar for emergency exit. A lighted exit signs may also be required above the door.

- The Low Flow building needs the hardware on the hinged door changed over to an emergency exit with a kick bar and a lit exit sign over inside of the door.

- Every station needs emergency lighting. Mount battery operated fixtures on the walls at a height that permits routine checking. Provide enough light to permit personnel to see the way to an exit.

- Every station needs a storage area. This building is too small for any type of storage and the size of the site limits possibilities.

- Convert the hydraulic system over to all electric, if possible.

- Improve ventilation; this may be tied to the fire department's new building codes.

- Have EBS inspect the roof of the Low Flow Station for wear. Repairs or replacement may be needed in the near future.

- Have Structural Engineer inspect brickwork and support structure for overhead crane.

3.4 Levee and Outfall

As at other stations, there is no foot traffic access to the top of the levee. This is a steep irregular grassy surface. Employees climb the levee to check equipment at the outfall structure.

The west side of the levee facing the station is well maintained with the slope even and smooth with an excellent grassy ground cover throughout. (Photo 3.25) The road on top is routinely graded and in good repair. The east side of the levee is in excellent condition with heavy ground cover and a smooth graded slope. There is an area to the south under an overpass that has been re-planted and covered with matting to prevent the soil from washing out until the new growth has a chance to bind the soil. (Photo 3.26)

Photo 3.25 - CX West Face of Levee

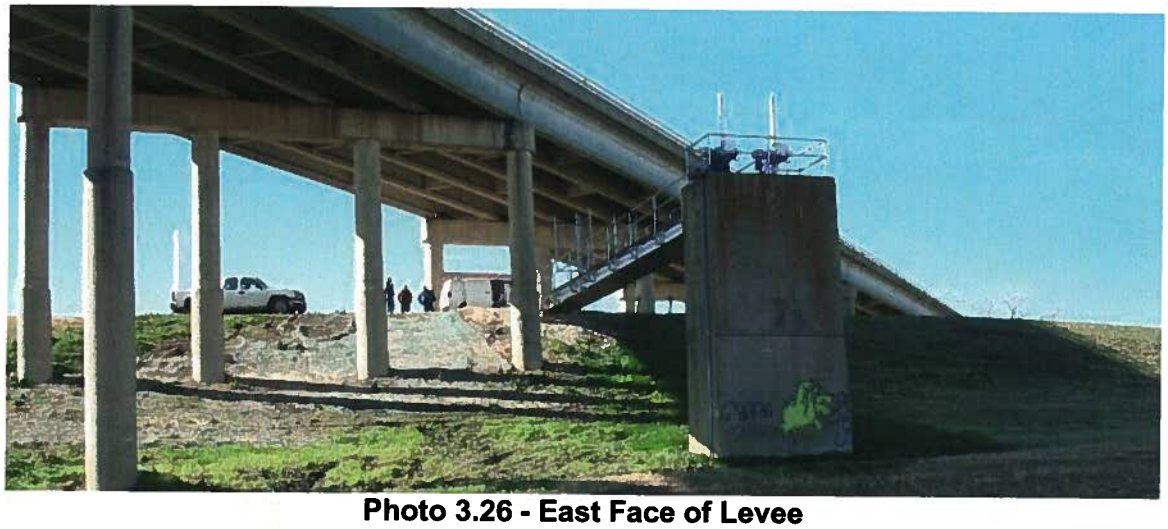


Photo 3.26 - East Face of Levee

The elevated bridge and valve vault appear to be in excellent condition. There are not any noticeable signs of the concrete structure moving or cracking. There are a few minor chips on corners from ground maintenance equipment. The metal bridge and its concrete walkway also appear to be in excellent condition. (Photo 3.27)

Photo 3.27 - CX Valve Structure and Elevated Bridge

Photo 3.28- CX South Sluice Gate

Photo 3.29 - CX North Sluice Gate

There are two electrically operated sluice gates at the end of the structure. Their operators and upper valve stems are well maintained. The shafts extending down into the vault are straight and the wall mounted shafts supporting them are secure. There are beginning signs of corrosion on some of the fasteners. It is suggested that a cleaning and re-coat of the fasteners with the silver paint is needed and appears to be working well in this environment. (Photos 3.28 & 3.29)

Photo 3.30 - CX Bridge Landing's Bottom View Showing Apron

On the opposite end of this structure, a brick and mortar apron under the landing requires repairs or replacement. The weight has caused some settling resulting in some areas breaking apart and others dropping down. This can be seen where the valves electrical service comes out of the ground and fastens to the bridge. The mortar mound is unsupported at the lowest end. (Photos 3.30 & 3.31)

Photo 3.31 - CX Bridge Landing

Photo 3.32 - CX Outfall structure

At the outlet structure, the vegetation stops +/- 25 feet from the water's edge. There is no sign of previous rip-rap near or at the structure. Water has washed out portions of the surrounding banks and the channel is narrow and winding from slippage. (Photos 3.32 & 3.33) The lose soil appears to be very unstable and likely to continue washing down in front of the structure into the outfall area until stabilized.

The circular pond of water at the structure's discharge shows heavy silting and erosion along south bank of the outlet structure and continuing down the channel to the river. It is suggested that the south side of the channel be graded at a more gradual slope and the channel cleared to the river.

The area surrounding the Outfall structure is also at a steep slope. It would be difficult and unsafe to attempt to establish and maintain a ground cover to bind the soil. Appropriately sized rip-rap is a good choice for this application and site.

Photo 3.33 – CX South Bank of Outlet Pond

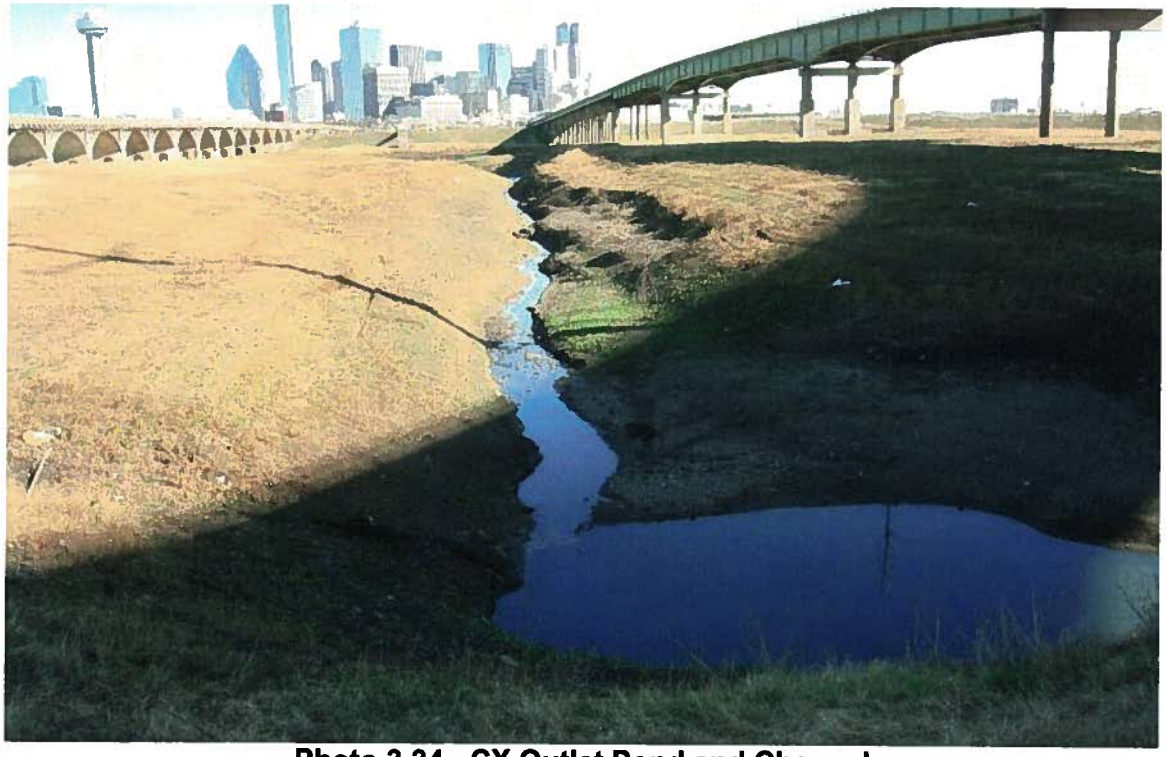


Photo 3.34 - CX Outlet Pond and Channel

The CX is located on the west levee due west of the Able site. Both the outfalls of these stations are in the same proximity on opposite sides of the river. Able's valve vault structure can be seen in Photo 3.34 to the left of CX's channel.

Concerns and Issues

- It is recommended that the outfall channel be re-sloped on the south bank to lessen slippage and erosion and straighten the channel.
- It is recommended that this site be considered for adding appropriately sized rip rap to surround the Outlet structure as a measure to stabilize the area.
- The apron at the bridge landing needs to be repaired or replaced.
- Personnel have no safe access up or down the levee. A stable pathway needs to be added.
- The addition of lights and GFI outlets installed on the valve vault would be helpful to personnel required to inspect and work on its equipment.

Delta (DX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. DELTA PUMP STATION (DX)

450 Yards North of Hampton Road Bridge, West Levee
Dallas, TX 75207
Mapsco 43H

Year Built: 1932

Renovations: 2007 service disconnect, 1991 SCADA, Low Flow Pump 1963, Farval Lubricating System

Current Design Pumping Capacity: 2 – Peerless 42" 300 hp, 503 rpm, 40,000 gpm vertical pumps for 80,000 gpm, 1 – Aurora Low Flow 16", 100 hp, 880 rpm, 6,000gpm
Overhaul Program: #1 in for scheduled overhaul, #2 overhauled 2007, #3 Low Flow overhauled in 2007.

Photo 1.1 – Delta Pump Station

2. MAINTENANCE PROGRAM

Flood Control Division does not have access to their budget on a level allowing a cost analysis for operation and maintenance. The division has recently had a change in management. The new staff began an aggressive overhaul schedule of pumps and motors. The current contract between the City of Dallas and the Corps of Engineers dictates a condition level that can only be met by an overhaul of equipment.

This contract should be reviewed. Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. This would enable personnel to diagnose potential problems prior to failure at a savings to the owner. It also better assurance of reliability than having an overhaul upon breakdown or on a five year schedule.

Vibration analysis can determine alignment, bad or worn bearings, soft foot, impeller wear or imbalance, shaft problems, etc. Thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues. Although these stations are not providing revenue requiring accurate metering, a meter would allow personnel to perform pump tests to determine a unit's efficiency, which is affected by many mechanical conditions such as worn wear rings, damaged or worn impeller, horsepower to pumpage ratio, etc.

If the contract with the Corps of Engineers can be re-negotiated where they accept and agree to a condition assessment level, the City of Dallas should be able to cut repair costs substantially.

3. DX ASSESSMENT

The Interviews with management and maintenance provides a better understanding of current practices, conditions, concerns and suggestions. A site inspection was made to evaluate and assign a condition rating of this station and its equipment.

3.1 OPERATIONS

This station is controlled and monitored by means of the Supervisory Control and Data Acquisition (SCADA) System located in Flood Control's main office at 2255 Irving Blvd. This allows an operator to monitor and control multiple stations from one location. Detailed information on what information and controls the SCADA System provides is included in the SCADA section.

In the event of a SCADA failure, personnel are able to manually operate this station from the switchgear cabinet by switching controls from remote to local and selecting the start or stop switch (Photo 3.1). Indicator lights and instrumentation provide the necessary information to an Operator. An operational chart provides guidelines when and which unit is to be put on line or taken off.

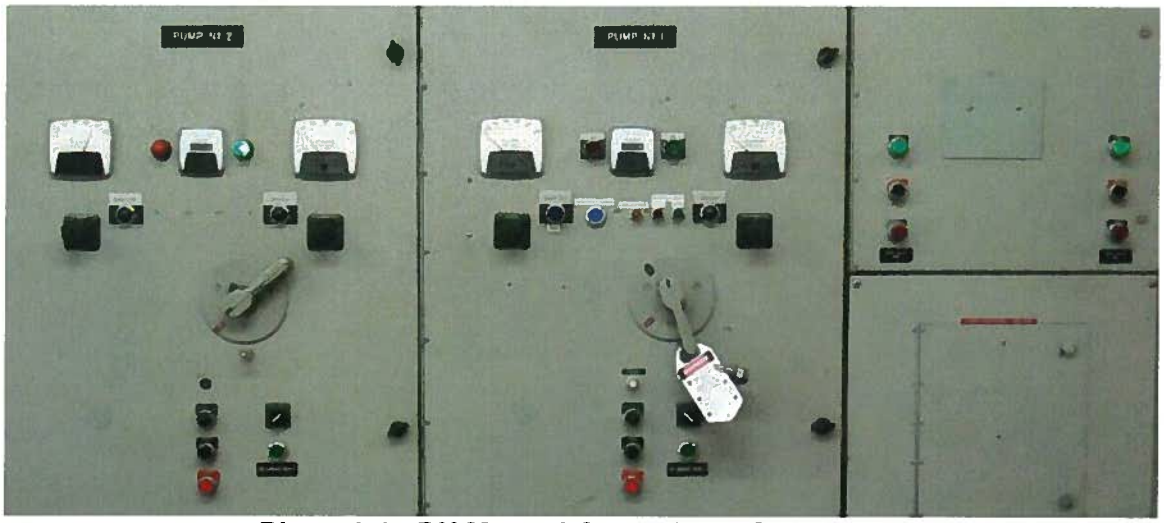


Photo 3.1 - DX Manual Controls on Switchgear

Delta pump station (DX) is located on the west levee and was completed in 1932. This was the same period that OBX, SAX and CX were added along the east and west levees. These were the first flood water pump stations built as part of the original levee system.

The operational duties of employees in the Flood Control Division are minimal and do not justify having a separate operational staff. This division has training classes for personnel to qualify in three areas of operations, Flood Alert System, Pump Station Operation and SCADA System Control. Employees must pass an exam prior to operational assignments and may only operate the system once they have completed and passed all three courses.

Unit #1 is currently pulled, and is at the vendors for overhauling on both the pump and motor. Work is to be completed and the pump and motor reinstalled by the first week of April. The #2 & 3 units were overhauled in the first half of 2007. This completes the overhaul cycle at Delta. The next overhaul cycle is scheduled to begin FY 11/12. The division has set an aggressive pace to get back on the original overhaul schedule for all their stations.

There has not been any recordable rainfall up to the time of this report. All sites will be re-visited during a rain event to witness the units while running. Condition assessment will be made based on physical inspection of each unit and this information will be documented and provided in spreadsheet format with comments.

Concerns and Issues

Delta Station is located to the east of a residential area but is separated by a large sump area. It is in a location not easily accessed by road, but easily reached on foot and in plain view. Fencing at this station has been removed in areas for concrete work but has not been replaced. Security at this location is locked doors only. Relocation of the fence and gate will be necessary due to the concrete work. The City of Dallas has a price agreement for installation and repairs of chain link fencing that could be used if the division personnel are unable to perform this task. Repairs to the fence will provide

security to personnel while at the station and protect exposed equipment from potential vandalism.

3.2 EXTERIOR EQUIPMENT

The DX screens are narrow in width, similar to those seen at Charlie Station. The screen's rake system is once again completely different from the other stations. The rakes rotate in front of the screens rather than behind them. In place of protruding rods, this system has shelves with a serrated lip that protrude towards the screen. The shelves rotate over the screens so the serrated edge points away from the screens on the back side of the rotation. (Photo 3.2)

Photo 3.2 - DX Screens

Talking with personnel, this system works well with small objects and floating debris. It has problems with large objects such as tree limbs, being too cumbersome to lift or fit between the two layers of rakes. When large objects work their way into the screens, it causes the rakes to lockup. Moving this system to another location that handles smaller debris has been discussed. There is merit to this idea as a better application for this design.

Photo 3.3 - DX Hinged Rails on Rake System

Photo 3.4 - DX Conveyor Reset Switch

The rakes mount to a hinged rail that locks in a straight line on the outward exposed section. The hinge design bends inward at the bottom of the rotation allowing the rakes to make contact against the screen while lifting debris. These hinged sections supporting the travel of the rakes look insubstantial, not designed to withstand a heavy impact. (Photo 3.3)

This station also has a conveyor system and again, different in design than at other locations. This is designed to pull debris out of a low level area to a high point that allows a dumpster to be located beneath the drop point. A safety line runs the length of the conveyor that allows personnel to shut off the system in the event of an emergency or equipment problems. The one glaring problem is the location of the reset switch. It is on the upper end of the conveyor that is over eight feet high and impossible to reach without a ladder. (Photo 3.4)

The Delta station has a very large holding area for a sump. The banks are on a gradual slope and have excellent ground cover, with no signs of slippage or erosion. (Photo 3.5)

Photo 3.5 - DX Sump Area Looking North

The sump backs up to a residential area and is not fenced off. Although it is only flooded for short periods, this area should be considered hazardous. No signage was visible to warn of flash flooding. The slope into this large sump is very gradual, making it appear shallow, but it is deceptively deep and the large open discharge structures are easily accessible and inviting to neighborhood children. (Photo 3.6)

Photo 3.6 - DX Discharge Structures to Sump Area in Residential Area

There are signs of routine traffic passing through the sump. A path across the southern end of the sump appears to be a neighborhood short-cut. This supports the concern that parents and/or children are not aware of the potential danger. This could be a potential legal liability to the City of Dallas, requiring mitigation. (Photo 3.7)

Photo 3.7 – Path through DX Southern Section of Sump

The discharge structure on the West bank of the sump area was a recent improvement. There are erosion problems occurring with soil washing out on both wing walls and soil is being undermined from under the connecting concrete slab. The flow dissipaters appear to be directing water to the end of the wing walls and washing away the embankment. There is also undermining of the pad's perimeter. If this was done under contract, the responsible engineering firm should be contacted, notifying them of the malfunction. This will require resolution before there is irreparable damage. (Photo 3.8)

Photo 3.8 - DX Sump Discharge Structure, West Bank

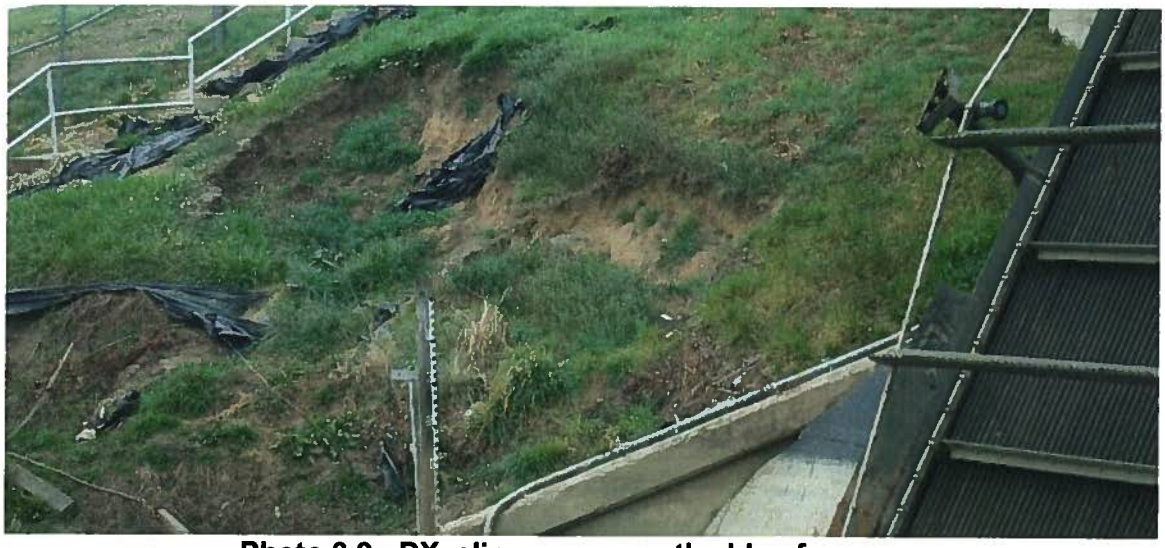


Photo 3.9 - DX, slippage on north side of screens

The north side of the screens has slipped and it appears there was an attempt to fix the problem with groundcover. The steep angle of the slope and flooding of the area will make it impossible to maintain any natural groundcover. A concrete apron over to the existing stairway and additional stairway on the side of the screens would be a better solution. (Photo 3.9)

There is adequate exterior lighting for personnel to perform their required tasks. The fence no longer provides any security. The section across the south end was removed for access to improve the paved area to the conveyor. This work is completed and the south fence line requires relocation to encompass the new paved area. As mentioned above, the City of Dallas has a price agreement for repairs, replacement or new installations on fencing. (Photo 3.10)

Photo 3.10 - DX South Fence Line Replacement Required

Photo 3.11 - DX, Flashing on East Roofline of Low Flow Station

There are no visible signs of movement in either the main station or the low flow pump station. The original capping on top of the main pump room has been replaced with what appears to be a solid concrete cap. A 90 degree metal flashing covers the top layer of brick and the capping on top of that with a thin layer of cement or mortar coating the flashing. (Photo 3.11)

All the grout work is in good condition. (Photo 3.12) It is not known when the bricks were last sealed but there are not any noticeable signs of moisture leeching through.

Photo 3.12 - DX West Wall's Brickwork

All paint on the interior that has flaked off, has a seal coat of paint beneath that is holding. (Photo 3.13) It would still be a good idea to have all brickwork sealed at the same time if possible

Photo 3.13 - DX Interior Wall Paint

There no signs of the roof leaking on the main pump room building. The roof is concrete and appears to have a membrane with rock topping. There are no signs of ponding or leakage inside or out.

A large equipment hatch is above each pumping unit to allow crane access. (Photo 3.14) These hatch penetrations have an excellent lip height above the roof's surface to prevent water from entering the pump room should the roof not drain properly. The hatch covers are in excellent shape providing a weather tight seal. There are no visible problems with the station's exhaust fan.

Photo 3.14 - DX Main Pump Room's Roof

The roofing system on the Low Flow building does not show any signs of leakage internally, but the roofing system may be allowing water to enter between the roofing system and the brick along the east wall where most of the top flashing is missing. This appears to be a membrane type of roofing system but it only extends down the walls and onto the roof for a +/- 6 inch lip. This is a solid roof with no seams, so this type of system is sufficient. (Photo 3.15)

Photo 3.15 - DX Low Flow Pump Station

Concerns and Issues

- The sump area has no signage, no barricades, bollards or fencing. There is evidence that the sump area is being used as a neighborhood short cut. This could be a potential legal liability to the City of Dallas.

- The conveyor belt has an emergency shutoff that is triggered by tugging on a wire line that runs the distance of the machine. This is an excellent safety device but it takes a step ladder to reach the reset switch. The reset switch is located on the high end of the conveyor, well over eight feet in the air. This is impractical and unsafe. Relocate this switch to a practical location.

- The groundcover area on the north side of the screen is not stable and shows signs of attempted repairs. A concrete apron with a stairway bordering the screens would prevent future slippage and safe access for personnel.

- There is a strip of flashing missing on the east roofline of the low flow building. Repairs are needed to prevent water damage. The EBS department within the City of Dallas should be notified of needed repairs.

- The brickwork on both pump rooms is in good repair but having the bricks re-sealed would be an excellent preventative measure against weather damage.

- The outlet structure located on the west bank of the sump area has erosion being caused by the structure's discharge. This is a new structure and the responsible engineering firm should be notified of the malfunction and directed to provide resolution.

- Replace the fence and gate on the south end of Delta's site.

3.3 INTERIOR EQUIPMENT

Photo 3.16 - DX Main Pump Room West Wall

The electrical cabinets are mounted on a raised concrete base and are against the west wall between the two main pumping units. (Photo 3.16) Electrical service enters the building through the upper portion of the south wall on the west corner. The electrical service enters the switchgear from the top. Only the motor leads exit from the lower sides of the cabinets, the remaining runs exit the cabinets through wall mounted conduits to the circuit panels and breakers.

The switchgear itself is in good operational order. As in other stations, its age makes acquiring parts difficult, the protection devices are the old mechanical type, and meters are out of calibration. The relays are minimal, requiring onsite personnel to see and reset alarm trips. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc.

The division's electricians have installed a service disconnect at this station. This allows the division to shutdown power at the station without having to call out the service provider to pull or restore power for the station's electrical maintenance activities. Charlie and Delta are currently the only stations where a service disconnection has been installed. The division will be adding this to all stations as time and money permits.

Preventative maintenance and most repairs on electrical switchgear and equipment are performed by the Division's Electrical section. This equipment has been well maintained. Each component is inspected and cleaned twice a year. All technical

sections within the division make routine inspections and perform related preventative maintenance that is recorded in weekly reports.

Photo 3.17 - DX Sluice gate Stems Photo

3.18 - DX Level Instrument (Blue green)

There are two manually operated sluice gates and two motor operated gates in the pump room. All are operational and well maintained. The manually operated valves have only half of the exposed threaded shaft covered. (Photo 3.17)

A full length cover would provide better protection by keeping contaminates from bonding to the grease used on the threads. If clear covers were not available from this manufacturer, a longer section of PVC with a small slot cut up the length would provide the coverage while allowing visual inspection of the stem's position.

The level instrument located to the south of the switchgear is obsolete and no longer in use. It is stored in place but needs to be removed. (Photo 3.18)

This instrument uses mercury switches that cannot be disposed of by normal means. Any disposal of a hazardous substance or material requires special procedures for disposal. This should not be a major problem as the mercury is contained in a sealed glass tube.

The Streets Department is involved with the newly formed Environmental Department and should have access to contacts that can provide information on appropriate procedures for disposal.

The Remote Terminal Unit (RTU) at this location is a newer "Smart Remote" which monitors and controls the station's equipment. It then reports its activities to the SCADA. The division is working towards having all facilities converted over to this type of remote. This allows the station to continue functioning on its own when

communications are lost between RTU and the SCADA. Once communications re-establish, the Smart remote updates the SCADA on what occurred during the outage. The new remote has a display panel that is identical to the graphics an operator sees in the control center. (Photo 3.19)

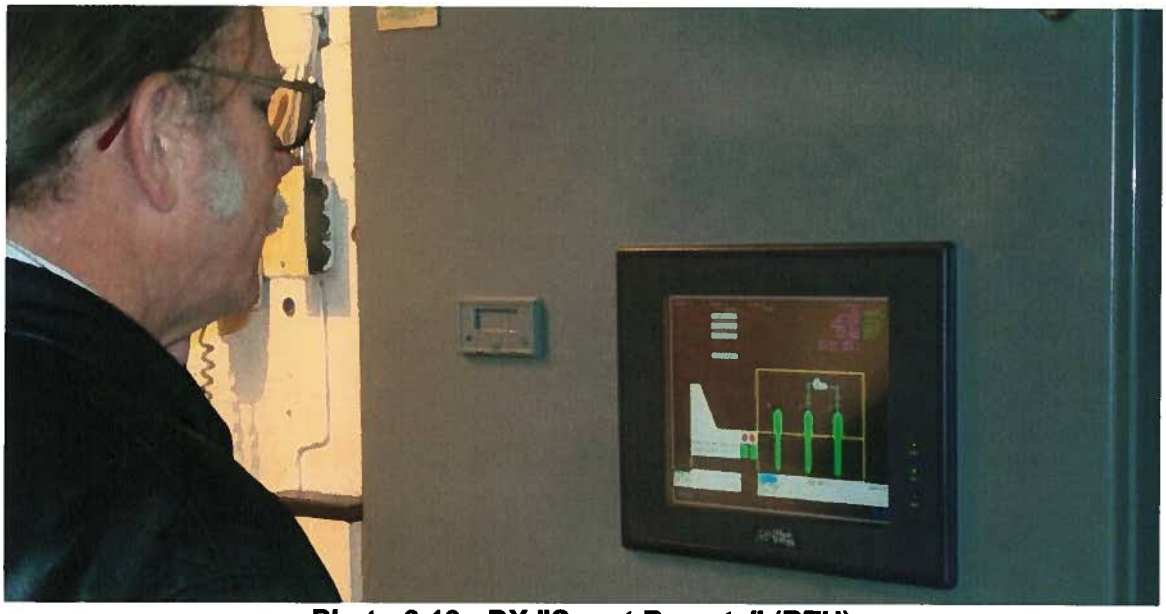


Photo 3.19 - DX "Smart Remote" (RTU)

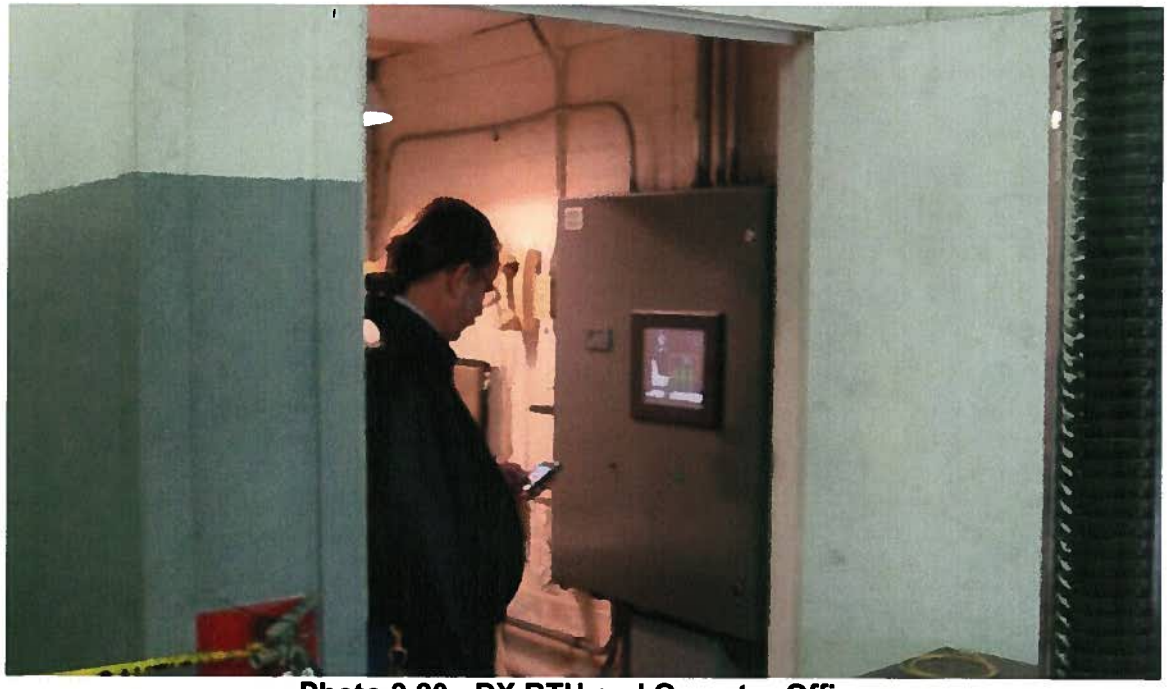


Photo 3.20 - DX RTU and Operator Office

The RTU is located in a room within the pump room. Personnel performing operator's duties use this as an office space. This location provides isolation from pump noise while using the telephone and added protection to the electronic equipment. (Photo 3.20)

There has not been any technical analysis conducted to determine levels of efficiency or vibration on any of the units. The only tests performed are by the contractor/vendor at the time of the unit's last overhaul.

Each site will be re-visited when the units are able to run. This will be to determine the condition based on a physical inspection only. A vibration analysis and thermal imaging should be added to the routine maintenance program.

Photo 3.21 - DX #2 Pumping Unit

There is nowhere in the stations to store parts or equipment. This station is an older design with minimal floor space. Renovation would be difficult and the down time required would be impractical. If there are long range plans for replacement, the new structure should add an area for storage.

Ventilation is currently directed towards the motors and switchgear before being exhausted out of the building. (Photo 3.21) air circulates from the sump up through the grates surrounding the motors, and is then exhausted through the roof's exhaust fan. AC is recommended for new or refurbished electrical switchgear areas to increase its service life. AC would also help control humidity. A/C is not practical at this location.

Photo 3.22 - DX Overhead Lighting Attached to the Rail System

The overhead crane has been removed from this building and the rail now supports the station's lighting. (Photo 3.22) The lighting was improved by adding fluorescent fixtures, providing adequate light that is easily maintained.

Photo 3.23 - DX Farval Lubricating System

The Farval lubrication system (Photo 3.23) provides each pump with a measured amount of lubrication at prescribed times. If the Farval system fails to operate correctly, the alarms in place prevent a pump from starting or take it off line.

Access to this building is limited to one sliding double wide door. This should be replaced with a hinged double door. The hardware needs to include a kick bar for emergency exit and the addition of safety glass would provide some natural lighting. An emergency exit sign should be mounted over the exit.

The Low Flow Station at Delta sits north of the main station. Power to this station passes through the main pump station into the bottom of the Low Flow's switchgear. As in the main pump station, division personnel are able operate from the switchgear in the event of a RTU failure. (Photo 3.24)

The low flow pump has a self contained lubrication system that mounts on the side of the motor base. This is an oil reservoir with a regulated drip to keep the unit lubricated. The pump will not start if the oil level is low or empty, but will not take the pump off line if it goes dry while running. This is a weekly check list item. The oil reservoir is filled as needed and this condition is not seen as a problem. (Photo 3.25)

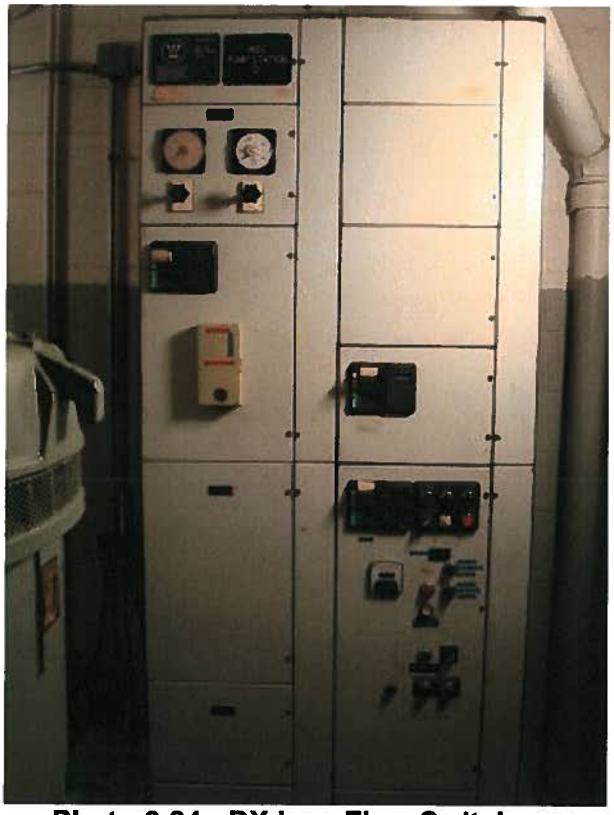


Photo 3.24 - DX Low Flow Switchgear

Photo 3.25 - DX Low Flow Pump

The building is just large enough to house the pumping unit and switchgear comfortably. Equipment is removed through the north roll up door. Normal foot traffic enters through a hinged door on the south wall. (Photo 3.26)

Photo 3.26 - DX Low Flow Pump Station's South Entrance

As mentioned in the comments for the main station, the hinged door should be equipped with a kick bar for emergency exit and a lighted exit sign unless the fire marshal approves the existing hardware.

The roof drain of this building is directly above the switchgear and the drain line runs through the station rather than outside the station. (Photo 3.27) This is not a known code violation, but the penetration in the roof for the drain is a potential leak on to medium voltage gear. It is a good design practice to keep water outside the building when possible. The roof should have scuppers with drainpipes down the outside walls to eliminate this concern.

Photo 3.27 - DX Low Flow roof drain over switchgear

Concerns and Issues

- The building does not have any lightning protection other then the lightning arrestors within the switchgear.

- Neither vibration analysis nor pump testing are performed to evaluate these units. Vibration analysis alone could warn of pending bearing failure, misalignment, soft foot, impeller wear and numerous other conditions before they cause a failure of the unit. This would also be a tool to lower repair costs. The units at this location operate during every rain event. Early diagnosis allows for in-house repairs on many of these listed conditions and minimizes catastrophic failures. Thermal imaging should also be considered. This provides personnel with images that locate hot spots in electrical equipment and can be used on mechanical equipment such as bearings, packing or mechanical seals, couplings, etc. This is an available service on price agreement, or the better solution would be to invest in a unit for the division.

- The Fire Department recently underwent changes in requirements for fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed, but is not required to be tied into the fire department's alarms "IF THERE IS SOMEONE INHOUSE MONITORING IT

24/7". There must be an external alarm to alert passer-bys. Verify that these changes are or are not grandfathered.

- There is only one access point into the main building. The entrance is a sliding door that needs to be changed out to a hinged double door and fitted with a kick bar for emergency exit. A lighted exit sign may also be required above the door.

- The Low Flow building needs the hardware on the hinged door changed over to an emergency exit with a kick bar and a lighted exit sign over inside of the door.

- There is not a paved surface to the equipment door on the low flow building.

- Every station needs emergency lighting. Mount battery operated fixtures on the walls at a height that permits routine checking. Provide enough light to permit personnel to see the way to an exit.

- Every station needs a storage area. This building is too small for any type of storage and the size of the site limits possibilities.

- Improve ventilation; this may be tied to the fire department's new building codes.

- Have EBS replace flashing on east roof line of the Low Flow Station.

- The obsolete level instruments have mercury switches. Although these are no longer in use and just being stored in place, they are a safety concern. These are located at several of the older stations. These should be brought to the attention of the responsible party, possibly the new Environmental Department to insure proper handling and disposal.

3.4 LEVEE & OUTFALL

As at other stations, there is no foot traffic access to the top of the levee. This is a steep irregular grassy surface. Employees climb the levee to check equipment at the outfall structure.

The west side of the levee facing the station has excellent groundcover and is well maintained. The slope of the levee changes to a slightly steeper grade near the bottom to make room for the road that passes between the bottom of the levee and the Delta site. There are signs of slippage and the increased angle make mowing difficult. (Photo 3.28) A retaining wall along the site's length would eliminate both concerns.

Photo 3.28 - DX Road Between Levee and Station, Slope Steepened to Allow Road

The road on top is routinely graded and in good repair. The east side of the levee has excellent ground cover and is in good shape. There are numerous ruts in the ground cover where it appears it was mowed while wet. This should correct itself in time. (Photo 3.29)

Photo 3.29 - DX West Levee, East Side

Photo 3.30 - DX Heavy Groundcover under Bridge

Photo 3.31 - DX Bridge and Valve Structure

This is the only location inspected that has excellent groundcover all the way up the levee under the bridge structure. (Photo 3.30) The elevated bridge and valve vault appear to be in excellent condition. There are not any noticeable signs of the concrete structure moving or cracking. The metal bridge and its concrete walkway are also in excellent condition. (Photo 3.31)

There are two electrically operated sluice gates at the end of the structure. Their operators and upper valve stems are well maintained. The bases show no signs of movement, a sign that too much torque has been applied
(Photo 3.32)

The shafts extending down into the vault are straight and the wall mounted brackets holding the shafts are secure. There is mild corrosion. A suggestion is to change out the nuts and bolts and cleaning the brackets and shafts then re-coat them with the silver paint that appears to be working well in this environment. (Photo 3.33)

Photo 3.32 - DX Electric Operated South Sluice Gate

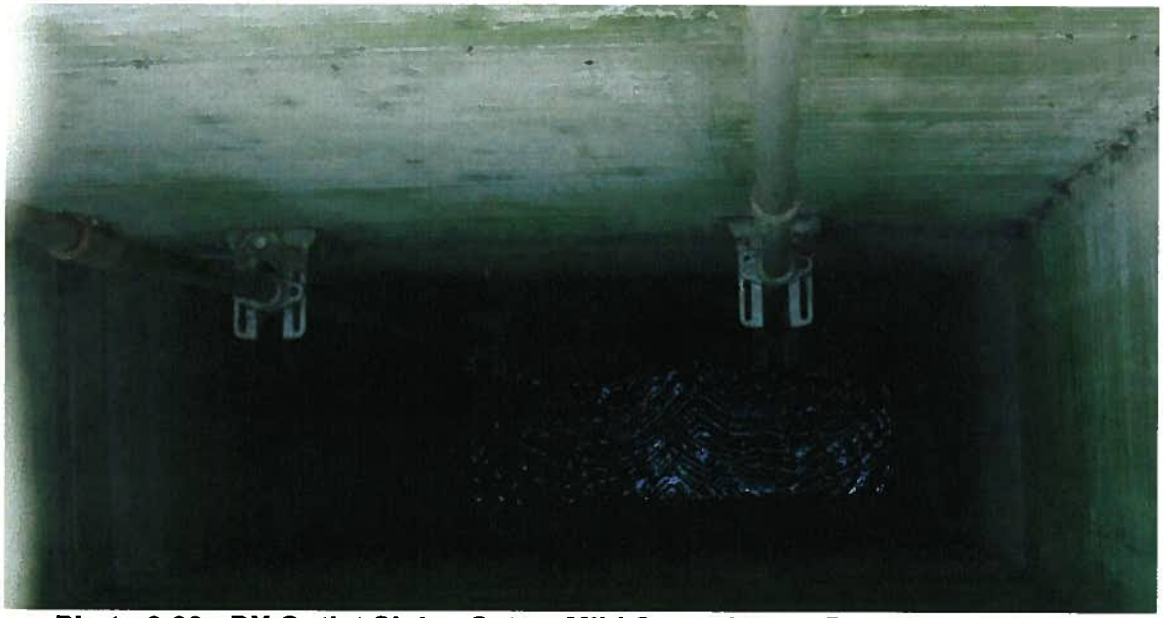


Photo 3.33 - DX Outlet Sluice Gates, Mild Corrosion on Brackets and Shafts

The South bank at the outlet structure has seen heavy slippage in the past. Groundcover is established in the area but there continues to be signs that the soil is still unstable. (Photo 3.34) The slope above the outlet structure has a shallow slope +/- 20

feet before making contact with the outfall structure. This along with the ground cover appears to be preventing slippage.

Photo 3.34 - DX Outfall Structure

The southern bank of the channel is showing minor problems and grading it back at a lesser angle would be helpful. Rip-rap around the structure may not be necessary at this location but it would improve the ability to avoid damages at the outfall structure from flood waters.

The exposed section of the outfall structure appears to be in good shape with minor chips on edges. (Photo 3.35)

Photo 3.35 - DX Outfall Structure

The north gate is not fully closed and may have silt built up preventing a full closure. There could also be a minor problem with the hinged gate itself. There is minor damage to the upper stiffening strut. This should be looked at by lifting the gate above the water

line to inspect for additional damage that could be causing an alignment problem. (Photo 3.36)

Photo 3.36 - DX Outfall Hinged Gates

The channel from the outfall structure has minor silting but is in excellent shape overall. The south bank appears to be the main issue with its bank at a steeper slope being more prone to minor washout. (Photo 3.37)

Photo 3.37 - DX Outfall Channel

Concerns and Issues

- It is recommended that the outfall channel at the structure be re-sloped on the south bank to lessen slippage and erosion. Grading the south bank to the river would also lessen washout.

- Personnel have no safe access up or down the levee. A stable pathway needs to be added.

- The addition of lights and GFI outlets installed on the valve vault would be helpful to personnel that are required to inspect and work on its equipment.

- An inspection of the north sluice gate is required to better determine its condition. There is a bent strut exposed above the waterline and the gate is partially open which could be an alignment problem or just silt built up under the gate.

Old Hampton (OHX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. OLD HAMPTON PUMP STATION (OHX)

End of Conveyor Road, 400 yards north of Hampton Road Bridge
Dallas, TX 75207
Mapsco 43D

Year Built: 1955

Renovations: Security Cameras, S.C.A.D.A., Farval Lubricating System

Current Design Pumping Capacity: 4 – Wheeler 36" 600 hp, 590 rpm, 50,000 gpm vertical pumps for 200,000 gpm. 1 – Low Flow Fairbanks Morse 10" pump, 30 hp 1760 rpm, 2,500 gpm.

Overhaul Program: Pump #1 was overhauled last in 1997; #2 is pulled and sent in for overhaul and #3 has been returned from overhauling but motor leads are disconnected and the motor is uncoupled. #4 was overhauled in 2007; # 5 was overhauled in 2004.

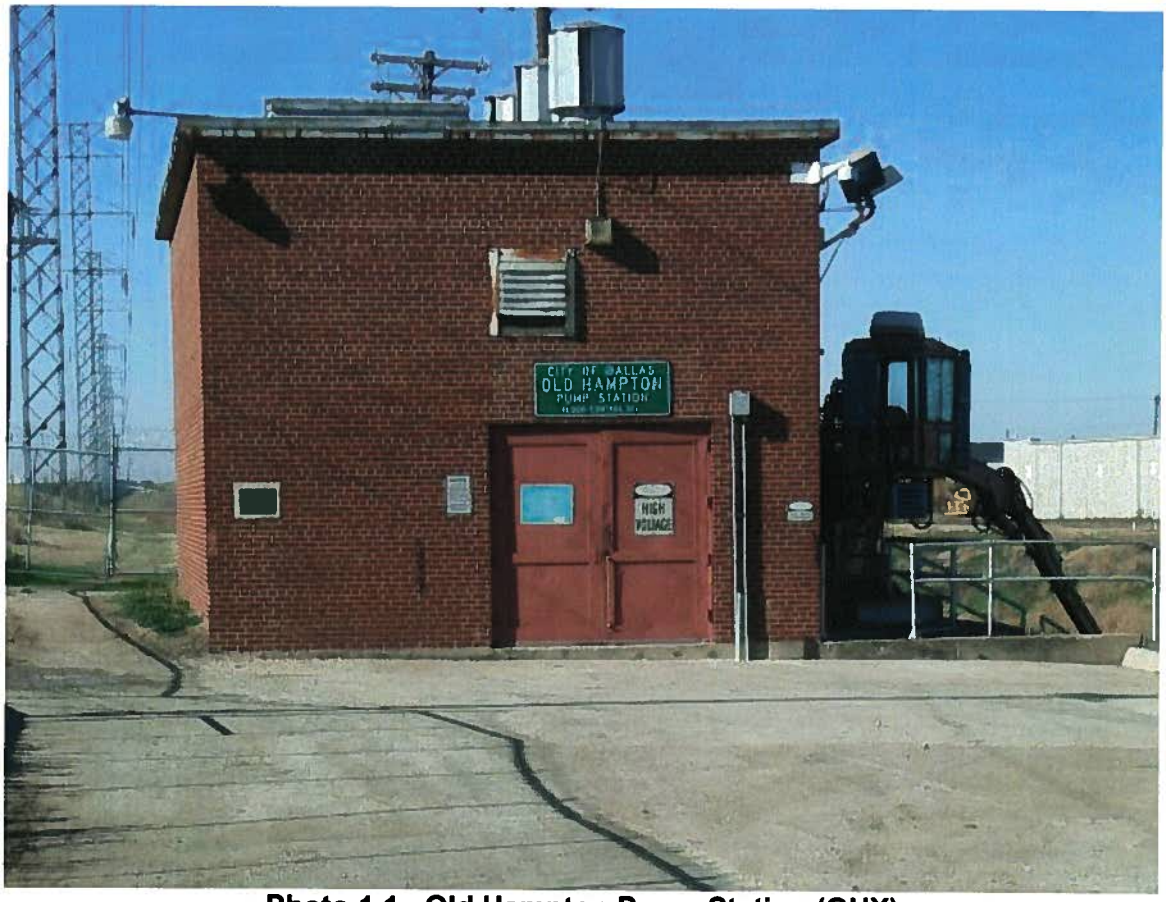


Photo 1.1 - Old Hampton Pump Station (OHX)

2. MAINTENANCE PROGRAM

The current contract between the City of Dallas and the US Army Corp of Engineers (USACE) dictates a condition level that can only be met by an overhaul of equipment. This contract should be reviewed and revised to reflect new technologies that could provide significant repair cost savings to the City of Dallas.

Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. Although these stations do not generate enough revenue to require accurate metering, meters would allow personnel to determine a unit's efficiency which can be affected by many mechanical conditions. Vibration analysis can determine, among other things, alignment, bad or worn bearings, soft foot, impeller wear or in-balance, and shaft problems. Additionally, thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues.
This monitoring would enable personnel to diagnose potential problems prior to failure which would translate to a savings to the owner.

3. OHX ASSESSMENT

The interviews with management and maintenance provide a better understanding of current practices, conditions, concerns and suggestions. As a result of the site inspection and interviews, an evaluation is made and a condition rating is assigned to this station and its equipment.

3.1 Operations

This station is controlled and monitored by means of the Supervisory Control and Data Acquisition (SCADA) System located in Flood Control's main office at 2255 Irving Blvd. This allows an operator to monitor and control multiple stations from one location. Detailed information on what information and controls the SCADA System provides is included in the SCADA section.

In the event of a SCADA System failure, personnel are able to manually operate this station from the switchgear cabinet by switching controls from remote to local and selecting the start or stop switch. (Photo 3.1) Indicator lights provide the necessary information to an Operator. An operational chart provides guidelines as to when each unit is to be put on-line or off-line.

Photo 3.1 - OHX switchgear and manual controls

This station was built in 1955 in addition to several other stations along the levee. In 1975 a new station was added to the site (NHX) and as a result OHX serves in a secondary role, as a backup for NHX, or when the incoming floodwater exceeds NHX's capacity.

The operational duties of employees in the Flood Control Division are minimal and do not justify having a separate operational staff. This division has separate training classes to train personnel to operate the Flood Alert System, Pump Station and SCADA System and also tests its personnel prior to allowing them to perform operational tasks.

At the time of this report, two of the main units are out of service, #2 & #3 are tagged and locked out. The #2 unit has been pulled and floor penetration is covered with plywood and barricaded with traffic cones. (Photo 3.2) Also note motor leads of #3 and lubrication lines of #2 left lying on the floor.

Photo 3.2 - OHX Motor Removed, Opening Improperly Protected

For the safety of personnel, more sufficient barricading should be provided when pumps are removed. The possibility and potential consequences of someone getting injured call for a more substantial safeguard surrounding the worksite. (Photo 3.3)

Photo 3.3 - OHX Pump Pit #2, Plywood Cover Not Adequate or Large Enough To Cover Entire Opening

All sites will be revisited during a rain event to provide the time and opportunity to cycle through the units at all locations. This information will be documented and provided in spreadsheet format with comments.

Concerns and Issues

- When personnel leave a worksite, regardless of whether teardown maintenance is underway, construction, or cleaning, the site must be safe and clear of hazards. Although attempts were made to secure and mark the area of work, additional effort is needed. A heavy steel plate to cover the entire opening, a welded rail system to surround the opening, and moving trip hazards are necessary to provide a safe environment. Wires and lube lines need to be secured and off the floor.

- Every station needs a storage area. Personnel are placing parts and materials wherever there is room at most locations. Lockable enclosures can be installed along with shelving to provide on-site parts and materials storage.

3.2 Exterior Equipment

The Old Hampton Station (OHX) is located to the North of the New Hampton station (NHX) and shares the same sump area (Photos 3.4 & 3.5). The screens at this site are shielded from major impacts by having the sump area flow by the stations. Large floating objects in the channel cannot plunge directly into the screens. Debris is pulled off the screens at OHX using the trash crane shown in Photo 3.4. The debris is then loaded into dumpsters, hauled to and emptied at the public landfill.

Photo 3.4 - OHX Screens and Trash Crane

Photo 3.5 - NHX Screen, OHX's Inlet in view

Photo 3.6 - OHX, North Wing Wall, Second Joint Showing Stress Cracks

There is concern about the integrity at OHX's north and south wing walls. There is a noticeable movement and damage at two of the joints. A Structural Engineer should make a closer examination to determine if repairs are necessary. (Photos 3.6 & 3.7)

Photo 3.7 - OHX, South Wing Wall, First Joint Showing Movement and Crack, See Shoe Lower Right for Scale

Photo 3.8 - OHX, West Bank Parking Area

Numerous indications of unstable conditions can be seen along the west bank of the sump area at the OHX site including the damage and movement of the wing walls, on-going repairs to the parking area along the Sump's west bank, (Photo 3.8) and tilting telephone poles along this same bank. (Photo 3.9) Additionally, one pole between OHX and NHX required a secondary pole be installed to support and brace a power pole that has a severe tilt. (Photo 3.10)

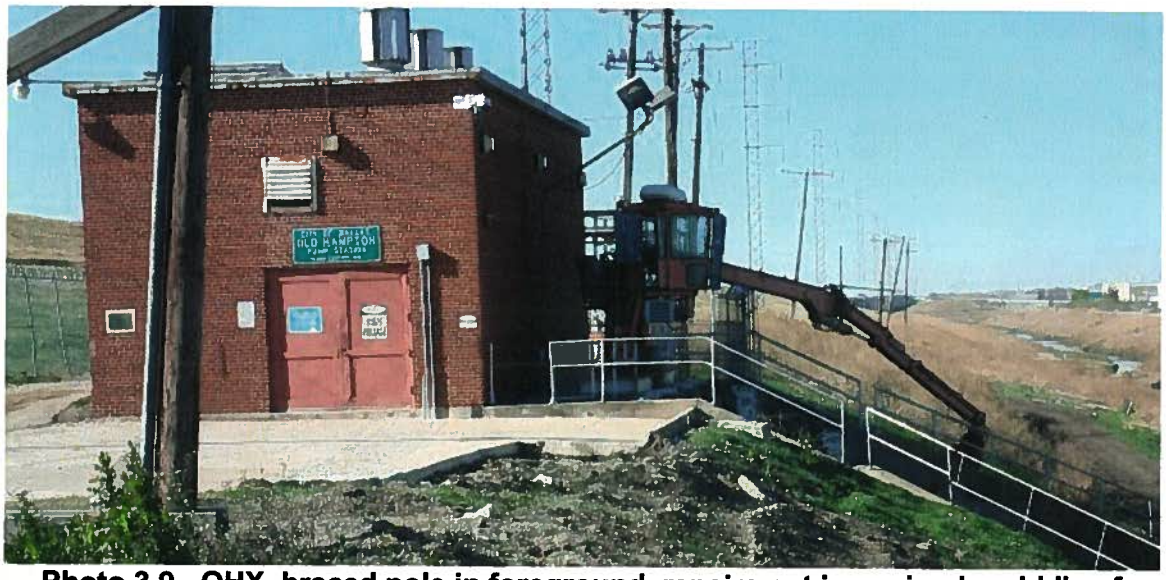


Photo 3.9 - OHX, braced pole in foreground, repairs cut in paving in middle of picture

Photo 3.10 - OHX, braced power pole

There is dirt piled on the east bank from the sump area. This is scheduled for removal per division's personnel. A temporary unpaved service road along the west bank was installed leading down into the sump area. The sump area at the Hampton site is not paved and requires access for heavy equipment to clean out large debris that is not pulled up at the stations. It appears that this temporary road was for this type of activity. (Photo 3.11)

Photo 3.11 - OHX Sump, Pile on East Bank - Service Road on West Bank

Lighting around the OHX is adequate for the type of outdoor tasks being performed. Additional lighting at the main entrance and its parking area would be helpful during evening or night maintenance activities.

The fencing around the perimeter of OHX is not adequate for preventing vandalism. The razor wire added to the top of the 8 foot chain link fence indicates that security is a concern. This effort is not effective if a gate is loosely chained and out of alignment causing a gap under its entire length. The electrical provider also needs to repair their adjacent fence surrounding their transformer yard. The missing barbed wire on their fence makes it a simple matter of climbing their fence and stepping over into the station and the entire Hampton site. (Photos 3.12 & 3.13) A concrete mowing strip along the fence would lessen the chance of tunneling or high weeds hiding a cut fence. The driveway should be paved to the fence perimeter to provide an anchor point for the gate and prevent rutting.

Photo 3.12 - OHX North and West Fence Line

Vandalism has occurred at the pump stations and vagrants are commonly living within the levee area. For the safety of intruders, employees and equipment, it is recommended that security and lighting in and around the site be upgraded per the recommendations above.

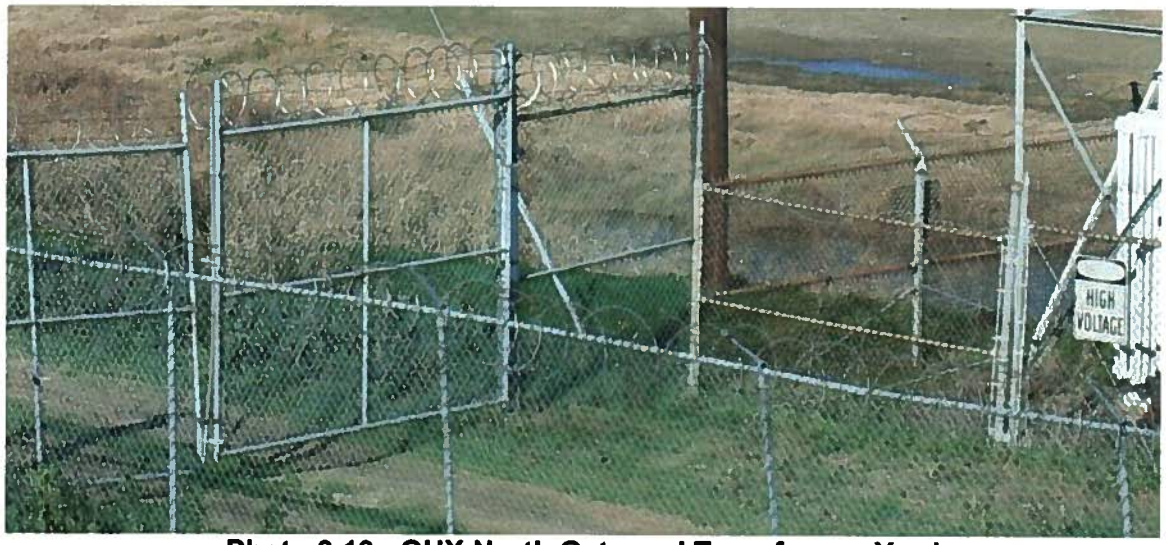


Photo 3.13 - OHX North Gate and Transformer Yard

The building as a whole appears to be in excellent condition with only minor repairs needed. The brickwork seems in excellent condition and there are no signs of cracking or movement. The roof is concrete and appears to have a membrane covered with rock, but there is no access to the roof for closer inspection. There are not any signs of leakage on the interior of the building. The roof is designed with a large equipment hatch above each pumping unit to allow crane access. There is evidence of minor leakage (Photo 3.14) where the weather striping is worn or the hatch could be sprung slightly.

Photo 3.14 - OHX, Daylight Seen At Equipment Hatch Cover

Roof ventilation covers appear to be in excellent condition. There is minor corrosion on the flashing surrounding hatches and the building's perimeter that should be addressed if a renovation of this station is scheduled.

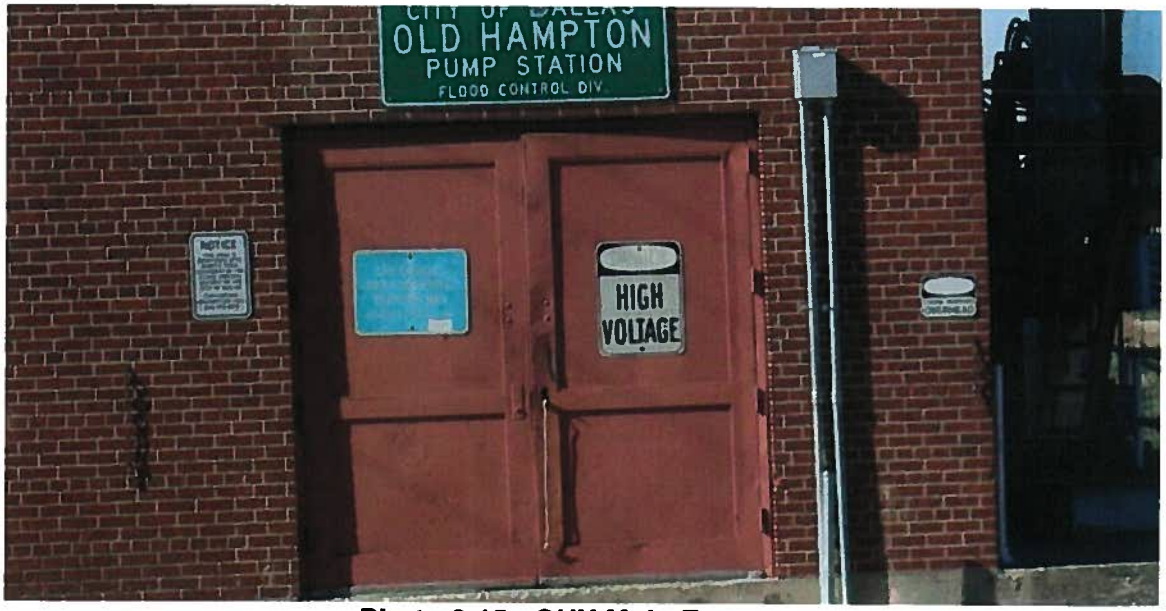


Photo 3.15 - OHX Main Entrance

The entrance to this station needs replacement. The entrance on the south wall does not have a handle, latch or any means to open from the outside. (Photo 3.15)

The only way to enter the building is through the door on the north. The south entrance can only be opened from inside the building. The appearance of this entrance implies that numerous attempts have been made at repairs. Replacement would be a better option and adding panels of safety glass would also provide some much needed natural light into the building.

Concerns and Issues

- Renovations and new construction should include a paved surface in the sump area for ease of maintenance and a safer work environment for personnel. Pavement also needs to be included for access down into or out of the sump area and for extending the drive way to the north gate.

- There are not any safety precautions or training for those personnel required to work on clearing the screens. This is hazardous work when the station is online. A strong current to the screens is caused by the pumps. Anyone falling into this area would be in a life-threatening situation.

- The wing walls and the west bank of the sump area is a concern. As stated above, the north and south wing walls show signs of damage and movement. OHX parking area repairs along the west bank, the power pole shifting requiring a second pole as a brace and other power poles also leaning toward the sump all indicate that the soil in this area is unstable. It is recommended that a geotechnical engineer be called in to investigate.

- Fence repairs are required to improve security. A mowing strip should have been installed when the fence was built. A concrete strip added at the gate areas would improve the ability to secure those access points. The power company needs to be contacted to make repairs to the fencing surrounding their equipment, to remove the ability for someone to step across where the City of Dallas and the power company's fences meet.

- Doors on this building need to be repaired or replaced. The entrances should have panic bars and exit lights inside for emergency exits.

- The sealant needs to be removed and replaced around the bottom edge of the building along the east wall.

3.3 Interior Equipment

Photo 3.16 - OHX Looking South on West Wall

The electrical cabinets are raised off the floor slab and mounted against the wall. (Photo 3.17) All large cable runs are below floor level. New conduit runs are secured firmly to the walls and not in conflict with other equipment. The switchgear itself is in good operational order but as in other stations, its age makes acquiring parts difficult and the protection devices are the old mechanical type and are not calibrated. Personnel do not have the equipment or experience to calibrate these relays. The information transmitted to the SCADA reflects these discrepancies, which are then altered within the SCADA to read, "What is believed to be correct". The switchgear equipment is at or past its expected service life. The relays are minimal, requiring on-site personnel to see and manually reset alarm flags. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc.

The units can be operated within the station but normal operations are executed and monitored by means of the Supervisory Control and Data Acquisition System (SCADA) located in Flood Control's main office at 2255 Irving Blvd.

Photo 3.17 - OHX Switchgear Cabinets and Controls

Storage is a large problem at all locations. There is nowhere in the stations to store parts or equipment. As a result the floors at most locations are filled with everything that should be in a designated storage area. This station's floor plan was not designed for future build-out. There is not adequate space to utilize for a small storage room without prohibiting access to other equipment.

There was an addition to the site with the building of The New Hampton Station (NHX) which does have more space and may have room for a much needed storage.

At the time of this report one pumping unit has been removed and sent in for overhaul, one unit has been returned from overhaul and set in place, but motor leads have not been terminated and the unit is uncoupled. The remaining two units are in service, along with the low flow pump, #5.

There has not been any analysis conducted to determine levels of efficiency or vibration on any of the units, other than what was performed by the contractor at the time of an overhaul. The maintenance program in place has pumps and motors sent out for overhaul on an established five year schedule, unless a failure occurs prior to the date scheduled.

Preventative maintenance and most repairs on electrical switchgear and equipment are performed by the Division's Electrical section. All technical sections within the division

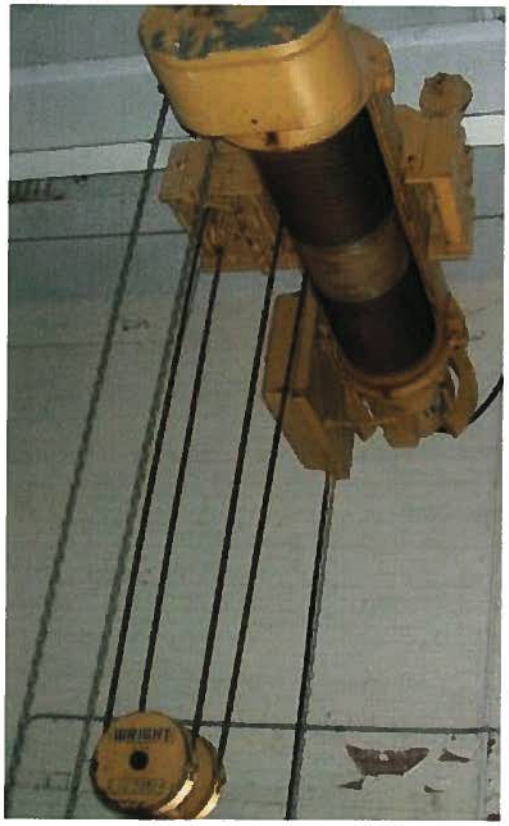
make routine inspections and perform related preventative maintenance, which is recorded in weekly reports.

The roofing structure is concrete, with poured-in-place beams that are sealed and painted. There are seven roof penetrations, four being equipment hatches and three for the ventilation. There are no visible signs of leakage at these penetrations, but there is a slight problem at the equipment hatch where it appears the hatch may be sprung slightly or the gasket may be missing.

There is only one exhaust fan that is gable mounted on the south wall, with an external louver cover. (Photo 3.18) The lowest blade in the louver is missing. There is also a place for a second exhaust fan on the North gable. This fan was removed some time in the past, but the external louvers are still in place. There are no air vents at ground level. It appears air is pulled in around the base of the motors. The exhaust fan and roof vents may be causing air to short circuit by being pulled from the ceiling rather than at floor level. A smoke test could provide information on the air circulation within the station. AC is recommended for new or refurbished electrical switchgear areas to increase its service life. This is not practical at this location but pulling air across the equipment would be something that should be tested in-house.

Photo 3.18 - OHX Lighting and Exhaust Fan

The lighting system is piece meal (Photo 3.18) with combinations of fluorescent ceiling-mounted fixtures, incandescent flood lights and wall packs with mercury vapor or metal halide. The high ceiling makes it difficult to change bulbs or make repairs and the multiple types of fixtures require more types of bulbs to carry in stock. For this facility the wall pack units would be well suited and could be installed by electrical staff when time permits.



The pump room has an electrically operated 10-ton crane used to pull and install equipment. The bridge and dolly are hand operated. Only the crane's lift is electrical. (Photo 3.19) The crane is in working order and is inspected by division personnel.

All equipment in the pump room is accessible to the overhead crane, but a mobile crane must be used when it becomes necessary to pull a pump. The extraction of a pump is done through the equipment hatch above the unit. An unpaved driveway on the west side of the building provides an area for a mobile crane to access the equipment hatch. This not may be adequate to safely support such a heavy vehicle under load conditions. The driveway's condition is acceptable for most traffic but heavy equipment is questionable for long term use. It is also very restrictive for a large piece of equipment, such as a mobile crane. The driveway does not have an adequate approach for a long vehicle and pot holes add to this problem. (Photos 3.20 & 3.21)

Photo 3.19 - OHX, Access to Equipment Hatches

Photo 3.20 - OHX, Pot Holes

The Farval lubrication system provides each pump with a measured amount of lubrication at prescribed times. The transfer of grease from the storage container to the Farval's main cylinder has experienced some problems with air pockets. There are alarms in place that prevent a pump from starting or take the pump off line, if the Farval system fails to operate correctly. These alarms transmit to the SCADA, informing the operator of the problem.

Photo 3.21 - OHB Low Flow with Oil Lubrication System

The low flow pump #5 has a separate oil lubrication system with a reservoir attached to the unit.

Concerns and Issues

- The overhead, 10 Ton, electrically operated crane located in the main pump room and the manually operated 3-ton overhead crane in the South room both need to be properly inspected as outlined under OSHA regulations as follows:

  The overhead cranes require proper inspections along with proper documentation. To be in compliance with OSHA STANDARD 29 CFR 1926.550(a)(6), the crane requires an annual inspection to be completed before it may be operated in the United States; it states:

  - *A thorough, annual inspection of the hoisting machinery shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The employer shall maintain a record of the dates and the results of inspections for each hoisting machine and piece of equipment.*

  A competent person, as defined in 29 CFR 1926.32(f), is *"one who is capable of identifying existing and predictable hazards in the surroundings or working conditions*

which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them."

- The building does not have any lightning protection other then the lightning arrestors within the switchgear.

- Neither vibration analysis nor pump testing are performed to evaluate these units. Vibration analysis alone could warn of pending bearing failure, misalignment, soft foot, impeller wear and numerous other conditions, before they cause a failure of the unit. This would also be a tool to lower repair costs. The units at this location operate during every rain event. Early diagnosis would allow for in-house repairs for many of these listed conditions and minimizes catastrophic failures.

- There is no access to the roof. This roof system should allow an adequate size opening cut through to allow internal access, preferred for security and minimizing exposure while climbing. A second method would be to install an exterior ladder, starting ten feet above the ground and permanently mounted to the structure. The remaining portion of the ladder could be stored within the building.

- There is no safe method of changing light bulbs or repairing these fixtures mounted on the ceiling. The area within the building would allow for easy installation of wall packs around the perimeter at a height that could be serviced with a step ladder.

- The Fire Department recently underwent changes in requirements for fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed but is not required to be tied into the fire department's alarms if someone is monitoring the system in-house at all times. There must be an external alarm to alert passers-by. It is recommended that the City verify whether these changes are grandfathered.

- There are two access points into this building. The South entrance is a hinged double door. There is not an outside latch, padlock, doorknob, etc. Access to the pump room is through the door on the north end of the building. This entrance is locked with a deadbolt and should be replaced with a kick bar to provide an emergency exit. Natural light cannot enter this building. There are no emergency exit signs or a fire alarm system. Lighted exit signs need to be installed on all exits. Repair or replace the hinged double door, preferably with doors that have safety glass to allow some natural light into the building.

- Every station needs emergency lighting. Mount battery operated fixtures on the walls at a height that permits routine checking. Provide enough light to permit personnel to see the way to an exit.

- Every station needs a storage area. Personnel are placing parts and materials wherever there is room at most locations. Lockable enclosures can be installed along with shelving to provide on-site parts and materials storage.

- Driveway on the west side of the station is not paved. This is the location that a portable crane must use to pull heavy equipment through the roof.

3.4 Levee and Outfall

As at other stations, there is no foot traffic access to the top of the levee. This is a steep irregular grassy surface, which employees climb to check equipment at the outfall structure.

The east side of the levee facing the station is not quite up to as high a standard as seen at the Baker site, but is well maintained. The road on top is compacted dirt that receives routine grading to keep it in shape. There are protruding vaults at numerous locations that appear to have been brushed by passing vehicles. (Photo 3.22)

Photo 3.22 - OHX manhole on levee

If this road is used at night or during foul weather, it would be easy to miss seeing these structures. This department has a street sign division. I suggest that border signs be made from reflective material and attached to the roadside corners or bollards.

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The valve vaults on top of the levee appear in excellent shape. Access to these should be considered a "confined space" when working within. It is not the depth but the limited entrance and confining area within that define these vaults as "confined space". (Photo 3.23)

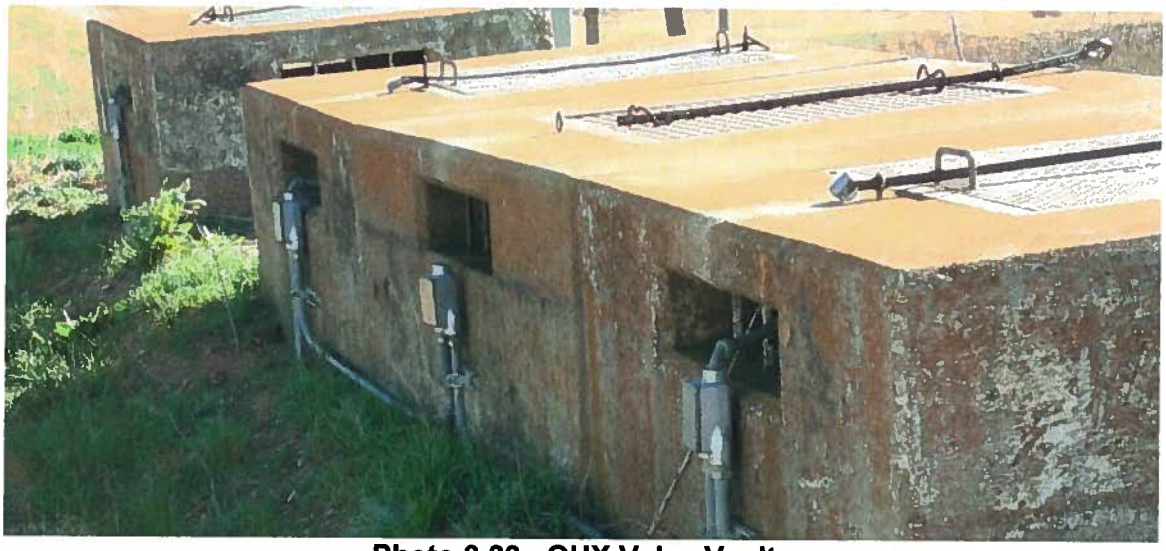


Photo 3.23 - OHX Valve Vaults

The west, or river side of the levee is in excellent shape, with the slope on an even grade and the area surrounding the outfall showing no signs of recent slips. The area surrounding the outlet structure is rounded with a gradual slope to the banks. (Photo 3.24)

Photo 3.24 - OHX Outlet Channel

There is a small channel feeding in from the North that will widen with time. This will limit access to the northern bank. This is probably not a problem for vehicle traffic if there are other access points, but foot traffic would be easier if some old sections of large concrete pipe were used as culverts and topped to form a foot bridge crossing.

The banks of the outfall area are covered with large areas of poison ivy. An approved systemic herbicide needs to be applied at the appropriate time of year to reduce the risk of contact by grounds crews.

The channel to the river was clear of obstacles (Photo 3.25) with silt forming a smooth transition into the banks. This small build up of silt was low and not needing any attention in the near future. Ground crews maintain these areas and routinely check to see if clean out needs to be scheduled.

Photo 3.25 - OHX and NHX Channels to River

The above water section of the Outlet structure does not show any signs of movement or cracking. There is spalling above the low flow and the discharge lines from the main pumps. This may be an indication of minor movement of the pipes but it is recommended that it be inspected by the Structural Engineer along with the other areas of concern. (Photo 3.26) Other than this observation, the structure appears sound.

Photo 3.26 - OHX Spalling Visible at Top of Pipes

It appears that rip rap was added around the structure at some time in the past. (Photo 3.27) Most is now gone but should be considered for replacement here and at other similar locations.

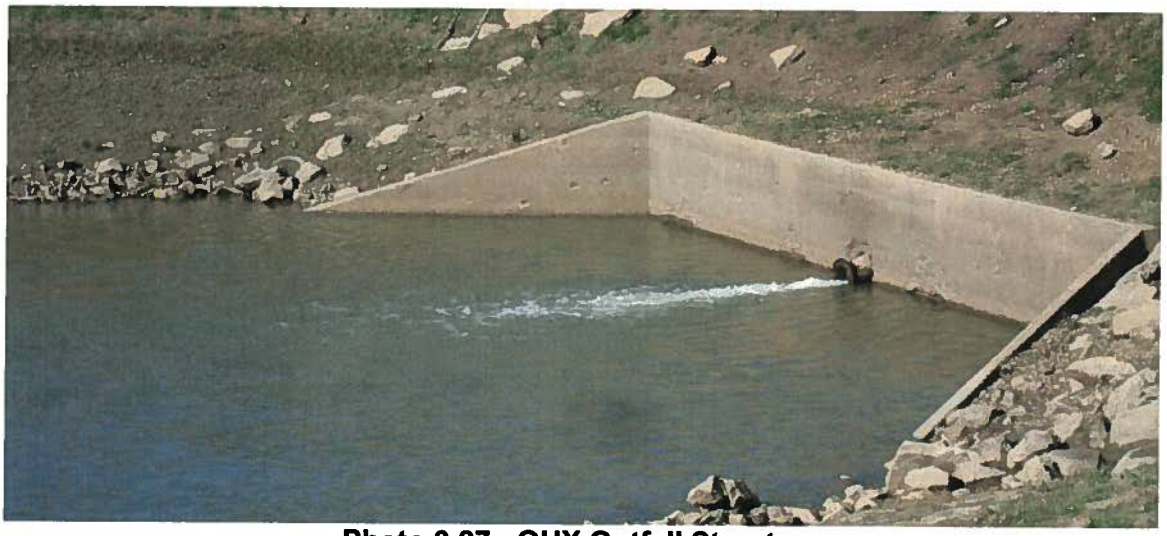


Photo 3.27 - OHX Outfall Structure

A base rock of the current size, topped off with a larger size rip rap would add more stability to the area surrounding the outlet.

Only the low flow discharge was visible above the water line and the water was too murky to see what conditions were beneath this level.

Concerns and Issues

- A large amount of the area along the banks of the outlet channel is covered in poison ivy and is a health hazard to grounds keeping crews. This needs to be destroyed by acceptable means of herbicides when conditions and time of year are correct.

- Broken manhole needs to be replaced and additional protection or marking need to be added.

- When a renovation is scheduled, if practical, the vacuum relief valve vaults should be modified or replaced to eliminate a confined space issue.

- Rip-rap added around the outlet structure has washed away. It is an excellent means of preventing erosion around the area, if done correctly. Larger sizes are available. Contacts within the Water Department can provide suggestions based on experience. René Caraveo at the East Side Treatment Plant is over the people that maintain the rip rap at Forney Dam on Lake Ray Hubbard.

- The outlet structure has spalling above the discharge lines that should be looked at by a Structural Engineer to eliminate any concerns.

New Hampton (NHX) Pump Station

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. NEW HAMPTON PUMP STATION (NHX)

2255 Irving Blvd.
Dallas, TX 75207
Mapsco 44F

Year Built: 1975

Renovations: Replaced electrical service to move disconnect into the station.

Current Design Pumping Capacity: 5 – Johnston 54" 900 hp, 300 rpm, 80,000 gpm vertical pumps for 400,000 gpm. 1 – Low Flow Johnston 16" 125 hp, 1180 rpm vertical pump for 6000 gpm.

Overhaul Program: Pumps #1,#2, #5 & #6 were overhauled last in 2003; #4 was overhauled in 1999; # 3 was overhauled in 2005.

Photo 1.1 - New Hampton Pump Station (NHX)

2. MAINTENANCE PROGRAM

The current contract between the City of Dallas and the US Army Corp of Engineers (USACE) dictates a condition level that can only be met by an overhaul of equipment. This contract should be reviewed and revised to reflect new technologies that could provide significant repair cost savings to the City of Dallas.

Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. Although these stations do not generate enough revenue to require accurate metering, meters would allow personnel to determine a unit's efficiency which can be affected by many mechanical conditions. Vibration analysis can determine, among other things, alignment, bad or worn bearings, soft foot, impeller wear or in-balance, and shaft problems. Additionally, thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues. This monitoring would enable personnel to diagnose potential problems prior to failure which would translate to a savings to the owner.

3. NHX ASSESSMENT

The interviews with management and maintenance personnel provide a better understanding of current practices, conditions, concerns and suggestions. As a result of the site inspection and interviews, an evaluation is made and a condition rating is assigned for this station and its equipment.

3.1 Operations

This station is controlled and monitored by means of the Supervisory Control and Data Acquisition (SCADA) System located in Flood Control's main office, at 2255 Irving Blvd. This system allows an operator to monitor and control multiple stations from one location. Detailed information on what information and controls the SCADA System provides is included in the SCADA section.

In the event of a SCADA System failure, personnel are able to manually operate this station from the switchgear cabinet by switching controls from remote to local and selecting the start or stop switch. (Photo 3.1) Indicator lights and trip relays along with labeling provide the necessary information to an Operator. An operational chart provides guidelines as to when each unit is to be put on-line or off-line. At the time of this report, all units are in-service.

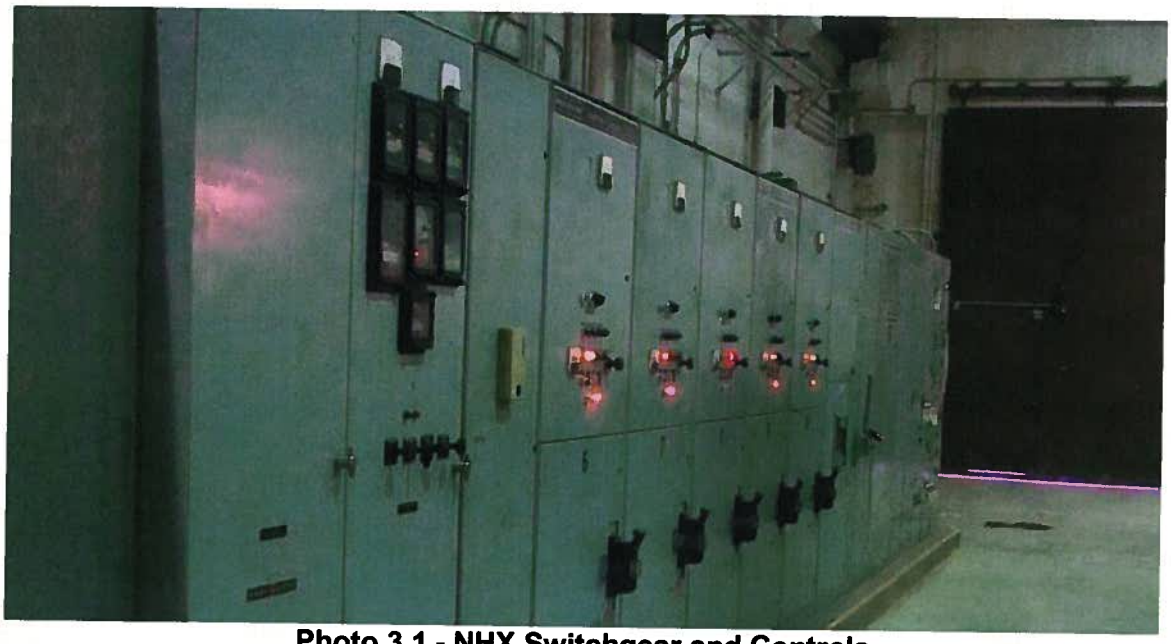


Photo 3.1 - NHX Switchgear and Controls

Approximately ninety percent of this division's man-hours are used maintaining equipment and facilities, grounds keeping and special projects. The remaining ten percent required to perform operational duties does not allow for a separate operational staff, as is used in other departments within the City of Dallas. This division has separate training classes to train personnel to operate the Flood Alert System, Pump Station and SCADA System and also tests its personnel prior to allowing them to perform operational tasks.

The New Hampton Station (NHX) has five vertical pumping units that can be operated within the station but normal operations are executed and monitored by means of the Supervisory Control and Data Acquisition System (SCADA) located in Flood Control's main office at 2255 Irving Blvd.

Issues and Concerns

- There are no emergency lights or lit exit signs for personnel that might be in the building at the time of a power outage.

- The stockpile of stored equipment and supplies and the damaged floor grates are trip hazards.

3.2 EXTERIOR EQUIPMENT

The New Hampton Station (NHX) is located to the South of the original Hampton Station, (OHX) sharing the same sump area (Photo 3.2). NHX is the primary station at the Hampton site. OHX is only used when the capacity of NHX is exceeded or when NHX has units out of service.

Photo 3.2 - NXH and OHX Screens

The screens at NHX and OHX are perpendicular to the sump's channel. This alignment helps shield the screens from major impacts but the 90 degree turn does cause a silt build-up at the inside corners, and debris not caught by the screen system accumulates in the sump area. This sump area is not paved, which makes clearing the channel more labor intensive than at other pump station sites that have a surrounding concrete base and apron. Heavy equipment is required for cleaning and repairs at this site. Drying out the site is time consuming and weather dependant.

The report on OHX mentions possible problems along the west bank with signs that the bank may be unstable. The addition of a concrete sump area should be considered to possibly eliminate this condition.

The paved surfaces and security fencing surrounding the NHX section appear to be in excellent condition. Security is a concern due to the adjoining OHX's fencing and gates issues mentioned in the OHX report. The two large gates at the south entrance to NHX are both used regularly. The main entrance is on the paved drive and the larger secondary gate is used when heavy equipment is needed. The paving ends prior to the secondary gate and the weight of the equipment has made some ruts that, if not corrected, will create a gap under the gate. (Photo 3.3)

Photo 3.3 - NHX South Heavy Equipment Gate

The NHX screen and rake system is in excellent operating condition. NHX is one of the few stations with a conveyor system to carry the screen's debris directly to a dumpster.

Photo 3.4 - Conveyor System, Problem Area at Incline Shown in Lower Left

(Photo 3.5) When functioning correctly, the conveyor eliminates the manual labor required at other pump stations, but the conveyor also requires excessive maintenance. According to personnel, the conveyor system's repairs and adjustments require more work hours than all other equipment. Chain tension is critical for proper function and needs constant attention. The inclined section has been adjusted because of the tendency of the debris to fall back onto itself, rolling into a bundle until it falls off or backs up the system. Lowering the incline has helped some, but this remains a problem. Once the debris starts up the incline, it continues without a problem.

A flexible bib applying downward tension through the transition area might prevent the debris from falling back before the debris stabilizes on the inclined surface. Once the debris is loaded into a dumpster, it is taken to the public land fill by City personnel. The

total debris from all flood water stations averages 36 to 72 cubic yards per 1.5" rain event, and as much as 240 cubic yards when rainfall exceeds 2.0".

Photo 3.5 - NHX Cable and post barricade/handrail

Outdoor lighting around the building perimeter is adequate for personnel to conduct operations during foul weather or night conditions but additional lighting is recommended at the staging area.

None of the handrails on site have toe boards, which should be considered for any area where tools or other items might be easily lost into the sump (see O.S.H.A.1926.451(g)(4)). The barricade/handrail at the north end of the screens (Photo 3.5), located on the top edge of a concrete slope into the sump, is a heavy duty cable and post system, but under the above O.S.H.A. standard may not meet its intent.

There is minor damage to the louvers and the mesh on the east wall vents. It is unclear how this damage occurred. The far north end has the most damage, and it appears something from in the building came out, or something outside got hung on the vent as it went by. All of this damage is repairable.

Photo 3.6 - NHX roof Vent Covers and flashing

(Photo 3.6 & 3.7) The roof vent covers are showing signs of corrosion at the edges and some of the end caps. There does not appear to be any physical damage to the metal, but close inspection would require access to the roof. The flashing surrounding the roof's perimeter shows no signs of corrosion. There are not any signs of blockage to the roof's drainage system.

Photo 3.7 - NHX Roof Vent Cover Close-up

Pavaho is only pump station in Flood Control that has a ladder onsite to access the roof. Access for all others requires a bucket truck or very long extension ladder, prohibiting routine inspections. By standing on top of the levee behind a station it is possible at some locations to see the condition of the roof and vents. Only the vents can be seen from the top of the levee at NHX. The majority the roofing systems at the pump stations are at or past their expected service life.

The brick work appears to be in excellent condition. There is no noticeable loss of grout in the joints, no separation, or cracked bricks. There is a sealant failure where the bricks and concrete meet near the roof, and some minor sealant failure areas around the building's foundation, where the walls and sidewalk meet. (Photo 3.8)

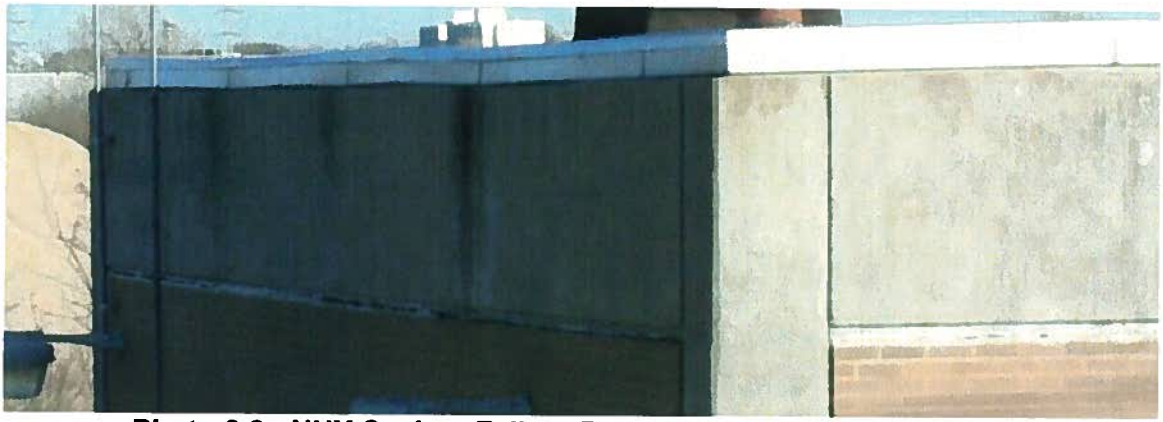


Photo 3.8 - NHX Sealant Failure Between the Brick and Concrete

Concerns and Issues

- Additional lighting would be helpful around the south end of the parking area, where vehicles and equipment are staged during maintenance activities. These lights should be wired through an outdoor switch so personnel could turn them on and off, before or after the building is opened.

- The seam between the brick and concrete on the outer walls has failed in several locations (Photo 3.8). There is also some separation around the foundation and the sidewalk.

- The handrails are in excellent shape but may not meet O.S.H.A.'s intent in areas where there is not a toe bar and at the post and wire fencing at the north end of the screens. Check O.S.H.A.1926.451(g)(4) to insure all guidelines are being met.

- Mechanics indicated that one of their primary function is maintaining the conveyor systems. If this system is prone to routine failure or excessive maintenance, it either needs a major overhaul or there is a design flaw and the manufacturer should be involved.

- Roof vent covers are beginning to corrode at the edges and need to be cleaned and painted before it becomes a problem.

- The paving on the site needs to be extended to include the secondary gate at the south entrance to prevent ruts from becoming easy access under the gate for vandals.

3.3 INTERIOR EQUIPMENT

NHX's main pump room is a large open structure designed only to house the five vertical floodwater pumps and related electrical and electronic equipment (Photos 3.9 & 3.10). This station's design is the same as NBX and comments will be similar. The vertical pump's impellers are located at the lowest point of the casing. This casing extends down into a suction well that is lower than the incoming water level. This allows all water entering the sump area to gravity flow into the suction well, giving the pump station the ability to pump the sump area dry.

Photo 3.9 - NHX Pump Room Looking North

Photo 3.10 - NHX Pump Control Switchgear

The layout in this building is excellent. There is adequate room for an entire crew to work on any piece of equipment. All cable runs are below floor level and grates allow for drainage and air circulation.

Lighting in the pump room is adequate with the use of ceiling-mounted metal halide lamps. These lamps are slow to come on, but this does not usually present any problems. There are incandescent fixtures mounted on the wall that provide immediate light. Consideration should be given to leaving one incandescent light fixture on at all times to serve as an emergency light.

There is not any type of emergency lights or exit signs. These are needed and can be connected to an Uninterrupted Power Supply (UPS), emergency generator or batteries.

Storage at this location is a major concern. Like other stations, areas between pumps are being used to store parts, equipment, tools, etc. There is so much lying on the floor areas that little work area is left around the pumps. (Photo 3.11)

Photo 3.11 - NHX Storage Concerns

The storage of these large parts has damaged the floor grates that surround the pumps. The grates in addition to all the stored equipment and parts on the floor.
are a trip hazard,

This station's design does not allow for further build-out. There is not adequate space within the building for any additional pumps and switchgear. Any expansion at the Hampton location would require new construction. There is some space that might be utilized for storage on the south end. It is currently being used for this but could be better utilized if a caged area was installed and industrial shelves were used to organize materials. This would not be able to contain everything currently in the station, but would improve the situation. (Photo 3.12)

Photo 3.12 - NHX Storage

The roofing structure is composed of concrete double "T" beams, supported by rectangular beams along the top of the walls (Photo 3.13) and spanning the pump room overhead. These are sealed and painted and appear to be in good shape. Spacing between beams is uniform with no visible signs of cracks or leakage at the seams. The exhaust fans mount internally to the beams with the exhaust vent penetrating the beam and roofing system with no signs of leakage at these penetrations. The lighting system also has ceiling mounted fixtures. These require personnel to ride the overhead crane to change bulbs or make repairs.

The main pump room has an electrically operated 20-ton crane (Photo 3.13) used to pull and install equipment. The bridge travels north – south and the dolly, east – west. All equipment in the main pump room is accessible to the crane. It is in working order and inspected by division personnel.

Photo 3.13 - NHX Double "T" Ceiling, Square Support Beams, Exhaust Blowers, 20 Ton Crane and Overhead Lighting

The extraction of a pump requires the motor to be detached and lifted off separately before pulling the pump. This is due to pump's length and the overhead crane's height restriction. This is a common practice for vertical units and is not a problem.

The Farval lubrication system (Photo 3.14) provides each pump with a measured amount of lubrication at prescribed times. The transfer of grease from the storage container to the Farval's main cylinder has experienced some problems with air pockets. The delivery of grease to the farthest pump is also experiencing some intermittent difficulties. There are alarms in place that prevent a pump from starting or take the pump off line, if the Farval system fails to operate correctly. These alarms transmit to the SCADA, informing the operator of the problem.

Photo 3.14 – NHX Farval Lubrication System

Photo 3.15 - NHX Switchgear with Attached Storage Area

The electrical switchgear is located on a solid raised concrete base. (Photo 3.15) The line of cabinets runs parallel to the pumping units, with a distance of 6 feet between the back of the cabinets and the east wall. Personnel have walled in this area to store electrical parts. Access is by key or climbing over the wall.

The switchgear itself is in good operational order, but as in other stations, its age makes acquiring parts difficult and the protection devices are the old mechanical type and are not calibrated. Personnel do not have the equipment or experience to calibrate these relays. (Photo 3.16) The information transmitted to the SCADA reflects these

discrepancies, then the information is altered within the SCADA to read, "what is believed to be correct".

Photo 3.16 NHX Switchgear's Manual Protection Relays

This switchgear equipment is at or past its expected service life. Its alarm relays are minimal, requiring on site personnel to see and reset alarm flags. By comparison, modern electronic protection offers dial-in capabilities, event recordings, warning and alarm conditions, programmable features, etc.

Division's electrical staff is responsible for maintaining and repairing electrical equipment. Switchgear is the majority of that equipment. All switchgear is inspected and serviced twice a year. Only very minor discrepancies were found while inspecting random cabinets. (Photos 3.17 & 3.18) Some labels in circuit breaker panels had not been updated. One penetration of a cabinet did not have a protective grommet installed. These are the typical findings.

If it is the City's intention to keep this equipment for any length of time, it would be worthwhile to have thermal imaging performed to expose hot spots within the gear. This technology can detect problem areas before a failure or damage can occur. It would be an excellent investment for this division to purchase their own equipment and make routine inspections.

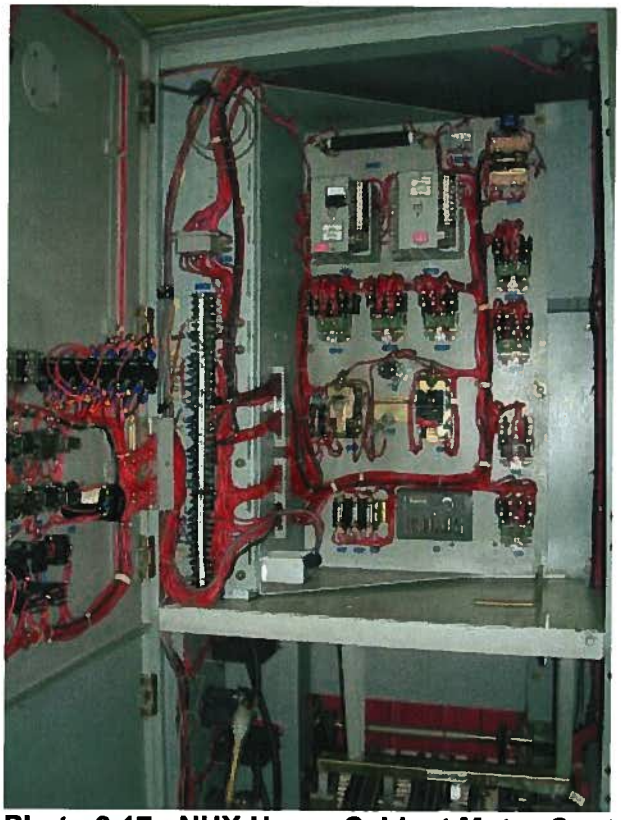


Photo 3.17 - NHX Upper Cabinet Motor Control

Photo 3.18 - NHX Lower Cabinet Motor Control

Ventilation of the main pump room is provided by seven interior roof mounted exhaust fans and louvers opened by the pressure differential created by the exhaust fans. The louvers inspected were not operating as freely as required for proper air movement. Another concern was the location of the louvers. The motors are located along the west wall, the louvers on the east wall behind the switchgear cabinets. The exhaust fans are located along the centerline of the building's ceiling north to south. An air flow test would most likely show that no air movement reaches the area of the motors. A better method would be to isolate and install HVAC in the switchgear area to maintain a lower humidity and controlled temperature. Tests have shown this can double the switchgear's service life. The existing intakes louvers should be eliminated and new intakes located where they provide circulation to the motors. Although the high ceiling does carry heat up and away from the motors, having air circulate across each motor would be more beneficial. Air entering below the pump room floor and through the grates surrounding the motors and exhausting through the exhaust system would provide a much improved air circulation. A less costly method would be to install wall mounted louvers inline with each motor. Directional vanes would be required to direct air towards the motors and to the exhaust fans.

The north end of the building has a separate attached small square room extending north of the main pump room. (Photo 3.19) The room contains a low flow-pumping unit, a small 3-ton hand operated overhead crane for pulling the low flow unit, an exit door on the east and an access door into the pump room on its south wall.

Photo 3.19 - NHX Low Flow Pump Room

Concerns and Issues

- The area behind the switchgear cabinets cannot be enclosed or used as a storeroom. This area must be clear of any obstacles and have no barriers. Appropriate storage areas are non-existent at this pump station. Each station needs a secured area such as a cage, with appropriate shelving to store parts and materials.

- The overhead, 20 Ton, electrically operated crane located in the main pump room and the manually operated 3-ton overhead crane in the Low Flow Pump Room need to be properly inspected as outlined under OSHA regulations:

  The overhead cranes require proper inspections along with proper documentation. To be in compliance with OSHA STANDARD 29 CFR 1926.550(a)(6), the crane requires an annual inspection to be completed before it may be operated in the United States; it states:

  - *A thorough, annual inspection of the hoisting machinery shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The employer shall maintain a record of the dates and the results of inspections for each hoisting machine and piece of equipment.*

  A competent person, as defined in 29 CFR 1926.32(f), is *"one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them."*

- This building does not have any lightning protection other then the lightning arrestors within the switchgear. This has not caused any outages in the past at this location. Newer facilities are including this protection in their design.

- There is no access to the roof. The double "T" roof system may not allow an adequate size opening cut through to allow internal access, which is preferred for security and minimizing exposure while climbing. A second method would be to install an exterior ladder, starting ten feet above the ground and permanently mounted to the structure. The remaining portion of the ladder could be stored within the building.

- The Fire Department recently underwent changes in requirements for fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed but is not required to be tied into the fire department's alarms if someone is monitoring the system in-house at all times. There must be an external alarm to alert passers-by. It is recommended that the City verify whether these changes are grandfathered.

- There are two access points into this building. The south entrance is a large sliding door, designed for heavy equipment vehicles, with a hinged personnel entrance built into it that is pad locked from the outside. The second entrance is in the low flow pump room's east wall and at the opposite end of the building and is secured with a deadbolt lock. There is a third door separating the low flow and main pump rooms that is locked with a deadbolt. There are no emergency exits in this building. No natural light can enter the building and there are no emergency exit signs or a fire alarm system. There needs to be kick bars installed on the doors and lighted exit signs on the exits.

- Every station needs emergency lighting. There needs to be battery-operated light fixtures mounted on the walls at a height that permits routine checking. These lights need to provide enough light to permit personnel to see the way to an exit in an emergency.

- The grates surrounding the motors are not fastened down; some are damaged and present a trip hazard. The grates removed to gain access down into the pump pit area should be hinged on one side with drop down handles installed to prevent back injury or dropping them into the pit.

- The installation of ladder-up devices on the pump pit's ladders would make it easier and safer during access and exiting.

- Every station needs a storage area. Personnel are placing parts and materials wherever there is room at most locations. Lockable enclosures can be installed along with shelving to provide on-site parts and materials storage

- A bollard should be added to protect the switchgear from vehicles backing into the pump room.

3.4 LEVEE, OUTFALL AND VALVE VAULT STRUCTURES

As at other stations, there is no foot traffic access to the top of the levee. This is a steep irregular grassy surface which employees climb to check equipment at the outfall structure.

The east side of the levee facing the station is not quite up to as high a standard as seen at the Baker site but is well maintained. The road on top is compacted dirt that receives routine grading to keep it in shape. (Photo 3.20) If this road is used at night or during foul weather, the structures along the road require better markings.

Photo 3.20 - Levee Road at NHX and OHX

Photo 3.21 - NHX Levee on River Side

The west or river side of the levee down to the lower road is in excellent shape, with the slope on an even grade. (Photo 3.21) The slope area surrounding the outfall has been lined with rip-rap. (Photo 3.22)

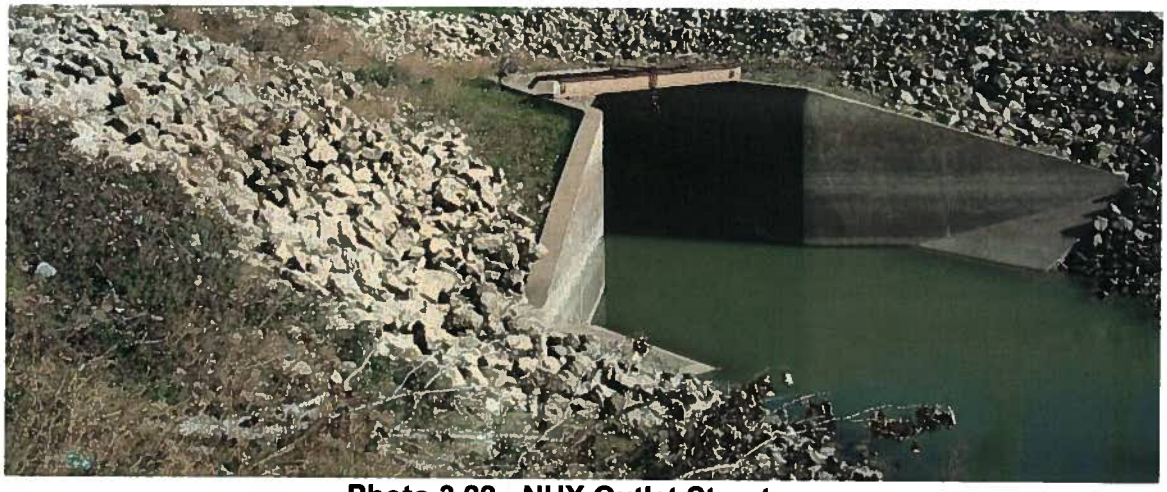


Photo 3.22 - NHX Outlet Structure

Photo 3.23 - NHX Outlet, Slippage on Both Banks

Approximately 40 feet west of the outlet structure, the rip-rap ends and there are signs of wash-out and slippage on both banks for the next fifty feet, with a scattering of rip-rap

visible on the water's edge and in the channel. (Photo 3.23) Past this point, the banks appear stable as the channel turns north to intersect with the OHX channel and flow on toward the river. (Photo 3.24)

Photo 3.24 - OHX and NHX Channels to River

Rip-rap at the outlet structure is the preferred approach for stabilizing the slope at the outlet structure, however, the size being utilized is not sufficient for the velocity and volume of water being discharged.

The outflow structure appears to be in excellent condition. There is no sign of movement or damage to the concrete or loss of soil at the structure (Photo 3.25)

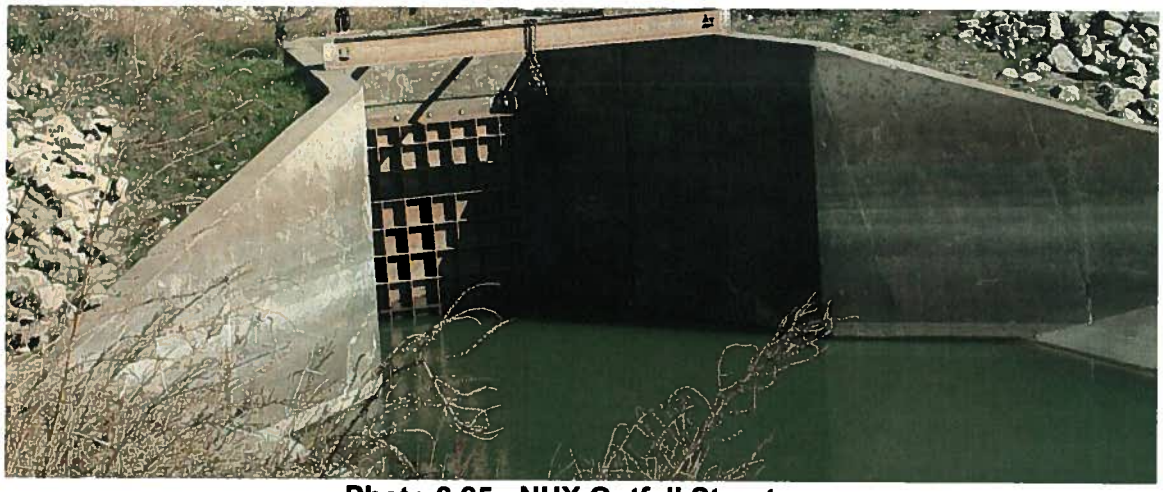


Photo 3.25 - NHX Outfall Structure

The exposed portion of the flap gate also appears to be in excellent condition but a visual inspection of the hinge pins is not possible without removing these pins. This should be scheduled as part of the preventive maintenance plan.

An "I" beam has been installed across the walled portion of the structure. (Photo 3.26) A manual winch has been secured to the center of this beam. Its purpose is to open the flap for internal inspections. It appears that this was built and installed in-house. Although it seems to have performed its intended function in the past, the stability and safety of this apparatus is questionable. There is a need for access to this line and a better design is needed for the safety of the personnel required to open this valve.

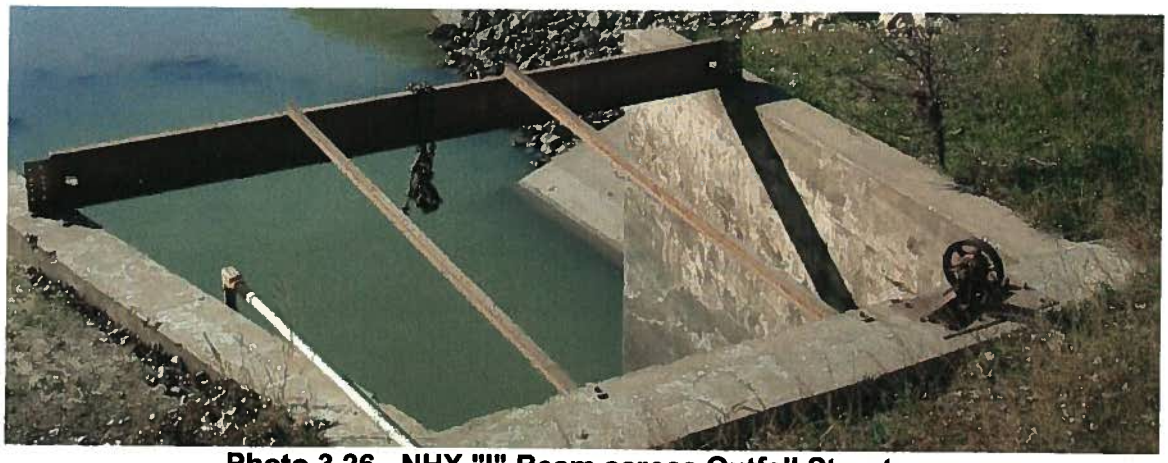


Photo 3.26 - NHX "I" Beam across Outfall Structure

The discharge line for NHX goes through the levee. A bridged structure extends from the top of the levee to the vault where the sluice gates are located. (Photo 3.27)

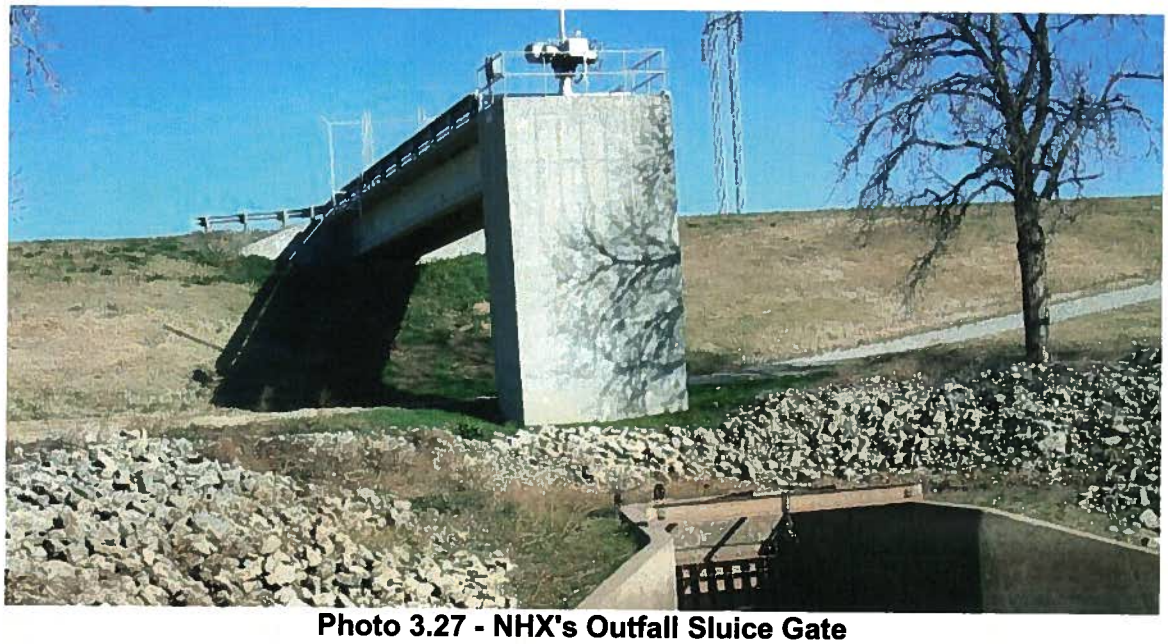


Photo 3.27 - NHX's Outfall Sluice Gate

The vault housing the stem and motor-operated sluice gate appears to be in excellent condition. No apparent signs of movement or cracking were found. (Photo 3.28)

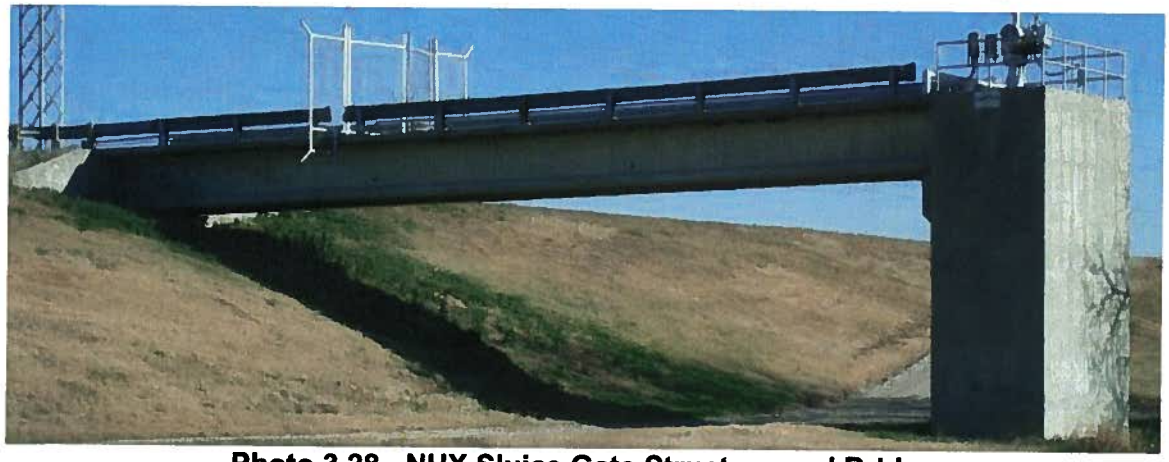


Photo 3.28 - NHX Sluice Gate Structure and Bridge

There are tiny divots in the concrete. There are no evident structural defects in the bridge crossing from the levee to the main valve vault. The area directly below bridge and levee is sparsely vegetated with only weeds due to little or no sun light. This area should be covered with rip-rap or concrete to prevent erosion.

Photo 3.29 - NBX Bridge landing foundation on levee

The bridge landing on the levee has lost soil around its foundation. (Photo 3.29) This area should be backfilled with a more stable material. Topsoil will only be washed away if vegetation is not immediately planted to anchor the soil.

At the time of the initial inspection, no access to the bridge structure was available. All outfall gates inspected to date appear to be in excellent condition. They all have had routine preventative maintenance within the past quarter.

Concerns and Issues

- Rip-rap added around the outlet structure is an excellent means of preventing erosion around the area, if done correctly. Larger sizes of rock are available. Contacts within the Water Department can provide suggestions, based on

experience. René Caraveo at the East Side Treatment Plant is over the people that maintain the rip rap at Forney Dam on Lake Ray Hubbard.

- The area below the outfall structure has had slippage serous enough to consider extending the rip-rap. The single discharge line may be causing a higher velocity further downstream than the channel was designed for.

- Replace the rig used to open the flap valve on the outfall with a properly designed system.

- Install lighting on the end of the valve vault structure. No electrical outlets were observed and the addition of an outlet would be useful for maintenance workers. Lighting and outlets should be tied to a ground fault interrupter circuit.

- A stairway up and down the levee is needed for safer access to the outfall area by foot traffic.

CITY OF DALLAS
STREETS DEPARTMENT
STORM WATER PUMP STATION EVALUATION

1. PAVAHO PUMP STATION (PX)

400 Canada Drive, West Levee
Dallas, TX 75212
Mapsco 44L

Year Built: 1954

Renovations: SCADA 1990/91, Flygt Pump estimated 2002, Low flow 1963
Current Design Pumping Capacity: 1 – Peerless pump 26", 250 hp, 705 rpm, 30,000 gpm; 1 – Flygt, Vertical Submersible 46.25", 355 hp., 710 rpm., 46,000 gpm., a total of 76,000 gpm. 1 – Aurora Low Flow Vertical model 16LM, 2 stage 16", 100 hp, 880 rpm, 6,000 gpm.

Overhaul Program: Pump #1 is scheduled to be overhauled 06/08; #2 & 3 were overhauled in 2007.

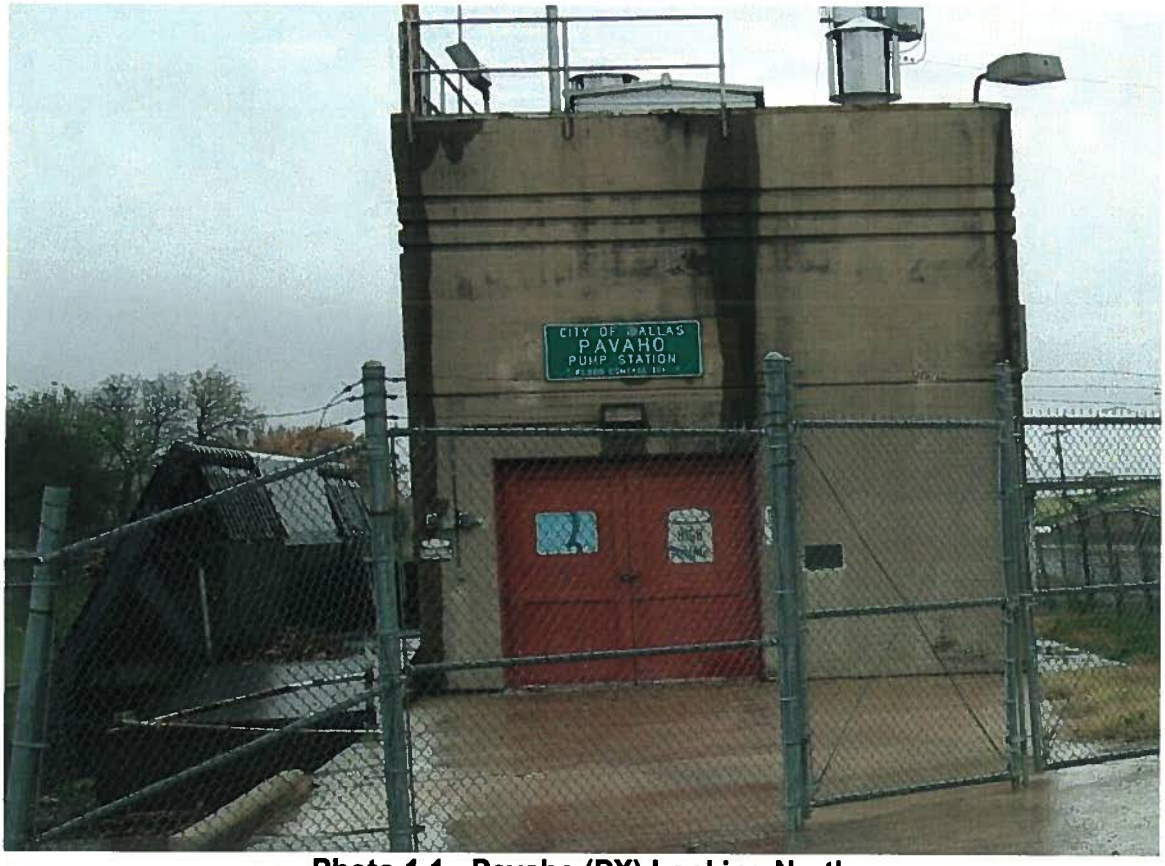


Photo 1.1 - Pavaho (PX) Looking North

2. MAINTENANCE PROGRAM

Flood Control Division does not have access to their budget at a level allowing a cost analysis for operation and maintenance. The division has recently had a change in management. The new staff began an aggressive overhaul schedule of pumps and motors. The current contract between the City of Dallas and the Corps of Engineers dictates a condition level that can only be met by an overhaul of equipment.

The existing contract between the Corps and the City should be reviewed and discussed with the Corps. Many improvements in technology have provided diagnostic instruments that allow an in-depth analysis of equipment. This would enable personnel to diagnose potential problems prior to failure, at a savings to the owner. It is also provide better assurance of reliability than having an overhaul upon breakdown or on a five year schedule.

Vibration analysis can determine alignment, bad or worn bearings, soft foot, impeller wear or imbalance, shaft problems, etc. Thermal imaging can detect hot bearings, hot coupling, motor winding problems, termination hot spots and any hot or cold related issues. Although these stations are not providing revenue requiring accurate metering, a meter would allow personnel to perform pump tests to determine a unit's efficiency. This efficiency is affected by many mechanical conditions, such as worn wear rings, damaged or worn impeller, horsepower to pumpage ratio, etc.

If the contract with the Corps of Engineers can be re-negotiated, where they accept and agree to a condition assessment level, the City of Dallas should be able to cut repair costs substantially.

3. PX ASSESSMENT

Interviews were conducted with management and maintenance staff to gain a better understanding of current practices, conditions, concerns and suggestions. An inspection of the site was conducted to evaluate and assign a condition rating of the station and its equipment.

3.1 Operations

Pavaho pump station (PX) is located on the west levee between CX and DX stations. It was completed in 1954 as part of the levee improvements along with LAX and OHX stations. PX has two vertical and one submersible pumping units that discharge through the levee. Unit #2, a large submersible, is having a Variable Frequency Drive (VFD) installed for operational flexibility by allowing the unit to run at a lower sump level.

The units can be operated within the station, but normal operations are executed and monitored by means of the Supervisory Control and Data Acquisition System.
In the event of a SCADA failure, personnel are able to manually operate this station from the switchgear cabinet by switching controls from remote to local and selecting the start or stop switch. (Photo 3.1) Indicator lights and instrumentation provide the necessary information to an Operator. An operational chart provides guidelines when and which unit is to be put on line or taken off.

At the time of this report, the two main units were in service. The low flow pump was on site for installation after being overhauled.

Photo 3.1 - PX Manual Controls

An attempt to start the #2 pump required re-valving to compensate for the sump being below the normal operating range. The valves went through full travel successfully with the electric operators exhibiting no signs of overload. A start command was given to #2 pump, but the unit went into an alarm state during the starting sequence. This was a minor discrepancy. Maintenance crews were dispatched to troubleshoot the problem and make required repairs. A second site visit is required to evaluate the units while running.

The operational duties of employees in the Flood Control Division are minimal and do not justify having a separate operational staff. This division has training classes for personnel to qualify in three areas of operations, Flood Alert System, Pump Station Operation and SCADA System Control. Employees must pass an exam prior to

operational assignments and may only operate the system after they have completed and passed all three courses.

The overhaul schedule lists the #1 Unit due for overhaul in June of 2008. This will complete the overhaul cycle at PX until 2011. The division has set an aggressive pace to get back on the original overhaul schedule for all of their stations.

There has not been any recordable rainfall up to the time of this report. The stations will be re-visited sites during a rain event to witness the units while running. Condition assessment will be made, based upon physical inspection of each unit. This information will be documented and provided in spreadsheet format with comments.

Concerns and Issues

Pavaho Station is in a location easily accessed by road and in plain view of the public. There are damaged areas to the fencing at this station. The City of Dallas has a price agreement for installation and repairs of fencing that could be used if the division personnel are unable to perform this work. Repairs will enhance security for personnel while at the station and protect exposed equipment from potential vandalism.

3.2 Exterior Equipment

The PX screens have a wider surface area than the other flood water stations. Two Automated rake sections cover approximately one third of the screen's surface area. The remaining screened sections have the potential to trap debris due to the current caused by the pumps. It is not safe for personnel to remove trapped debris by hand due to restricted access to these areas. (Photo 3.2)

Photo 3.2 - PX Screen and Rake System

Silt in the sump area is preventing the use of the low flow pump, per division personnel. This site requires silt removal before it can impact the operation of the flood water pumps. Plans are in the development phase to build a new station to replace Pavaho. Construction of the new station in close proximity could increase the existing silting problem. It is recommended that this be addressed during the design phase.

The main channel into the sump area has a straight approach, allowing large objects to make a high velocity impact into the screens. There are no signs of damage but it appears that sections of the screens may have been replaced adding credence to the potential for damage.

The channels feeding the Pavaho Station are wide and long, terminating in a large sump area. Both channels and sump are located within a residential area. It appears that the majority of residents have installed fencing to provide a barricade between their property and the channels. (Photos 3.3 & 3.4) Residential streets come to a dead end on the east side of the sump area. Guard Rails separate the street's end from the slope leading into the sump. (Photo 3.5)

Photo 3.3 - PX North/South Channel to Sump

Photo 3.4 - PX East/West Channel & Sump

Photo 3.5 - PX East Bank of Sump

All banked areas to the channels and the sump have gradual slopes with excellent ground cover. There appears to be no signs of slippage or erosion within sight of the station. (Photos 3.3 – 3.5)

Although only flooded for short periods, these areas should be considered hazardous. The roads dead ending at the sump only have guard rails. There are no signs posted to warn of flash flooding.

Neighborhood children have easy access to this area and they may not be aware of the potential danger. Recent incidents occurring within the Metroplex area demonstrates a potential legal liability to the City of Dallas. Mitigation is recommended.

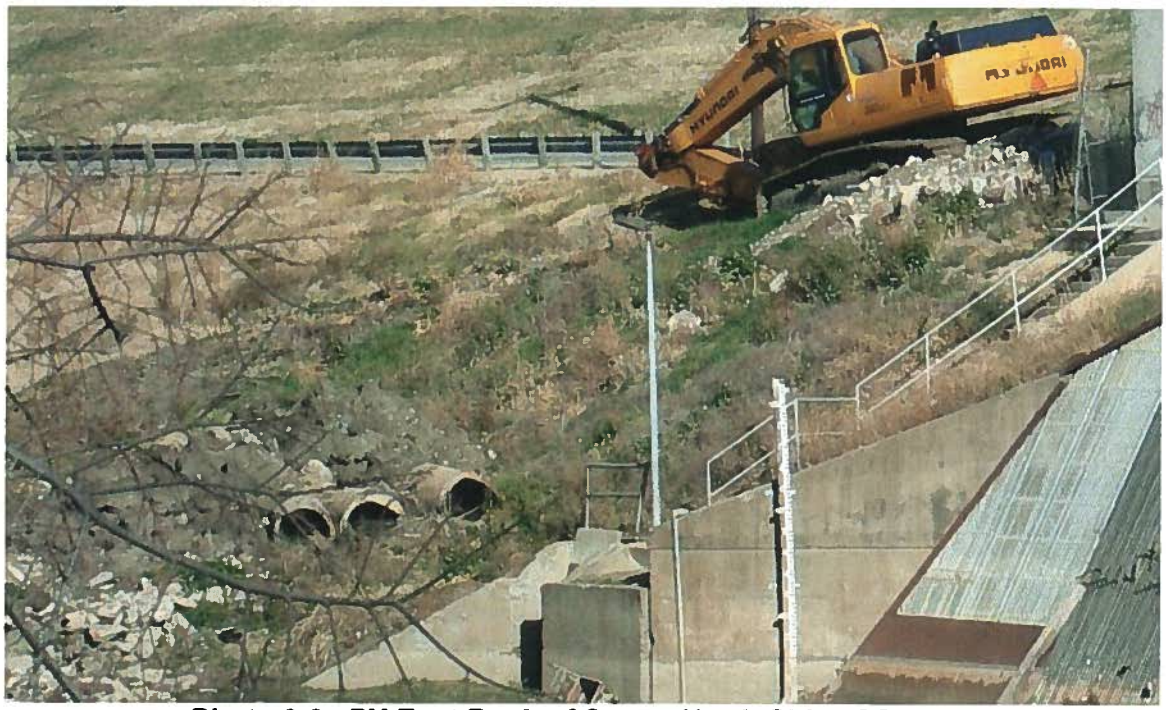


Photo 3.6 - PX East Bank of Sump, North Side of Station

(Photo 3.6) Construction equipment was on site at the time of the inspection. The east/west channel has a temporary service road on its north bank extending over the north/south channel. This may be an indication that the problem with the blocked low flow pump's inlet may be cleared.

Photo 3.7 - DX, slippage "prior to repairs" on north side of screens

(Photo 3.7) The South end of the station's driveway had a major erosion problem that required immediate attention. +/- Three feet of soil had washed out under this driveway,

exposing the support piers and leaving an expansion joint unsupported for over ten feet. A determination was made that until repairs were made, the driveway's condition was unsafe for any vehicle or heavy objects. This was reported to management and repairs were made and verified on 04/04/08.

This station does not have a conveyor system to carry debris to a dumpster. Debris drops behind the screens onto a plated passageway easily accessible for personnel using pitchforks. The area is too limited for the safe use of a skidsteerer. The landing area requires a 90 degree turn to enter and exit an incline to the debris. There is little room to maneuver while between the building and the screens and the there is insufficient rails to prevent a fall while on the ramped area. There were handrails installed on this ramp but they are damaged and sections of the handrails are missing. The use of a skidsteerer in these tight quarters may have been responsible. (Photo 3.8)

The passageway's metal plating has a raised pattern providing some footing in a very wet area. The rakes dump debris onto the plated area and drain back into the sump. There are not any drainage holes in the plating but does appear to have a slight slope to drain water away.

Photo 3.8 - PX Ramp to Debris Drop-off

Photo 3.9 - PX Fence Fabric Missing From Gate

There is adequate exterior lighting for personnel to perform their required tasks and to provide security around the buildings.

As mentioned above, the fence requires repair work to secure the site. The equipment gate post is bent at the base. The gate was extended but does not have fencing material covering the opening. (Photo 3.9) The top rail is missing on the north fence line and the perimeter's three strands of barbed wire need to be adjusted and tightened.

There appears to be no signs of movement in either the main station or the low flow pump station. The main station is a poured concrete structure with visible patterns of the forms used and the finished surface slightly course. It was misting the day of the inspection and the concrete was absorbing the moisture suggesting the structure has not been sealed. There is a small circular pock mark over the front entrance that looks to be manmade, possibly a fastener was there at one point. It is not a structural concern and does not require repair.

The only entrance to this station is a hinged double door located on the south wall. Some of the station's equipment can be removed at this entrance but large and long pieces of equipment, such as the pumps and motors, are lifted through the equipment hatches in the roof. A large equipment hatch is located above each pumping unit to allow crane access from the south driveway. The raised hatches have a flanged bottom that sits on top of the roof with a gasket between them. This is a flat concrete roof surface. Water is unable to pond in sufficient amounts to be a concern, should the gasket fail. The mounting of the two vent stacks are also flanged with gaskets. All appear to have a good coat of protective silver paint.

The two electric sluice gate operators mounted on the roof are controlled from the SCADA or locally in the pump room. When maintenance or inspection is required, they are accessed by the use of a long extension ladder kept inside the station. The roof has been fitted with handrails for the safety of personnel while on the roof but, it does not meet the current OSHA standard. (Photo 3.10)

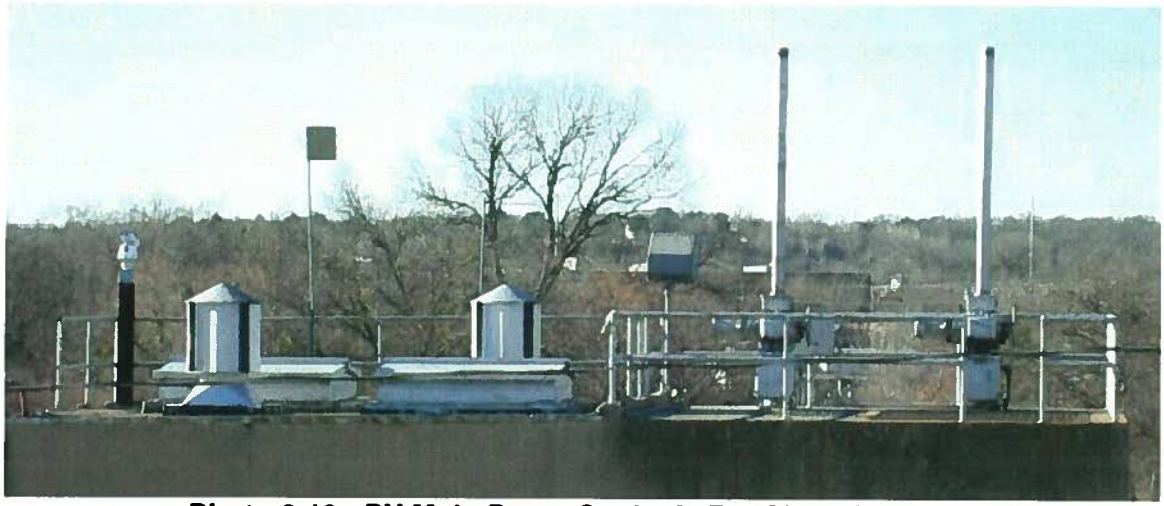


Photo 3.10 - PX Main Pump Station's Roof Looking West

The low flow pump station building is composed of concrete block with a brick veneer exterior. There are two entrances, one on the South wall used for personnel and a large roll-up door on the north wall for equipment.

Photo 3.11 - PX Low Flow Building's Roof

The brickwork is in excellent condition but the grout lines could use re-pointing and a sealant added to the bricks. The cap on the roof's perimeter is a solid flat metal that appears to be aluminum. It is sloped to drain onto the building's roof where the water is carried through a drain line that runs through the ceiling to beneath the foundation to the sump area. (Photo 3.11)

Concerns and Issues

- The driveway to the screens at the south end of the station had a severe erosion problem. The entire area had been washed out and undermined for a depth of three feet or more, leaving support piers exposed and an expansion joint un-supported. Management was informed took appropriate actions to limit access until repairs were made. As of 04/04/08, repairs have been made and appear to be holding at this time.

- The sump area and channels are in a residential area. Residents have fence lines backing up to the channels and portions of the sump areas. There are not any visible signs warning of flood possibilities anywhere along the perimeter. City streets also dead end at the perimeter of the sump. There are guard rails but no restrictions to foot traffic or warning signs. This has the potential of being a legal liability to the City of Dallas.

- The channels approaching the sump area allow debris to travel unimpeded into the screens. This is the potential of damage to the screens, if large objects make hard contact. Objects this large would also be difficult for the rakes to lift. A perimeter of pilings could be installed to re-direct large objects to slow their momentum before reaching the screens but allow heavy equipment into the area for large debris removal.

- Railings at the station have been damaged in some areas and the remainder fail to meet current O.S.H.A.1926.451 (g) (4) standard.

- The fence surrounding the perimeter of the site needs attention. The top rail on the north border is missing, allowing the fence material to sag, and there are no supports to hold the three strands of barbed wire upright. It appears that the fence material was removed and then improperly re-installed. This may be

related to the heavy equipment on site. The South Gate entrance has a bent gate post and the gate has been modified to extend its length by an additional two feet. There is no fencing material covering this extension, allowing foot traffic access to the building and exterior equipment.

- The brickwork on the low flow station is in good condition, but having the bricks re-pointed and sealed would be an excellent preventative measure against weather damage.

- The North equipment door on the low flow station has no access gate or driveway to provide heavy equipment access to the building.

3.3 Interior Equipment

The Pavaho station (PX) is a functional design at best. The structure is divided into north and south portions. The southern portion of the building is the pump room, with the north section used for a sluice gate structure. The pump room is very confining. Equipment fills the majority of space leaving very little work area.

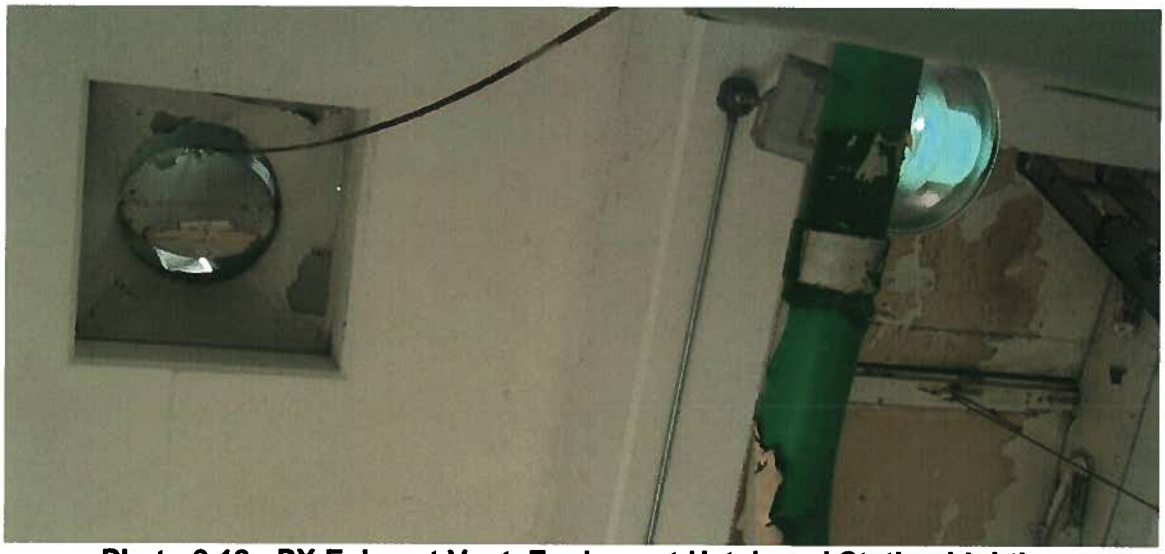


Photo 3.12 - PX Exhaust Vent, Equipment Hatch and Station Lighting

(Photo 3.12) There are no exhaust fans in this station. Air is circulated from the floor grates around the motors that are open to the sump, and the air exhausts through the roof vents. This would be a concern if it were decided not to decommission this station, once the new station is completed. If PX is to remain in service, forced air ventilation should be installed in the existing exhaust vents in the roof. This improvement would be something that could be accomplished in-house. The hinged double doors need to have new hardware installed. A kick bar is needed to allow for emergency exit. A lighted exit sign may also be required.

The overhead lighting in use is excellent in the amount of light provided to the work area, but the Metal-halide lamps also generate a large amount of heat, especially in such a small space.

A Flygt submersible pump unit replaced one of the original vertical units. This unit has a greater capacity than the original. This created a problem with a large drawdown in the suction well, when started. This interferes with the running of the other main unit. A Variable Frequency Drive (VFD) was purchased and is being installed to give the Flygt pump a wide range of pumping capabilities and a lower starting speed to eliminate the drawdown problem. There is a concern with this application at this location. A VFD has a high heat generation factor, and as mentioned, the pump room is very small. There is not any forced air ventilation or plans to add any type of cooling system. The VFD may or may not solve the problem. They are not designed to run a full bandwidth of 0 to 100% but are limited to about a range of +/- 70 to 100%. When operated below the design range, the unit does not pump or operates very inefficiency, which is hard on the motor. This installation is being done in-house, which is commendable, but it is recommended that an engineer with VFD knowledge look over the application to ensure it is capable of meeting the needs of the division as intended, and the place of installation also meets the needs of the VFD.

The #1 vertical pump is the only unit visible in the pump room. The #2 Flygt pump, is a submersible unit that sits beneath the water. There is only the flanged plate and air relief valve visible that is over its location. (Photo 3.13)

Photo 3.13 - PX #1 Pump, #2 Flange Cover, Lower Right

Photo 3.14 - PX Operator Office, RTU Cabinet

The Remote Terminal Unit and the Pavaho river gauge's standpipe are located in a small in-house built office area. The Pavaho river gauge can only be used when the sluice gates are closed because of a broken pipe between the station and the river.

Plans for replacing this station are in the development stage. The new station will be replacing and not supplementing the existing station. The Pavaho River level instrument will be re-located to the new station, eliminating the need to make repairs on the broken section of pipe.
Management decided that until the new station is on line, personnel will close the sluice gates when readings are required. These valves are remotely controlled at the control center, making this an easy task when needed. (Photo 3.14)

Photo 3.15 - PX Switchgear and Pump Controls

The station's electrical cabinets mount on a raised concrete pedestal and are perpendicular to the east wall. (Photo 3.15) This allows access to the back of the switchgear for maintenance and repairs.

Preventative maintenance and most repairs on electrical switchgear and equipment are performed by the Division's Electrical section. This equipment appears to have been well maintained. Each component is inspected and cleaned twice a year. All technical sections within the division make routine inspections and perform related preventative maintenance that is recorded in weekly reports.

The switchgear appears to be in good operational order. If this station is to be decommissioned, the division should request salvage rights. This type of equipment is difficult to find and would provide spare parts for the division's inventory.

The division does not have the technical analysis equipment required to determine efficiency levels or vibration on any of the units. With the addition of a new station at Pavaho, this type of test equipment and the required training should be included in the contract. This is also an excellent time to decide whether the station's design could

include the ability to perform pump efficiency testing by the addition on a test loop with a venturi meter or by other means.

There has not been any recordable rainfall requiring the running of pumps. Each site will be re-visiting when it rains and the units can be run. This will be to determine the condition, based upon a physical inspection only. A vibration analysis and thermal imaging should be added to the routine maintenance program, if the division is successful in acquiring the needed test equipment.

This station is incapable of storing anything due to its confined area. This is also something that needs to be included in the plans of the new station. The division needs a secure area to store spare parts, tools, lifts to pull out electrical switchgear, materials, shop tools, etc.

The Farval lubrication system (Photo 3.16) is also used at this station as it is on all other flood water pumps. This may be overkill for a station with only one pump but it is in place and functioning as designed by providing the #1 pump with a measured amount of lubrication at prescribed times. If the Farval system fails to operate correctly, the alarms in place prevent a pump from starting or take it off.

Photo 3.16 - PX Farval Lubrication System

The low flow pump is located in a separate building. There are two points of entry. The south wall has a single hinged door used for normal inspections and access. (Photo 3.17) As mentioned in the comments for the main station, this hinged door should be equipped with a kick bar for emergency exit and a lighted exit sign, unless the fire marshal approves the existing hardware.

The equipment door is difficult to use as intended. There is not a paved surface providing vehicle access and the fence does not have a gate allowing a vehicle to the equipment door.

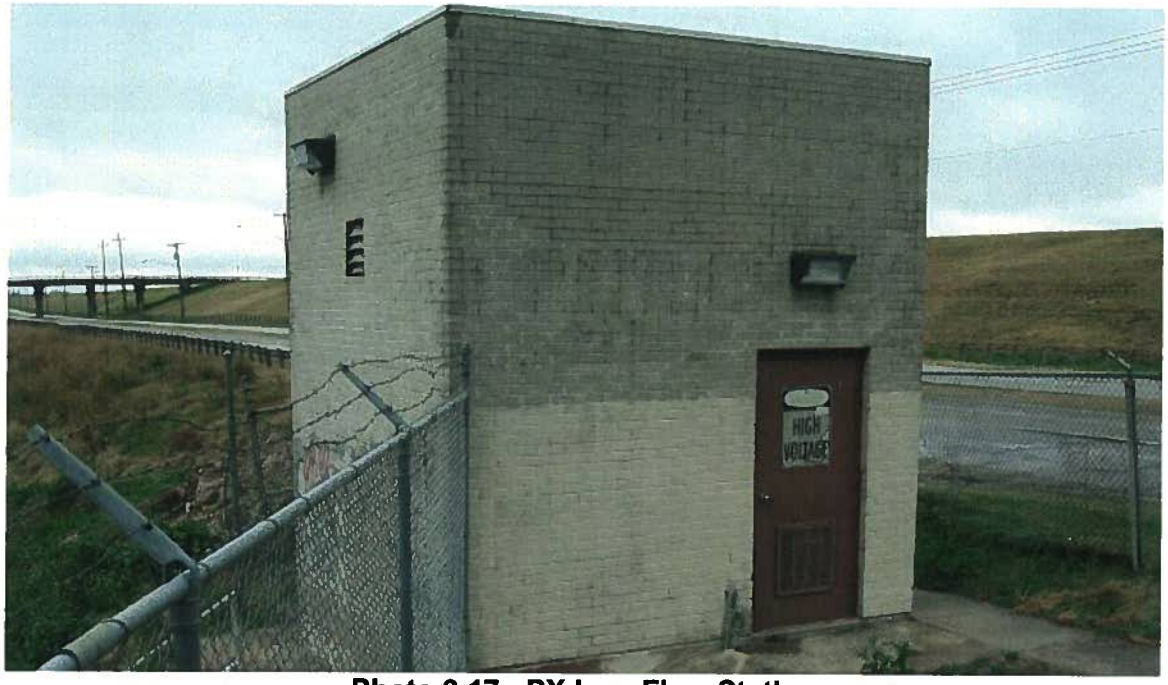


Photo 3.17 - PX Low Flow Station

Photo 3.18 - PX Low Flow Equipment Door on North Wall

The North wall has a large equipment roll-up door for removal and installation of the equipment. (Photo 3.18) As mentioned, there is not a paved surface or drive of any sort to the equipment door.

Photo 3.19 - PX Low Flow Pump

Photo 3.20 - PX Low Flow Switchgear

Power to this building passes through the main station and goes underground into the bottom of the low flow station's switchgear. (Photo 3.20) The building is just large enough to house the pumping unit and switchgear comfortably.

The roof drain of this building is directly above the switchgear and the drain line runs through the station rather than outside the station. This may not be a code violation, but the penetration in the roof for the drain is a potential leak onto medium voltage gear. It is a good design practice to keep water outside the building when possible. The roof should have scuppers with drainpipes down the outside walls to eliminate this concern.

Concerns and Issues

- The building does not have any lightning protection other than the lightning arrestors within the switchgear.

- Neither vibration analysis nor pump testing are performed to evaluate these units. Vibration analysis alone could warn of pending bearing failure, misalignment, soft foot, impeller wear and numerous other conditions before they cause a failure of the unit. This would also be a tool to lower repair costs. The units at this location operate during every rain event. Early diagnosis allows for in-house repairs on many of these listed conditions and minimizes catastrophic

failures. Thermal imaging should also be considered. This provides personnel with images that locate hot spots in electrical equipment and can be used on mechanical equipment such as bearings, packing or mechanical seals, couplings, etc. This is an available service on price agreement, but the better solution would be to invest in a unit for the division.

- The Fire Department recently underwent changes in requirements for Fire alarm systems. The Water Department's pump stations were exempted in the past from the requirement of a sprinkler system. New construction is no longer exempt. Air handling systems are required to evacuate smoke from the building. An alarm system must be installed, but is not required to be tied into the fire department's alarms "IF THERE IS SOMEONE INHOUSE MONITORING 24/7". There must be an external alarm to alert passer-bys. Verify that these changes are or are not grandfathered.

- There is only one access point into the main building. The entrance is a hinged double door that needs the hardware changed out and a kick bar added for emergency exit. A lighted exit sign may also be required above the door.

- The Low Flow building needs the hardware on the hinged door changed over to an emergency exit with a kick bar and a lighted exit sign over the door.

- Every station needs emergency lighting. Mount battery operated fixtures on the walls at a height that permits routine checking. Provide enough light to permit personnel to see the way to an exit.

- Every station needs a storage area. This building is too small for any type of storage.

- Install ventilation; this may be tied to the Fire Department's new building codes but may not be enforced if building is to be de-commissioned in the near future.

- Install a safer means to access the roof in the main pump room.

3.4 Levee and Outfall

There is no foot traffic access up or down the levee. This is a steep grassy surface. Employees climb the levee to check equipment at the outfall structure.

The west side of the levee facing the station has excellent groundcover and is well maintained. The slope of the levee changes to a slight grade, leveling off to a flat shoulder for +/- 8 feet before intersecting with the road that passes between the levee and the station. (Photo 3.20)

Photo 3.20 - PX West side of West Levee

There are roads on top and bordering the west levee's east slope. These are routinely graded and in good repair but not all weather type roads. Any rainfall makes these roads hazardous for light vehicles and heavy equipment could cause damage. (Photos 3.21 & 3.22)

Photo 3.21 - PX Road on Top of West Levee

Photo 3.22 - PX West Levee, East Side with Border Road

The levee's top road at PX is not as clearly defined. Groundcover encroaches on both sides. An approved systemic herbicide would remove this and not affect the road surface.

Photo 3.23 - PX Outfall Channel to the River

(Photo 3.23) The north bank of the outfall is unstable and there are signs of major slippage from the outfall structure for a distance of +/- 100 feet. This problem continues down the length of the channel until it reached the river. This area needs attention in the near future to prevent slippage from closing the channel as seen at NBX's gravity sluice gate's channel.

The south bank is in much better condition. This slope appears to be the result of slippage over a greater distance from the channel and over a long time period. (Photo 3.24) The groundcover appears to have stabilized the south bank along most of the channel but there is a large amount of silt at the outfall structure on both north and south sides that needs to be removed. (Photo 3.25)

Photo 3.24 - PX South Bank of Outfall Channel

Photo 3.25 - PX Outfall Silt Build-up

The outlet structure has damage to the north wing wall. There is a hairline stress crack running up/down the wall but there are no signs of movement in the forward/backward or up/down planes. The remaining walls and disks appear to be in good shape and the disks seat properly so the silt has not washed through the station where silt is also heavy. (Photo 3.26)

Photo 3.26 - PX Hairline Crack running up/down on the North Wing Wall

The outlet structure appears to have soil washed over the wing walls. The soil appears stable above the outlet structure but as the sides slip, it is believed the soil over the structure will also begin to slip.

The outfall structures in the flood water division would benefit from the proper installation of riprap surrounding the outfall structure and the ponding area in front of the structure. Attempts have been made in the past. What size and how it was installed is not known. If discharge velocities were carrying away the riprap, a larger size or wire enclosed riprap (gabions) would be a better application.

Concerns and Issues

- It is recommended that the outfall channel at the structure to the river be re-sloped on the north bank to lessen slippage problem.

- The road surface on top of the levee is being taken over by groundcover making climbing turns difficult to judge where the road begins. The use of an approved systemic herbicide would clear away unwanted growth and not require removal of soil.

- The outlet structure has a hairline crack running up/down on the north wall. A structural engineer needs to determine if repairs are required.

- Personnel have no safe access up or down the levee. It is recommended that a stable pathway be added.

SCADA System

Assessment

City of Dallas
Streets Department
Storm Water Pump Station Evaluation

1. FLOOD WATER OPERATIONS - SCADA

2255 Irving Blvd.
Dallas, TX 75207
Mapsco 44F

Year Built: 1991

Renovations: Two upgrades on hardware (Larger Servers 1999 & 2007) and manufacturer's upgrades to software. Numerous improvements in-house include remote lighting, video surveillance, RTU upgrades, Live Weather Data and radar, addition of back-up server, employee training on station operation, alert system and SCADA operation, ongoing documentation of changes and additions to system and training manuals.

Current Design: Installed in 1990-91, the Supervisory Control and Data Acquisition (SCADA) system is from HSQ, San Francisco, CA and the Alert system for rain & stream gauges from Hydro Links, Sacramento, CA. Both SCADA & Alert are Dual server systems with a hot backup, meaning both servers have identical live data with one designated as in control. When the control unit fails, the other server takes command automatically.

Photo 1.1 - SCADA Computer Office

2. SCADA INTRODUCTION

Don Lawrence, the System Analyst and Steven Anderson, his assistant, were interviewed to gain a better understanding of the SCADA and Alert systems used by the Flood Water Control Division.

A Supervisory Control and Data Acquisition (SCADA) system has become a valuable tool and is in wide use in the utility industries. In its simplest form, a computer sends and receives information from a site such as a water pump station. The information may be a reservoir elevation and the ability to start and stop a pump that fills the reservoir. In reality a SCADA is designed to control large operations, where thousands of bits of information are received every few seconds and hundreds of pieces of equipment are controlled based on that information. Common applications are electrical power plants, water treatment plants, water distribution systems and in this report, the control of a system that prevents flooding in the City of Dallas.

This system is fully automated with programming designed to monitor, evaluate and make the necessary adjustments without the aid of an operator. On duty staff is only required to monitor the system and reset equipment if required. The reliability of the RTUs is monitored and has only been below 99.955% for overhaul maintenance.

3. SCADA OPERATIONS

The SCADA and Alert system was built using telephone and radio for the transfer of data between the control center and the field locations. The system is now moving away from telephone circuits and going to a different form of radio using encrypted data transmitted on a narrow radio beam through a hopper. The hopper uses +/- 20 frequencies to transmit data. The data is broken down into small sections, and then each section is sent on a random frequency. On the receiving end, these sections are reassembled to the original data. This is a spread spectrum using HSQ's protocol for these transmissions. Only a change in status is sent, not an entire packet as used in Pro Logic Control (PLC).

The SCADA system polls the Remote Terminal Units (RTUs) in the field every +/- 5 seconds to see if any changes have occurred or to send a start or stop command. If an RTU is down, the SCADA will poll that RTU three times before moving on to the next location in the polling order. On the next round of polls to all stations, it again polls the out of service RTU three times. On the third round of polls, three more attempts to contact the RTU are made, and then the SCADA places the out of service RTU on a slow poll which polls all other sites ten times before polling the one out of service. The system transparently can switch between phone lines or radio on Ethernet hoppers, switching between them to find a working link to the RTU. The operator can determine which line of communication the SCADA is using by calling up a display showing this information for all stations.

The other end of the system, or the RTU, is expecting to receive these data polls from the SCADA. When this does not happen within 60 seconds, it also switches to the other communication path.

The RTUs are in the process of being replaced with an upgraded series which are called "Smart Terminals". These RTUs are able to be programmed to function separately from the SCADA, when necessary. This allows the RTU to take control of the station when the SCADA or the communication links are down. Once operations are back to normal, the Smart Remote sends the SCADA a report of activities that took place during the outage.

This RTU upgrade will be an ongoing, in-house project. As the RTUs are changed out, some cards from the old model can be used in their present condition while other cards will require re-configuring or can be used as spares in the remaining RTUs.

A touch screen using an Ethernet interface communication via Modbus protocol will be mounted on the front of the new RTUs. This will provide the operator with an operational display identical to the one seen in the control room. Controls will remain on the switchgear, but the touch screen is also capable of this function.

Radio communications require line of sight to work. This is not a problem at the SCADA control center. There is a 150 feet tall radio tower on site. There has been an ongoing problem with the current Ethernet hoppers. The hoppers are obsolete, and to correct this, the manufacturer is now sending out the next generation. The newer system incorporates into the city's microwave loop. This will also requires higher antennas at the field sites. The intention is to use the division's operating budget to fund the conversion over to this new system.

The SCADA system's current capacity of 200,000 data points meets the division's planned needs well into the future. If this system approaches full capacity, it is easily capable of expanding to over 2,000,000 points, making any plans to expand to the flood water division's remote sites possible.

The system is user friendly with all logic being user programmable, including a user modifiable Graphics package for building displays. This means the core of the operating system has been developed to be versatile. Start/Stop, Open/Close, Send/Receive, etc. sequences can be added as needed for individual applications, such as pump stations, remotely operated valves, rain gauge stations, data polling, etc.

The division has two employee positions responsible for maintaining, programming and implementing operational improvements to the SCADA system. These are critical positions that are unique. Although there are numerous SCADA systems within the City of Dallas, each is unique in its

functions, controls, programming, etc. This requires a high skill level in scripted language programming. The entry level programming experience is a minimum of five years. It requires someone of this level an additional two years to learn how each piece of equipment is controlled and how it is related to the Flood water and Alert system.

Most innovations to the SCADA are designed, built and installed by these two in-house technicians. The upgrade of the RTUs is an example of one of these projects. Another in-house project will attempt to implement a web based operator interface to provide additional operational flexibility. This is an excellent tool, but unauthorized access to this system could become a concern. There are Homeland Security Guidelines for SCADA systems that should be investigated before finalizing plans.

The SCADA system currently has nine work stations. Six of these are off site capable by using X Windows with VPN. These six work stations allows critical staff members to monitor the SCADA when in or out of the office. When entering the SCADA system using X Windows, the City of Dallas' Firewall is the SCADA and ALERT system's main defense against online hackers attempting to gain access. A second important defense is the type of programming language used by the SCADA system. The VMS protocol is not prone to the levels of hacking seen used against the general public in home and office computing. As mentioned in the last paragraph, the Homeland Security has guidelines on SCADA security. This may meet the criteria, but should be verified before continuing the project.

Concerns and Issues

- The SCADA and Alert system, as it now designed, utilizes X Windows for remote capabilities. Although well protected, this may not be adequate to stop hackers, and it may not meet the current Homeland Security standard. The Homeland Security's guideline is that a SCADA system must be on a totally private link and terminal. If utilizing publicly accessible communications, the connection must be disconnected between uses.

- There are two employee positions responsible for maintaining all equipment related to the SCADA and Alert system. One of the two is always on call and is required to be onsite during rain events. These positions require an extended training period of two or more years to reach the level of competency required. The workload would easily justify a third position and the on call requirement would allow needed flexibility for sick, vacation and other types of excused absences that occur. Another concern is the possibility of turnover in a critical position. Retirement and promotion are a very real possibility.

- The City of Dallas has numerous divisions in different departments that have SCADA systems. Although each system is unique, numerous functions are similar. It would benefit the City of Dallas to promote and support an in-house user group for these SCADA users. This would provide an exchange of ideas and problem solving, giving them someone to contact if they run into a new problem or discover a better method or technology.

- On going training is essential in the computer field. As mentioned, SCADA systems have differing needs and programming is constantly being improved and changed. The computer personnel currently need courses for Sequel, .Net, visual studio and visual basic. The department, not the division, handles the training budget and its distribution. The appropriate department's training staff needs to be made aware of courses, locations, fees and dates to allow personnel to enroll through city's protocol.

4. COSTS

The funding for Flood Control Division's SCADA and ALERT system was approved through a bond election. Since its installation in 1991, the operating budget has covered the costs associated with upgrades and improvements. The division does not have access to their budget on a line item level, making cost analysis impossible. The only ongoing known expense is a maintenance agreement covering phone line and software maintenance, at $250 monthly. The operating budget appears to be adequate to meet the division's needs, considering that the system upgrades and pump and motor overhaul costs can be substantial. It would benefit management staff if a breakdown of the funding in each object code were made available to better plan future needs. The division has recently had a change in management. The new manager has directed staff to have pumps and motors overhauled per the existing schedule. Some units are several years behind schedule, and this aggressive schedule is required to honor the agreement between the City of Dallas and the Corp. of Engineers. This is a large undertaking and costs cannot be determined until the vendor is able to tear down the equipment to assess required replacement parts and labor costs. Not knowing what is in the budget could easily be exceeded before work is completed.

This is a demand based operation with the amount of runoff created by rainfall creating the demand. Electrical cost cannot be estimated without knowing how much rain will occur. Mechanical costs are largely based on the overhaul schedule, but even then, it depends on what is reported wrong before the costs can be estimated and these repairs are very expensive when motors require a rewind or a pump requires a new rotating assembly. The only large operating cost that is predictable is employee's wages and benefits.

Issues and Concerns

- The City of Dallas employees receive performance evaluations. These evaluations determine if and how much of a merit raise they will earn. Management is required to meet all system demands and stay within projected expenses. The management staff needs to be provided budget information if they are to determine and prioritize expenses. Staff requires this information so they can determine which projects have adequate funding. Without this information, it is impossible to achieve a fair evaluation.

5. EXTERIOR EQUIPMENT

The radio system used for the division's SCADA system has to have line of sight to communicate between the remotes in the field and the control center. This could become a problem as development along the Trinity River continues. Antennas currently mounted on the roof of each station may require a taller mast to maintain line of sight. The division is currently in the process of upgrading the radio system and replacing the existing antennas as part of the improvements.

The current location of the control center should be scrutinized. This site has experienced high water in the past and has the potential for even higher water levels as the hard surfaces increase and development in north Texas continues.

Concerns and Issues

- Moving the control center to a higher elevation needs to be considered if the high water problem in the area is not or cannot be moderated. A control room site should have all weather access, uninterruptible power, all weather communication capabilities and weather radar link. The facility should be built to withstand tornados and other severe weather, in a safe and secured location, with provisions for extended shifts, such as a small kitchen area, shower and lockers.

- Existing antennas may need replacement with taller masts to maintain line of sight communications due to continuous building of roads and structures along the river's banks. This is in the plans for upgrading the radio system.

- Lightning protection needs to be installed to protect electronic equipment.

6. INTERIOR EQUIPMENT

The new management staff is attempting to make improvements to the division's maintenance and office buildings. Two existing pump stations are being replaced. These are in the planning stage and additional funding was included to make maintenance and office space improvements.
The area housing the division's control center and SCADA and Alerts System is crude and insufficient. The City of Dallas has an important capital investment in a space that falls short of protecting this asset. The current building is an old tractor warehouse. The control center, SCADA and Alert offices, the room

housing the servers and the majority of the office staff are in makeshift offices created out of the warehouse space.

A firewall exists across the front section of the building where the original offices were located. This offers no protection from fire spreading through the majority of the building. There are hand held extinguishers and a smoke detector in the SCADA room but this building is not manned 24/7. If a fire occurs after normal working hours the smoke detector will dial the division's appropriate personnel. Without an automated extinguisher system there is not time to prevent a potential total loss the division's SCADA system.

The computer and servers are tied into an Uninterruptible Power Supply (UPS) and an emergency generator. The generator is wired to the UPS to stabilize the power being fed to the Computer and servers. The generator is routinely tested and serviced with run times long and often enough to keep the diesel fuel from becoming stale. The loading on the generator may require balancing. According to onsite personnel the generator is under a 50% load. Generators should have a 60 to 80% amp load to operate efficiently. This can be achieved by adding additional lighting and/or equipment to bring the amperage to an efficient level.

The UPS has sufficient batteries to provide +/- one hour run time for the computer and servers. This allows the generator to come on line and be shutdown as necessary for refueling. The load factor on the UPS is said to be +/- 75%. This is excellent.

This building does not have any windows in the work and office areas to provide natural lighting. Battery operated emergency lighting should be installed to provide personnel sufficient light to evacuate the building in the event of an emergency.

As mentioned in the exterior equipment section, this building is also in an area that has seen very high water in the past, and there is a potential for the building being flooded.

The current lighting in a programmer's and system operator's space does not meet their needs. These needs differ from that used in normal office areas. Too much direct lighting makes the monitors difficult to see. Indirect lighting provides better area lighting in this situation with task lighting in designated desk areas. The SCADA and Alert area has insufficient space for the required tasks. Work benches, test cabinets, backup servers, office chairs, tech and maintenance manuals, monitors, work stations, test cabinets, tools, printers, etc. are filling the space floor to ceiling. Two people work together in this space and are in constantly interfacing with each other. A third person is needed and this position would also be required to be in the same area. A larger space is needed.

The servers were moved out of the computer room due to lack of space and because of the amount of heat they generate. They are now in an adjoining room with copy machines and office supplies. Servers have special cooling requirements and are normally placed in a space or room with its own HVAC. The portable A/C unit works for a temporary situation but should not be considered for long term usage.

The City of Dallas department of Equipment and Building Services provided an estimate of $30,000 to upgrade the building's current HVAC system. The division was not given any information on how the system would be installed and the funding was never provided.

Concerns and Issues

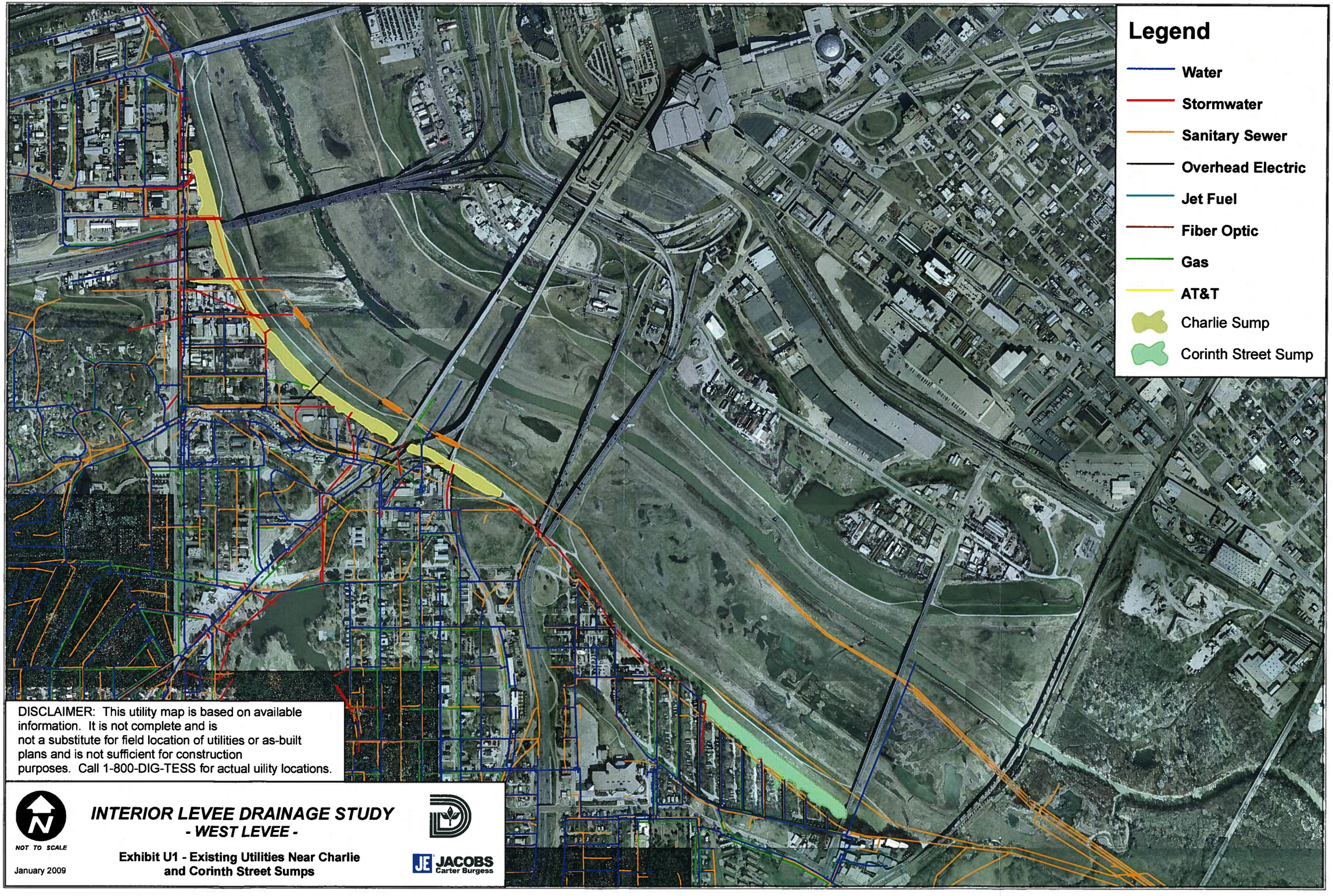
- The SCADA system is not protected from fire. Funding needs to be found to provide adequate protection to this City of Dallas capital investment and critical component of the Flood Water System. Additions of fire walls in the building also need to be installed but the fire extinguishing system needs immediate attention.

- Location of the control center is another concern that should be addressed. The surrounding area has experienced flood water levels high enough to endanger the entire building. Continued construction will only increase run off so higher water levels should be a concern. With construction of a new Baker Pump Station, consideration of including a new control center and computer room might be a good option with it being in close proximity of the existing site. This would remove concerns over flooding and update the space needs for the computer analysis. A control center built on top of the station would provide a control tower where the other stations might be within view. This would also free up existing space for less critical use.

- A portable/temporary AC unit is being used to keep the SCADA's server cool. This unit is not intended as a permanent fixture. This type of unit is cumbersome, it vents high amounts of heat into the drop ceiling and is not evacuated through a roof vent or exhaust fan.

- This building has no natural lighting. Emergency backup lighting and lighted exit signage should be installed.

Utility Maps



DISCLAIMER: This utility map is based on available information. It is not complete and is not a substitute for field location of utilities or as-built plans and is not sufficient for construction purposes. Call 1-800-DIG-TESS for actual uility locations.

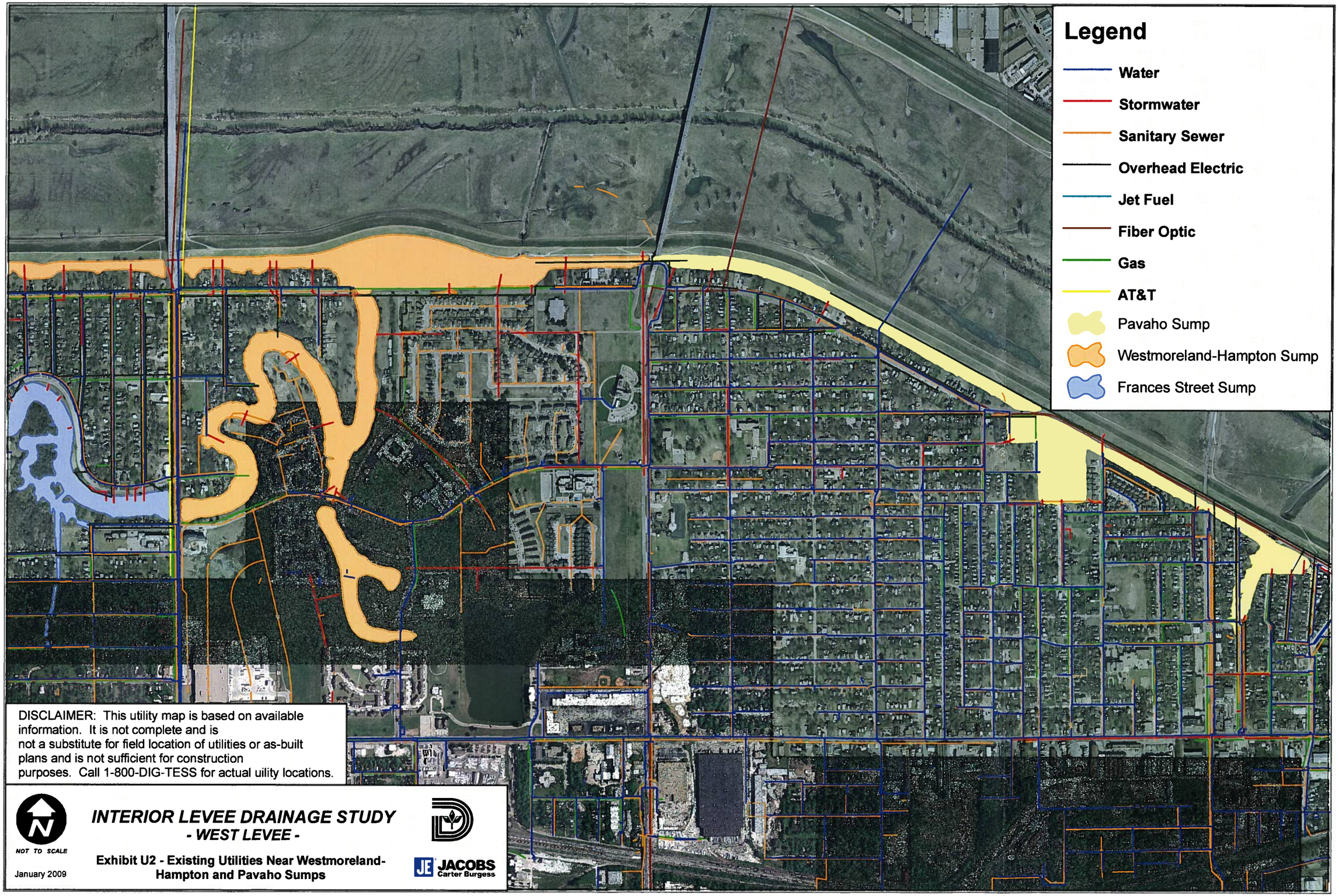
NOT TO SCALE

January 2009

INTERIOR LEVEE DRAINAGE STUDY
- WEST LEVEE -

Exhibit U1 - Existing Utilities Near Charlie and Corinth Street Sumps

JACOBS Carter Burgess



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NOT TO SCALE

January 2009

INTERIOR LEVEE DRAINAGE STUDY
- WEST LEVEE -

Exhibit U2 - Existing Utilities Near Westmoreland-Hampton and Pavaho Sumps

JACOBS Carter Burgess

Legend

- Water
- Stormwater
- Sanitary Sewer
- Overhead Electric
- Jet Fuel
- Fiber Optic
- Gas
- AT&T
- Westmoreland-Hampton Sump
- Trinity-Portland Sump
- Frances Street Sump

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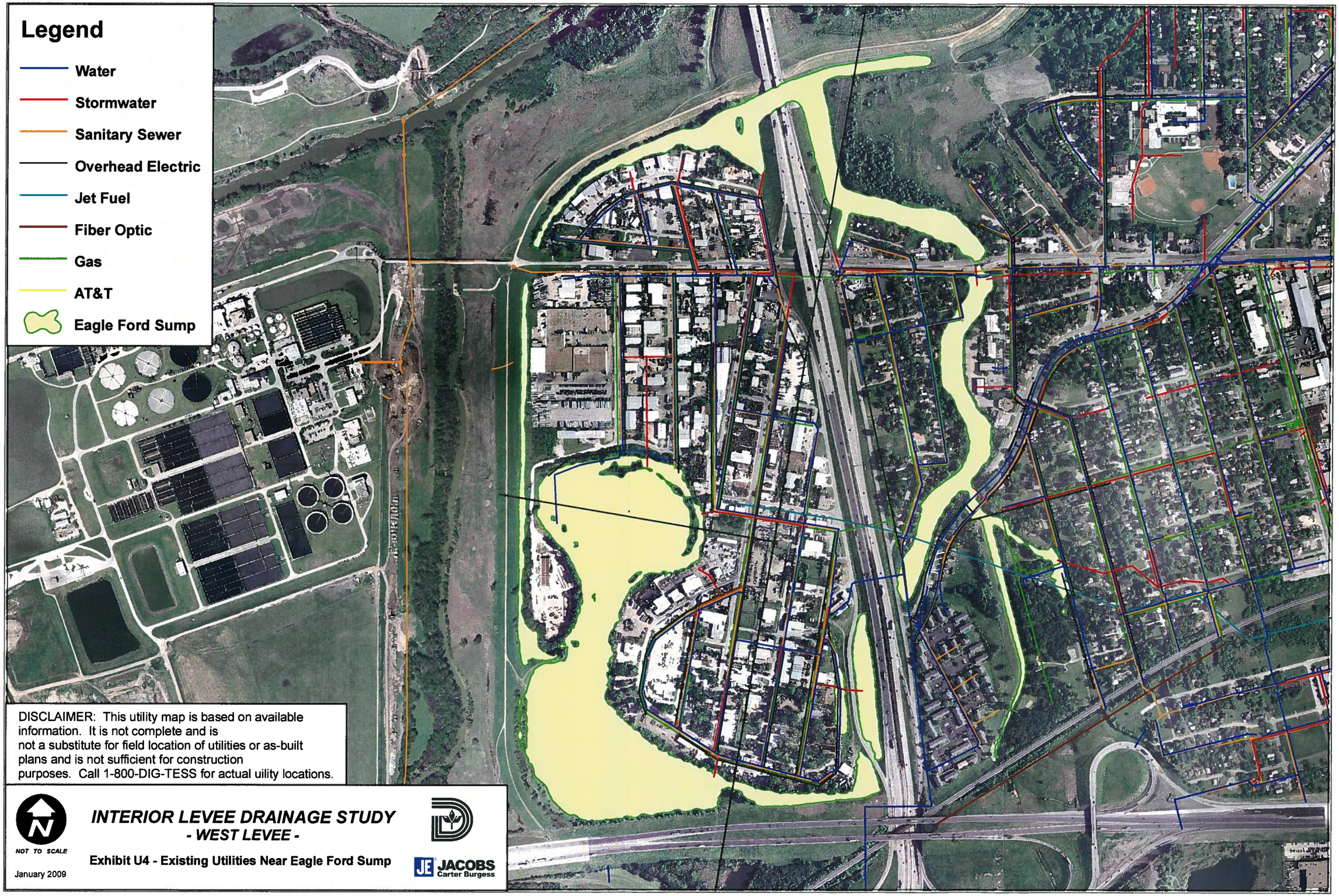
NOT TO SCALE

January 2009

INTERIOR LEVEE DRAINAGE STUDY
- WEST LEVEE -

Exhibit U3 - Existing Utilities Near Trinity-Portland, Frances Street, and Westmoreland-Hampton Sumps

JACOBS Carter Burgess



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NOT TO SCALE

January 2009

INTERIOR LEVEE DRAINAGE STUDY
- WEST LEVEE -

Exhibit U4 - Existing Utilities Near Eagle Ford Sump

JE JACOBS Carter Burgess

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