



City of Las Vegas Department of Public Works
Bonneville Pump Station Replacement

PRELIMINARY DESIGN REPORT

DRAFT | December 2019







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Abbreviations

amp	ampere
ATS	automatic transfer switch
Bonneville Avenue dip section or underpass	Catch basins in underpass of Bonneville Avenue between Grand Central Parkway and Main Street
BPS	Bonneville Pump Station
Carollo	Carollo Engineers, Inc.
CCRFC	Clark County Regional Flood Control District
cfs	cubic feet per second
City	City of Las Vegas
CLSM	controlled low-strength material
CPVC	chlorinated polyvinyl chloride
DCE	cis-1,2-dichloroethene
DIP	ductile iron pipe
fps	feet per second
FRP	fiber-reinforced plastic
ft	feet
gpd	gallons per day
gpm	gallons per minute
HDPE	high-density polyethylene
Horizon	Horizon Surveys
hp	horsepower
I/O	Input/Output
in.	inch(es)
KCI	KCI Technologies
kVA	kilovolt-ampere
kW	kilowatt
LDPE	low-density polyethylene
LVVWD	Las Vegas Valley Water District
µg/L	micrograms per liter
M	million
MCC	motor control center
mil	thousandth of an inch
NDEP	Nevada Division of Environmental Protection
NEC	National Electrical Code
NPDES	National Pollutant Discharge Elimination System

OIT	Operator Interface Terminal
PCE	perchloroethylene, tetrachloroethene, tetrachloroethylene
PLC	programmable logic controller
PS	pump station
psi	pounds per square inch
psf	pounds per square foot
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride
PW-1	pump well No. 1
PZ	piezometer
SST	stainless steel
SUE	subsurface utility engineering
TCE	trichloroethylene, trichloroethene
UDACS	Uniform Design and Construction Standards for Potable Water Systems
UPRR	Union Pacific Rail Road
V	volt
W	watt
WPCF	Water Pollution Control Facility

EXECUTIVE SUMMARY

In May 2017, Carollo Engineers, Inc. (Carollo) was tasked by the City of Las Vegas (City) to perform a condition assessment on the Bonneville Pump Station (BPS) located at Symphony Park. Based on the recommendations made in the condition assessment report, the City elected to demolish and replace the BPS.

Replacement of the pump station includes the following key improvements:

- Full replacement of the wet well structure with the new structure designed to accommodate a surcharge load of 2,000 pounds per square foot (psf).
- Raising the top of the wet well structure above the 100-year flood plain elevation.
- Installing three large submersible solids handling pumps rated at 5,400 gallons per minute (gpm) each to handle a 100-year storm event.
- Installing two small submersible solids handling pumps rated at 550 gpm each to handle flows up to the equivalent of a 2-year storm event.
- Installing swing check valves and plug valves in a buried vault adjacent to the wet well.
- Drilling and equipping two dewatering wells to lower the groundwater elevation 3-feet or more below the underpass at Bonneville Avenue. Sample ports and flow measurement will be included.
- Replacing 800 lineal feet of force main originating from the North dewatering well and discharging to a sanitary sewer manhole on the northeast corner of Promenade Place and Bonneville Avenue.
- Installing a new manhole and approximately 40 lineal feet of force main originating from the South dewatering well.
- Installing new electrical equipment within a climate controlled pre-fabricated enclosure.
- Installing new NV Energy electrical service to meet increased power requirements at the site.
- Installing a new backup generator and fuel tank with automatic transfer switch.
- Site design enhancements for ease of maintenance and access.

Considerations and basis for design for each of the above components is presented herein. The 30-percent Design Drawings are provided in Appendix A of this report. A preliminary construction cost included as Appendix L presents a probable construction cost of \$4,300,000 (AACE International Class III).

Section 1

INTRODUCTION

1.1 Project Background and Purpose

The City's BPS site is located in the southeast corner of Symphony Park, bordered by the Union Pacific Rail Road (UPRR) and Bonneville Avenue. Two catch basins in the underpass of Bonneville Avenue between Grand Central Parkway and Main Street (hereinafter referred to as the Bonneville "dip section" or "underpass") collect and convey stormwater via two 24-inch inlet pipes into the BPS. The BPS pumps the stormwater approximately 20-feet vertically to grade into an adjacent storm channel. Figure 1 provides an overview of the BPS site location, and Figure 2 provides an overview of both the BPS and the existing 4-inch force main.

The construction of the BPS was completed in 1995 and serves to eliminate the flooding that occurs at the Bonneville Avenue underpass during storm events. However, the station is situated at the lowest elevation in Symphony Park, making the pumping station prone to on-site flooding during storm events. Additionally, since the groundwater elevation (EL 2018) is higher than the Bonneville Avenue underpass roadway (EL 2010), the pump station continually receives flow contribution from contaminated groundwater that seeps out of the concrete pavement seams and cracks and into the catch basins. The groundwater at the site is monitored by the City due to known toluene and perchloroethylene (PCE) contamination. The City holds a Class II Wastewater Control Permit (Appendix B) to discharge groundwater to the sanitary sewer. Further discussion on this topic is included in Section 1.4.

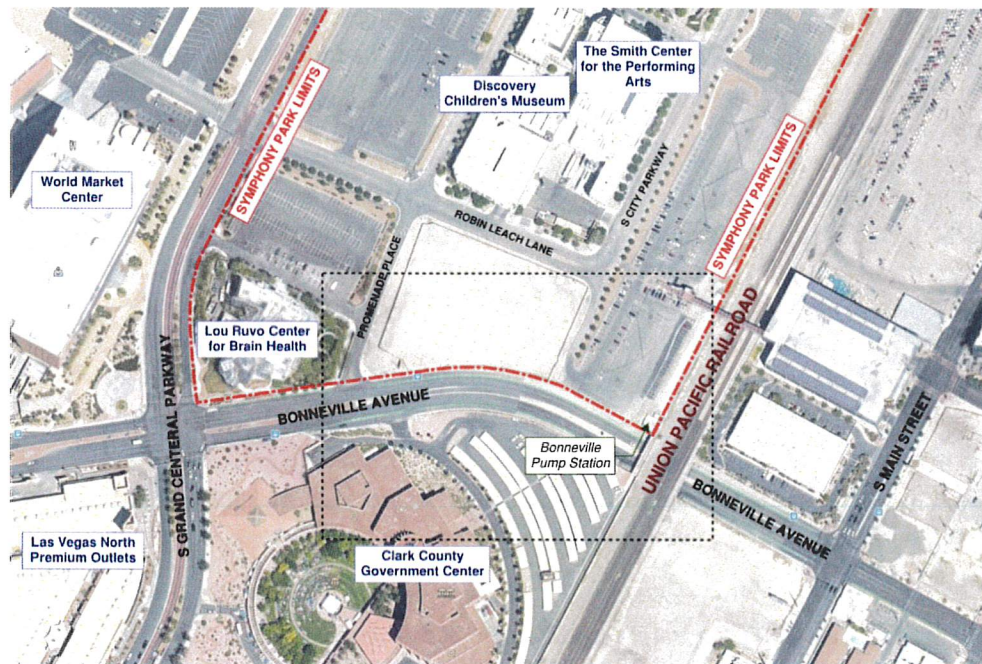


Figure 1 Vicinity of the Bonneville Pump Station

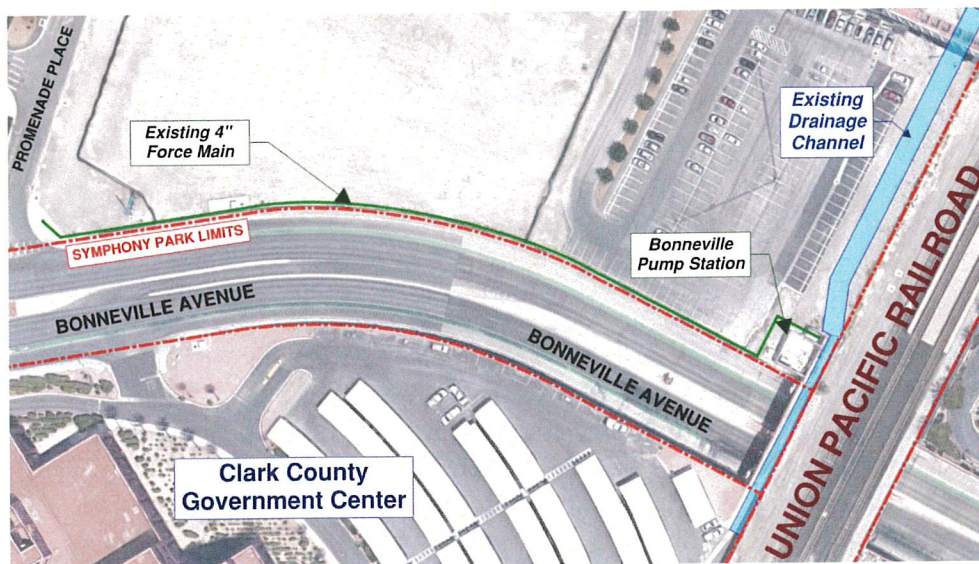


Figure 2 Bonneville Pump Station and Force Main Location

1.2 Existing Conditions Inventory

1.2.1 Existing Pump Station Wet Well Structure

The existing pump station structure consists of a 29-foot deep reinforced concrete wet well. Record drawings and subsequent site visits have confirmed that the wet well structure contains a baffle structure, pumps, piping and their associated appurtenances for the pumping station, while the electrical equipment and instrumentation are located above grade on the wet well and surrounding concrete pad.

1.2.2 Existing Pumps and Piping

Two catch basins in the Bonneville Avenue underpass collect stormwater into two separate 24-inch diameter polyvinyl chloride (PVC) inlet pipes, which feed into the pump station's wet well. The pumps and discharge piping at the pump station include four 12-inch large-capacity pumps dedicated to stormwater, one 3-inch jockey pump for groundwater, a 24-inch diameter cement mortar lined and coated steel header, and a 4-inch diameter groundwater loop assembly. The 24-inch diameter header discharges stormwater through a flap gate to the adjacent box culvert, which conveys stormwater to the North. The 3-inch jockey pump is used to purge groundwater from the wet well to the 4-inch PVC / ductile iron pipe (DIP) groundwater discharge pipeline, which conveys groundwater approximately 800 lineal feet to the west and discharges into the City's sewer system through a manhole on the northeast corner of Promenade Place and Bonneville Avenue.

The pumps are further discussed in Sections 1.2.2.1 and 1.2.2.2. Additionally, some non-functional 2-inch diameter PVC piping was observed in the wet well; the purpose of this piping was not immediately obvious, even upon review of the record drawings.

1.2.2.1 Existing Stormwater Pumps

Four 12-inch Flygt model CP-3201 submersible pumps are dedicated to stormwater flows into the BPS wet well. Stormwater enters the wet well from the Bonneville Avenue catch basins that convey stormwater through dual 24-inch drain pipes. The four submersible pumps operate to pump the water through the 24-inch diameter header pipe and out a flap gate, discharging to

the adjacent box culvert. Assuming that the Flygt catalog at the time of as-builts is similar to the Flygt catalog today, and assuming the total dynamic head is approximately 32 feet, the capacity of the station is between 2,700 to 8,500 gpm, with one to three pumps operational, respectively.

1.2.2.2 Existing Groundwater Pump

Groundwater is primarily collected by Pump No. 1, a 3-inch Mody submersible jockey pump situated in the east corner of the wet well. This pump is primarily used to purge groundwater entering the wet well from Bonneville Avenue underpass, and discharges to a 4-inch diameter PVC / DIP force main into a sewer manhole located approximately 800 lineal feet west on Promenade Place.

1.2.2.3 Existing Stormwater Discharge Piping

Stormwater is discharged from the four stormwater pumps detailed above. Each stormwater pump discharges through a 12-inch diameter cement mortar-lined and coated steel pipeline with a 12-inch Flygt HOL Ball Check Valve Type 2016 Sinking Ball and a buried 12-inch DeZurik Plug Valve (Model 0400-FIG 118-F-G-RS16 Operating Nut Fig 614 Tee Wrench Fig 337). The four 12-inch diameter discharge pipes tie into a single 24-inch diameter discharge header buried beneath the wet well concrete slab and daylights into the adjacent stormwater channel. A flap gate is attached to the above-grade discharge 90-degree bend to prevent backflow.

1.2.2.4 Existing Groundwater Force Main Piping

Record drawings indicate that the existing force main is a 4-inch diameter PVC / DIP pipe located within a 5-foot permanent utility easement along the north side of Bonneville Avenue. This force main discharges into a sewer manhole on the northeast corner of Promenade Place and Bonneville Avenue.

The record drawings indicated that the force main was buried at a minimum depth of 3.5 feet. However, Carollo's Subsurface Utility Engineering (SUE) contractor, KCI Technologies (KCI), performed potholing excavation and determined that the existing force main was buried at a shallower depth in some instances, ranging from 1.3 to 2.0 feet. A portion of the existing force main also transitioned from ductile iron to PVC and back, indicating previous repair-work along a portion of the alignment. The City's maintenance crew has also indicated that a visual assessment of a portion of the existing force main exhibited cracks along its length.

1.2.3 Existing Site Power Feed from NV Energy

The BPS is powered by a NV Energy transformer immediately adjacent to the site. As NV Energy did not provide information on the existing transformer, the transformer rating was back-calculated to a rating of 200 amperes (amps). Like the pump station, the transformer is susceptible to flood damage as a result of its location in the lowest drainage point on the Symphony Park property. A backup generator with a 300-gallon fuel tank is also located on-site, and is also susceptible to flood damage.

1.2.4 Existing On-Site Electrification and Control Panels

Existing on-site pumps' control panel, main distribution panel, automatic transfer switch, circuit breaker, telephone cabinet, and flow meter panel are wall-mounted on the south and east inner walls. In addition to being susceptible to flood damage, there have been some observed code violations and housekeeping items of note:

- Programmable logic controller (PLC) cabinet has automotive style splicing which is in violation of current National Electrical Code (NEC) standards.

- Old equipment is being stored in the bottom of the PLC cabinet.
- No arc flash labels were present on any electrical enclosures, nor was there any record of an arc flash study performed at the site.

1.3 Condition Assessment Results

On June 7, 2017, Carollo conducted an on-site review of the BPS including evaluation of the above-ground site, the existing wet well structure, and the pump station equipment and operational characteristics. In August 2017, Carollo conducted a thorough condition assessment of the BPS, which is provided as a reference in Appendix C. The key findings of that assessment are summarized below:

- Due to the surrounding site grade, the BPS is the lowest drainage point on the Symphony Park parcel. Flooding of the site is a regular occurrence, and it is recommended that the site should be raised above the 100-year flood elevation as part of the proposed design. On-site earthen berms with k-rails have been erected in an attempt to divert flow out of the pump station.
- As a result of poor soil compaction during construction of the pump station, the walls and front gate of the pump station are leaning. Numerous cracks have been observed in the concrete pads and the walls adjacent to the wet well top. The settlement and cracking may be attributed to buoyancy forces acting on the wet well structure as a result of high groundwater levels.
- The pump station's electrical panels and equipment exhibit corrosion and are susceptible to damage from flood events. The equipment is also out of compliance with current NEC, as no record of any arc flash study could be located. In addition, arc flash labels were not present on the on-site equipment.
- The wet well structure itself appears to be in good condition with no visible corrosion or cracking. However, visible cracking was observed on the top and bottom of the wet well cover. A structural evaluation of the wet well determined the well was structurally deficient and would be unable to support additional loads from modifications of raising the wet well top slab elevation above the 100-year flood plain elevation, or from surcharge loads from current and future planned development adjacent to the site.
- The pumps within the wet well exhibited corrosion and pitting. The large capacity pumps showed extensive corrosion of the pump guide rails and pump impellers. At the time of the condition assessment, two of the large capacity pumps (Pump Nos. 4 and 5) were out of service and their motors removed. However, inspection of the two pumps in service, Pump Nos. 2 and 3, along with the pump volutes of the out-of-service pumps, revealed corrosion and pitting. Both in-service pumps also exhibited corrosion and pitting of the impeller, and were recommended for replacement. The pump motors and the pump guide rails also exhibited corrosion and pitting. In addition to exhibiting excessive corrosion, the Pump No. 3 guide rail was broken.
- Corrosion and pitting were observed on the pump motors, ball check valves, and the discharge piping for each pump. Above grade, the header discharge with flap gate and the groundwater discharge pipeline both exhibited signs of corrosion. The groundwater discharge pipeline was visibly leaking at the joints.

Based on these findings, it was determined that the pump station could not continue operation if site conditions were significantly altered. Given the anticipated nearby construction at Symphony Park, Carollo's recommendation, and ultimately the City's direction, was that the pump station should be demolished and replaced.

1.4 Discharge Permit and Contamination History

Groundwater pumped from the BPS is monitored by the City due to Nevada Division of Environmental Protection (NDEP) reportable levels of toluene and PCE, which is also known as tetrachloroethene or tetrachloroethylene. PCE is a regulated human hazard with possible carcinogenic properties after processing by the liver. It is also a precursor to the more hazardous and carcinogenic vinyl chloride. The EPA maximum contaminant level for PCE in drinking water is 5 micrograms per liter ($\mu\text{g/L}$), identical to the NDEP reportable concentration in groundwater.

From 2016 to 2019, the PCE concentrations in the Bonneville groundwater have varied with a high of 80 $\mu\text{g/L}$ in January 2016 to a non-detect result in July 2018. The most recent samples from October 2019 had a PCE concentration of 37 $\mu\text{g/L}$. Trichloroethylene (TCE), chloroform, and cis-1,2-dichloroethene (DCE) have also been recovered in samples from the pump well, but concentrations have been below the reportable limits from NDEP.

Dewatering of groundwater at the BPS was originally permitted under National Pollutant Discharge Elimination System (NPDES) permit NV0022748, which was granted in 1997, renewed in 2002, then again in 2007. During this time, groundwater was pumped by the 3-inch jockey pump and treated with granular activated carbon before discharging directly into the storm channel. On August 31, 2012, the groundwater treatment system was decommissioned, two sanitary sewer manholes were installed in the northeast corner of Promenade Place and Bonneville Avenue, and untreated groundwater was re-routed to discharge into the sanitary sewer system. The City currently holds a Class II Wastewater Control Permit MSC-0018, issued through City of Las Vegas Environmental Compliance. According to City staff, it is estimated that 15,000 gallons per day (gpd) are currently being discharged into the sanitary sewer. With continuous operation of two new proposed dewatering wells, each operating at 30 gpm, approximately 86,400 gpd will now be discharged to the City sewer system.

1.5 Adjacent Projects

Several active and future projects are planned for the Symphony Park development. The surcharge loads of these proposed developments, constructed adjacent to the BPS, will be much greater than what was originally accounted for in the structural design of the 1995 BPS, requiring an increase in structural strength for the new design. The following list of projects is based on public information and these surcharge loads have been considered in the structural integrity of our BPS design:

- 61 acre Master development at Symphony Park:
 - Parking garage development in two parcels at the site.
 - Two residential multi-family complexes:
 - Ashen Heights.
 - Southern Land.
 - Symphony Park Hotel and Conference Center.
 - Downtown Convention Center.

Discussion on the BPS wet well structural design is included in Section 6 of this report.

1.6 Risk Matrix

A draft risk matrix is provided below in Table 1. Highest risks are those which possess high probability of occurring and high severity if it were to occur. Some of the highest risks to the Project include lead time for design and construction of a new NV Energy transformer and bypass equipment failures during replacement of the BPS.

Table 1 Draft Risk Matrix

Desired Result: Provide operational stability to BPS. Complete successful project on time and under budget.					
Actions Critical to the Success of the Project	Risks Associated with Actions	Level of Risk			Risk Mitigation
		S	P	Risk Allocation	
1. Complete Project without disrupting BPS	1. Bypass equipment and/or piping could fail during construction.	H	L	Contractor	Provide redundancy in pumps/piping. Require full-time operator ahead of storm event.
	2. Existing pumps/motors may fail before replacement project begins.	H	M	City	Be proactive with pump maintenance.
	3. Flood water breach into Pump Station during construction/bypass.	M	L	Contractor	Contractor to confirm site is protected prior to any large monsoon event.
	4. Equipment/pipeline failures after start-up and commissioning.	M	L	Contractor	Pressure test pipeline. Witnessed pump testing. Use latest Carollo pump commissioning specification.
2. Meet Project Schedule and Budget	1. Lead times could be longer than expected.	M	L	City/Carollo	Stay current with latest global market trends.
	2. Change in market volatility or allowable budget.	H	L	City/Carollo	Pre-negotiated rate for high-priced items. Value engineering.
	3. NV Energy Transformer Replacement Design and Construction	H	M	City/Carollo	Coordination with NV Energy related to project status and schedule.
	4. Construct dewatering wells ahead of construction.	M	L	Contractor	Pre-negotiated rate for high-priced items. Value engineering.
	5. Design review times and select final scope items at 30%.	M	M	City	Progress meeting to follow design workshop. Meeting minutes to memorialize scope selections.
3. Equipment Failing To Meet Design Intent	1. Pump not meeting head and flow design points.	H	L	Contractor	Post-construction operational testing.
4. Safety for All Work Personnel	1. Injury during construction.	H	L	Contractor	Contractor to hold daily safety briefings. Be aware of electrical status.
Note: Abbreviations, Levels of Risk: S – Severity if event occurs. P – Probability of event occurring; H – high; M – medium; L – low.					

Section 2

SURVEYING

2.1 Surveying and Aerial Topography

Carollo has subcontracted Horizon Surveys (Horizon) for topographic surveying/mapping, site survey, on-site field surveys for existing site conditions, and record of survey. Horizon has performed a field survey to locate the position of monuments, utilities, and physical features pertinent to the project site, and reviewed existing records to determine the locations of existing right-of-ways and easements in accordance with the Nevada Administrative Code Minimum Standards of Practice for Professional Land Surveyors. Horizon provided topographic mapping with one-foot contour intervals and five-foot index contours for the BPS and the force main alignment.

A total of four storm drain catch basins, one storm drain manhole, nine sewer manholes, and three electrical boxes were surveyed. The Record of Survey is provided as part of the 30-percent drawings.

Section 3

GEOTECHNICAL EVALUATION, AQUIFER TESTING, AND GROUNDWATER WELL AND FORCE MAIN DESIGN

3.1 Geotechnical Evaluation and Proposed Groundwater Mitigation

A major issue at the project site is contaminated groundwater. Currently, the high groundwater level in the area creates enough pressure to force its way onto the Bonneville Avenue dip section through seam or cracks in the concrete roadway and adjacent retaining walls (Figure 3). The groundwater is then conveyed to the BPS wet well via the two storm water inlets at the low points of the Bonneville Avenue dip section. As the groundwater continually collects and rises in the wet well, the existing jockey pump within the wet well turns on, purging the groundwater to the City's sewer system. But when the jockey pump fails to operate, the groundwater level will continue to rise until the large storm water pumps turn on, discharging the contaminated groundwater to the adjacent stormwater channel and into surface waters untreated, which is an NDEP violation. Ninyo and Moore was contracted to perform four exploratory borings, installation of three piezometers for water quality testing analysis, and one pumping well for aquifer testing. The draft geotechnical report is provided in Appendix D.



Figure 3 Groundwater Seepage from the Bonneville Avenue Underpass

The draft Geotechnical Report states an approximate depth to groundwater of 16.5 feet below the surface elevation as measured from the finished grade adjacent to the existing BPS. To prevent further groundwater seepage into the Bonneville Avenue underpass and reduce construction costs of the new pump station, Broadbent was contracted to conduct an aquifer test and analysis at the pumping well, recommending a permanent dewatering system. Based on the results, two dewatering wells are proposed to draw down the groundwater to 3-feet or more below the lowest point on the Bonneville Avenue dip section. A detailed discussion of the aquifer testing is provided in Section 3.1.1. As large flows are expected to be pumped out of the site, provisions for settlement monitoring were also added to the design. The Contractor will be required to install this groundwater dewatering system as early construction milestone.

The dewatering technical memorandum by Broadbent, provided in Appendix E, assumes a maximum design flow of 30 gpm per dewatering well. Part of the dewatering well installation includes flowmeters to measure the totalized volume being pumped out of the project site. The choice of flowmeter is dependent on optimum flow velocity, which in turn will affect the pump discharge pipe diameter. Table 2 shows different flowmeters evaluated for the dewatering system design.

Table 2 Flowmeters Evaluated for Groundwater Dewatering System Design

FM Manufacturer	Model	Pipe Diameters Served (inches)	Velocity Range (fps)
Endress + Hauser	L / W with 400 Series Transmitter	1 – 90	0.3 - 33.0
	Promag H, 100 or 300 Series Transmitter	0.5 - 6	1.0 - 32.8
Emerson	Rosemount 8750W	0.5 - 48	0.04 - 39.0
Yokogawa	ADMAG AXF	0.1 - 16	0.15 - 10.0
ABB	Watermaster	0.375 - 96	N/A
McCrometer	Water Specialties	2 - 72	0.5 - 15.0
Zenner	ZTMB	1.5 - 8	0.54 - 29.0

Note:

Abbreviation: fps – feet per second.

The Zenner Bronze Turbine Meter Model ZTMB, in conjunction with Zenner VL-9M remote reader, is recommended. Assuming an operating velocity range of 1 to 10 feet per second (fps) to maintain laminar flow through the flowmeter, the pump discharge pipe diameter would range from 1.0 to 3.5 inches. To operate in the ideal range of several of the listed flowmeters, a velocity of 6 fps was selected, resulting in a force main diameter selection of 1-1/2 inches.

3.1.1 Aquifer Pumping Test Results

On May 21-23, 2019, Broadbent performed a 48-hour aquifer test at the Project site to obtain hydrologic data for the groundwater dewatering system well design. The draft hydrologic report is provided in Appendix E. Four wells were prepared for the aquifer test; information about depths and distances relative to the pump station are provided in Table 3 and are shown in Figure 4. All four wells were installed by Cascade Drilling two months prior to the aquifer test. Ninyo and Moore oversaw well drilling operations and logged the well lithology.

Table 3 Aquifer Test Well Information

Well ID	Diameter (in.)	Depth Below Ground Surface (ft)	Location
PW-1	4	51.5	Adjacent to PS west wall
PZ-1	2	51.5	9.5 ft from PW-1, near the PS
PZ-2	2	51.5	20.5 ft from PW-1, near the PS
PZ-3	2	51.5	162 ft from PW-1, in the Clark County Gov. Center parking lot

Note:

Abbreviations: PW-1 – pump well No. 1; in. – inch(es); ft – feet; PS – pump station; PZ – piezometer.



Figure 4 Location of Aquifer Pumping Test Wells

A Grundfos SPE pump was set in pump well No. 1 (PW-1) at a depth of 42 feet, and In-Situ LevelTroll 700 pressure transducers were installed in piezometers PZ-1, PZ-2 and PZ-3 to continuously record water levels during the aquifer test.

The target depth to groundwater for the test was three feet below the Bonneville Avenue underpass roadway, at elevation 2,007 feet. This depth was based on the required groundwater depth needed for a permanent dewatering system to prevent groundwater seepage onto the Bonneville Avenue underpass roadway. The lowest point of the roadway is at an elevation of 2,010.78 feet according to record drawings of the Project site. Other reference points included the elevation of the current pump station base of 2,030 feet, and the current groundwater level of 2,013 feet.

The aquifer test was performed in five stages, starting at a flow rate of 5 gpm for 8 hours. Once water levels stabilized, the pumping rate was incrementally increased to the maximum pumping rate of 23 gpm for 12 hours. The final pumping schedule was as follows:

1. 5 gpm - 8 hours.
2. 8 gpm - 8 hours.
3. 12 gpm - 8 hours.
4. 17 gpm - 8 hours.
5. 23 gpm - 12 hours.
6. Pump shut-off and aquifer recovery - 2 hours.

Following the aquifer test, the data was then analyzed and used to develop a numerical groundwater model to determine the optimal placement of the dewatering wells. The dewatering simulations included 90 days, 180 days, 270 days, 360 days, and three years of pumping from the site.

Based on the simulation results, the proposed dewatering system would consist of two pumping wells. The first well is recommended at the BPS site on the north side of Bonneville Avenue and the second well is recommended in the northeast corner of Clark County Government Center parking lot on the south side of Bonneville Avenue. Both wells will be contained in existing easements and will have a local readout of instantaneous and totalized flow available inside the electrical room. The wells will be installed to a depth of 15 feet below the target dewatering elevation, placing the elevation of the bottom of the wells at 1,998 feet. The target groundwater elevation of 2,007 feet was achieved following 180 days of simulated pumping (Figure 5).

CLV Bonneville Pump Station Replacement
 Broadbent Project No. 18-01-111-101
 180-Day Simulation

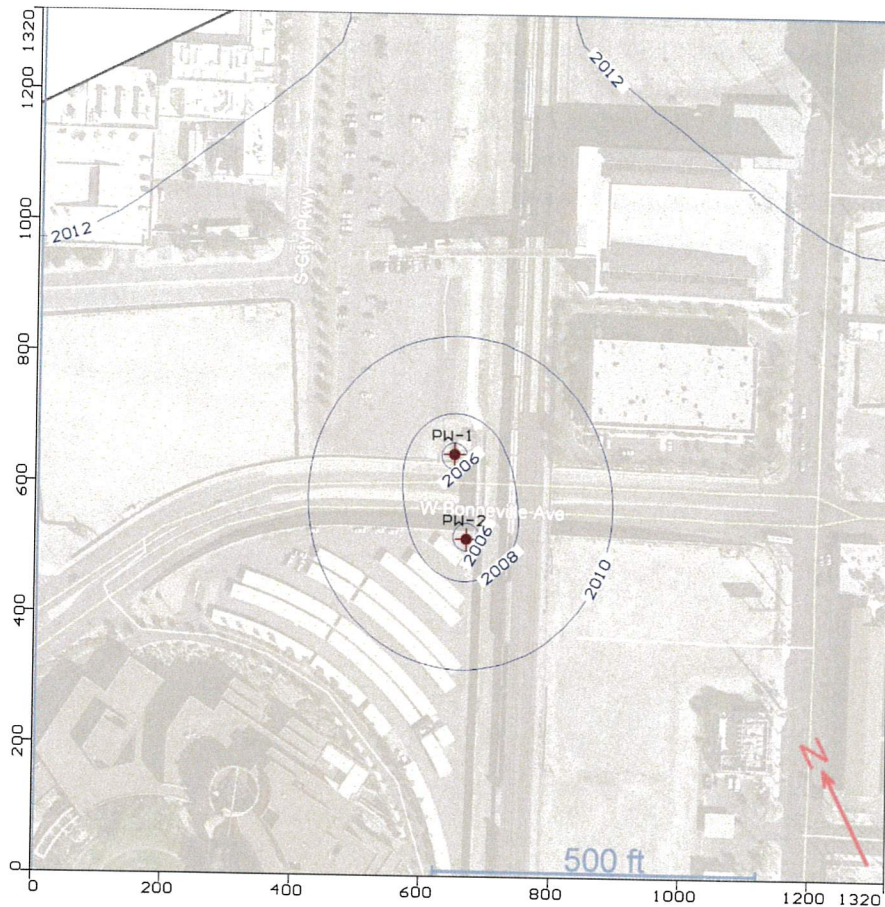


Figure 5 180-Day Groundwater Dewatering Simulation

3.1.2 Dewatering System Force Main

To achieve scouring velocities and to meet the recommended velocity range of the selected flow meter, a 1-1/2 inch diameter pipe is proposed from each dewatering well to its discharge location. The selection of a 1-1/2 inch diameter pipe results in a velocity of roughly 6 fps for a flow of 30 gpm. Given the required diameter of pipe, ductile iron cannot be selected as the minimum diameter of DIP is 3 inches. Alternative materials include PVC, chlorinated polyvinyl chloride (CPVC), high-density polyethylene (HDPE), fiber-reinforced plastic (FRP), Galvanized Steel, stainless steel (SST), and Copper. Upon review of pipe material compatibility with the potential contaminants on-site (namely, PCE and toluene), PVC, CPVC, HDPE, and FRP are also eliminated due to contaminant incompatibility. Table 4 shows pipeline material compatibility with PCE and toluene. Of the remaining materials, Carollo recommends copper pipe/tubing as it commonly used in the Valley at this size range in buried conditions. Copper tubing is available in a seamless 60-foot roll and allows for curved installations, as required by the existing roadway/right-of-way curvature of Bonneville Avenue and the adjacent property.

Design of the trench for force main installation largely follows the Clark County Uniform Standard Drawings for Public Work Construction for installation of underground pipe, with the key difference being that the work area is largely unpaved ground. The pipe will be buried in controlled low-strength material (CLSM) due to the shallow depth of installation (i.e. 2-feet). A typical trench detail is provided in the 30-percent drawings. Compression fittings, as approved in Las Vegas Valley Water District's (LVVWD's) Approved Products catalog, and two layers of 6 thousandths of an inch (mil) polyethylene encasement, per the Uniform Design and Construction Standards for Potable Water Systems (UDACS), will be included in the design documents.

Table 4 Pipe Material Compatibility Chart with PCE/Toluene

Metals							
	Carbon Steel ⁽¹⁾	Ductile Iron ⁽¹⁾	Stainless Steel 304 ⁽¹⁾	Stainless Steel 316 ⁽¹⁾	Cast Iron ⁽²⁾	Copper ⁽²⁾	Galvanized Steel ⁽³⁾
Toluene	A	A	A	A	A	A	A
PCE	A	A	A	B	A	B	A
Plastics and Other							
	CPVC ⁽²⁾	PTFE ⁽²⁾	PVC ⁽²⁾	LDPE ⁽²⁾	HDPE ⁽⁴⁾	Fiberglass Reinforces Polyester ⁽⁵⁾	
Toluene	D	A	D	C	U	U	
PCE	D	A	D	D	U	L	
Notes:							
Source		Rating					
(1)	Graco	A - Excellent					
(2)	Cole Parmer	B - Good					
(3)	Steven Engineering	C - Fair					
(4)	Thermofisher	D - Poor					
(5)	Champion Fiberglass	L - Less resistant, suitable for some conditions					
Abbreviations: LDPE - low-density polyethylene; PTFE – polytetrafluoroethylene.							

Section 4

BASIS OF DESIGN FLOWS

4.1 Proposed Design Flows

Carollo prepared a Drainage Design Project Memorandum dated September 9, 2019 which documented the review and analysis procedure that identified the new Bonneville stormwater design flow rate. The Drainage Design Memorandum was approved on October 8, 2019, by City flood control personnel and serves as the basis for the BPS design. This Drainage Design Project Memorandum is included in Appendix F.

Table 5 presents the total estimated flows to the pump station for each storm event and includes the breakout flows for both sides of the Bonneville Avenue dip section. The analysis was prepared using the Modified Rational Method per the Clark County Regional Flood Control District (CCRFCDD) Hydrologic Criteria and Drainage Manual. Figure 6 shows the analysis that Carollo performed to determine the flows contributing to the BPS.

Table 5 Hydraulic Basis for New Bonneville Pumping Station Flowrates

Side of Bonneville	Return Interval (years)	Rainfall Intensity (in/hr) ⁽¹⁾	Q (cfs) ^(2,3,4)	Break Out Flow (cfs) ⁽⁵⁾	Total Flow (cfs)
South Side of Street	2	1.80	1.1	0	1.1
	5	3.24	2.0	0	2.0
	10	4.20	2.5	1	3.5
	100	7.56	4.6	12	16.6
North Side of Street	2	1.80	1.3	0	1.3
	5	3.24	2.4	0	2.4
	10	4.20	3.1	1	4.1
	100	7.56	5.6	2	7.6
Total Flow to Pump Station, cfs	2				2.4
	5				4.4
	10				7.7
	100				24.2

Notes:

- (1) Rainfall intensity is based on the Time-Intensity-Frequency Values for McCarran Airport Rainfall Area as shown in Table 506 of the CCRFCDD manual. Values used assume a Time of Concentration of 5 minutes due to the small size of the drainage area.
- (2) Q = flow, $Q=KCiA$ for the Modified Rational Method, $K=0.50$ per CCRFCDD Hydrologic Criteria and Drainage Manual.
- (3) C is 0.93 since the entire drainage area is impervious.
- (4) The area (A) for the south side of the street is 1.30 acres and the area for the north side of the street is 1.6 acres.
- (5) Breakout flow is per Main-Commerce Final Drainage Design Report. Since the Main-Commerce design represents a 10-year event. No breakout is expected for lesser events.

Abbreviations: cfs – cubic feet per second; hr - hour.

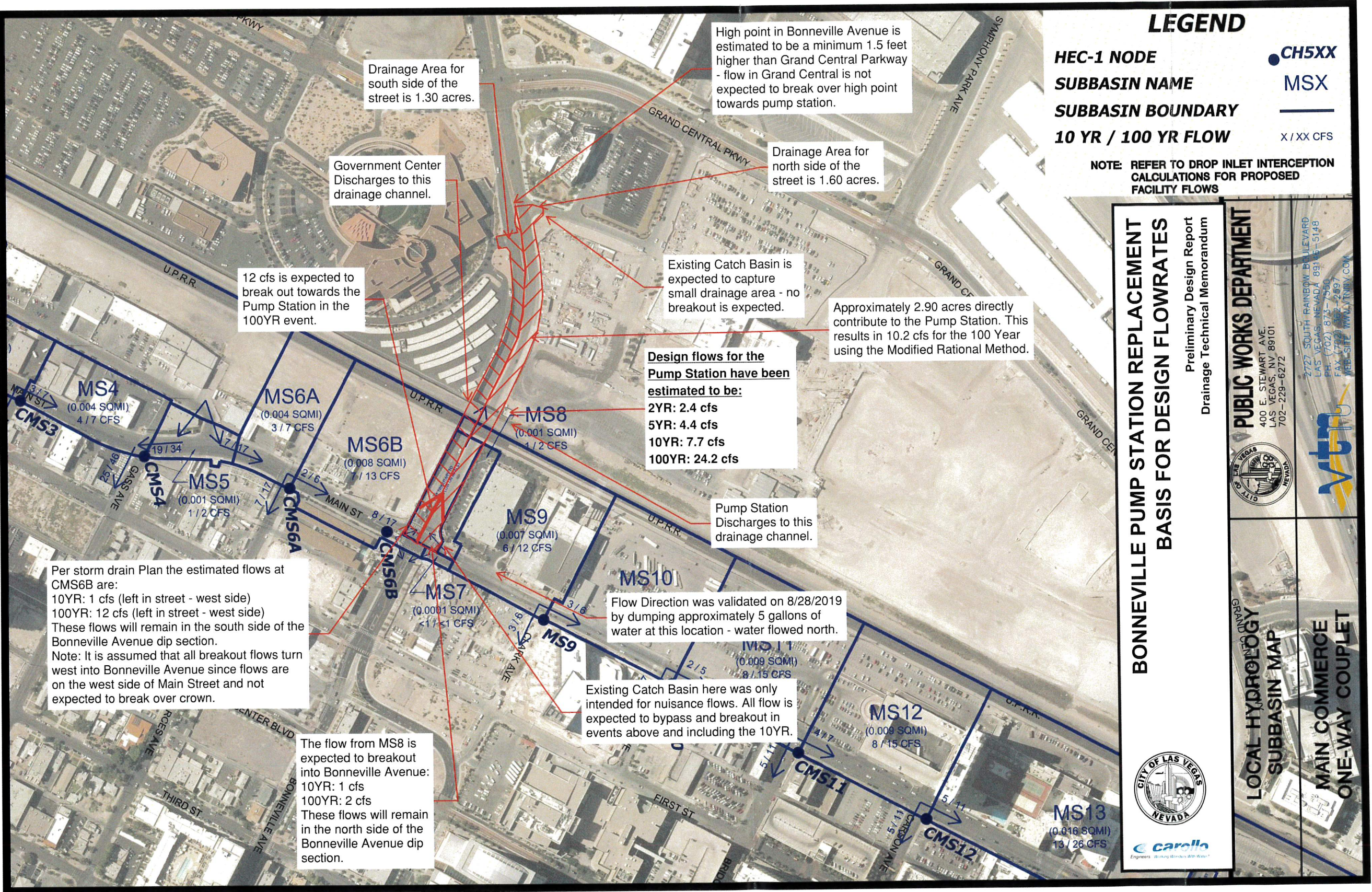


Figure 6 Stormwater Flows Contributing to the BPS

Section 5

MECHANICAL DESIGN AND ASSUMPTIONS

5.1 Mechanical Design Summary

The BPS will be designed to accommodate a flow range between a 1-year and 100-year flood events. Two small-capacity constant-speed submersible pumps operating in lead-lag configuration will provide pumping capacity up to the 2-year flood event. Three large capacity constant-speed submersible pumps operating in lead-lag-standby configuration will provide pumping capacity up to the 100-year flood event. The wet well will be designed as a self-cleaning wet well per Hydraulic Institute standards. A buried valve vault will contain a swing check valve, plug valve, air release valve, and high pressure switch. A davit crane will be used to remove pumps and valves for maintenance. Additional detail is provided in the following Sections.

5.2 Wet Well Design

The wet well will be designed to Hydraulic Institute standards which limits submerged and free surface vortices, limits entrained air or gas bubbles, and creates a self-cleaning wet well environment where solids are conveyed into the pump inlets. Flow from the two 24-inch inlet pipes will be directed towards an energy baffle and then sloped towards the pump inlets in such a way that the flow reaches the inlets with minimum turbulence.

5.3 Solids Removal

Trash racks and bar rack screens were considered, but ultimately ruled out due to the depth of solids extraction. At greater than roughly 28-feet of depth, a vacuum-truck is incapable of pulling adequate suction to retrieve debris from the wet well. Given this constraint, it is recommended to routinely clean and maintain the grating at the catch basins in the Bonneville Avenue underpass to avoid accumulation of large debris.

5.4 Stormwater Pump Design and Hydraulics

System curves for the stormwater pumping system were modeled using Darcy-Weisbach and industry-standard minor loss coefficients. A system curve was developed assuming both a full wet well and an empty wet well. Drawings MM02 and MM03 in the 30-percent drawings were used to identify quantities of pipe, valves, and appurtenances.

Carollo evaluated solids handling pump selections from Flygt, Wilo, and KBS. All three manufacturers' pump curves were plotted against the project-specific system curves. Preliminary pump selections and dimensional data of Flygt N-Impeller Model No. NP-3202 (60 horsepower [hp]) and NP-3127 (7.5 hp) are provided in Appendix G.

Figures 7 and 8 present the Large and Small Pump Analysis and Pump Selections, respectively.

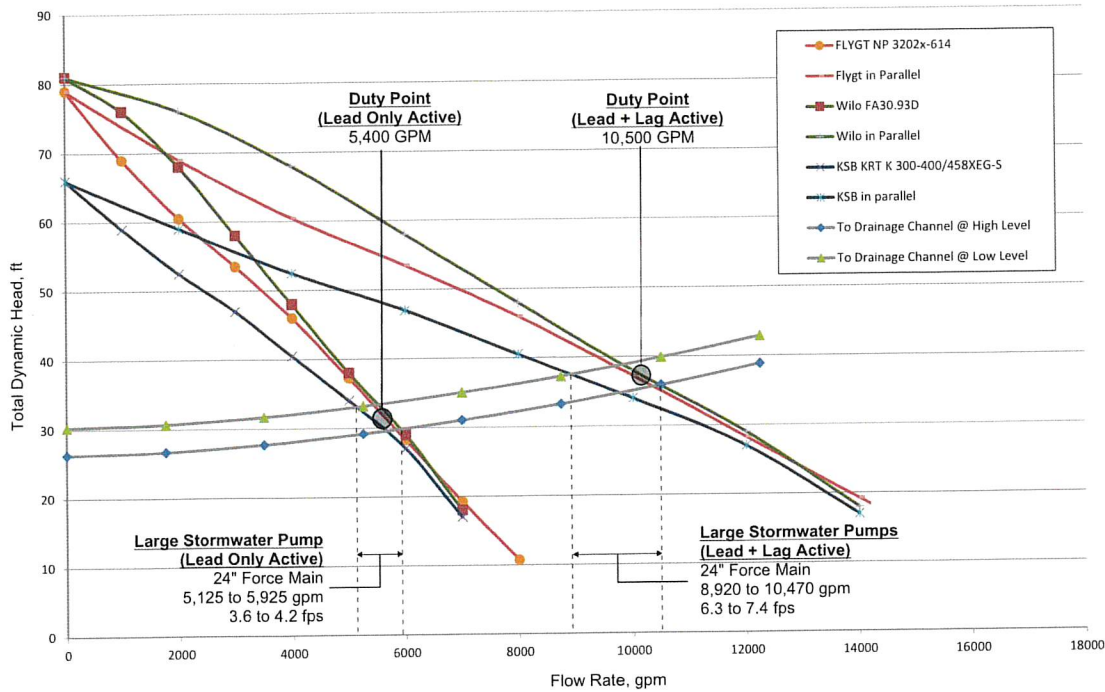


Figure 7 Large Pump Curve Analysis and Pump Selection

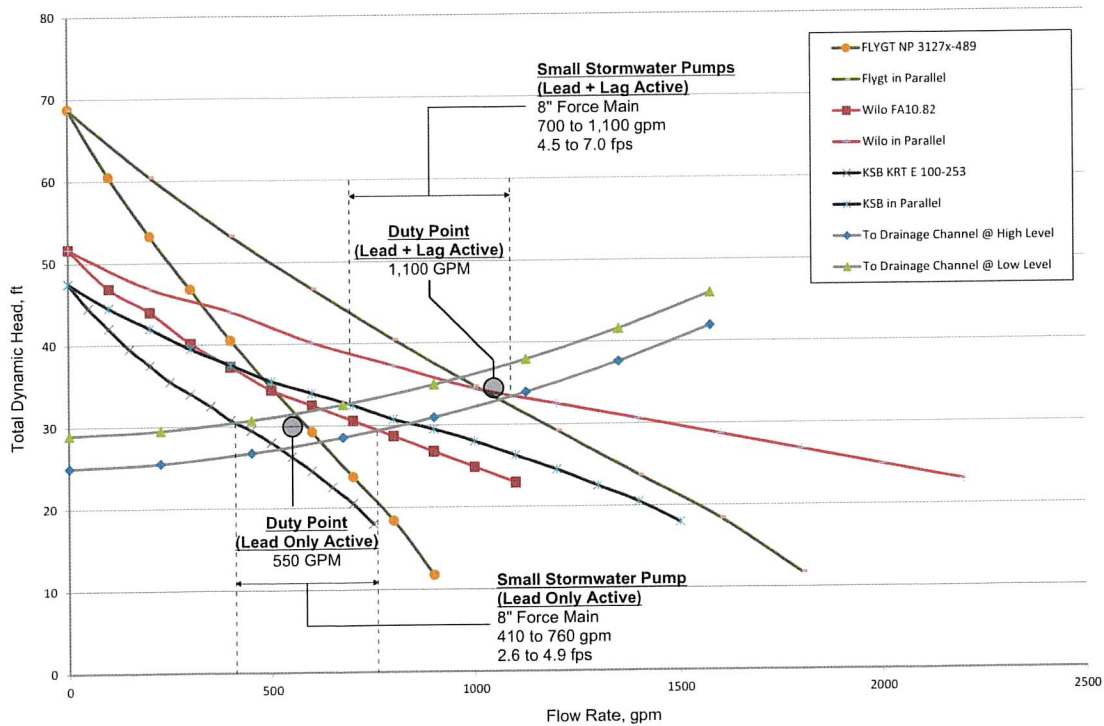


Figure 8 Small Pump Curve Analysis and Pump Selection

Results of the analysis show that operational flowrange for a single large pump is 5,125 to 5,925 gpm (empty to full wet well, respectively) while the operational flowrange for two large pumps operating in parallel is 8,920 to 10,470 gpm. The operational flowrange for a single small

pump is 410 to 760 gpm while the operational flowrange for two small pumps operating in parallel is 700 to 1,100 gpm. These flow ranges are wide due to the variance of manufacturers. KSB's proposed selections are unable to meet the required flowrates at the system conditions and will therefore have their submittals rejected if unable to meet the duty design points identified in the project specifications.

In summary, the stormwater pumping operation will consist of the following:

- **Two small-capacity constant-speed submersible pumps.** The small-capacity pumps will operate in a lead/lag configuration to handle the 2-year flood event and less. Each pump will be rated for 550 gpm. Together, both pumps can handle the anticipated 2.4 cfs flowrate associated with the 2-year flood event as presented in Section 4.1:
 - In order to reduce site footprint, a standby pump will not be provided in the wet well. A shelf-spares will be provided and kept on-site to facilitate a quick replacement.
 - The two small-capacity pumps will discharge into an independent 8-inch diameter discharge line tied into the adjacent storm channel with a flap gate.
 - At the end of each pump run, the designated "duty" will cycle so that each pump receives equal run times.
 - Velocities in the 8-inch diameter discharge header will be 7.0 feet per second at the maximum flow condition, when both pumps are in operation.
 - Pressure switches will be provided upstream of each pump check valve to protect the pumps in case of a closed valve.
 - A descriptive sequence of pumping operations is provided in Section 7.
- **Three large-capacity constant-speed submersible pumps.** The large-capacity pumps will operate in a lead/lag/standby configuration to accommodate the 100-year flood event. Each individual pump will be capable of approximately 5,400 gpm. When the lead and lag pumps operate in parallel, they will be capable of handling the 24.2 cfs flowrate associated with the 100-year flood event:
 - Given the criticality of the large-capacity pumps, a third pump will be installed in the wet well as a redundant pump.
 - At the end of each pump run, the designated "duty" will cycle so that each pump receives equal run times.
 - The two large-capacity pumps will discharge into a single 24-inch diameter discharge header tied into the adjacent storm channel with a flap gate.
 - At maximum flow conditions, when both pumps are operating, velocities in the 24-inch diameter discharge header are estimated at 7.4 feet per second.
- Swing check valve, plug valves, and air release valves will be provided in a valve vault.
- Pressure switches will be provided upstream of each pump check valve to protect the pumps in case of a closed valve.
- A descriptive sequence of pumping operations is provided in Section 7.

5.4.1 Valving and Appurtenances Vault

Given the depth of the wet well, diameter of the discharge piping, and requirement for routine maintenance and access of the valves and appurtenances, Carollo recommends placing the swing check valve, plug isolation valves, air release valves, and pressure switches in a buried vault.

A portable 3-ton davit crane will be provided to facilitate removal of the pumps and valves. Floor sleeves will be cast into the concrete between all five pumps and respective valves, enabling the portable davit crane to be moved from pump-to-pump. The minimum reach of the 3-ton davit crane is 42-inches and the maximum reach is 153-inches.

5.5 Bypass Pumping During Construction

One critical aspect of this project during construction of the BPS is a safe and reliable stormwater bypass system. Carollo anticipates three independent bypass systems to convey flow from the two stormwater catch basins on the north and south side of the Bonneville Avenue dip section, and the overchute channel adjacent to the BPS.

The bypass system will incorporate 100 percent redundancy for pumps and will be tested prior to shutdown of the BPS for work. The contractors bypass plan will also include, but is not limited to the following elements:

- Drawings indicating the scheme and location of pumps, suction location/manhole, suction piping, discharge location, discharge piping, temporary pipe plugs, flow diversion structures, dams, and related materials and equipment for each of the bypass pumping site.
- Vehicular and pedestrian access to public and private facilities shall be coordinated with the traffic control plan. The traffic control plan shall show how vehicles and pedestrians will be protected from injury resulting from bypass operations.
- Capacities and sizes of pumps, standby equipment, and power requirements if applicable.
- Key operational control factors, (i.e., maximum flow elevations at the overchute channel adjacent to the BPS).
- Design calculations sealed and signed by a Professional Engineer in Nevada proving adequacy of the system and selected equipment, including static lift, friction losses, fitting losses, flow velocity, pump curves identifying operating range, and pipe thickness calculations. Pipe thicknesses calculations shall assume an H-20 live loading at crossings.
- Sewer plugging method and type of plug.
- Method of noise control for each pump and generator.
- Site layout showing all major components.
- Wet weather event procedures.
- Staffing plan, including names for bypass pumping operators.

Section 6

STRUCTURAL DESIGN AND ASSUMPTIONS

6.1 Structural Design Summary

The new wet well design will incorporate a rectangular configuration. It was assumed that the soil case would control the design due to the large surcharges associated with the adjacent Symphony Park development, and because it is not possible for water to completely fill the pump station. Soil pressures are presented in the Geotechnical Report located in Appendix D. Since the top of the pump station is supported by a slab, “at-rest” pressures were assumed.

6.2 Basis for Structural Design

A major consideration for the replacement pump station is a design that could accommodate future development around the BPS site. In preparing the preliminary design for the pump station wet well, future development was simulated by adding a surcharge load of 2,000 psf. This loading scenario was selected to accommodate potential structures near the site, such as high-rise buildings or large parking structures.

A conservative load factor of 1.7 was applied to all loads, rather than the 1.6 required, to provide additional flexibility in accommodating the load variability of future structures. In summary, shear controlled the wall thicknesses while reinforcing was added to resist anticipated moments. Table 6 summarizes the material parameters in the Structural Calculations included in Appendix H.

Table 6 Pump Station Wet Well Structural Design Parameters

Material	Design Value
Concrete	4,500 psi
Reinforcing	60,000 psi

Note:

Abbreviation: psi – pounds per square inch.

6.3 Self-Cleaning Wet Well Arrangement

The new wet well will be designed according to the latest Hydraulic Institute guidelines; namely, a confined, self-cleaning wet well style design with inlet energy dissipation, one-to-one inlet slope, and individually confined pumping zones. This wet well arrangement isolates the pumps from any flow disturbances that might be generated by adjacent pumps and minimizes the accumulation of solids.

Section 7

ELECTRICAL, INSTRUMENTATION, AND CONTROLS DESIGN AND ASSUMPTIONS

7.1 Electrical, Instrumentation, and Controls Upgrade

7.1.1 Electrical Design Summary

The existing pump station is served by a 150 kilovolt-ampere (kVA) utility transformer connected to a 225-amp distribution panel through a 225-amp automatic transfer switch (ATS). The ATS is also connected to a 150 kilowatt (kW), 480Y/277 volt (V), 3 phase, 4 watt (W) standby generator. The existing electrical equipment is approximately 25 years old and has reached the end of its useful life.

Due to the spatial expansion and increasing power requirements of the wet well, a new pad-mounted utility transformer will be provided by NV Energy with an adjacent utility meter pedestal. A new prefabricated electrical enclosure will house all the new electrical equipment installed for the pump station.

The new pump station loads are summarized in Table 7. A new 175 kW standby generator, automatic transfer switch, and motor control center (MCC) will be installed to run all the loads at the pump station.

Table 7 New Electrical Loads

Name	State	Load	Load (kVA)
P-001 - Large Stormwater Pump No. 1	DUTY	60 hp	
P-002 - Large Stormwater Pump No. 2	DUTY	60 hp	
P-003 - Large Stormwater Pump No. 3	STANDBY	60 hp	
P-011 - Small Stormwater Pump No. 1	DUTY	7.5 hp	
P-012 - Small Stormwater Pump No. 2	DUTY	7.5 hp	
P-021 - North Dewatering Well Pump	DUTY	2 hp	
P-022 - South Dewatering Well Pump	DUTY	2 hp	
BCR-030 - Crane Hoist Motor	DUTY	7 amp	
XFMR-1	DUTY	30 kVA	
Total Load		160 KVA	

7.1.2 Instrumentation and Control Design Summary

The new PLC-based control panel will adhere to the "Hardware Design Standard" of the City's Water Pollution Control Facility (WPCF) and be located in the new electrical enclosure near the MCC.

The new control panel will house a Schneider Modicon M340 PLC system with the appropriate communication (Ethernet TCP/IP) and Input/Output (I/O) modules to control the pumps and monitor the instrumentation. In the MCC, the motor starters will have smart controllers that will utilize the Ethernet TCP/IP (Modbus /TCP) communications protocol to communicate with the M340 PLC.

The front of the control panel will have a Schneider Magelis Operator Interface Terminal (OIT) touch screen to display instrument values as well as recent trends. The level setpoints that control and protect the pumps will be adjustable on the OIT screen with the appropriate security protection. Instruments will be hard-wired to PLC I/O modules and control will be available from either the OIT or the Start/Stop devices on the front of the MCC.

In addition to controlling the pump equipment, the PLC will control and operate two strobe lamps (red and green) on the outside of the electrical enclosure. The lights will allow the City to remotely monitor the status of the facility.

Automatic control of the stormwater pumps will be available through PLC logic based on the basin level transmitter (LIT-011). In the event of stormwater flow, one small capacity pump will engage first, and as the level rises the second small capacity pump will start. If the water level drops to a pre-determined stop elevation, both pumps will turn off. However, should water levels continue to rise, the two small capacity pumps will stop and one large capacity pump will engage.

With one large pump operating, should the water level drop, the pump will stop. If the level continues to rise, a second large capacity pump will start. The large capacity pumps will operate in a lead/lag/standby configuration until the water level in the wet well decreases to the programmed stop level. The start/stop set points will be adjustable at the OIT with the appropriate security clearance.

The two dewatering pumps will be automatically controlled in a similar manner to the wet well pumps using submersible level transmitters contained in each respective well. Flow measurement from each of the dewatering wells will be transmitted to a local readout in the electrical enclosure at the BPS.

In the event of a failure of the automatic system (the PLC or the level transmitter), float switches will serve as a hard-wired emergency backup to start/stop the stormwater pumps without the PLC.

Section 8

UTILITY CONFLICTS AND ISSUES

8.1 Subsurface Utility Engineering Review

Pothole data for the existing force main, as well as other existing utilities at locations of anticipated crossings, are included in Appendix I. This SUE data, along with utility verification through as-builts and agency reviews, has been reviewed and incorporated into the Design Documents.

8.2 Utility Conflicts North of Bonneville Ave and Easement Requirements

Based on review of the SUE data, a significant utility challenge anticipated at the site is the electrical utilities, including the existing NV Energy transformer adjacent to the site. Refer to Drawings CI01 and DM01 in the 30-percent Drawings. Removal of the pump station requires removal of the existing transformer and its associated concrete pad. In addition, the replacement transformer will need to be upsized to accommodate additional electrical load requirements from the groundwater dewatering wells to be constructed with the replacement pump station, per Section 7.1. In order to remain within the 60-foot permanent drainage easement (as measured from the UPRR property line westward), the new NV Energy transformer will be located to north of the site per Drawing CI03 in the 30-percent Drawings. Alternatively, the City could elect to procure an additional easement in order to locate the new NV Energy transformer near the current transformer location. Carollo recommends placing the new transformer north of the site, since that is where the new electrical enclosure and generator are being proposed. Refer to Drawing CI03 in the 30-percent Drawings.

The existing 4-inch diameter PVC / DIP force main is located directly above an existing electrical duct bank, and is also routed below an existing electrical pad on the north side of Bonneville Avenue near Promenade Place. The existing permanent utility easement is 5 feet from the existing property line. The replacement 1-1/2-inch diameter copper force main needs to be routed around the existing electrical pad, which is greater than 10 feet in width. Re-routing the replacement 1-1/2-inch diameter force main around the existing electrical pad requires additional width to the existing permanent utility easement. Figure 9 identifies these additional easement requirements.

8.3 Utility Conflicts South of Bonneville Avenue

For the new dewatering well on the south side of Bonneville Avenue at the Clark County Government Center, a new 60-inch manhole is required to be installed on top of an existing 21-inch sanitary sewer. The 1.5-inch diameter dewatering well discharge pipe and manhole can be contained within the existing City utility easement on County property; however, the width of the manhole creates a utility conflict with four 1-inch street lighting conduits. These conduits will need to be slightly relocated as part of this design.

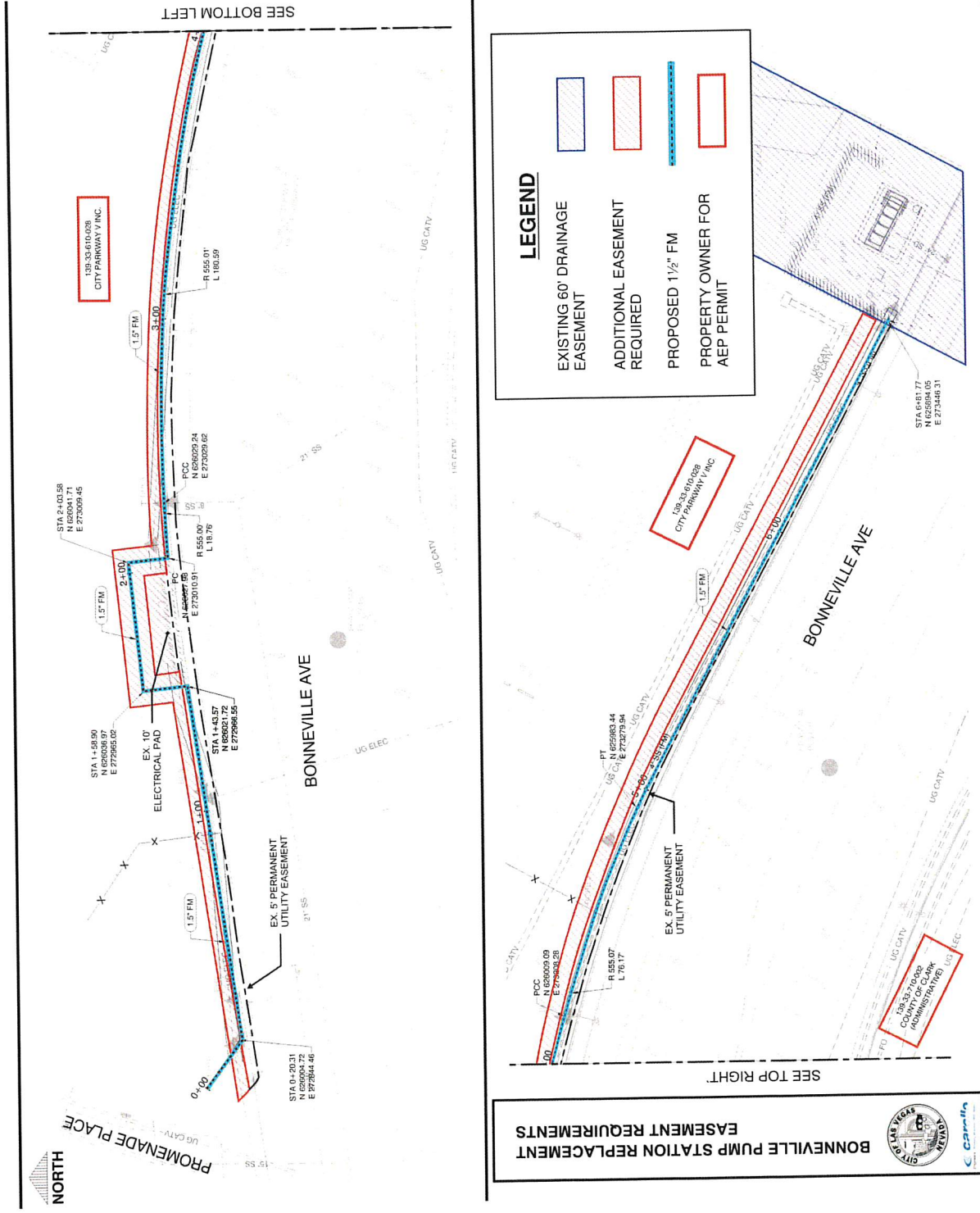


Figure 9
Locations of New Easement Requirements

Section 9

SPECIAL PROVISIONS

9.1 Project Specifications

A preliminary list of project specifications is provided in Appendix J. The first half of the list contains City's Special Provisions and the second half are Carollo Supplemental Specifications.

Given that the City has adopted the Clark County Uniform Standard Specification for Public Work Construction, Carollo will use these standard specifications where applicable. Any modification to a standard specification or missing technical specification will be supplemented using special provisions. For example, Carollo will provide the Submersible Stormwater Pump specification (Carollo Section 43_25_13.31) while using the City's Bypass Pumping specification (City Special Provision Section 695) which defines the City's traffic control, submittal requirements, and other City-specific requirements.

Section 10

PERMITTING REQUIREMENTS

10.1 Project Permits

Required project permits and reviews are presented in the matrix in Appendix K. There are twelve authorities having jurisdiction for the work in Symphony Park, the Clark County Government Center parking lot, and Public Right-of-Way. Carollo anticipates coordination and submittal efforts for a total of 18 permits.

Section 11

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

11.1 30-Percent Opinion of Probable Construction Cost

The 30-percent Opinion of Probable Construction Cost included in Appendix L is based on standard methodologies and best practices as prescribed by the AACE International Cost Estimating Committee. According to AACE International, a Class III estimate is generally prepared to form the basis for budget authorization, appropriation, and/or funding. Typical accuracy ranges for Class III estimates are -20 percent on the low side to +30 percent on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

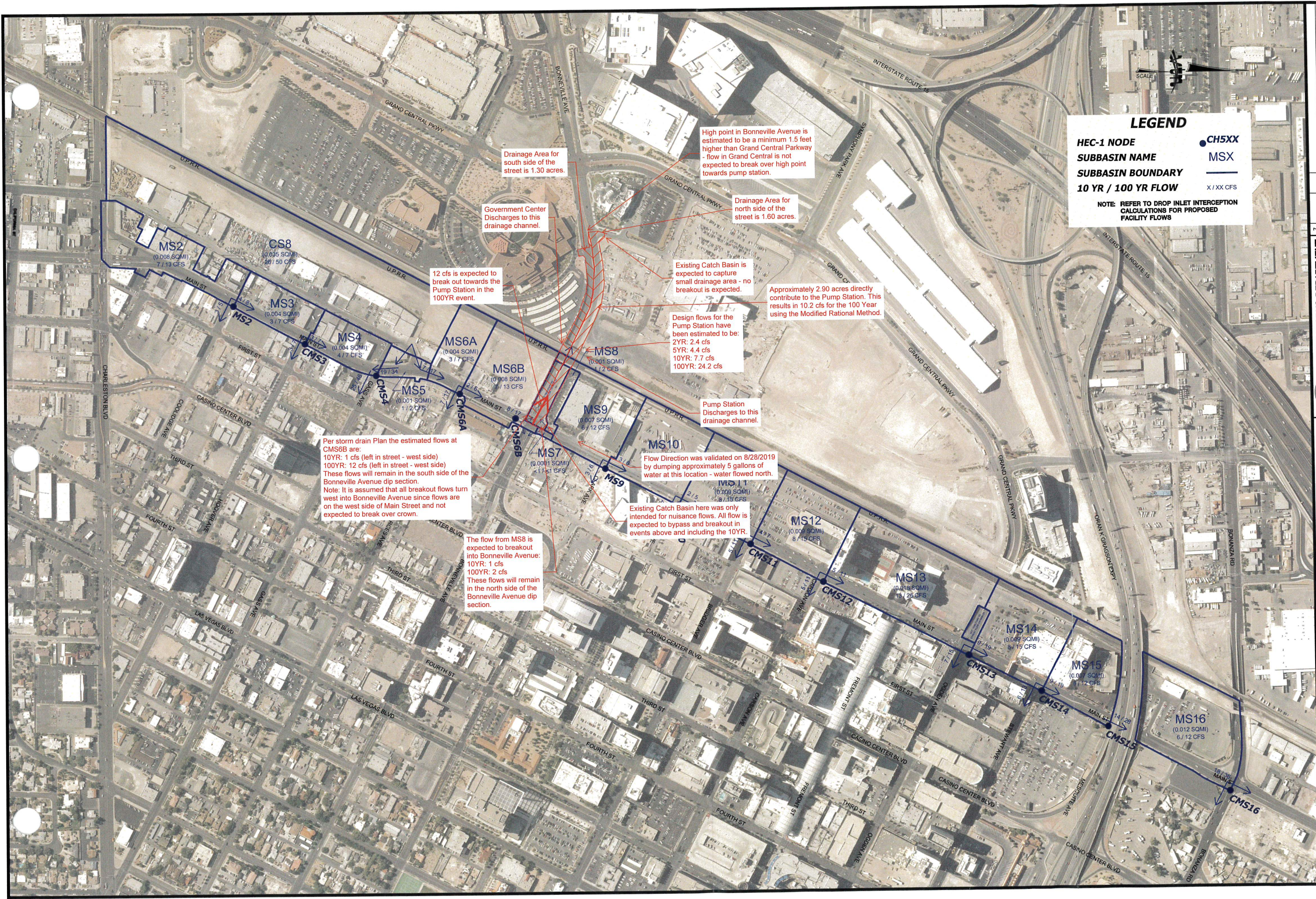
A Class III cost estimate for the Project is \$4.3 million (M) (with an estimated range of \$3.4M to \$5.6M).

In the 2017 Condition Assessment (Appendix C), a Class V cost estimate developed a cost range between \$1.1M and \$4.4M with \$2.2M as the estimated cost to replace the BPS in-kind. In addition to the detailed quantity takeoffs in a Class III versus Class V cost estimate, the following factors contributed to the increased estimated cost:

1. Proposed stormwater design flowrates for the BPS increased significantly from the original design, as documented in Appendix F.
2. Wet well wall thickness increased compared to existing structure size due to existing structural deficiencies as documented in Appendix C and anticipated future adjacent loading as calculated in Appendix H.
3. Stormwater discharge piping diameters, footprint of proposed stormwater pumps, and wet well interior dimensions increased, due to the increased pumping capacity.
4. Addition of a set of vaults to house the pump check valve and isolation valve for ease of operation and maintenance.
5. Electrical load and equipment (transformer, motor control center, and generator) increased in size due to the larger design flowrate.
6. An electrical enclosure with climate-control is recommended to prolong useful life of electrical elements.

Appendix A

30-PERCENT DESIGN DRAWINGS



LEGEND

HEC-1 NODE

SUBBASIN NAME

SUBBASIN BOUNDARY

10 YR / 100 YR FLOW

CH5XX

MSX

X / XX CFS

NOTE: REFER TO DROP INLET INTERCEPTION CALCULATIONS FOR PROPOSED FACILITY FLOWS

7

6

5

4

3

2

1

REV

DATE

BY

LOCAL HYDROLOGY

SUBBASIN MAP

MAIN COMMERCE

ONE-WAY COUPLET

DRAWN BY:

NAME

DATE

DESIGNED BY:

LKL

DATE

CHECKED BY:

NAME

DATE

PROJECT NO:

7318

SCALE: HORIZ 1"=250'

VERT. 1"=2'

PROFESSIONAL ENGINEER-STATE OF NEVADA

LANT K. LEAVITT

EXP. 2/31/18

CIVIL

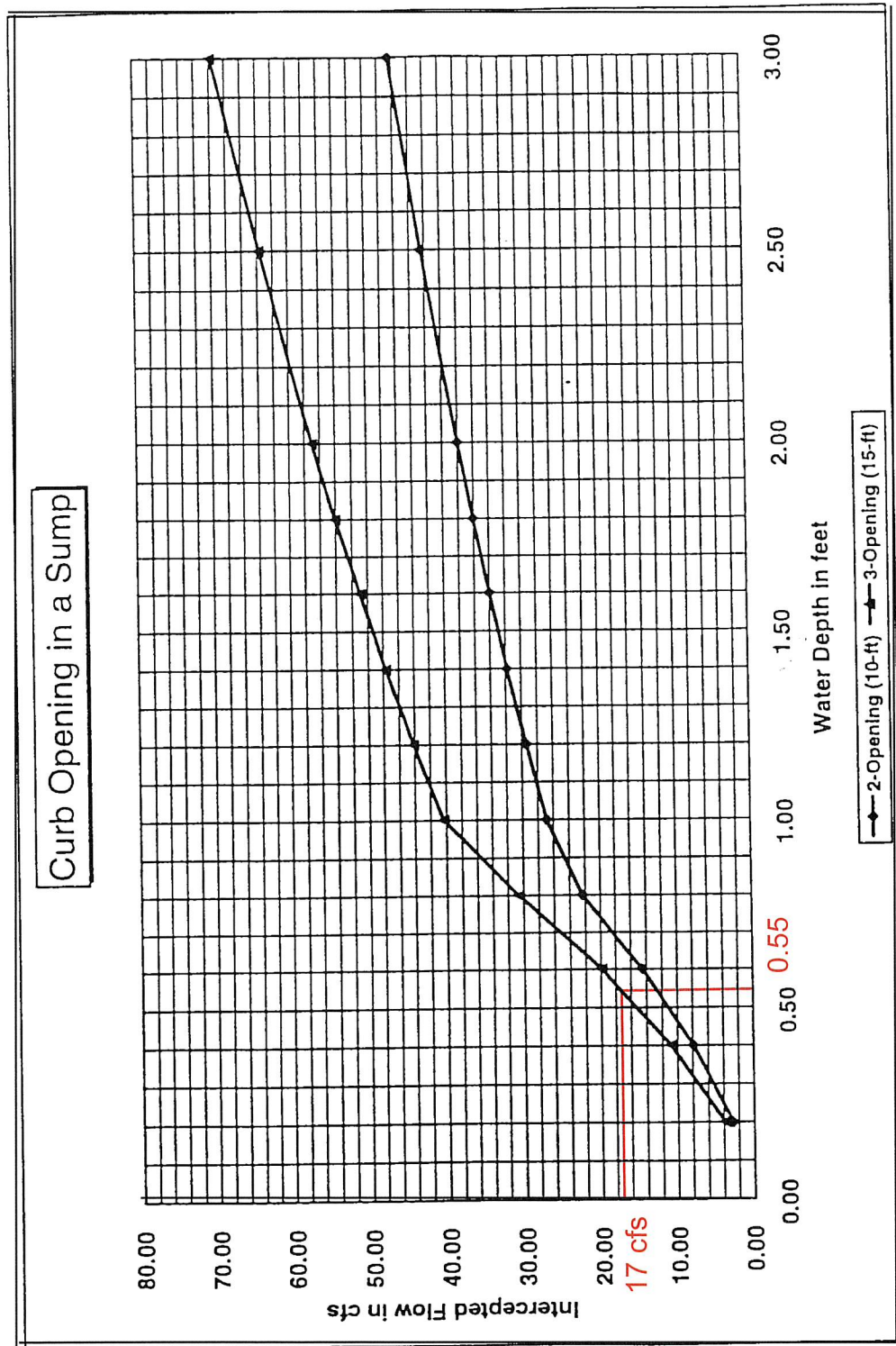
No. 18287

FIGURE 4

PUBLIC WORKS DEPARTMENT

400 E. STEWART AVE
LAS VEGAS, NV 89101
702-259-6272

2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NV 89146-5148
PHONE (702) 873-7550
FAX (702) 362-2597
WEB SITE WWW.VTNV.COM



Where: $Q_i = 2.30 (L_c + 1.8 w_g) (Y_s + Y)^{1.5}$

Q_i = Ideal inlet capacity
 L_c = Length of the curb opening inlet in ft
 w_g = Lateral width of depression in ft

Y_s = Sump depth in addition to flow depth in ft
 Y = Gutter flow depth in ft

REFERENCE:

Revision	Date

FIGURE 813

				TIME	3.58	LP100SD3.OUT 3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CMS4	.02	1	FLOW TIME	10. 3.58	10. 3.58	9. 3.58	9. 3.58	9. 3.58	9. 3.58	9. 3.58	9. 3.58	9. 3.58
HYDROGRAPH AT													
+	CS8	.04	1	FLOW TIME	50. 3.67	49. 3.67	48. 3.67	46. 3.67	46. 3.67	45. 3.67	45. 3.67	45. 3.67	44. 3.67
DIVERSION TO													
+	DCOMMSD	.04	1	FLOW TIME	5. 2.50	5. 3.17	5. 3.17	5. 3.17	5. 3.17	5. 3.17	5. 3.17	5. 3.17	5. 3.17
HYDROGRAPH AT													
+	DCOMMSD	.04	1	FLOW TIME	45. 3.67	44. 3.67	43. 3.67	41. 3.67	41. 3.67	40. 3.67	40. 3.67	40. 3.67	39. 3.67
HYDROGRAPH AT													
+	MS5	.00	1	FLOW TIME	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58
2 COMBINED AT													
+	CMS5	.04	1	FLOW TIME	46. 3.67	46. 3.67	44. 3.67	43. 3.67	42. 3.67	42. 3.67	41. 3.67	41. 3.67	40. 3.67
DIVERSION TO													
+	DCOMMN	.04	1	FLOW TIME	15. 3.67	14. 3.67	13. 3.67	12. 3.67	12. 3.67	12. 3.67	12. 3.67	11. 3.67	11. 3.67
HYDROGRAPH AT													
+	DCOMMS	.04	1	FLOW TIME	32. 3.67	31. 3.67	31. 3.67	30. 3.67	30. 3.67	30. 3.67	30. 3.67	29. 3.67	29. 3.67
2 COMBINED AT													
+	CGASS	.05	1	FLOW TIME	41. 3.58	40. 3.58	39. 3.58	38. 3.58	38. 3.67	38. 3.67	37. 3.67	37. 3.67	37. 3.67
DIVERSION TO													
+	DGASSSD	.05	1	FLOW TIME	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50	9. 3.50
HYDROGRAPH AT													
+	DGASSSD	.05	1	FLOW TIME	32. 3.58	31. 3.58	30. 3.58	29. 3.58	29. 3.67	29. 3.67	28. 3.67	28. 3.67	28. 3.67
HYDROGRAPH AT													
+	DCOMMN	.00	1	FLOW TIME	15. 3.67	14. 3.67	13. 3.67	12. 3.67	12. 3.67	12. 3.67	12. 3.67	11. 3.67	11. 3.67
ROUTED TO													
+	RDCOMMN	.00	1	FLOW TIME	14. 3.67	14. 3.67	13. 3.67	12. 3.67	12. 3.67	11. 3.67	11. 3.67	11. 3.67	11. 3.67
HYDROGRAPH AT													
+	MS6A	.00	1	FLOW TIME	7. 3.58	7. 3.58	6. 3.58	6. 3.58	6. 3.58	6. 3.58	6. 3.58	6. 3.58	6. 3.58
2 COMBINED AT													
+	CMS6A	.00	1	FLOW TIME	20. 3.67	19. 3.67	18. 3.67	17. 3.67	17. 3.67	16. 3.67	16. 3.67	16. 3.67	16. 3.67
DIVERSION TO													
+	DGARCS	.00	1	FLOW TIME	3. 3.67	3. 3.67	3. 3.67	3. 3.67	3. 3.67	3. 3.67	3. 3.67	3. 3.67	3. 3.67
HYDROGRAPH AT													
+	DGARCS	.00	1	FLOW TIME	16. 3.67	16. 3.67	15. 3.67	14. 3.67	14. 3.67	14. 3.67	14. 3.67	13. 3.67	13. 3.67
DIVERSION TO													
+	DGARCE	.00	1	FLOW TIME	5. 3.67	5. 3.67	4. 3.67	4. 3.67	4. 3.67	4. 3.67	4. 3.67	4. 3.67	4. 3.67
HYDROGRAPH AT													
+	DGARN	.00	1	FLOW TIME	11. 3.67	11. 3.67	10. 3.67	10. 3.67	10. 3.67	10. 3.67	9. 3.67	9. 3.67	9. 3.67
ROUTED TO													
+	RGARN	.00	1	FLOW TIME	11. 3.75	11. 3.75	10. 3.75	10. 3.75	9. 3.75	9. 3.75	9. 3.75	9. 3.75	9. 3.75
HYDROGRAPH AT													
+	MS6B	.01	1	FLOW TIME	13. 3.58	13. 3.58	13. 3.58	12. 3.58	12. 3.58	12. 3.58	12. 3.58	12. 3.58	12. 3.58
2 COMBINED AT													
+	CMS6B	.01	1	FLOW TIME	21. 3.67	21. 3.67	20. 3.67	19. 3.67	19. 3.67	19. 3.67	18. 3.67	18. 3.67	18. 3.67
DIVERSION TO													
+	DBONNSD	.01	1	FLOW TIME	9. 3.67	9. 3.67	9. 3.67	9. 3.67	9. 3.67	9. 3.67	9. 3.67	9. 3.67	8. 3.67
HYDROGRAPH AT													
+	DBONNSD	.01	1	FLOW TIME	12. 3.67	11. 3.67	11. 3.67	10. 3.67	10. 3.67	10. 3.67	10. 3.67	10. 3.67	10. 3.67
HYDROGRAPH AT													
+	MS7	.00	1	FLOW TIME	0. 3.50	0. 3.50	0. 3.50	0. 3.50	0. 3.50	0. 3.50	0. 3.50	0. 3.50	0. 3.50
HYDROGRAPH AT													
+	MS8	.00	1	FLOW TIME	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58	2. 3.58

Flow left in Main St in 100-year event.
This flow breaks out into Bonneville Ave.

+ 3.	MS6A	.00	1	FLOW	3.	3.	3.	3.	3.	3.	3.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3.58												
+ 2 COMBINED AT	CMS6A	.00	1	FLOW	8.	8.	7.	7.	7.	7.	7.	7.
+ 7.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ DIVERSION TO	DGARCSD	.00	1	FLOW	3.	3.	3.	3.	3.	3.	3.	3.
+ 3.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ HYDROGRAPH AT	DGARCSD	.00	1	FLOW	5.	5.	4.	4.	4.	4.	4.	4.
+ 4.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ DIVERSION TO	DGARCE	.00	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.
+ 0.				TIME	.00	.00	.00	.00	.00	.00	.00	.00
.00												
+ HYDROGRAPH AT	DGARCN	.00	1	FLOW	5.	5.	4.	4.	4.	4.	4.	4.
+ 4.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ ROUTED TO	RGARCN	.00	1	FLOW	4.	4.	4.	4.	4.	4.	4.	4.
+ 4.				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
3.75												
+ HYDROGRAPH AT	MS6B	.01	1	FLOW	7.	7.	6.	6.	6.	6.	6.	6.
+ 6.				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3.58												
+ 2 COMBINED AT	CMS6B	.01	1	FLOW	10.	9.	9.	9.	8.	8.	8.	8.
+ 8.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ DIVERSION TO	DBONNSD	.01	1	FLOW	9.	8.	8.	8.	8.	8.	8.	8.
+ 7.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ HYDROGRAPH AT	DBONNSD	.01	1	FLOW	1.	1.	1.	1.	1.	1.	1.	1.
+ 1.				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.67												
+ HYDROGRAPH AT	MS7	.00	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.
+ 0.				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3.50												
+ HYDROGRAPH AT	MS8	.00	1	FLOW	1.	1.	1.	1.	1.	1.	1.	1.
+ 1.				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3.58												
+ 3 COMBINED AT	CMS8	.01	1	FLOW	2.	2.	2.	2.	2.	2.	1.	1.
+ 1.				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3.58												
+ HYDROGRAPH AT	MS9	.01	1	FLOW	6.	6.	6.	5.	5.	5.	5.	5.
+ 5.				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3.58												
+ DIVERSION TO	DCLRKSD	.01	1	FLOW	2.	2.	2.	2.	2.	2.	2.	2.
+ 2.				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3.58												

Flow left in Main St in 10-year event.
This flow breaks out into Bonneville Ave.

Appendix G

PRELIMINARY PUMP SELECTIONS

NP 3127 HT 3~ Adaptive 489

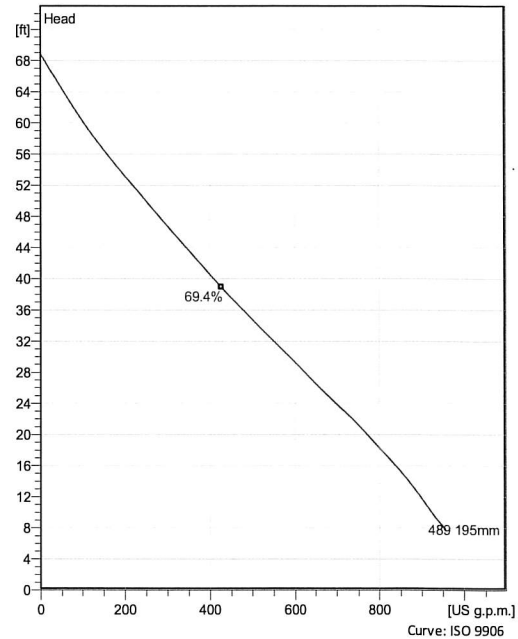
Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.



Technical specification



Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Configuration

Motor number N3127.070 21-10-4AL-W 7.5hp	Installation type P - Semi permanent, Wet
Impeller diameter 195 mm	Discharge diameter 3 15/16 inch

Pump information

Impeller diameter 195 mm
Discharge diameter 3 15/16 inch
Inlet diameter 100 mm
Maximum operating speed 1740 rpm
Number of blades 2

Materials

Impeller Hard-Iron™
Stator housing material Grey cast iron

Project
Block

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Created on 10/22/2019

Last update

NP 3127 HT 3~ Adaptive 489

Technical specification



Motor - General

Motor number N3127.070 21-10-4AL-W 7.5hp	Phases 3~	Rated speed 1740 rpm	Rated power 7.5 hp
Approval FM	Number of poles 4	Rated current 9.6 A	Stator variant 12
Frequency 60 Hz	Rated voltage 460 V	Insulation class H	Type of Duty S1

Motor - Technical

Power factor - 1/1 Load 0.88	Motor efficiency - 1/1 Load 83.8 %	Total moment of inertia 1.01 lb ft ²	Starts per hour max. 30
Power factor - 3/4 Load 0.85	Motor efficiency - 3/4 Load 84.7 %	Starting current, direct starting 52 A	
Power factor - 1/2 Load 0.77	Motor efficiency - 1/2 Load 83.7 %	Starting current, star-delta 17.3 A	

Project
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Created on 10/22/2019

Last update

NP 3127 HT 3~ Adaptive 489

Performance curve

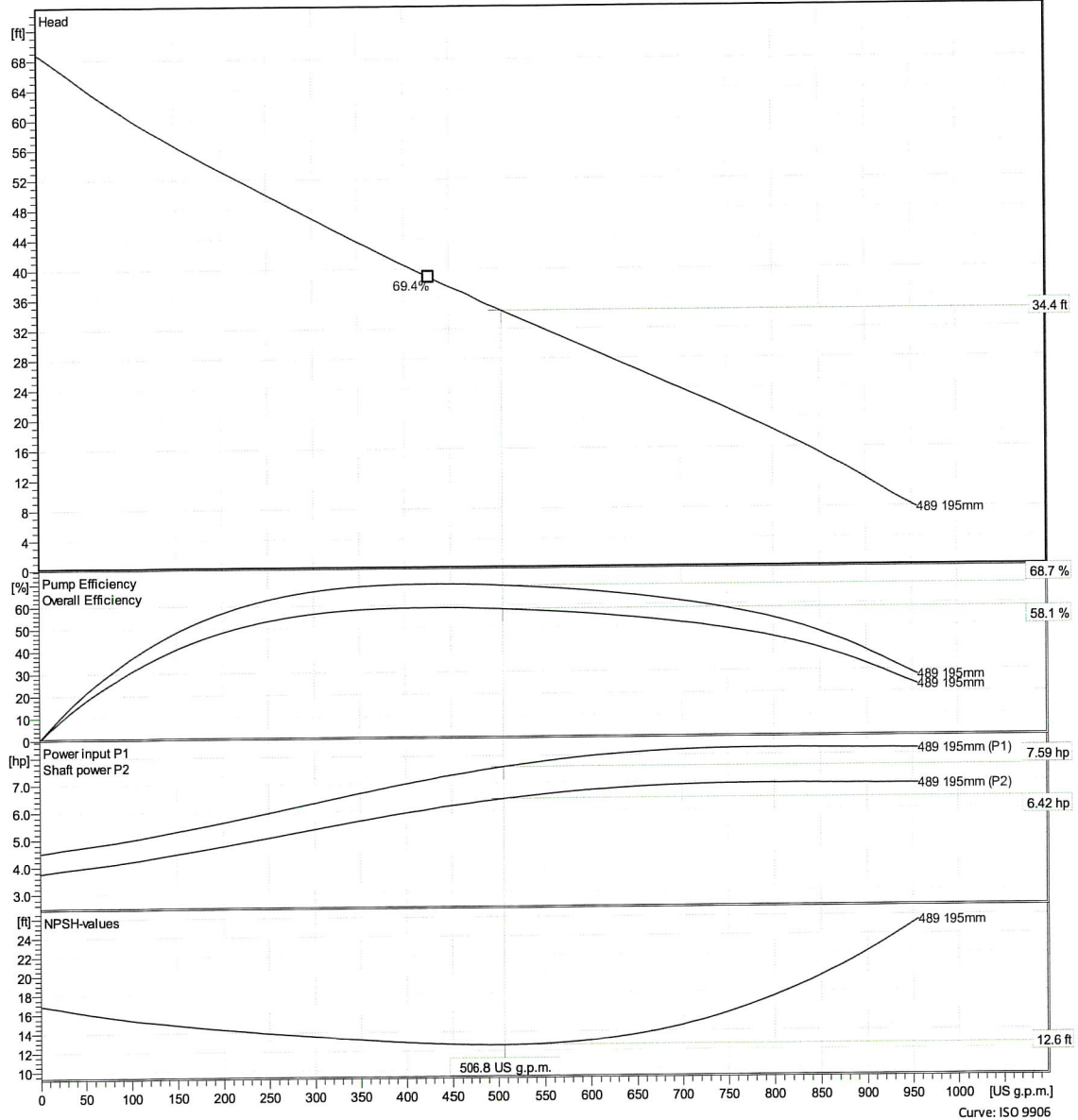


Duty point

Flow
507 US g.p.m.

Head
34.4 ft

Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Project
Block

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Created on 10/22/2019

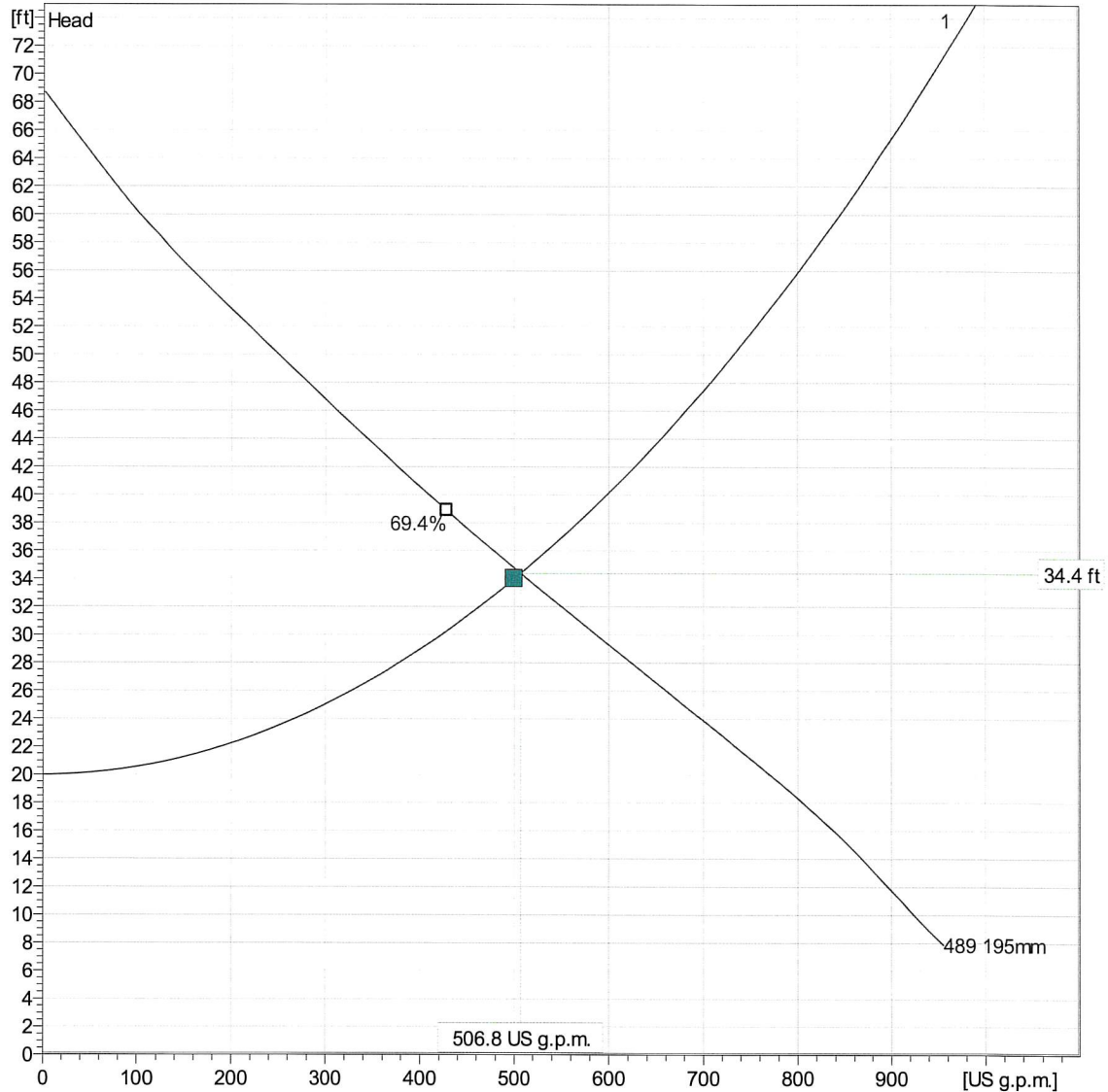
Last update

NP 3127 HT 3~ Adaptive 489

Duty Analysis



Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Curve: ISO 9906

Operating characteristics

Pumps/Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHr
1	507 US g.p.m.	34.4 ft	6.42 hp	507 US g.p.m.	34.4 ft	6.42 hp	68.7 %	186 kWh/US M	12.6 ft

Project
Block

Created by
Created on 10/22/2019

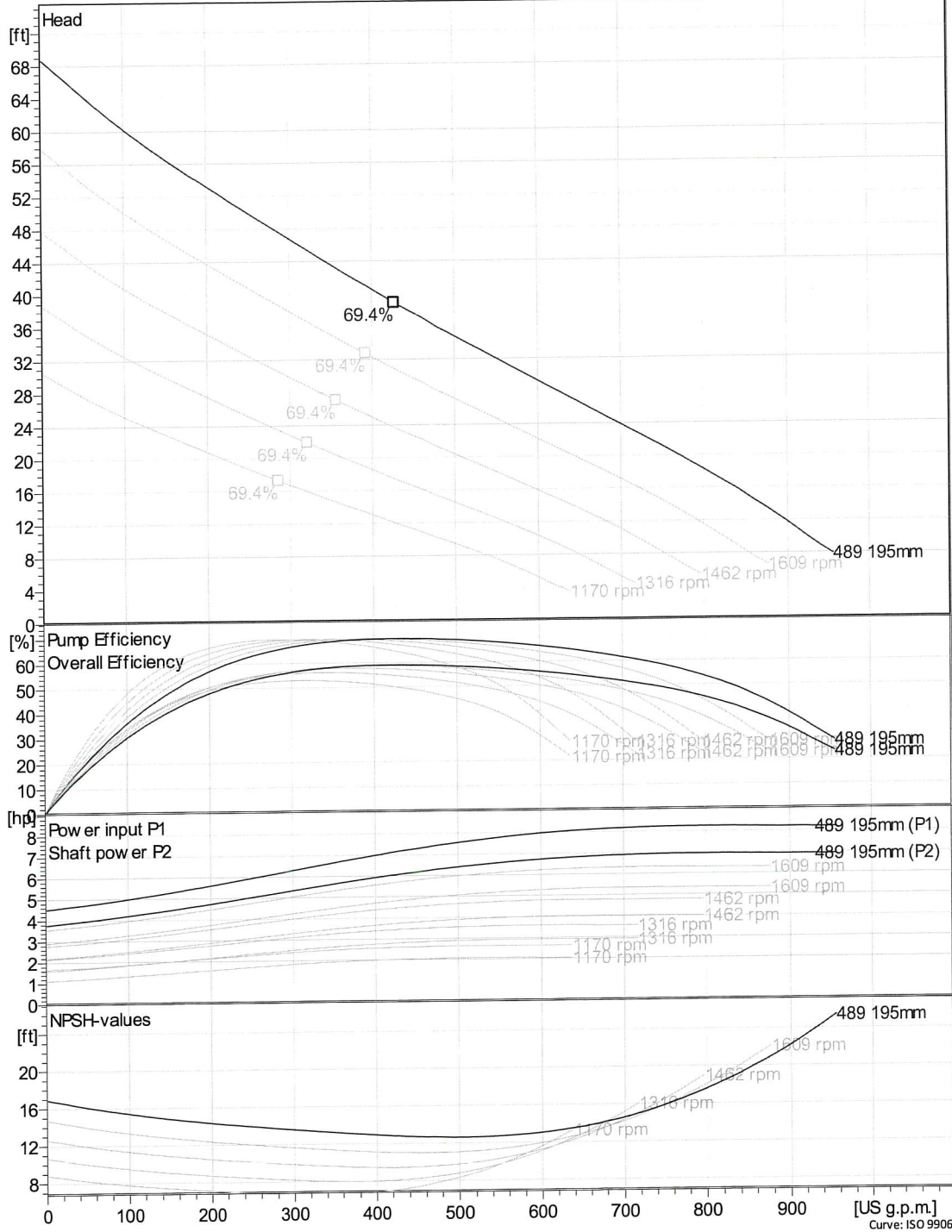
Last update

NP 3127 HT 3~ Adaptive 489

VFD Curve



Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Project
Block

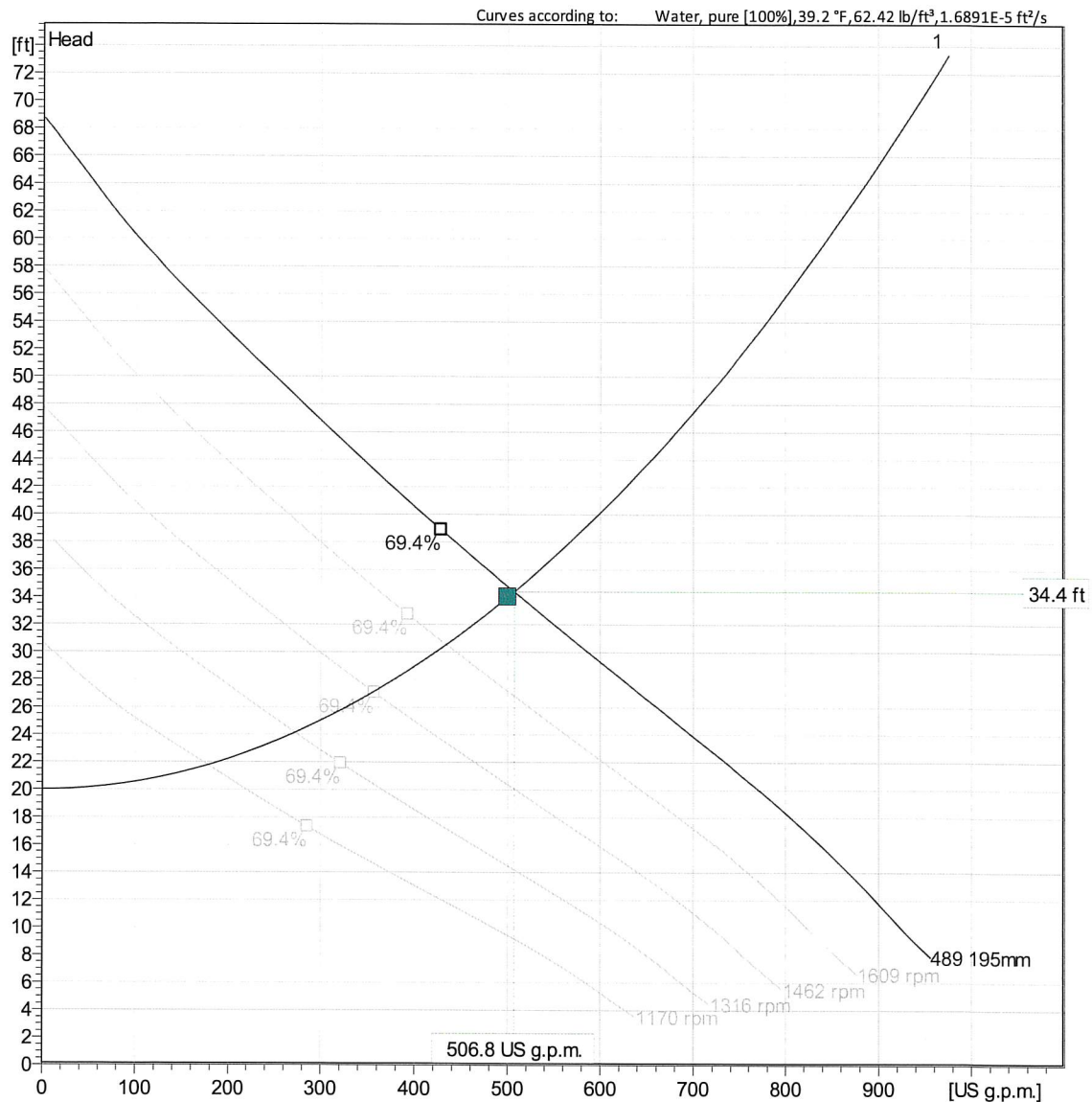
Created by
Created on 10/22/2019

Last update

Curve: ISO 9906

NP 3127 HT 3~ Adaptive 489

VFD Analysis



Operating Characteristics

Curve: ISO 9906

Pumps/Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr. eff.	Specific energy	NPSHr
1	60 Hz	507 US g.p.m.	34.4 ft	6.42 hp	507 US g.p.m.	34.4 ft	6.42 hp	68.7 %	186 kWh/US M	12.6 ft
1	55 Hz	436 US g.p.m.	30.7 ft	4.89 hp	436 US g.p.m.	30.7 ft	4.89 hp	69.2 %	165 kWh/US M	11.1 ft
1	50 Hz	358 US g.p.m.	27.2 ft	3.55 hp	358 US g.p.m.	27.2 ft	3.55 hp	69.4 %	148 kWh/US M	9.6 ft
1	45 Hz	274 US g.p.m.	24.2 ft	2.44 hp	274 US g.p.m.	24.2 ft	2.44 hp	68.8 %	138 kWh/US M	8.32 ft
1	40 Hz	180 US g.p.m.	21.8 ft	1.54 hp	180 US g.p.m.	21.8 ft	1.54 hp	64.4 %	145 kWh/US M	7.23 ft

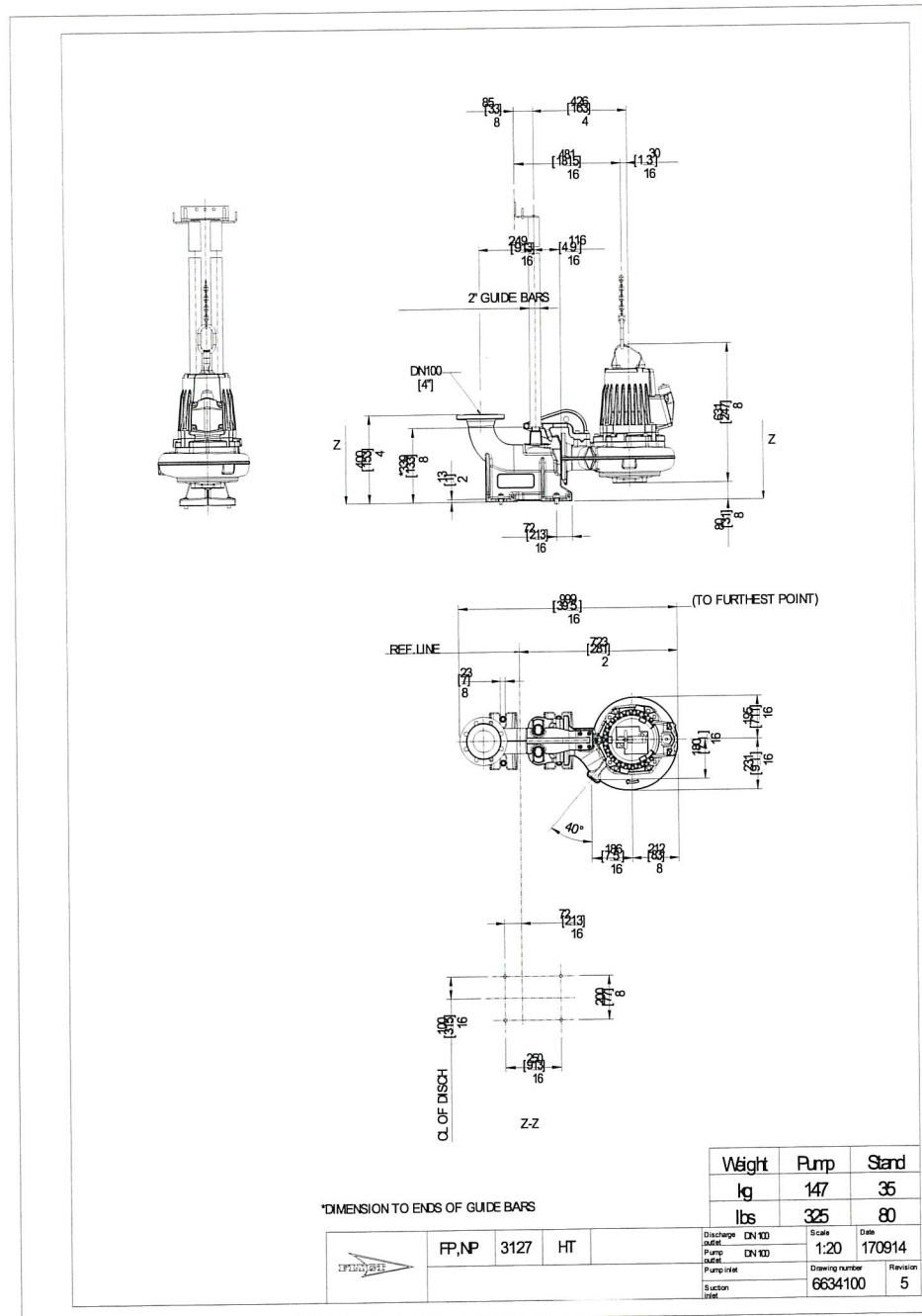
Project
Block

Created by
Created on 10/22/2019

Last update

NP 3127 HT 3~ Adaptive 489

Dimensional drawing



Project
Block

Created by
Created on 10/22/2019

Last update

Item number : 001
Service :
Quantity : 1
Quote number : 940107

Size : EMU FA10.82E with Motor
T17-6/16KEx
Stages : 1
Based on curve number : FA10.82E 1140
Article Number :
Date last saved : 05 Nov 2019 4:19 PM

Operating Conditions

Flow, rated : 500.0 USgpm
Head, rated (requested) : 34.00 ft
Head, rated (actual) : 34.17 ft
Suction pressure, rated / max : 0.00 / 0.00 psi.g
NPSH available : Ample
Frequency : 60 Hz

Performance

Speed : 1105 rpm
Impeller dia. : 10.59 in
Impeller diameter, maximum : 10.83 in
Impeller diameter, minimum : 8.46 in
Efficiency : 74.49 %
NPSH required / margin required : 5.48 / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow) : 2,749 / 5,952 US Units
MCSF : 230.1 USgpm
Head max. : 50.61 ft
Head rise to shutoff : 48.76 %
Flow, best eff. point : 921.0 USgpm
Flow ratio, rated / BEP : 54.29 %
Diameter ratio (rated / max) : 97.82 %
Head ratio (rated dia / max dia) : 94.33 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010] : 1.00 / 1.00 / 1.00 / 1.00
Selection status : Acceptable

Liquid

Liquid type : Water
Additional liquid description :
Solids Diameter, required / pump max : 0.00 in / 3.90 in
Solids concentration, by volume : 0.00 %
Temperature : 68.00 deg F
Fluid density : 1.000 / 1.000 SG
Viscosity : 1.00 cP
Vapor pressure, rated : 0.34 psi.a

Material

Material selected : Standard

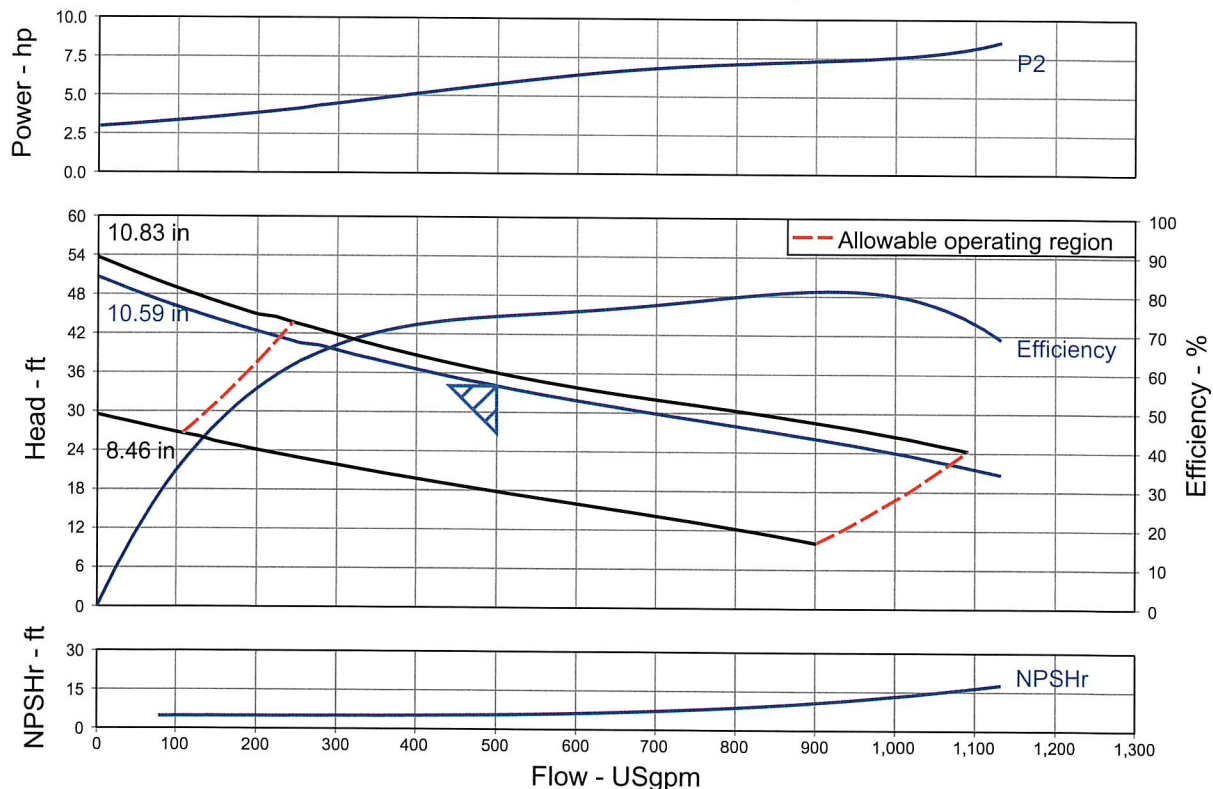
Pressure Data

Maximum working pressure : 21.90 psi.g
Maximum allowable working pressure : N/A
Maximum allowable suction pressure : N/A
Hydrostatic test pressure : N/A

Driver & Power Data (@Max density)

Driver sizing specification : Rated power
Margin over specification : 0.00 %
Service factor : 1.00
Power, hydraulic : 4.29 hp
Power, rated : 5.76 hp
Power, maximum : 8.55 hp
Motor rating : 6.10 hp / 4.55 kW

Maximum Power exceeds Motor Rating



NP 3202 LT 3~ 614

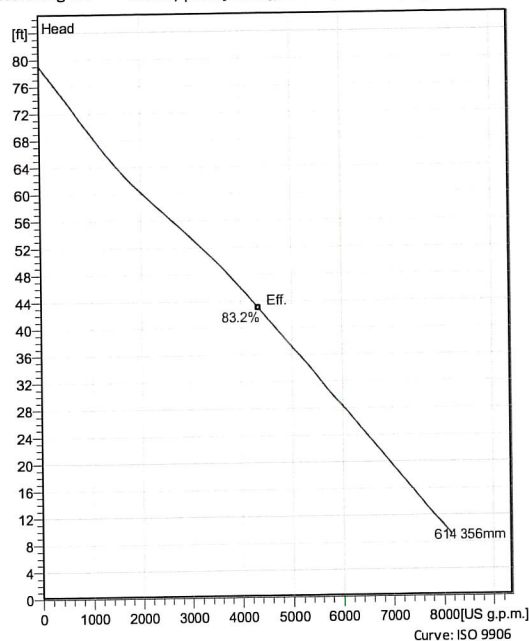
Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.



Technical specification



Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Configuration

Motor number	Installation type
N3202.095 30-29-6AA-W	P - Semi permanent, Wet
60hp	
Impeller diameter	Discharge diameter
356 mm	11 13/16 inch

Pump information

Impeller diameter
356 mm
Discharge diameter
11 13/16 inch
Inlet diameter
300 mm
Maximum operating speed
1170 rpm
Number of blades
2

Materials

Impeller
Hard-Iron™

Project
Block

Created by
Created on 10/22/2019

Last update

NP 3202 LT 3~ 614

Technical specification



Motor - General

Motor number N3202.095 30-29-6AA-W 60hp	Phases 3~	Rated speed 1170 rpm	Rated power 60 hp
Approval FM	Number of poles 6	Rated current 72 A	Stator variant 1
Frequency 60 Hz	Rated voltage 460 V	Insulation class H	Type of Duty S1

Motor - Technical

Power factor - 1/1 Load 0.86	Motor efficiency - 1/1 Load 90.5 %	Total moment of inertia 15.5 lb ft ²	Starts per hour max. 30
Power factor - 3/4 Load 0.83	Motor efficiency - 3/4 Load 91.0 %	Starting current, direct starting 420 A	
Power factor - 1/2 Load 0.74	Motor efficiency - 1/2 Load 91.0 %	Starting current, star-delta 140 A	

Project
Block

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Created on 10/22/2019

Last update

NP 3202 LT 3~ 614

Performance curve

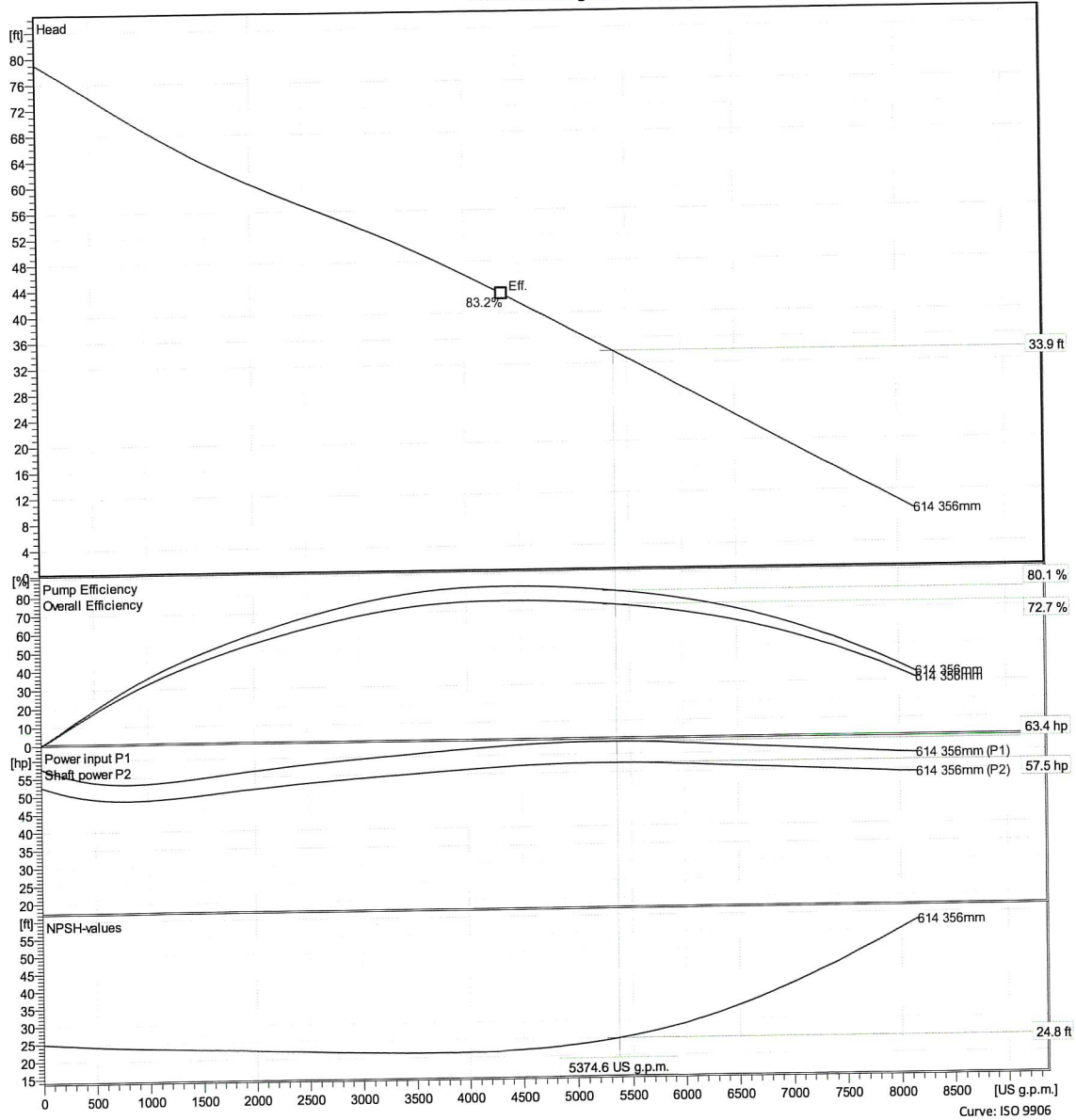


Duty point

Flow
5370 US g.p.m.

Head
33.9 ft

Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Project
Block

Created by
Created on 10/22/2019

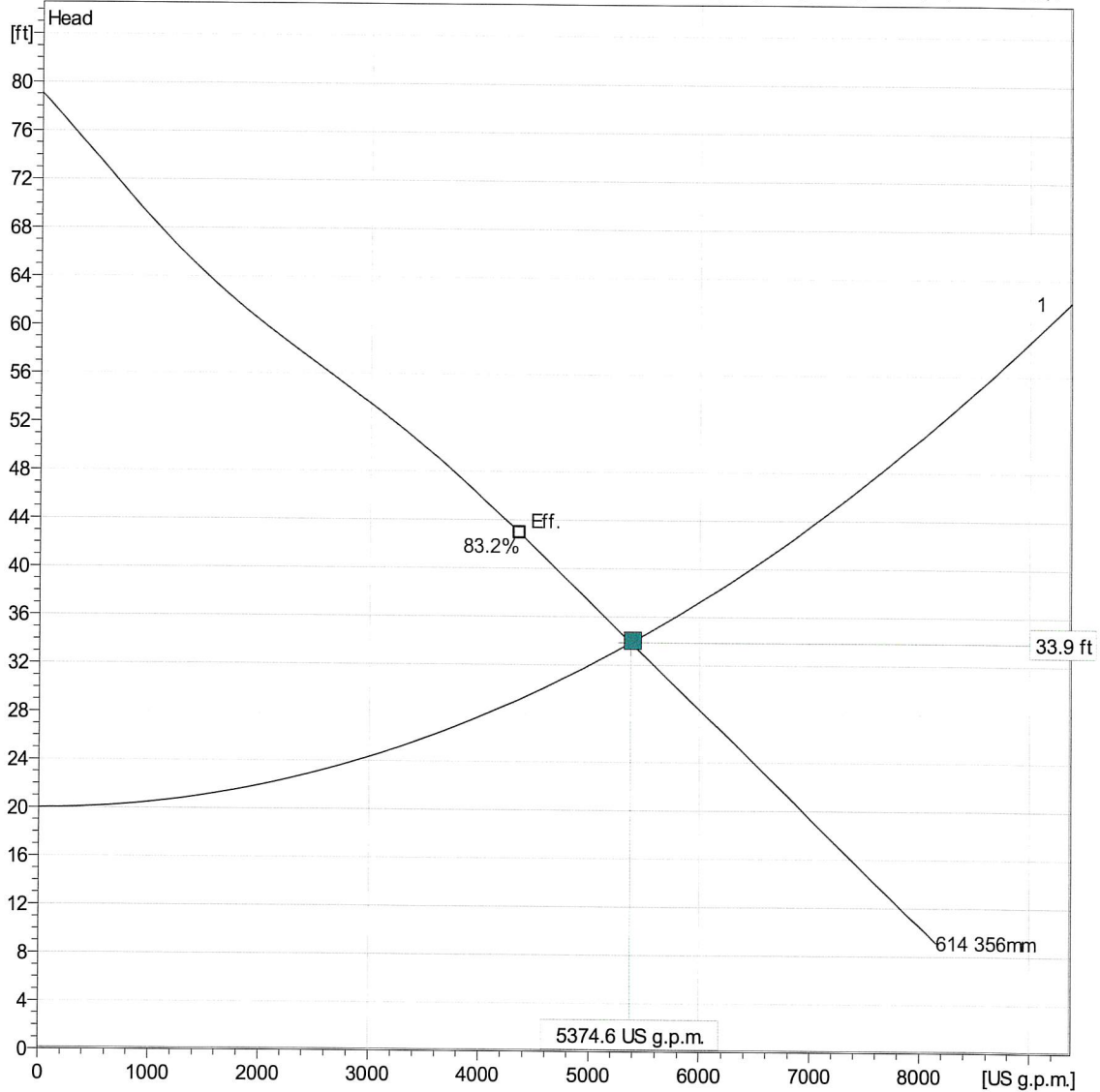
Last update

NP 3202 LT 3~ 614

Duty Analysis



Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Operating characteristics

Curve: ISO 9906

Pumps/Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHr
1	5370 US g.p.m.	33.9 ft	57.5 hp	5370 US g.p.m.	33.9 ft	57.5 hp	80.1 %	147 kWh/US Ml	24.8 ft

Project
Block

Created by
Created on 10/22/2019

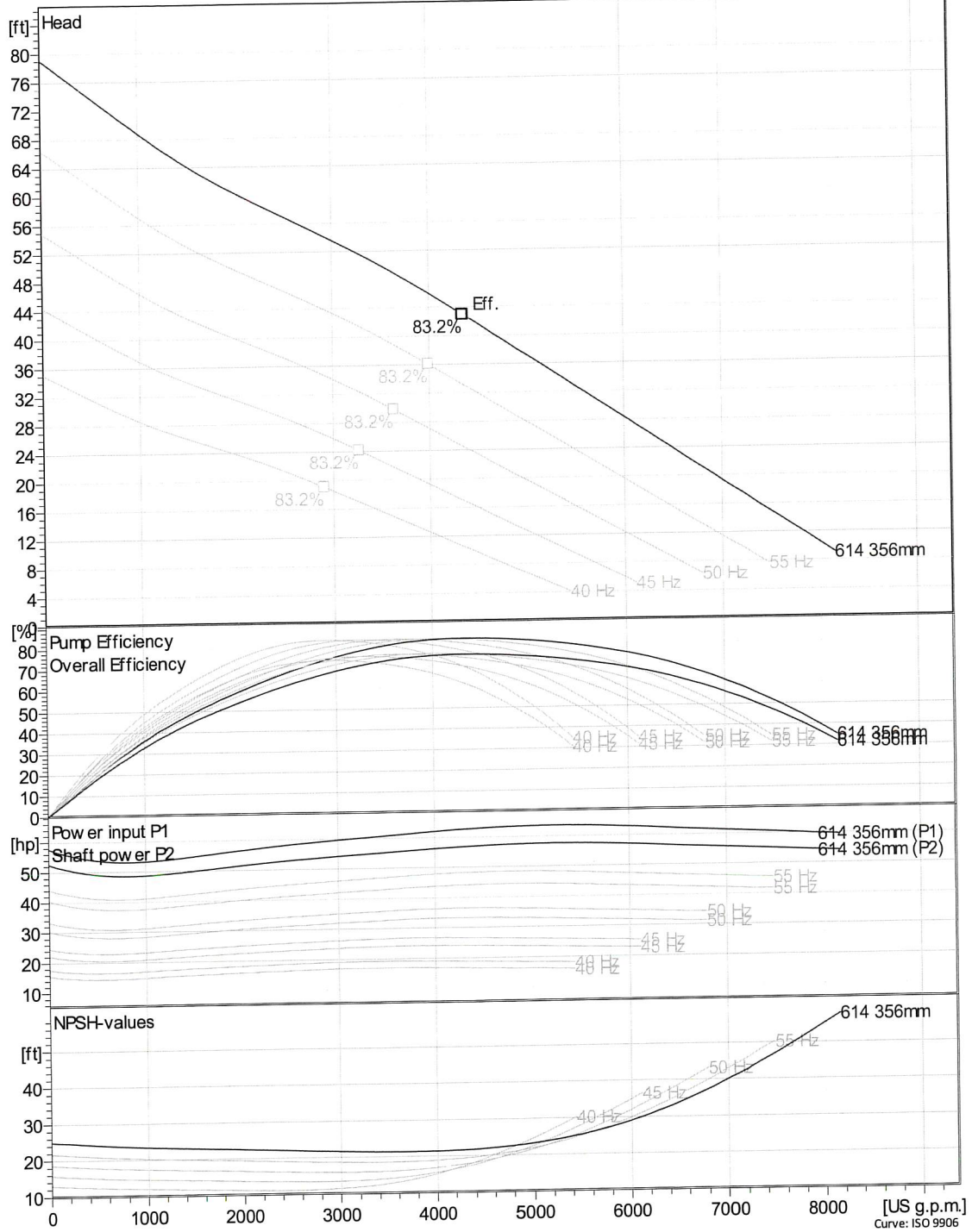
Last update

NP 3202 LT 3~ 614

VFD Curve



Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



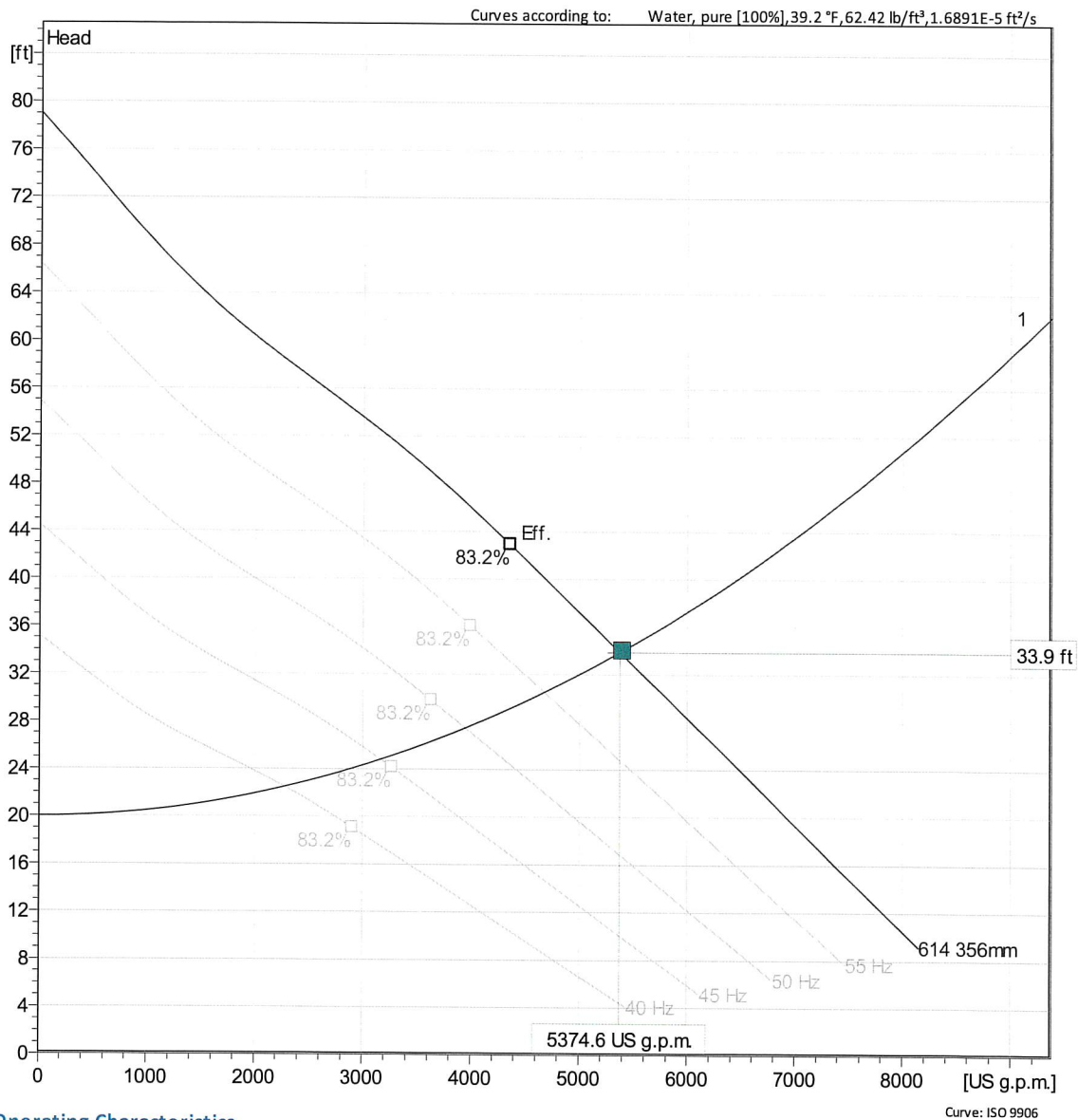
Project
Block

Created by
Created on 10/22/2019

Last update

Curve: ISO 9906

VFD Analysis



Operating Characteristics

Pumps/Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHr
1	60 Hz	5370 US g.p.m	33.9 ft	57.5 hp	5370 US g.p.m	33.9 ft	57.5 hp	80.1 %	147 kWh/US M	24.8 ft
1	55 Hz	4680 US g.p.m	30.5 ft	44.3 hp	4680 US g.p.m	30.5 ft	44.3 hp	81.5 %	129 kWh/US M	20.5 ft
1	50 Hz	3950 US g.p.m	27.5 ft	33.2 hp	3950 US g.p.m	27.5 ft	33.2 hp	82.8 %	114 kWh/US M	16.7 ft
1	45 Hz	3160 US g.p.m	24.8 ft	23.9 hp	3160 US g.p.m	24.8 ft	23.9 hp	83.2 %	104 kWh/US M	13.6 ft
1	40 Hz	2280 US g.p.m	22.5 ft	16.3 hp	2280 US g.p.m	22.5 ft	16.3 hp	79.5 %	101 kWh/US M	11.1 ft

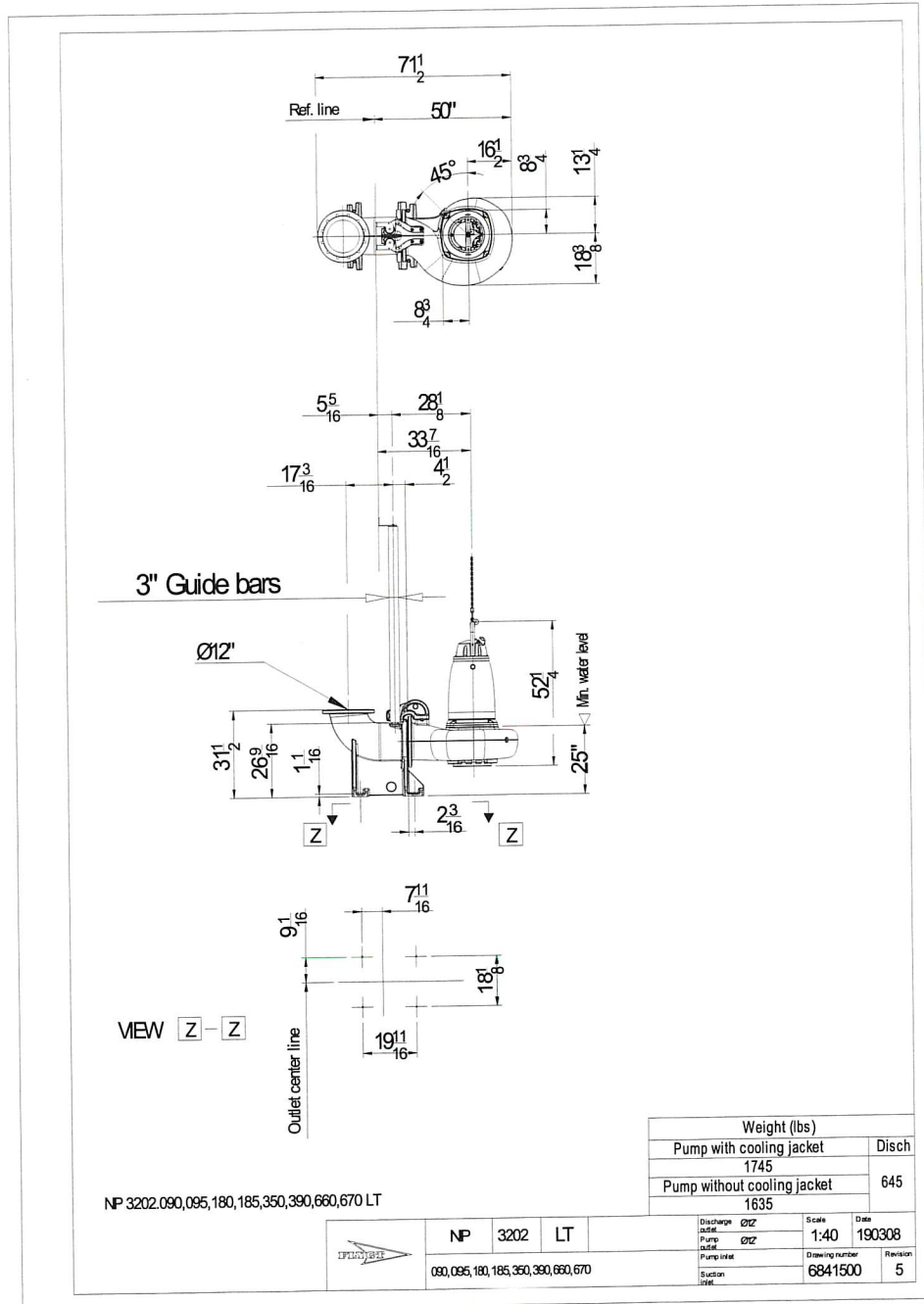
Project Block

Created by
Created on 10/22/2019

Last update

NP 3202 LT 3~ 614

Dimensional drawing



Project
Block

Created by
Created on 10/22/2019

Last update

Item number : 001
Service :
Quantity : 1
Quote number : 940107

Size : EMU FA30.93D with Motor
T34-8/41KEx
Stages : 1
Based on curve number : FA30.93D 890
Article Number :
Date last saved : 05 Nov 2019 3:59 PM

Operating Conditions

Flow, rated : 5,400.0 USgpm
Head, rated (requested) : 34.00 ft
Head, rated (actual) : 34.21 ft
Suction pressure, rated / max : 0.00 / 0.00 psi.g
NPSH available : Ample
Frequency : 60 Hz

Performance

Speed : 890 rpm
Impeller dia. : 16.57 in
Impeller diameter, maximum : 17.76 in
Impeller diameter, minimum : 13.23 in
Efficiency : 77.38 %
NPSH required / margin required : 17.82 / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow) : 2,823 / 7,886 US Units
MCSF : 902.6 USgpm
Head max. : 80.63 ft
Head rise to shutoff : 137.16 %
Flow, best eff. point : 3,984.2 USgpm
Flow ratio, rated / BEP : 135.54 %
Diameter ratio (rated / max) : 93.35 %
Head ratio (rated dia / max dia) : 80.54 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010] : 1.00 / 1.00 / 1.00 / 1.00
Selection status : Acceptable

Liquid

Liquid type : Water
Additional liquid description :
Solids Diameter, required / pump max : 0.00 in / 3.10 in
Solids concentration, by volume : 0.00 %
Temperature : 68.00 deg F
Fluid density : 1.000 / 1.000 SG
Viscosity : 1.00 cP
Vapor pressure, rated : 0.34 psi.a

Material

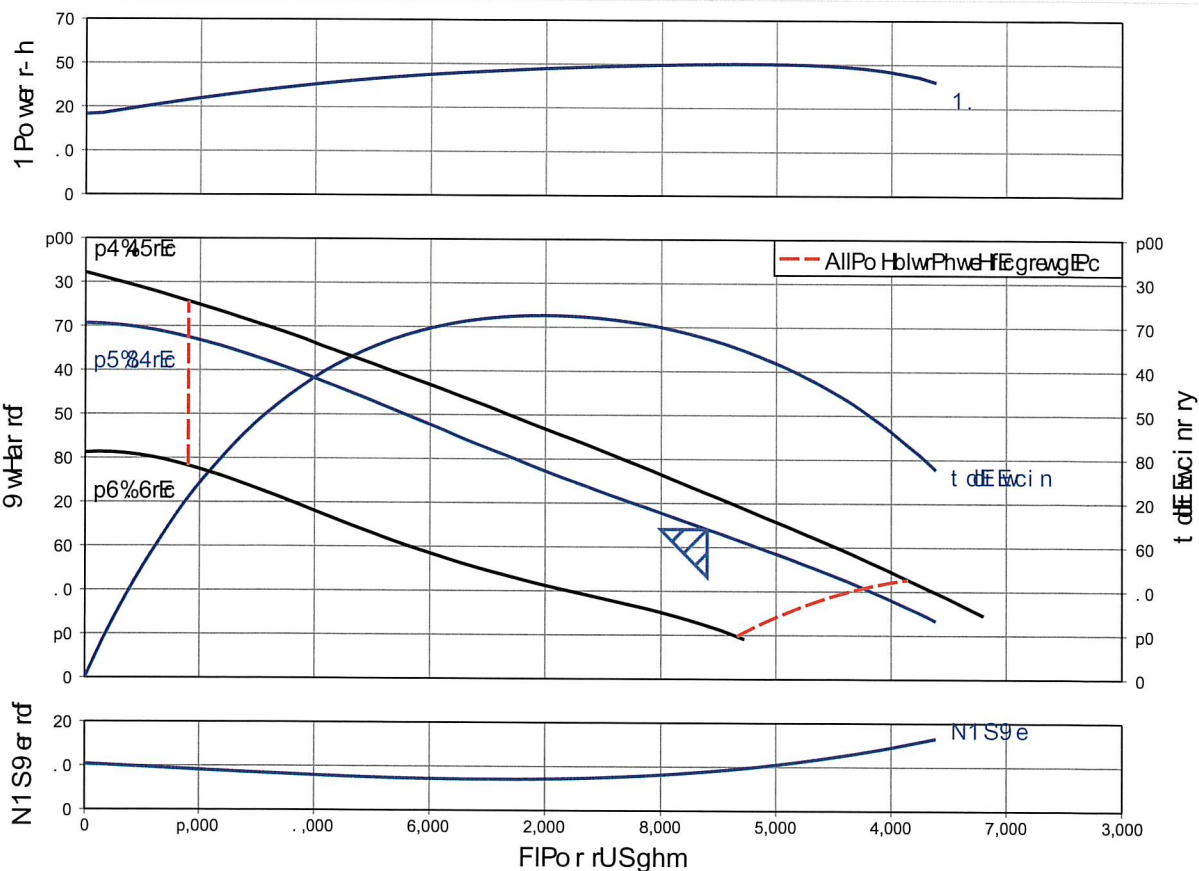
Material selected : Standard

Pressure Data

Maximum working pressure : 34.90 psi.g
Maximum allowable working pressure : N/A
Maximum allowable suction pressure : N/A
Hydrostatic test pressure : N/A

Driver & Power Data (@Max density)

Driver sizing specification : Rated power
Margin over specification : 0.00 %
Service factor : 1.00
Power, hydraulic : 46.35 hp
Power, rated : 59.90 hp
Power, maximum : 60.06 hp
Motor rating : 73.80 hp / 55.03 kW



Appendix H

STRUCTURAL CALCULATIONS FOR PROPOSED WET WELL

BY: Joel DATE: Nov-19 CLIENT

City of Las Vegas

SHEET:

CHKD: DESCRIPTION:

Bonneville Pump Station

JOB NO: 10444A.10

DESIGN TASK:

Main Wall with 2000 psf Surcharge

Rectangular Plate:

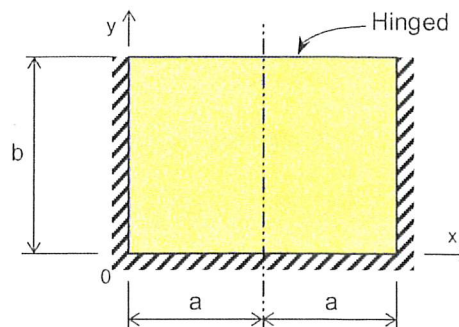
plate boundary condition case number (1, 2, 3, 4, or 5) = 2

total plate width = $2 \cdot a = 2 \cdot 16 = 32$ ft

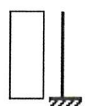
plate dimension, $a = 16$ ft

plate dimension, $b = 34$ ft

plate sides ratio, $a/b = 0.4706$



Available Loading Selections - (loads 1 thru 9 , 100 , or 400)



load 1



load 2
($2/3$ b)



load 3
($1/3$ b)



load 4



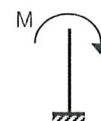
load 5
($2/3$ b)



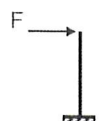
load 6
($1/3$ b)



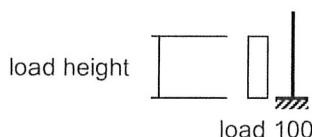
load 7
($1/6$ b)



load 8

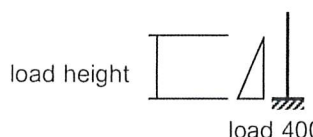


load 9



load height

load 100



load height

load 400

Choice of Available Loadings

load conditions (4 max)	load type	load height, (ft) ...only for custom loads 100 or 400	unfactored loads: q , or M (ksf, ft-k/ft)	concrete load factors	
	Loading Selection Number			for moment	for shear
A	1	18.000	1.000	1.7	1.7
B	4		2.140	1.7	1.7
C	400		0.540	1.7	1.7
D					

← Surcharge
← At-Rest
← Submerged

Notes: 1). Load 100 = uniform load of any load height $\geq b/3$; Load 400 = triangular load of any load height $\geq b/6$.

2). load height must be less than or equal to "b", and uniform load height $\geq "b / 3"$, and triangular load height $\geq "b / 6"$.

3). loads may be positive or negative.

plate thickness, $h = 44$ in

concrete strength, $f'c = 4.5$ ksi

reinforcing steel strength, $f_y = 60$ ksi

reinforcing clear cover to face of concrete = 2 in

number of curtains of reinforcing, (1 or 2) = 2

Are bars in "x" or "y" direction closest to face of concrete ? y

minimum ratio of horizontal shrinkage-temperature steel = 0.00400

minimum ratio of vertical shrinkage-temperature steel = 0.00300

note: plate thickness is $\geq 24"$, per ACI350 7.12.2.1 the minimum area of steel will be considered using a 12" layer each face.

bar locations	d (in)	d' (in)
Mx bending	41"	3"
My bending	41.5"	2.5"

2

BY: Joel DATE: Nov-19 CLIENT
CHKD: DESCRIPTION:
DESIGN TASK:

City of Las Vegas
Bonneville Pump Station
Main Wall with 2000 psf Surcharge

SHEET:
JOB NO: 10444A.10

M _x - Moment Summary													
a = 16 b = 34 a / b = 0.4706		Loads q, or M				Boundary Case 2				SUMMARY			
		1.000	2.140	0.540						Final Moments		Reinforcing: (d = 41")	
		Moment Coefficient Multipliers								M _x ft-k/ft	M _{lx} ft-k/ft	A _{s(req'd)} in ² /ft	A _{s(min)} in ² /ft
		1156.000	2473.840	624.240									
		Moment Coefficients				M _x Moments, ft-k/ft							
x / a	y / b	A	B	C	D	A	B	C	D	ft-k/ft	ft-k/ft	in ² /ft	in ² /ft
0	1	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.58
0	0.8	0.0390	0.0129	0.0022		45.11	31.99	1.37		78.47	133.39	0.73	0.98
0	0.6	0.0539	0.0230	0.0063		62.27	56.94	3.96		123.18	209.40	1.16	1.54
0	0.4	0.0482	0.0257	0.0109		55.71	63.61	6.81		126.13	214.42	1.18	1.58
0	0.2	0.0240	0.0157	0.0094		27.69	38.76	5.87		72.32	122.94	0.67	0.90
0	0	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.58
0.2	0	0.0017	0.0013	0.0008		1.94	3.10	0.52		5.56	9.45	0.05	0.58
0.4	0	0.0045	0.0030	0.0020		5.15	7.40	1.22		13.77	23.41	0.13	0.58
0.6	0	0.0070	0.0046	0.0028		8.08	11.26	1.72		21.05	35.79	0.19	0.58
0.8	0	0.0086	0.0055	0.0033		9.99	13.61	2.03		25.64	43.58	0.24	0.58
1	0	0.0092	0.0059	0.0035		10.63	14.52	2.17		27.32	46.44	0.25	0.58
1	0.2	-0.0093	-0.0058	-0.0032		-10.78	-14.46	-2.00		-27.24	-46.31	-0.25	-0.58
1	0.4	-0.0222	-0.0116	-0.0047		-25.63	-28.60	-2.95		-57.18	-97.21	-0.53	-0.71
1	0.6	-0.0251	-0.0109	-0.0031		-29.03	-26.86	-1.93		-57.82	-98.29	-0.54	-0.72
1	0.8	-0.0178	-0.0063	-0.0012		-20.60	-15.61	-0.78		-36.98	-62.87	-0.34	-0.58
1	1	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.58
0.8	1	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.58
0.8	0.8	-0.0164	-0.0056	-0.0011		-18.97	-13.94	-0.66		-33.57	-57.07	-0.31	-0.58
0.8	0.6	-0.0230	-0.0099	-0.0028		-26.58	-24.39	-1.73		-52.70	-89.59	-0.49	-0.65
0.8	0.4	-0.0203	-0.0106	-0.0045		-23.51	-26.32	-2.78		-52.61	-89.44	-0.49	-0.65
0.8	0.2	-0.0087	-0.0055	-0.0031		-10.04	-13.64	-1.96		-25.65	-43.60	-0.24	-0.58

max negative moment, M_{ux}(-) = -98.29 ft-k/ft
max negative steel req'd, A_s(-) = -0.54 in²/ft
minimum steel req'd = -0.72 in²/ft

max positive moment, M_{ux}(+) = 214.42 ft-k/ft
max positive steel req'd, A_s(+) = 1.18 in²/ft
minimum steel req'd = 1.58 in²/ft

Use

Use

BY: Joel DATE: Nov-19 CLIENT
CHKD: DESCRIPTION: City of Las Vegas
DESIGN TASK: Bonneville Pump Station
Main Wall with 2000 psf Surcharge

SHEET: JOB NO: 10444A.10

M _y - Moment Summary													
a = 16 b = 34 a / b = 0.4706		Loads: q _u or M				Boundary Case 2				SUMMARY			
		1.000	2.140	0.540						Final Moments		Reinforcing: (d = 41.5")	
		Moment Coefficient Multipliers											
		1156.000	2473.840	624.240		M _y Moments, ft-k/ft		M _y ft-k/ft	M _{uy} ft-k/ft	A _s (req'd) in ² /ft	A _s (min) in ² /ft		
x / a	y / b	A	B	C	D	A	B	C	D				
0	1	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.43
0	0.8	0.0078	0.0026	0.0005		8.98	6.43	0.29		15.70	26.69	0.14	0.43
0	0.6	0.0107	0.0046	0.0013		12.42	11.39	0.79		24.60	41.82	0.22	0.43
0	0.4	0.0097	0.0052	0.0022		11.19	12.75	1.38		25.31	43.03	0.23	0.43
0	0.2	0.0048	0.0032	0.0019		5.52	7.79	1.18		14.49	24.64	0.13	0.43
0	0	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.43
0.2	0	0.0083	0.0061	0.0043		9.60	15.05	2.67		27.32	46.45	0.25	0.43
0.4	0	0.0221	0.0151	0.0097		25.53	37.38	6.04		68.96	117.23	0.63	0.85
0.6	0	0.0348	0.0228	0.0139		40.20	56.40	8.69		105.28	178.98	0.97	1.30
0.8	0	0.0432	0.0277	0.0165		49.92	68.42	10.27		128.60	218.63	1.19	1.59
1	0	0.0461	0.0293	0.0173		53.31	72.59	10.81		136.71	232.40	1.27	1.67
1	0.2	-0.0042	-0.0053	-0.0049		-4.85	-13.09	-3.06		-21.00	-35.70	-0.19	-0.43
1	0.4	-0.0170	-0.0104	-0.0049		-19.61	-25.79	-3.08		-48.48	-82.42	-0.44	-0.59
1	0.6	-0.0195	-0.0077	-0.0012		-22.58	-19.01	-0.75		-42.34	-71.98	-0.39	-0.52
1	0.8	-0.0171	-0.0037	0.0005		-19.74	-9.16	0.31		-28.59	-48.61	-0.26	-0.43
1	1	0.0000	0.0000	0.0000		0.00	0.00	0.00		0.00	0.00	0.00	0.43
1	0.4	-0.0170	-0.0104	-0.0049		-19.61	-25.79	-3.08		-48.48	-82.42	-0.44	-0.59
0.8	0.4	-0.0157	-0.0097	-0.0046		-18.13	-23.96	-2.88		-44.97	-76.45	-0.41	-0.55
0.6	0.4	-0.0120	-0.0076	-0.0036		-13.89	-18.71	-2.26		-34.86	-59.26	-0.32	-0.43
0.4	0.4	-0.0061	-0.0042	-0.0020		-7.07	-10.27	-1.28		-18.62	-31.65	-0.17	-0.43
0.2	0.4	0.0014	0.0003	0.0000		1.63	0.82	0.00		2.45	4.17	0.02	0.43

max negative moment, M_{uy}(-) = -82.42 ft-k/ft

max negative steel req'd, A_s(-) = -0.44 in²/ft

minimum steel req'd = -0.59 in²/ft

Use

max positive moment, M_{uy}(+) = 232.40 ft-k/ft

max positive steel req'd, A_s(+) = 1.27 in²/ft

minimum steel req'd = 1.67 in²/ft

Use

4

BY: Joel DATE: Nov-19 CLIENT: City of Las Vegas
CHKD: DESCRIPTION: Bonneville Pump Station SHEET: 10444A.10
DESIGN TASK: Main Wall with 2000 psf Surcharge

Shear Summary												
a = 16 b = 34 a / b = 0.4706		Loads: q, or M				Boundary Case 2				SUMMARY		
		1.000	2.140	0.540						Final Shears		
		Shear Coefficient Multipliers										
		34.000	72.760	18.360		Shears, k/ft				V k/ft	V _u k/ft	ϕV _c k/ft
		Shear Coefficients										
x / a	y / b	A	B	C	D	A	B	C	D			
0	1	-0.0809	-0.0354	-0.0065		-2.75	-2.58	-0.12		-5.45	-9.26	56.79
0	0.8	0.3777	0.0990	0.0036		12.84	7.21	0.07		20.11	34.19	56.79
0	0.6	0.4566	0.1875	0.0388		15.53	13.64	0.71		29.88	50.80	56.79
0	0.4	0.4171	0.2387	0.1061		14.18	17.37	1.95		33.50	56.95	56.79
0	0.2	0.2076	0.1648	0.1209		7.06	11.99	2.22		21.27	36.16	56.79
0	0.00	-0.0217	-0.0012	0.0129		-0.74	-0.08	0.24		-0.59	-1.00	56.79
0.2	0	0.0500	0.0692	0.0779		1.70	5.04	1.43		8.17	13.89	56.79
0.4	0	0.2194	0.1854	0.1525		7.46	13.49	2.80		23.74	40.37	56.79
0.6	0	0.3386	0.2587	0.1931		11.51	18.83	3.55		33.88	57.60	56.79
0.8	0	0.4071	0.2982	0.2130		13.84	21.70	3.91		39.45	67.07	56.79
1	0	0.4293	0.3106	0.2189		14.60	22.60	4.02		41.21	70.06	56.79
0.2	1	-0.0046	-0.0380	-0.0135		-0.16	-2.76	-0.25		-3.17	-5.39	56.79
0.4	1	0.1486	0.0129	-0.0051		5.05	0.94	-0.09		5.90	10.03	56.79
0.6	1	0.2409	0.0464	0.0019		8.19	3.38	0.04		11.60	19.72	56.79
0.8	1	0.2901	0.0651	0.0064		9.86	4.74	0.12		14.72	25.02	56.79
1	1	0.3055	0.0712	0.0080		10.39	5.18	0.15		15.71	26.71	56.79

NG ①

NG ②

NG ③

NG ④

Concrete strength reduction factor for shear, φ = 0.85

d = 41.5 in

maximum shear, V_u = 70.06 k/ft

$$\phi V_c = \phi * 2 * (f'c)^{1/2} * b * d = (0.85 * 2 * (4500)^{1/2} * 12 * 41.5) / 1000 = 56.79 \text{ k/ft}$$

SHEAR NOT SATISFIED ! , CHANGE PLATE THICKNESS, or CHECK SHEAR AT DISTANCE "d".

Reference:

"Moments and Reactions for Rectangular Plates"

Engineering Monograph No. 27

By: W. T. Moody, United States Bureau of Reclamation

Notes:

Quadratic interpolation is used for intermediate values within the Moody tables and between Moody figures.

The positive sign convention for moments M_x and M_y is tension on the loaded face of the plate.

The M_x moment is in the direction of the x-axis and the M_y moment is in the direction of the y-axis by plate sign convention.

BY Joel DATE 11-14-19 SUBJECT Bonnyville Pump Station SHEET NO. OF
CHKD. BY DATE JOB NO. 10444110

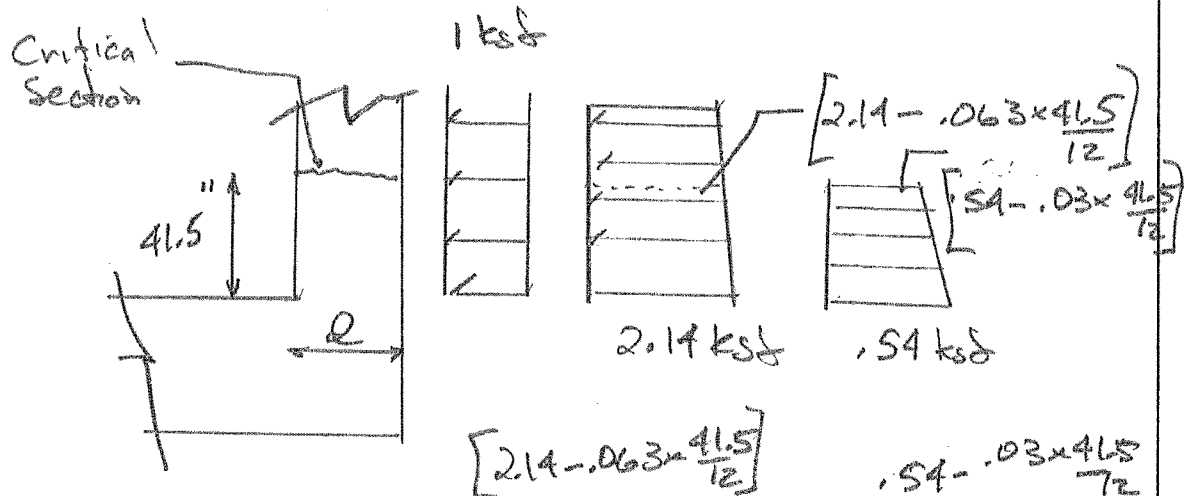
Validating Shear Overstresses

① $\frac{56.95}{56.79} = 1.0033$ Say OK.

② }
③ } Max Shear = 70.06 k/ft
④ }

Shear can be calculated "d"
from edge

Unfactored Loads



At Critical Section

$$V = 70.06 \text{ k/ft} - \left[1 \text{ ksf} + \frac{2.14 + 1.92}{2} + \frac{.54 + .44}{2} \right] \frac{41.5}{12} \times 1.7$$

$$= 49.4 \text{ k/ft} < 56.79 \text{ k/ft} \quad \text{OK}$$

Appendix I

SUBSURFACE UTILITY ENGINEERING REPORT

KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 1

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

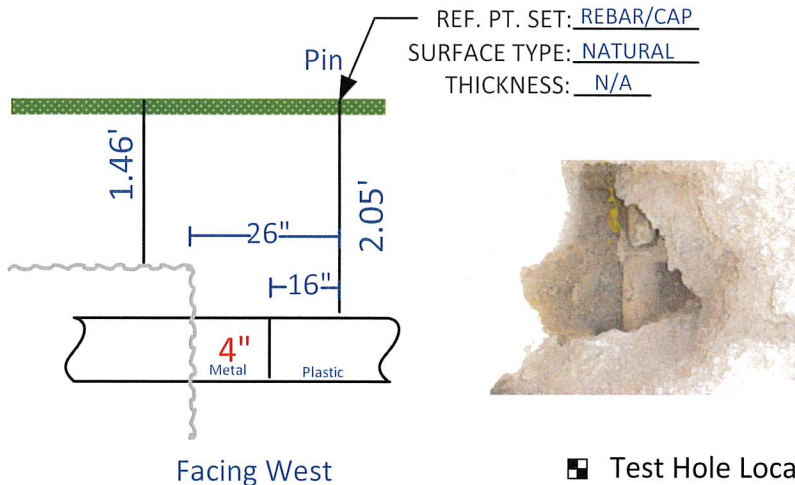
TEST HOLE DATE: 9-5-19

PROJECT LOCATION: Bonneville/UPRR

UTILITY TYPE: Force Main
OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4"

UTILITY MATERIAL: Plastic
(visual appearance)



Field Calcs. (ft)	
Rod-Top Util.	
Rod-Ref. Pt.	
Top of Util.	2.05'
Hand Measure	
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Street Light	24'	B Wall	9'	C Corner of Wall	30'

NOTES:

Reference Point set over north leg of FM.

Quality Control Checks:
Field Check DS (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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Lic # NV0081727

KCI

UTILITY TEST HOLE REPORT

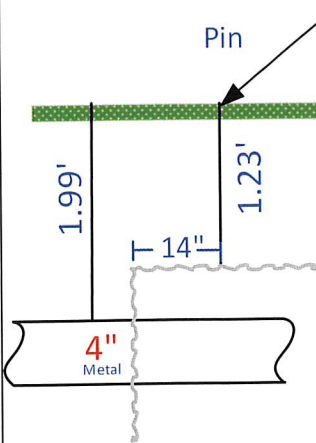
TEST HOLE NO: 1A
 TEST HOLE DATE: 9-5-19

KCI JOB NO: 211901729-A
 CLIENT JOB NO: 10444A.10
 PROJECT LOCATION: Bonneville/UPRR

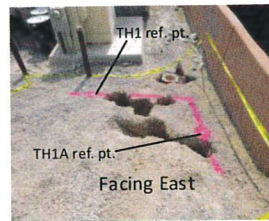
UTILITY TYPE: Force Main
 OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4"

UTILITY MATERIAL: Metal
 (visual appearance)



REF. PT. SET: REBAR/CAP
 SURFACE TYPE: NATURAL
 THICKNESS: N/A

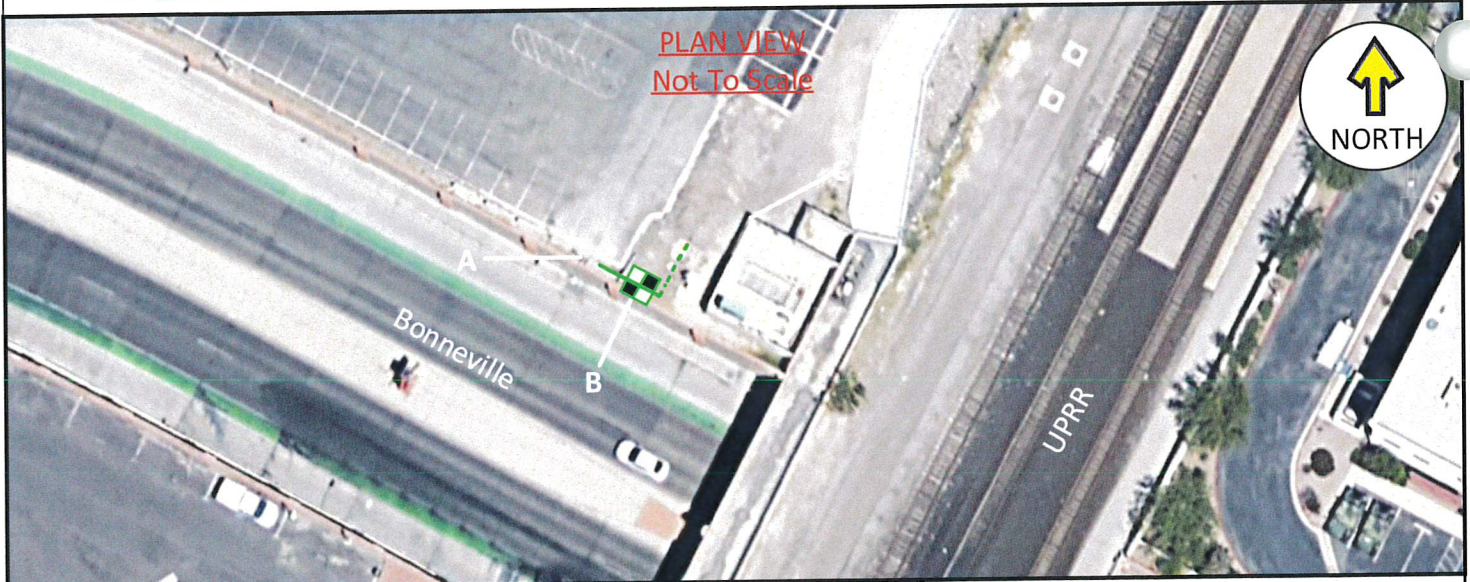


Field Calcs. (ft)	
Rod-Top Util.	
Rod-Ref. Pt.	
Top of Util.	1.99'
Hand Measure	
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Facing North

■ Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Street Light	20'	B Wall	2'	C Corner of Wall	37'

NOTES: Reference point set over west leg of FM pipe. Actual angle point is east of this point encased in concrete.

Quality Control Checks:
 Field Check DS (Initials)
 Office Check DE (Initials)
 Final Check RT (Initials)



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UTILITY TEST HOLE REPORT

TEST HOLE NO: 2 - rev1

KCI JOB NO: 211901729-A

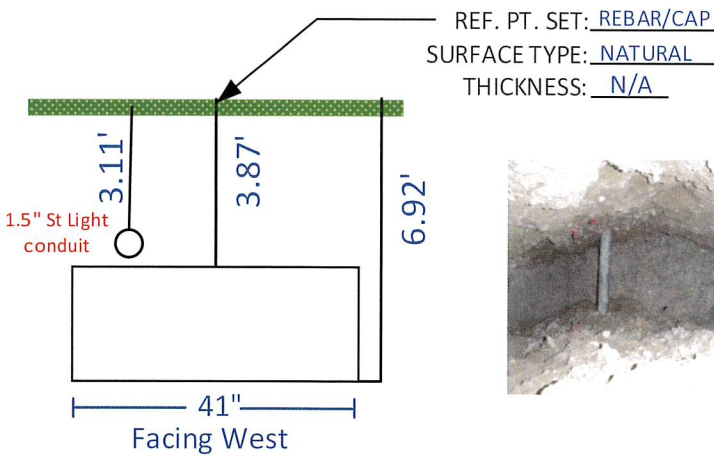
CLIENT JOB NO: 10444A.10

TEST HOLE DATE: 9-4-19

PROJECT LOCATION: Bonneville/Grand Central

UTILITY TYPE: St Light / Electric
OWNER: NV Energy

UTILITY SIZE (NOMINAL): 1.5"/41" wide UTILITY MATERIAL: Plastic/Concrete
(visual appearance)



Field Calcs. (ft)	
Rod-Top 1"	10.42'
Rod-Ref. Pt.	7.31'
Top of 1.5"	3.11'
Hand Measure	3.10'
Rod-Bottom Enc.	14.23'
Rod-Ref. Pt.	7.31'
Bottom of Enc.	6.92'
Hand Measure	6.93'

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location

PLAN VIEW
Not To Scale



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Street Light	27'	B Corner of Platform	3'	C Corner of Building	11'

NOTES:

Red tear tape at 2.59' and 3.49'.

Quality Control Checks:
Field Check **DM** (Initials)
Office Check **DE** (Initials)
Final Check **RT** (Initials)



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KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 3 KCI JOB NO: 211901729-A
 CLIENT JOB NO: 10444A.10
 TEST HOLE DATE: 8-29-19 PROJECT LOCATION: Bonneville/UPRR

UTILITY TYPE: Sewer UTILITY SIZE (NOMINAL): 21" UTILITY MATERIAL: Plastic
 OWNER: City of Las Vegas (visual appearance)

REF. PT. SET: REBAR/CAP
 SURFACE TYPE: NATURAL
 THICKNESS: N/A

8.51'

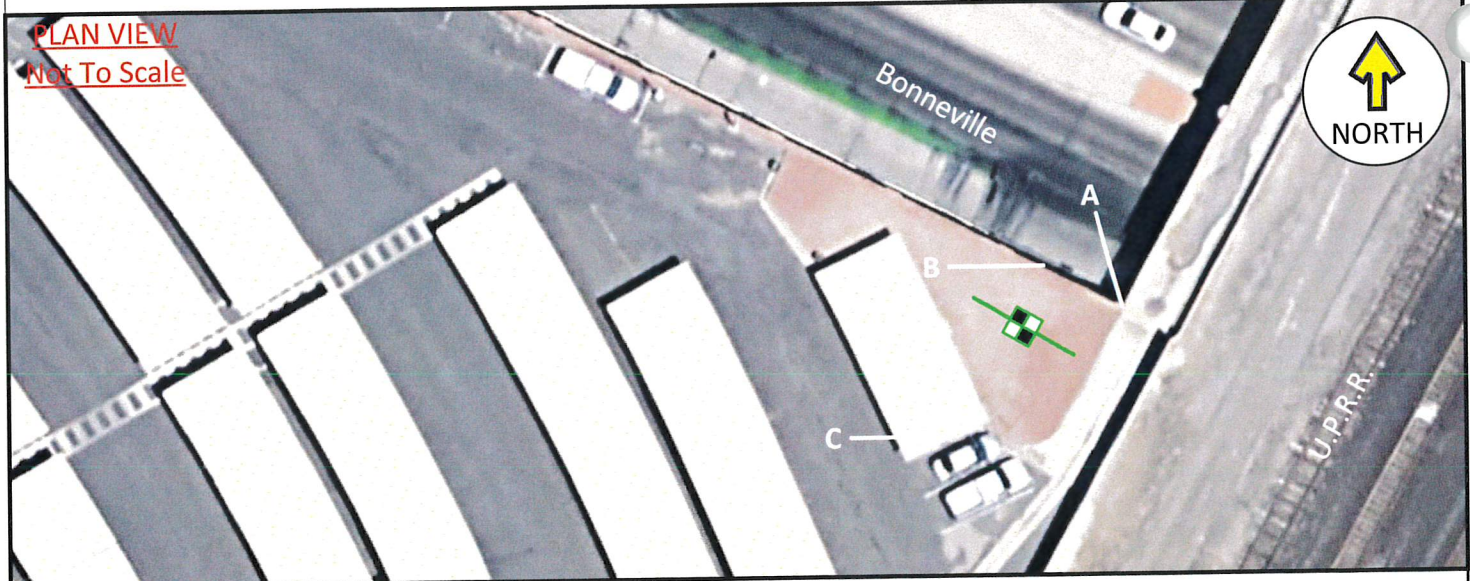
21"



Field Calcs. (ft)	
Rod-Top Util.	13.19'
Rod-Ref. Pt.	4.68'
Top of Util.	8.51'
Hand Measure	8.52'
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Corner of Wall	14'	B Face of Wall	7'	C Awning Post	35'

NOTES:

Quality Control Checks:
 Field Check DM (Initials)
 Office Check DE (Initials)
 Final Check RT (Initials)



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KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 4

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

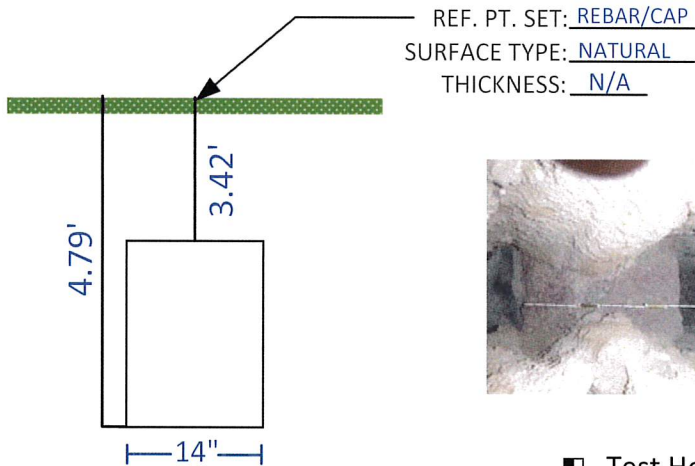
TEST HOLE DATE: 8-28-19

PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Electric
OWNER: NV Energy

UTILITY SIZE (NOMINAL): 14" wide

UTILITY MATERIAL: Concrete
(visual appearance)



Field Calcs. (ft)	
Rod-Top Util.	8.61'
Rod-Ref. Pt.	5.19'
Top of Util.	3.42'
Hand Measure	
Rod-Bottom Util.	9.98'
Rod-Ref. Pt.	5.19'
Bottom of Util.	4.79'
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location

PLAN VIEW
Not To Scale



SWING TIE DATA

DESCRIPTION			DIST (FT)	DESCRIPTION			DIST (FT)	DESCRIPTION			DIST (FT)
A	Street Light	2'	B	Street Light	120'	C	End Fence Line	40'			

NOTES:

Quality Control Checks:
Field Check DM (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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Lic # NV0081727

KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 5

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

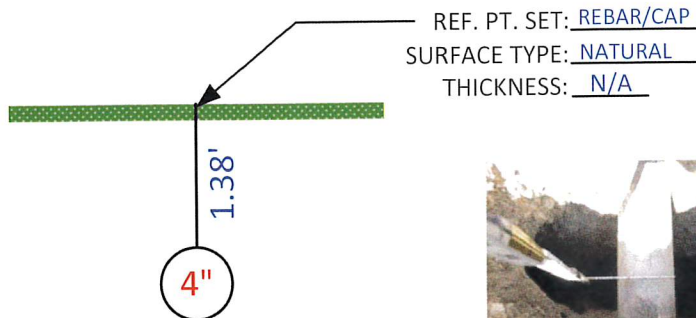
TEST HOLE DATE: 8-28-19

PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Sewer FM
OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4"

UTILITY MATERIAL: Plastic
(visual appearance)



REF. PT. SET: REBAR/CAP
SURFACE TYPE: NATURAL
THICKNESS: N/A



Field Calcs. (ft)	
Rod-Top Util.	6.63'
Rod-Ref. Pt.	5.25'
Top of Util.	1.38'
Hand Measure	
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

■ Test Hole Location

PLAN VIEW
Not To Scale



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Street Light	3'	B Street Light	120'	C End Fence Line	40'

NOTES:

Tear Tape at 0.80'

Quality Control Checks:
Field Check **DM** (Initials)
Office Check **DE** (Initials)
Final Check **RT** (Initials)



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KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 6

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

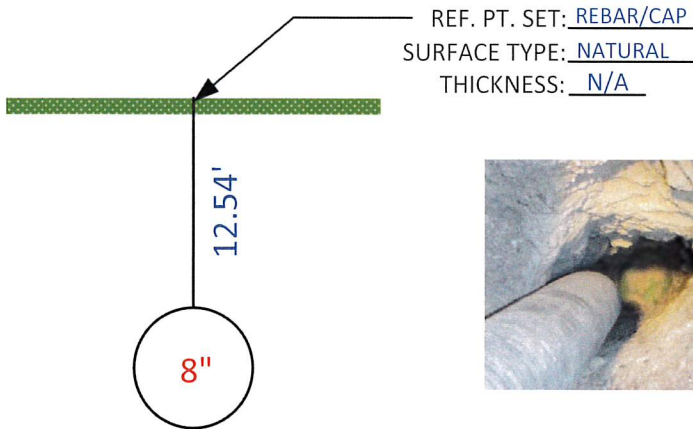
TEST HOLE DATE: 8/30/19

PROJECT LOCATION: Bonneville / E of Promenade

UTILITY TYPE: Sewer
OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 8"

UTILITY MATERIAL: Plastic
(visual appearance)

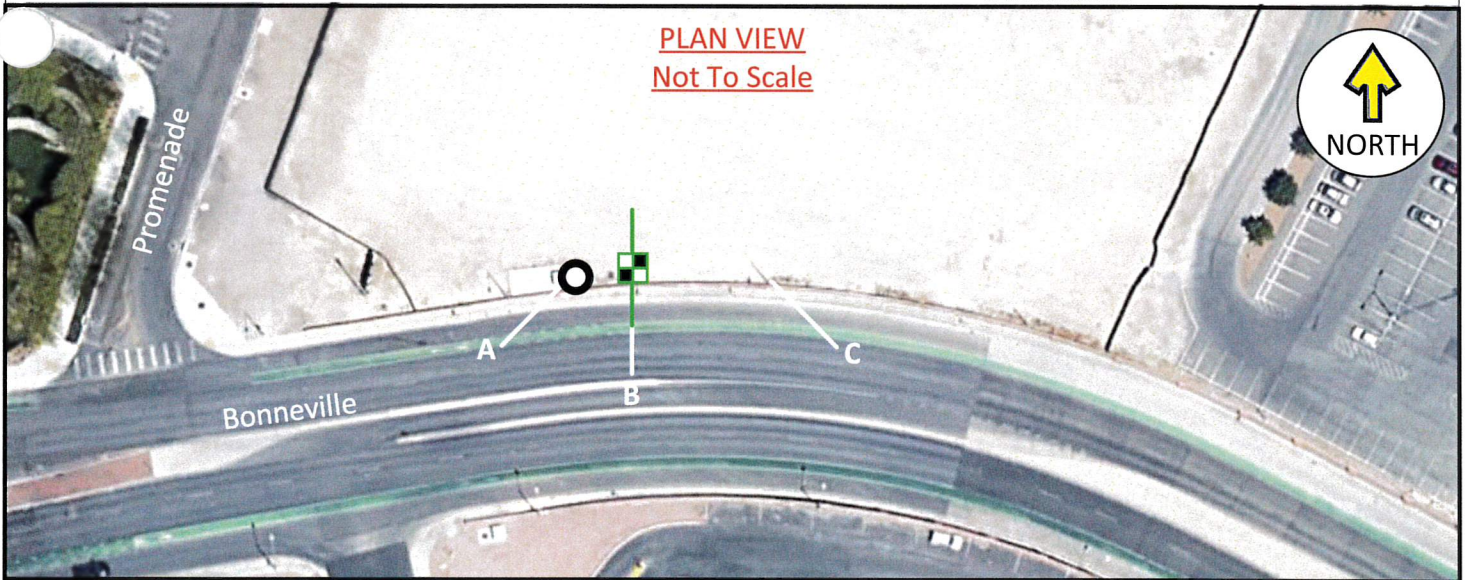


Field Calcs. (ft)	
Rod-Top Util.	17.45'
Rod-Ref. Pt.	4.91'
Top of Util.	12.54'
Hand Measure	12.44'
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

■ Test Hole Location

PLAN VIEW
Not To Scale



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Electric Manhole	29'	B Face of Wall	0.5'	C Street Light	50'

NOTES:

Actual end of sewer stub unknown.
Potholed between FM and barrier wall.

Quality Control Checks:
Field Check PT (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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KCI

UTILITY TEST HOLE REPORT

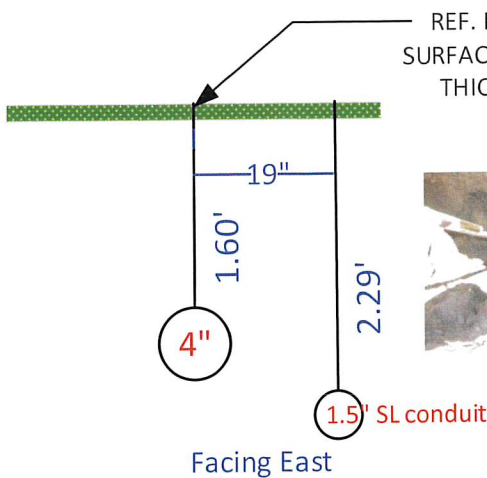
TEST HOLE NO: 6A
 TEST HOLE DATE: 8/30/19

KCI JOB NO: 211901729-A
 CLIENT JOB NO: 10444A.10
 PROJECT LOCATION: Bonneville / E of Promenade

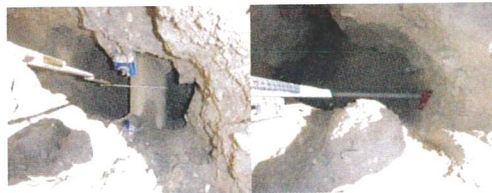
UTILITY TYPE: Sewer Force Main/
Street Light
 OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4"/1.5"

UTILITY MATERIAL: Plastic
 (visual appearance)



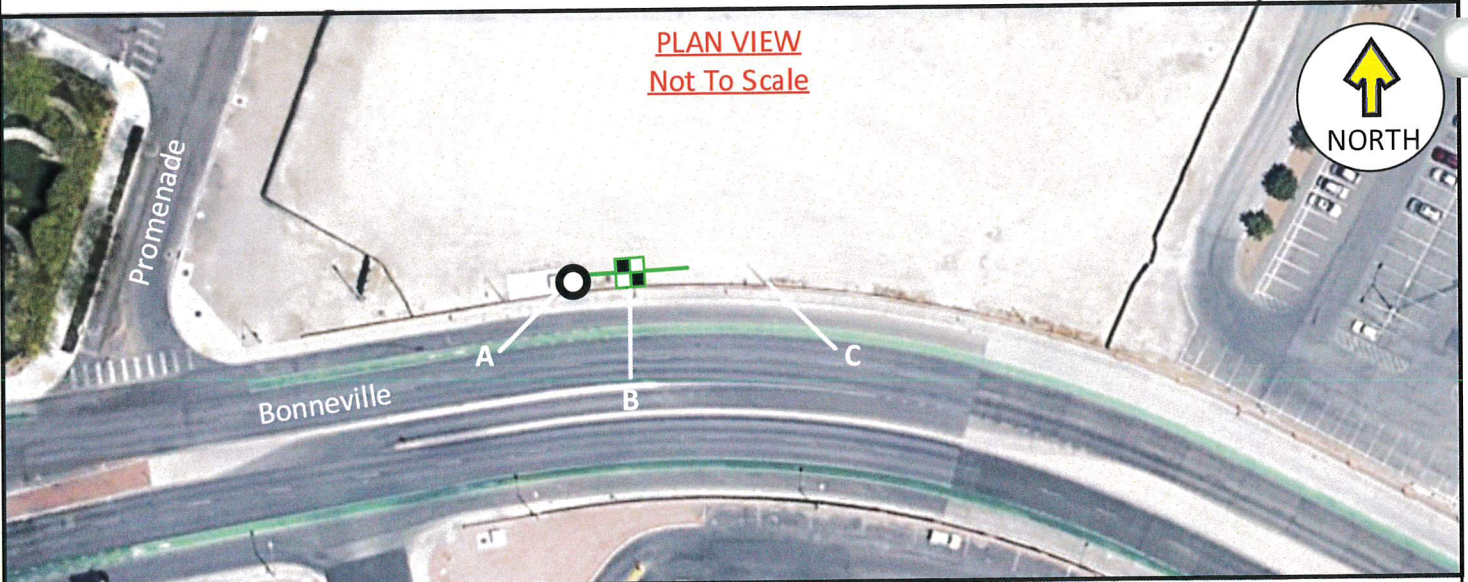
REF. PT. SET: REBAR/CAP
 SURFACE TYPE: NATURAL
 THICKNESS: N/A



Field Calcs. (ft)	
Rod-Top 4"	6.97'
Rod-Ref. Pt.	5.37'
Top of 4"	1.60'
Hand Measure	1.61'
Rod-Top 1.5"	7.52'
Rod-Ref. Pt.	5.23'
Top of 1.5"	2.29'
Hand Measure	2.29'

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA			
DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Electric Manhole	29'	B Face of Wall	3'
		C Street Light	50'

NOTES:

Blue tear tape at 1.45' (FM)
 Red tear tape at 2.00' (SL)

Quality Control Checks:
 Field Check PT (Initials)
 Office Check DE (Initials)
 Final Check RT (Initials)



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KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 7

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

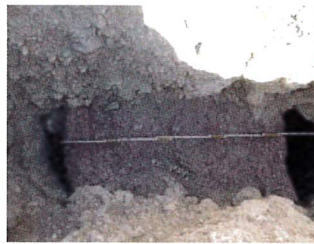
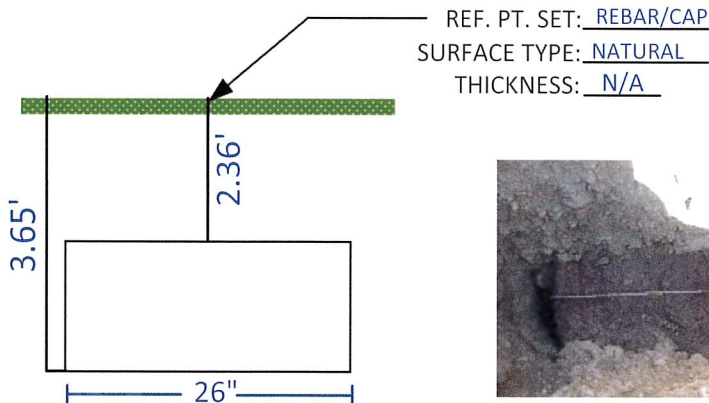
TEST HOLE DATE: 8-28-19

PROJECT LOCATION: Bonneville/ E of Promenade

UTILITY TYPE: Electric
OWNER: NV Energy

UTILITY SIZE (NOMINAL): 26" wide

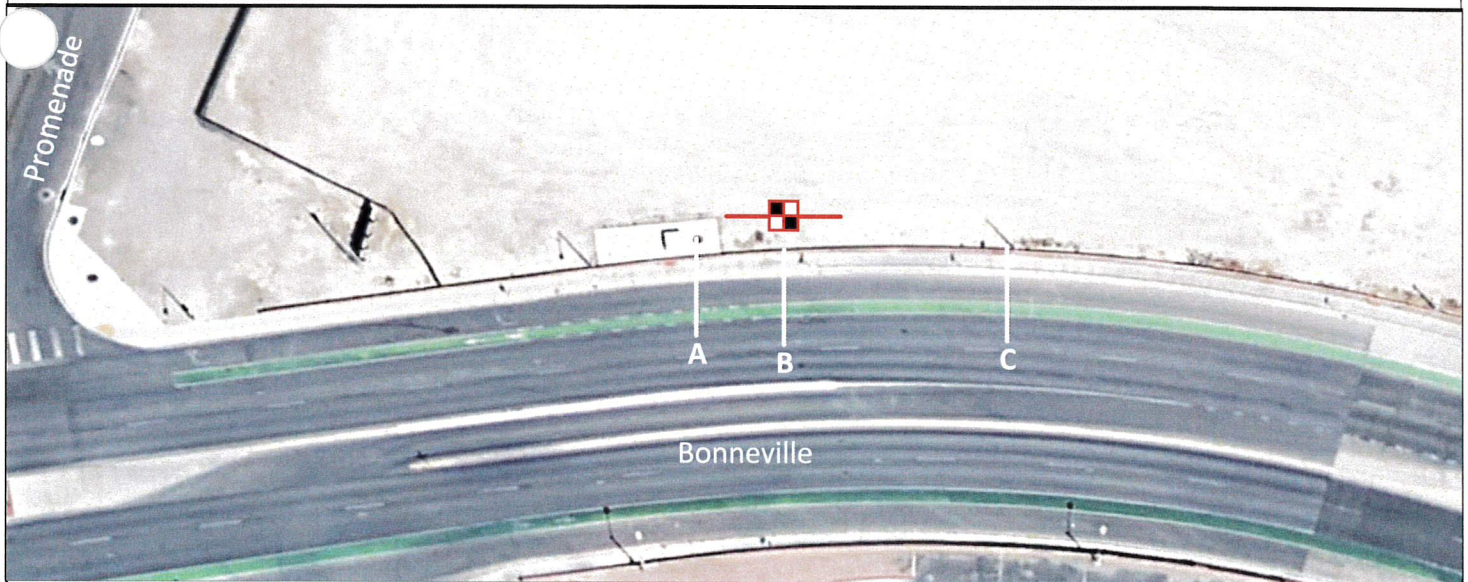
UTILITY MATERIAL: Concrete
(visual appearance)



Field Calcs. (ft)	
Rod-Top Util.	7.19'
Rod-Ref. Pt.	4.83'
Top of Util.	2.36'
Hand Measure	
Rod-Bottom Util.	8.48'
Rod-Ref. Pt.	4.83'
Bottom of Util.	3.65'
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Electric Manhole	19'	B Face of Wall	7'	C Street Light	74'

NOTES:

Quality Control Checks:
Field Check DM (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 8

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

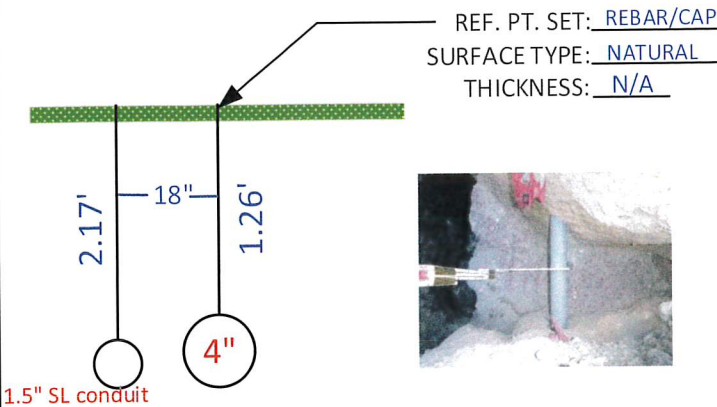
TEST HOLE DATE: 8-27-19

PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Force Main/Street Light
OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4" / 1.5"

UTILITY MATERIAL: Plastic
(visual appearance)



Facing West

Test Hole Location

Field Calcs. (ft)

Rod-Top Util. 6.46'

Rod-Ref. Pt. 5.20'

Top of 4" FM 1.26'

Hand Measure

Rod-Top Util. 7.47'

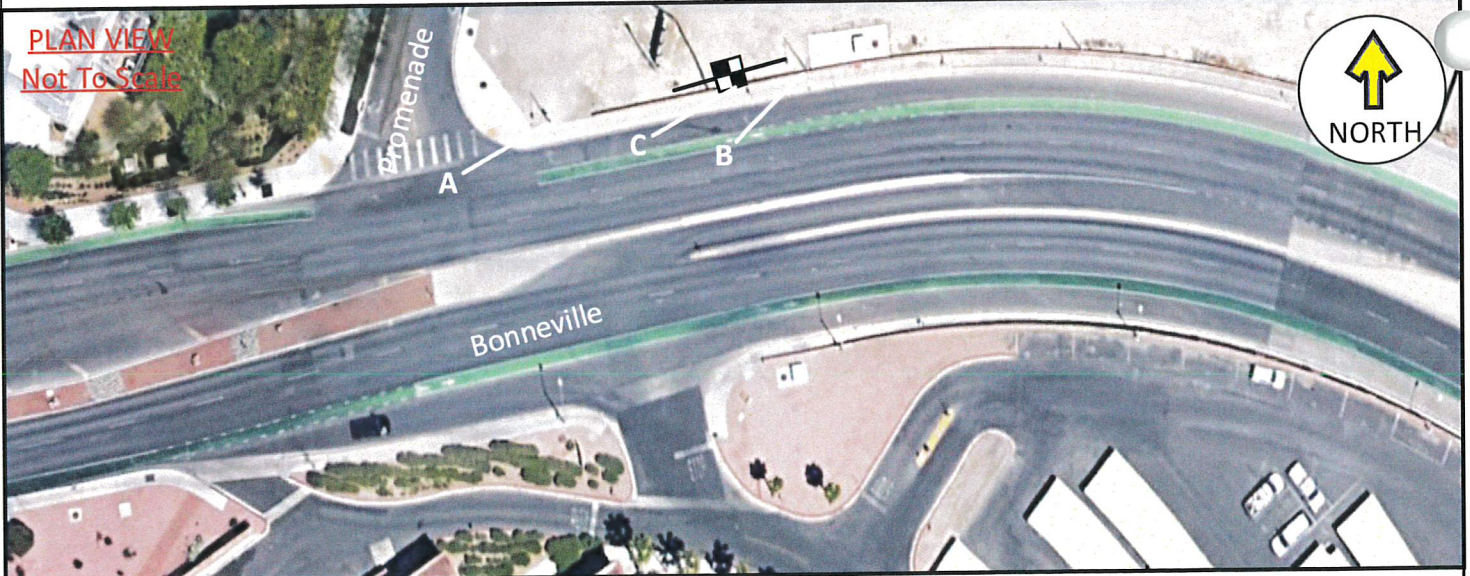
Rod-Ref. Pt. 5.30'

Top of SL 2.17'

Hand Measure

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

PLAN VIEW
Not To Scale



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Street Light	75'	B Street Light	37'	C Face of Wall	3'

NOTES:

Quality Control Checks:

Field Check DM (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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UTILITY TEST HOLE REPORT

TEST HOLE NO: 8A – rev 1

KCI JOB NO: 211901729-A

CLIENT JOB NO: Tesora Phase 2

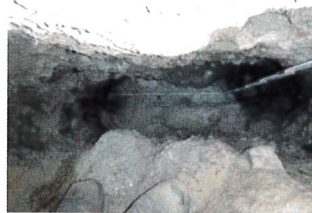
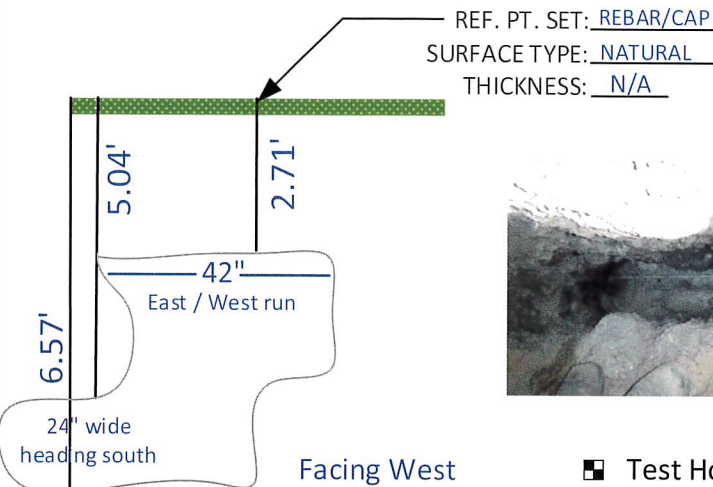
TEST HOLE DATE: 8-27-19

PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Electric
OWNER: NV Energy

UTILITY SIZE (NOMINAL): 42" wide (E/W)
24" wide (N/S)

UTILITY MATERIAL: Concrete
(visual appearance)



Field Calcs. (ft)	
Rod-Top 42"	7.89'
Rod-Ref. Pt.	5.18'
Top of 42"	2.71'
Hand Measure	2.72'
Rod-Bottom 24"	11.75'
Rod-Ref. Pt.	5.18'
Bottom of 24"	6.57'
Hand Measure	6.58'

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Street Light	72'	B Street Light	40'	C Face of Wall	1'

NOTES:

Quality Control Checks:
Field Check DM (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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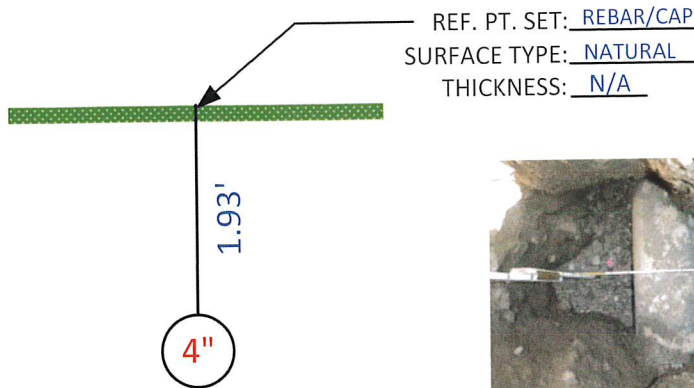
UTILITY TEST HOLE REPORT

TEST HOLE NO: 9 KCI JOB NO: 211901729-A
 CLIENT JOB NO: 10444A.10
 TEST HOLE DATE: 8-26-19 PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Sewer FM
 OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4"

UTILITY MATERIAL: Plastic
 (visual appearance)



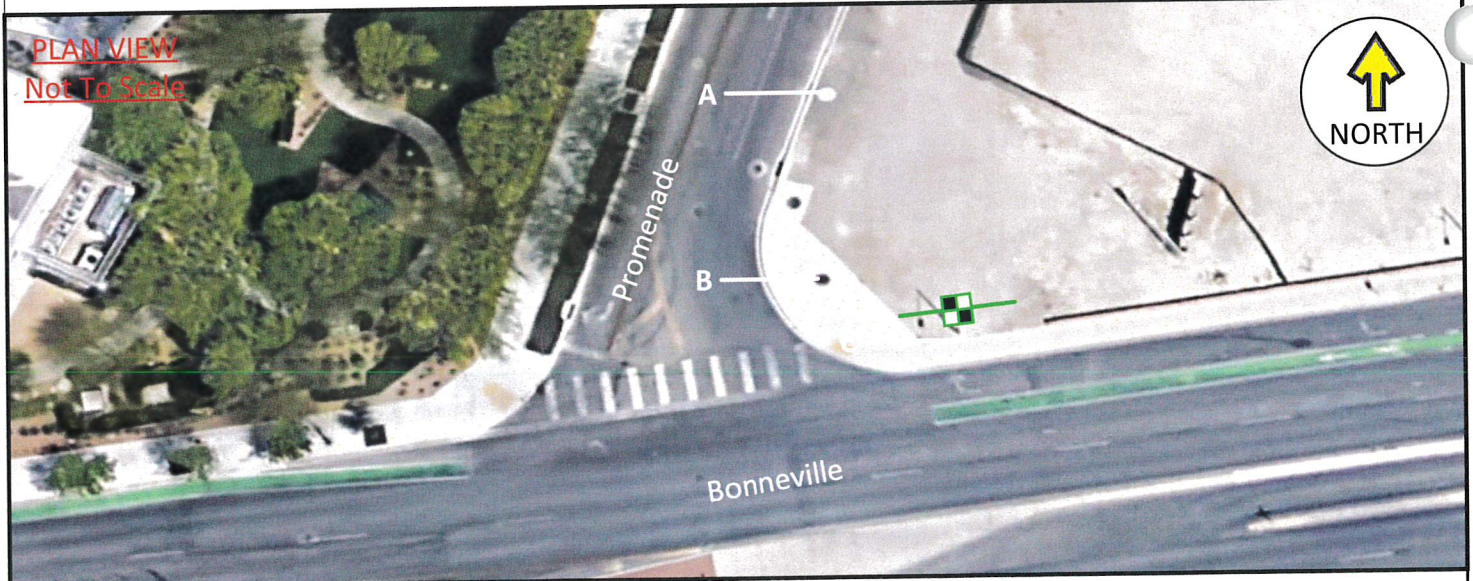
REF. PT. SET: REBAR/CAP
 SURFACE TYPE: NATURAL
 THICKNESS: N/A



Field Calcs. (ft)	
Rod-Top Util.	8.00'
Rod-Ref. Pt.	6.07'
Top of Util.	1.93'
Hand Measure	1.94'
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Water Valve	64'	B Sewer Manhole	31'	C Street Light	4'

NOTES:

Quality Control Checks:
 Field Check DM (Initials)
 Office Check DE (Initials)
 Final Check RT (Initials)



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UTILITY TEST HOLE REPORT

TEST HOLE NO: 10

KCI JOB NO: 211901729-A

CLIENT JOB NO: Tesora Phase 2

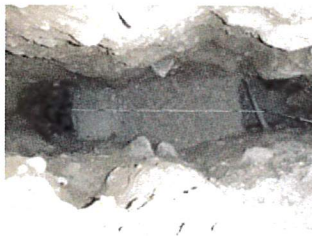
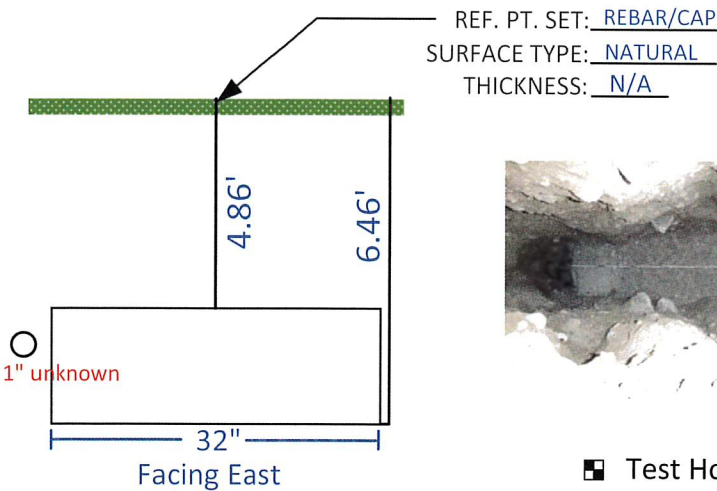
TEST HOLE DATE: 8-26-19

PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Electric
OWNER: NV Energy

UTILITY SIZE (NOMINAL): 32" wide

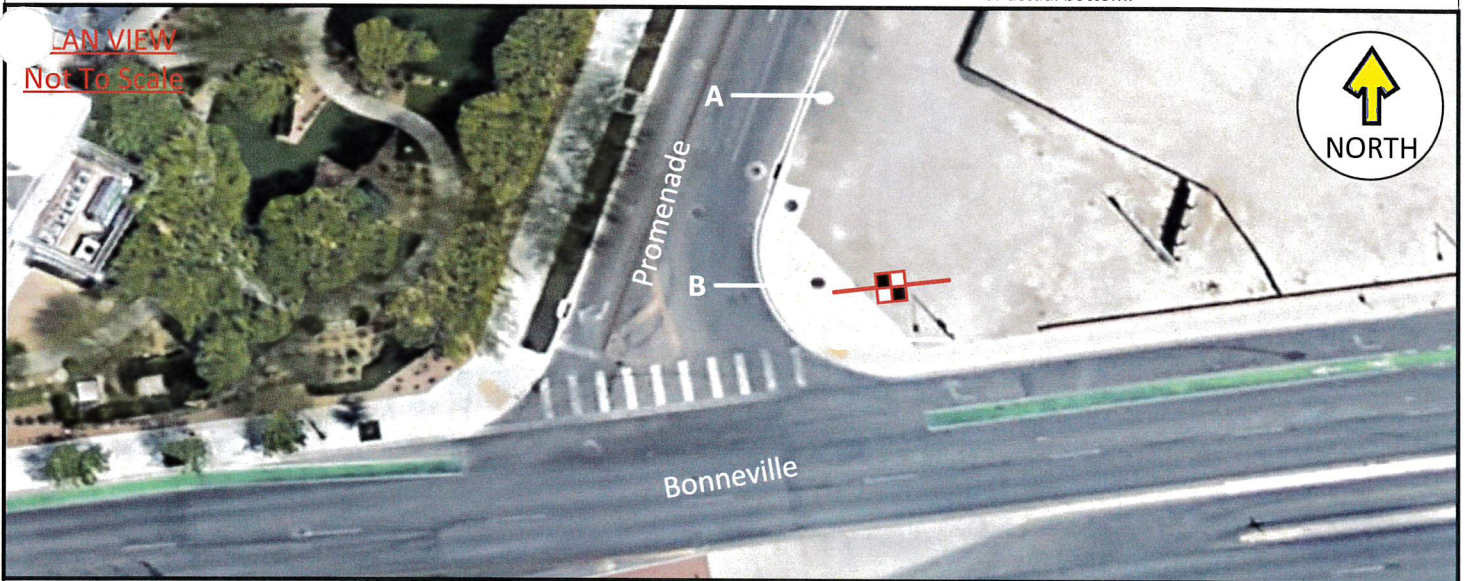
UTILITY MATERIAL: Concrete
(visual appearance)



Test Hole Location

Field Calcs. (ft)	
Rod-Top Util.	10.65'
Rod-Ref. Pt.	5.79'
Top of Util.	4.86'
Hand Measure	
Rod-Bottom Util.	12.25'
Rod-Ref. Pt.	5.79'
Bottom of Util.	6.46'
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Water Valve	56'	B Sewer Manhole	17'	C Street Light	14'

NOTES:

Quality Control Checks:
Field Check **DM** (Initials)
Office Check **DE** (Initials)
Final Check **RT** (Initials)



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UTILITY TEST HOLE REPORT

TEST HOLE NO: 10A

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

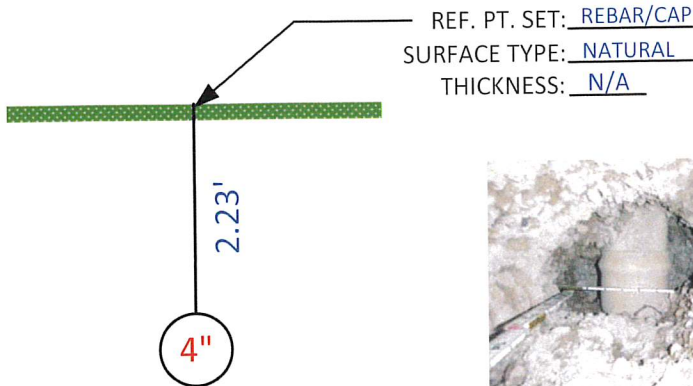
TEST HOLE DATE: 8-26-19

PROJECT LOCATION: Bonneville/Promenade

UTILITY TYPE: Sewer FM
OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4"

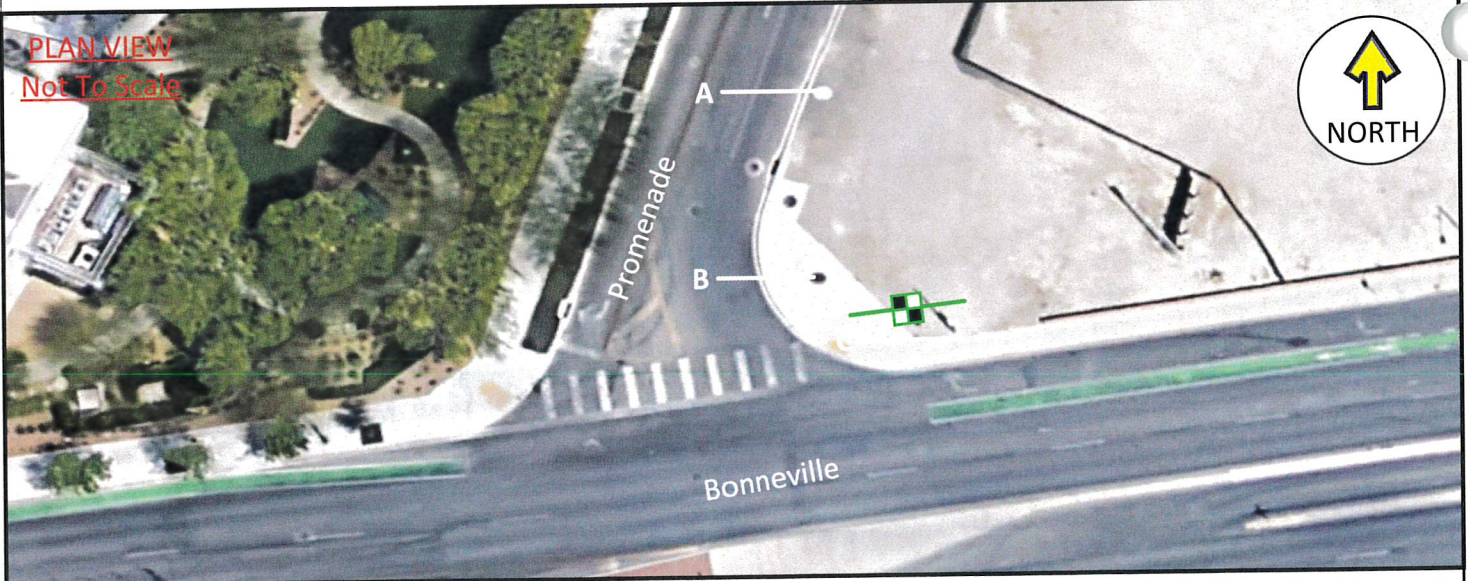
UTILITY MATERIAL: Plastic
(visual appearance)



Field Calcs. (ft)	
Rod-Top Util.	8.09'
Rod-Ref. Pt.	5.86'
Top of Util.	2.23'
Hand Measure	
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA			
DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Water Valve	59'	B Sewer Manhole	20'
		C Street Light	11'

NOTES:

Quality Control Checks:
Field Check DM (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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KCI

UTILITY TEST HOLE REPORT

TEST HOLE NO: 11

KCI JOB NO: 211001729-A

TEST HOLE DATE: 9-5-19

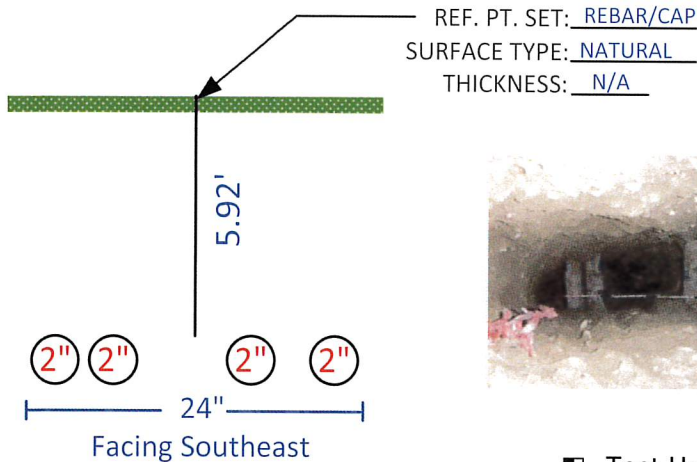
CLIENT JOB NO: 10444A.10

PROJECT LOCATION: Bonneville/UPRR

UTILITY TYPE: Fiber Optic
OWNER: City of Las Vegas

UTILITY SIZE (NOMINAL): 4-2"

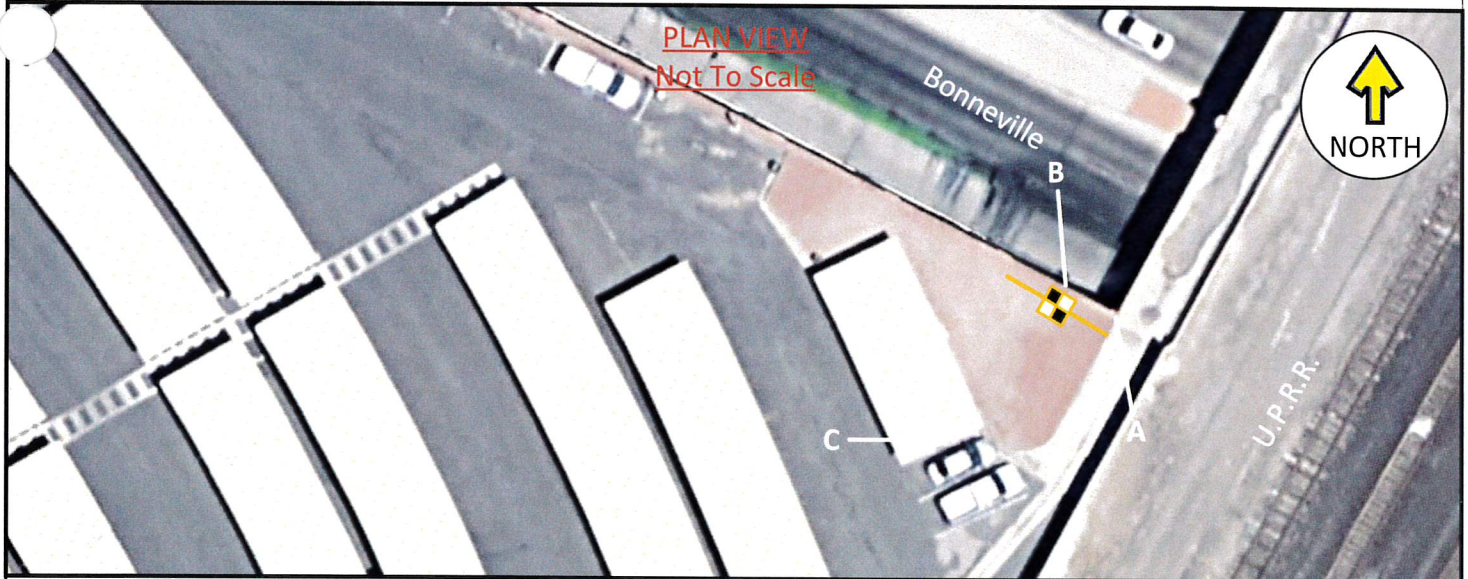
UTILITY MATERIAL: Plastic
(visual appearance)



Field Calcs. (ft)	
Rod-Top Util.	11.73'
Rod-Ref. Pt.	5.81'
Top of Util.	5.92'
Hand Measure	5.92'
Rod-Bottom Util.	
Rod-Ref. Pt.	
Bottom of Util.	
Hand Measure	

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Corner of Wall	4'	B Face of Wall	10'	C Awning Post	38'

NOTES:

Quality Control Checks:
Field Check DS (Initials)
Office Check DE (Initials)
Final Check RT (Initials)



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UTILITY TEST HOLE REPORT

TEST HOLE NO: 12

KCI JOB NO: 211901729-A

CLIENT JOB NO: 10444A.10

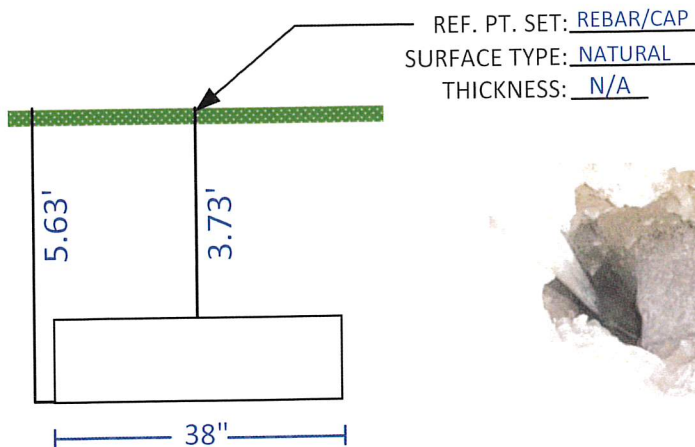
TEST HOLE DATE: 8-29-19

PROJECT LOCATION: Bonneville / UPRR

UTILITY TYPE: Electric
OWNER: NV Energy

UTILITY SIZE (NOMINAL): 38" wide

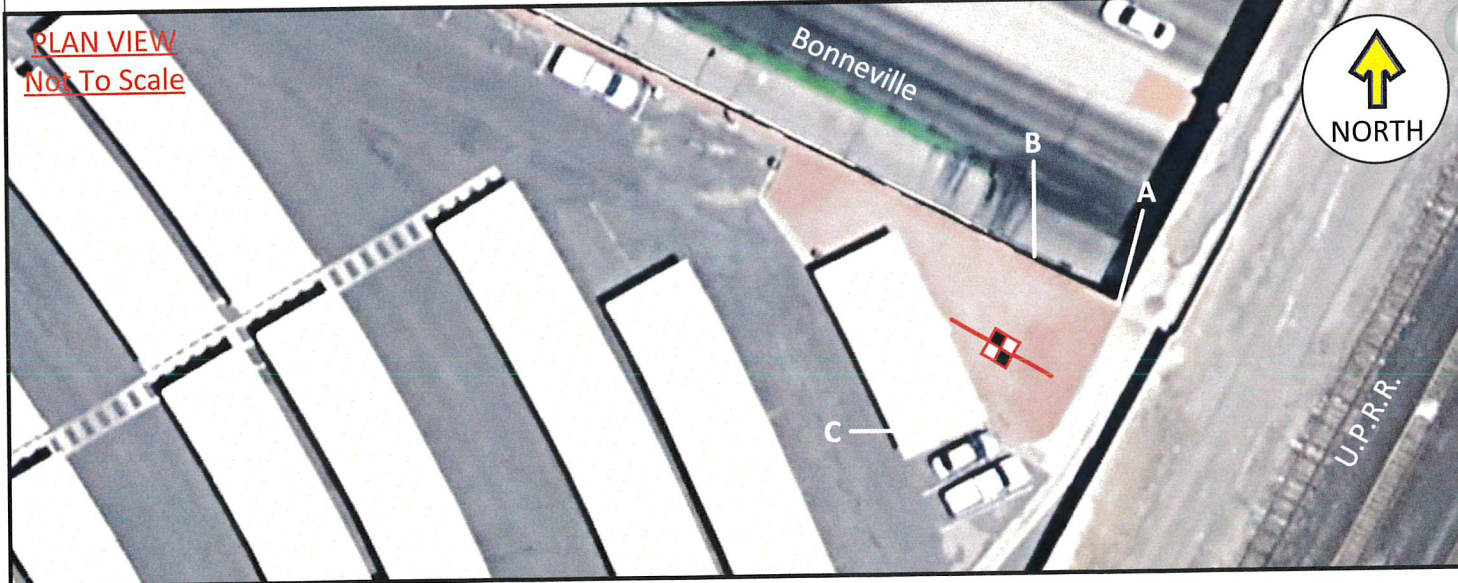
UTILITY MATERIAL: Concrete
(visual appearance)



Field Calcs. (ft)	
Rod-Top Util.	8.16'
Rod-Ref. Pt.	4.43'
Top of Util.	3.73'
Hand Measure	3.74'
Rod-Bottom Util.	10.06'
Rod-Ref. Pt.	4.43'
Bottom of Util.	5.63'
Hand Measure	5.64'

*Where applicable, utility bottom noted is apparent bottom unless noted as actual bottom. Additional material and/or utilities may exist below apparent or actual bottom.

Test Hole Location



SWING TIE DATA

DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)	DESCRIPTION	DIST (FT)
A Corner of Wall	23'	B Face of Wall	18'	C Awning Post	23'

NOTES:

Quality Control Checks:
Field Check **DM** (Initials)
Office Check **DE** (Initials)
Final Check **RT** (Initials)



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Appendix J

LIST OF PROJECT SPECIFICATIONS

CITY SECTIONS & TITLE

SECTION 100 – GENERAL PROJECT REQUIREMENTS
SECTION 101 – DEFINITIONS AND TERMS
SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS
SECTION 103 – AWARD AND EXECUTION OF CONTRACT
SECTION 104 – SCOPE OF WORK
SECTION 105 – CONTROL OF WORK
SECTION 106 – CONTROL OF MATERIALS
SECTION 107 – LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC
SECTION 108 – PROSECUTION AND PROGRESS
SECTION 109 – MEASUREMENT AND PAYMENT
SECTION 110 – WAGES, HOURS, AND CONDITIONS OF EMPLOYMENT
SECTION 170 – CONSTRUCTION CONFLICTS AND CONTINGENCIES
SECTION 200 – MOBILIZATION AND DEMOBILIZATION
SECTION 202 – REMOVAL OF STRUCTURES AND OBSTRUCTIONS
SECTION 203 – EXCAVATION AND EMBANKMENT
SECTION 206 – STRUCTURE EXCAVATION
SECTION 207 – STRUCTURE BACKFILL
SECTION 208 – TRENCH EXCAVATION AND BACKFILL
SECTION 270 – DEWATERING
SECTION 302 – AGGREGATE BASE COURSES
SECTION 401 – PLANTMIX BITUMINOUS PAVEMENTS - GENERAL
SECTION 402 – PLANTMIX BITUMINOUS SURFACE
SECTION 405 – TACK COAT
SECTION 406 – PRIME COAT
SECTION 501 – PORTLAND CEMENT CONCRETE
SECTION 502 – CONCRETE STRUCTURES
SECTION 505 – REINFORCING STEEL
SECTION 570 – CONCRETE MASONRY UNIT WALLS
SECTION 612 – POLYMER CONCRETE SANITARY SEWER MANHOLES
SECTION 613 – CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS
SECTION 616 – FENCING
SECTION 621 – MONUMENTS
SECTION 622 – CONSTRUCTION SURVEYING BY THE CONTRACTOR
SECTION 624 - ACCOMMODATIONS FOR PUBLIC TRAFFIC
SECTION 625 – CONSTRUCTION SIGNS
SECTION 626 – FINAL CLEANUP
SECTION 627 – PERMANENT SIGNS
SECTION 628 – TRAFFIC STRIPING, PAVEMENT MARKINGS, AND CURB MARKINGS
SECTION 637 – POLLUTION CONTROL
SECTION 650 – ONSITE IMPROVEMENTS
SECTION 654 – SHAFT EXCAVATION SUPPORT AND PROTECTION
SECTION 655 – GEOTECHNICAL MONITORING
SECTION 670 – UTILITY CONDUITS
SECTION 671 – UTILITY SUBSTRUCTURES
SECTION 695 – DIVERSION OF SEWAGE FLOW
SECTION 703 – BITUMINOUS MATERIALS
SECTION 705 – AGGREGATES FOR BITUMINOUS COURSES

ADDITIONAL SECTIONS (PROVIDED BY CAROLLO)

SECTION 00_73_00 - SUPPLEMENTARY CONDITIONS
SECTION 01_75_17 - COMMISSIONING
SECTION 01_81_01 - PROJECT DESIGN CRITERIA
SECTION 01_81_02 - SEISMIC DESIGN CRITERIA
SECTION 01_81_04 - WIND DESIGN CRITERIA
SECTION 13_34_24 - PRE-FABRICATED WALK-IN ELECTRICAL ENCLOSURES
SECTION 26_05_00 - COMMON WORK RESULTS FOR ELECTRICAL
SECTION 26_05_03 - UTILITY COORDINATION
SECTION 26_05_09 - LOW VOLTAGE MOTORS UP TO 500 HORSEPOWER
SECTION 26_05_18 - 600-VOLT OR LESS WIRES AND CABLES
SECTION 26_05_22 - MEDIUM VOLTAGE CABLE CONNECTIONS
SECTION 26_05_26 - GROUNDING AND BONDING
SECTION 26_05_29 - HANGERS AND SUPPORTS
SECTION 26_05_33 - CONDUITS
SECTION 26_05_34 - BOXES
SECTION 26_05_35 - WIREWAY
SECTION 26_05_53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
SECTION 26_06_01 - CONDUIT SCHEDULE
SECTION 26_08_50 - FIELD ELECTRICAL ACCEPTANCE TESTS
SECTION 26_12_16 - DRY-TYPE, MEDIUM-VOLTAGE TRANSFORMERS
SECTION 26_24_20 - LOW VOLTAGE MOTOR CONTROL CENTERS
SECTION 26_29_05 - MOTOR STARTERS
SECTION 26_32_14 - SINGLE DIESEL FUELED ENGINE GENERATOR ABOVE 200 KW
SECTION 26_36_24 - TRANSFER SWITCHES
SECTION 26_50_00 - LIGHTING
SECTION 26_50_10 - LIGHTING: LED LUMINAIRES
SECTION 31_23_24 - CONTROLLED LOW STRENGTH MATERIAL (CLSM)
SECTION 31_62_16.13 - SHEET STEEL PILES
SECTION 32_31_00 - FENCES AND GATES
SECTION 33_05_00.01 - COMMON WORK RESULTS FOR GENERAL PIPING - INFRASTRUCTURE
SECTION 33_05_00.03 - PIPE IDENTIFICATION - INFRASTRUCTURE
SECTION 33_20_05 - WELL DRILLING
SECTION 33_71_21 - PRECAST ELECTRICAL HANDHOLES AND ELECTRICAL MANHOLES
SECTION 40_05_00.01 - COMMON WORK RESULTS FOR GENERAL PIPING - PLANT
SECTION 40_05_06.01 - PIPING SPECIALTIES
SECTION 40_05_06.03 - PIPE COUPLINGS - PLANT
SECTION 40_05_07.01 - PIPE SUPPORTS
SECTION 40_05_17.05 - COPPER WATER TUBE: SEAMLESS, ASTM B88
SECTION 40_05_19.01 - DUCTILE IRON PIPE: AWWA C151 - PLANT
SECTION 40_05_51.01 - COMMON WORK RESULTS FOR VALVES
SECTION 40_05_52 - SPECIALTY VALVES
SECTION 40_05_62 - PLUG VALVES
SECTION 40_05_65.24 - CHECK VALVES
SECTION 40_05_67.40 - AIR AND VACUUM RELIEF VALVES
SECTION 40_05_71.16 - FLAP GATES
SECTION 40_61_00 - COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS
SECTION 40_61_15 - CONTROL STRATEGIES
SECTION 40_61_16 - SPECIFIC CONTROL STRATEGIES
SECTION 40_64_01 - CONTROL SYSTEMS: PROGRAMMABLE LOGIC CONTROLLERS
SECTION 40_67_01 - CONTROL SYSTEMS: PANELS, ENCLOSURES, AND PANEL COMPONENTS
SECTION 40_71_79 - FLOW MEASUREMENT: SWITCHES
SECTION 40_72_13 - LEVEL MEASUREMENT: ULTRASONIC
SECTION 40_72_76 - LEVEL MEASUREMENT: SWITCHES

SECTION 40_73_13 - PRESSURE/VACUUM MEASUREMENT: GAUGES
SECTION 40_73_36 - PRESSURE/VACUUM MEASUREMENT: SWITCHES
SECTION 40_73_63 - PRESSURE/VACUUM MEASUREMENT: DIAPHRAGM AND ANNULAR SEALS
SECTION 40_73_65 - PRESSURE MEASUREMENT: SUBMERSIBLE
SECTION 40_80_01 - COMMISSIONING FOR INSTRUMENTATION AND CONTROLS
SECTION 40_96_15 - SCHEDULES: I/O LIST
SECTION 40_96_20 - SCHEDULES: FIELD INSTRUMENTS
SECTION 40_96_21 - SCHEDULES: CONTROL PANELS
SECTION 41_22_17 - DAVIT CRANES
SECTION 43_25_13.31 - SUBMERSIBLE MEDIUM CAPACITY CENTRIFUGAL PUMPS
SECTION 46_73_13 - ALUMINUM COVERS

CITY APPENDICES

APPENDIX A – PROJECT SIGNS
APPENDIX B – CITY OF LAS VEGAS TRENCH PLATE REQUIREMENTS
APPENDIX C – SAMPLE PROJECT SCHEDULES
APPENDIX D – SWPPP CHECKLIST

City of Las Vegas Department of Public Works
Bonneville Pump Station Replacement
Preliminary Design Report
Appendix K - Permit Matrix (Draft)

Number	Issuing Agency	Permit Required	Regulated Activity	Requirements & Prerequisites	Comments
1	City of Las Vegas - Construction Management, City Engineering Division	Traffic Barricade Plan Approval	Traffic barricade plan associated with construction activity or discharge activity impacting a City of Las Vegas ROW	Not required prior to issuing Excavation and Construction Permits except for Excavation Permit for discharge of water. Approved barricade plan with the City of Las Vegas Traffic Department. Include plans, valuation, and location.	Required for stormwater flow bypass operations during construction, as the bypass system will be constructed in the Bonneville Avenue ROW, in the underpass dip section.
2	City of Las Vegas - Department of Building and Safety	Block Wall / Fence Permit	Site perimeter block wall or fence	Desert tortoise mitigation fees paid, County Dust Control Permit, one set of approved grading plans, total acres (clearing and grubbing); total cubic yards of material being moved, cut and imported (grading), permit fees, and valuation (necessary for statistical report).	Required for the construction of the perimeter block wall and discharge header fencing for the replacement pump station.
3		Grading Permit	On-site grading activity	Must consult with Flood Control Section and Traffic Division to determine if a drainage study and traffic impact analysis are required. No application. Must submit approved Barricade Plan and plans must be approved from plans check above. Barricade plan is approved by the Traffic Department. Must also have County Dust Permit.	Required for grading activities associated with construction of the replacement pump station.
4	City of Las Vegas - Land Development Services, Public Works	Plans check	Construction within City Jurisdiction	Section and Traffic Division to determine if a drainage study and traffic impact analysis are required. No application. Must submit approved Barricade Plan and plans must be approved from plans check above. Barricade plan is approved by the Traffic Department. Must also have County Dust Permit.	-
5		Excavation Permit	Underground construction on private property or within a City of Las Vegas ROW.	Project-specific.	Required for excavation of new pump station wetwell.
6	City of Las Vegas - Right of Way, City Engineering Division	Authorization to Enter Property (AEP) Permit	Activity on private property	Project-specific.	For encroachment onto north side of Bonneville Avenue for force main removal and replacement.
7		AEP Permit	Activity on private property	Project-specific.	For encroachment onto south side of Bonneville Avenue (Clark County Government Center parking lot) for dewatering well installation.
8	City of Las Vegas - Environmental Oversight Services, Public Works	Easement Acquisition	-	Project-specific.	For additional easement acquisition for the replacement force main.
9		Groundwater Discharge Permit	-	Project-specific.	For discharge of groundwater from the pump station site and the Clark County Government Center dewatering well into the City sanitary sewer.
10	City of Las Vegas - Fire Prevention Division, Fire & Rescue	Liquid Petroleum Tank / System Permit	Use/storage of liquid petroleum on-site.	Project-specific.	May be needed if the replacement pump station auxiliary generator is powered with diesel fuel.
11	City of Las Vegas - Flood Control, City Engineering Division, Public Work	Drainage Study Review / Approval	Site drainage associated with construction of new facility	Completed drainage study checklist must accompany the study. Need consultation for review.	For review and approval of the drainage study performed to develop design flows for the new pump station.

12	Clark County - Division of Air Quality & Environmental Management	Dust Control Permit	Required for any grading or other land-disturbance activities within Clark County. This permit is required for construction activity in Clark County impacting greater than 0.5 acre or 100 linear feet of trench.	An application form, project location map, and dust mitigation plan are required for submittal.	Required for grading activities associated with construction of the replacement pump station. May not be needed if the total area of the project site is less than 0.5 acre.
13		Temporary Sign Permit	Construction of on-site and off-site temporary signs. Not required for signs required by dust control permit or for signs located in public ROW.	Community Development Division review and permits are required before issuing any Building Department permits.	Required for construction activities associated with the removal and replacement of the pump station.
14	Clark County Building Department	Block Wall / Fence Permit	Construction of perimeter block wall or fence.	Application number obtained; submit application with Site Plan, Zoning Permit, Drainage Review, Building Plan Examination, and Notarized Property Line Authorization form if wall/fence is on property line.	Required for the construction of the groundwater well site on south side of Bonneville Avenue.
15	Clark County - Community Development Division, Public Works	Encroachment Permit	Activity within Clark County ROW.	Construction activity within Clark County ROW. Requires 100 percent design. Required prior to encroachment.	For encroachment onto south side of Bonneville Avenue (Clark County Government Center parking lot) for dewatering well installation.
16		DeMinimis Permit	Discharges to point source discharges into waters of the U.S. pursuant to NRS 445A.465	Project-specific.	Required for discharge of storm water from the new pump station into the adjacent drainage channel. The specific permit needed is dependent on water quality and discharge category.
17	Nevada Division of Environmental Protection - Bureau of Water Pollution Control	NPDES Temporary Discharge Permit	Temporary point source discharge to surface water, i.e. natural channel, roadway, or storm drain, for duration less than 6 months. Required for dewatering during construction, and also required for flow bypassing operations.	A water quality analysis from a Nevada State certified lab, the quantity of discharge, a topographic map and site map showing location, direction, and route of discharge, and any other required water-related permits.	For dewatering activity and storm water bypass during construction. May be required along with the groundwater discharge permit since the dewatering wells will be constructed prior to pump station removal and replacement.
18	Nevada Division of Water Resources	Waiver (dewatering well, monitoring well, and/or testing well waiver)	Waiver required for temporary dewatering wells during construction activities. Also required for testing and monitoring wells.	Required prior to drilling activities.	This permit specifically indicates temporary dewatering/testing/monitoring wells. Need to see if this is required for the on-site dewatering well since that will be a permanent installation.

Appendix L

30-PERCENT OPINION OF PROBABLE CONSTRUCTION COSTS

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

