# City of Pinole

# Pinole/Hercules WPCP Project

## Technical Memorandum 14

## Effluent Pumping

March 1, 2013

PRELIMINARY
FOR REVIEW ONLY


Prepared under the responsible charge of

Craig Olson
39819

2365 Iron Point Road, Suite 300
Folsom, CA 95630

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# TM 14 - EFFLUENT PUMPING

***Pinole/Hercules WPCP Project*** ***March 1, 2013***

Reviewed by: Craig Olson, P.E.

Prepared by: Dana Hunt, P.E., Brad Leidecker, P.E.

## Executive Summary

### Purpose

The purpose of this technical memorandum (TM) is to establish design and operating performance criteria for the effluent pumping facilities at the Pinole/Hercules Water Pollution Control Plant (WPCP).

### Background

The WPCP was issued a revised National Pollutant Discharge Elimination System (NPDES) permit in August 2012. The revised permit requires that effluent flows up to 14.6 million gallons per day (mgd) be discharged through Rodeo Sanitary District's Deep Water Outfall (Deep Water Outfall), and flows greater than 14.6 mgd can be discharged to the WPCP's Emergency Outfall. The current reliable capacity of the effluent pump station and existing forcemain system limit effluent flows to 10.3 mgd to the Deep Water Outfall. This TM presents the development of four alternatives, an evaluation of the alternatives, and recommendation for improvements required for pumping the WPCP's effluent to the Deep Water Outfall.

### Conclusions

Although Alternative 2 (retrofit the existing Effluent Pump Station and modify a portion of the existing Outfall Pipeline) does not meet the current NPDES permit conditions (requiring plant effluent flows up to 14.6 mgd to be discharged through the Deep Water Outfall prior to discharge through the Emergency Outfall), it has been selected as the recommended alternative over Alternative 4, which requires construction of a parallel pipeline at this time. The additional cost of conveying 14.6 mgd to the Deep Water Outfall (Alternative 4) is not recommended because the frequency of Emergency Outfall use does not significantly increase between 13.9 mgd and 14.6 mgd. Alternative 2 provides a slightly lower reliable effluent pumping capacity at a significantly lower cost and would result in a construction cost savings to the WPCP rate payers of $7,365,000.

Prior to implementation of Alternative 2, discussions with the RWQCB are needed to revise the NPDES permit to allow effluent discharge to the Emergency Outfall at flows greater than 13.9 mgd.

Alternative 2 includes the following:

- Retrofit of the existing Effluent Pump Station including reuse of the existing concrete wetwell building.
- Demolition and replacement of the three existing vertical turbine pumps with larger capacity pumps.
- Modifications to the existing concrete deck for installation of larger pumps.
- Demolition and replacement of existing motors, variable frequency drives (VFDs), electrical equipment, and instrumentation to accommodate larger pumps and motors.
- Reuse of the existing structure, piping, gates, valves, and flow meter.

In addition to modifications of the existing Effluent Pump Station, some modifications to the Outfall Pipeline are recommended under Alternative 2. These improvements include the following:

- Modification to the localized highpoint to replace the gravity manhole with pressure rated piping and installation of a combination air release/vacuum valve.
- Perform of a surge analysis for the retrofitted pump station and forcemain system including the existing air/surge relief valves at the Rodeo vault structure to determine if damaging transient forces can occur and, if so, inclusion of surge protection facilities to protect the forcemain.
- Replace the 14-inch piping located at the Rodeo vault structure with 24-inch piping.

The total estimated construction cost for the recommended alternative (Alternative 2) is $1,512,000. This includes $1,213,000 for Effluent Pump Station improvements and $299,000 for outfall improvements.

# Introduction

The Pinole/Hercules Water Pollution Control Plant (WPCP) is preparing a preliminary design for treatment plant upgrades that are necessary to meet the revised Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) National Pollutant Discharge Elimination System (NPDES) Permit No. CA0037796 issued on August 14, 2012. The permit requires secondary treatment for peak wet weather flows (PWWF) up to 20 million gallons per day (mgd) and conveyance of 14.6 mgd to the Rodeo Sanitary District's Deep Water Outfall (Deep Water Outfall). Flows greater than 14.6 mgd are permitted to be discharged to the Emergency Outfall.

The components of this technical memorandum (TM) include the following:

- Review of Existing Facilities
- Review of Existing Hydraulic Conditions

- Development of Design Criteria
- Development of Design Alternatives
- Comparison of Alternatives
- Development of the Recommended Alternative

## Existing Facilities

The Effluent Pump Station and Outfall Pipeline allow the WPCP to discharge to the Deep Water Outfall that was constructed under the Effluent Pumping and Forcemain to Rodeo project designed by Metcalf & Eddy Engineers in 1977 and the Pinole and Hercules Effluent Disposal Facility project designed by Camp Dresser & McKee, Inc. in 1979. The project included a new pumping station, with three vertical turbine pumps discharging through approximately 20,625 linear feet of 24-inch pipeline and 3,900 linear feet of 30-inch deep water outfall located within San Pablo Bay near the Rodeo Sanitary District's WWTP site. Upon leaving the WPCP, the 24-inch Outfall Pipeline passes through the Cities of Pinole, Hercules, and Rodeo. The flow from the WPCP combines with the effluent from Rodeo Sanitary District prior to discharging into San Pablo Bay.

Figure 14-1 shows the location of the existing Effluent Pump Station on the WPCP site and Figure 14-2 shows the location of the existing 24-inch Outfall Pipeline and 30-inch Deep Water Outfall.

### Effluent Pump Station

The existing Effluent Pump Station is located on the southwest edge of the WPCP site. The pumping station has a total of three two-stage, 1760-revolution-per-minute (rpm), vertical turbine pumps with 200-horsepower and 460-volt motors, and is operated on VFDs. Two pumps are duty pumps and the third pump serves as the standby unit. The pumps were manufactured by J-Line Pump Company (model number 16MS). They have 13-inch diameter impellers and are rated for 3,600 gallons per minute (gpm) at 171 feet of head at full speed.

The pumping station's reinforced concrete structure was constructed in 1977 and consists of dual below-grade wetwells, one with a single pump and one with two pumps. The flow enters the station through a 36-inch influent pipe and can enter either or both wetwells via 24-inch sluice gates. An above-grade building is located over a portion of the wetwell. The building houses one of the plant's two 800-kW standby generators and the electrical equipment for the pump station (see TM No. 18 - Electrical Distribution System Configuration Evaluation). The pump's motors and discharge piping are located above the wetwell at grade, outdoors adjacent to the building. Each pump has a 14-inch steel discharge pipe which reduces to a 12-inch steel discharge pipe. The discharge pipe contains an air release valve, control valve, knife gate isolation valve, and pressure gauge. Flow from the discharge pipe enters the steel 24-inch above-grade header that contains a Controlotron (model number 1010N) magnetic flowmeter. Following the flowmeter, the header turns downward 45 degrees to transition below grade.

1" = 30'

SECONDARY CLARIFIER #3
SECONDARY CLARIFIER #4
SECONDARY CLARIFIER #5
SECONDARY CLARIFIER #2
SECONDARY CLARIFIER #1
AERATION BASINS
ODOR CONTROL
DEWATERING
GST
DIGESTER #3
DIGESTER #4
CO-GEN
POLYMER STORAGE
DIGESTER #1
DIGESTER #2
PRIMARY CLARIFIER #3
PRIMARY CLARIFIER #1
PRIMARY CLARIFIER #2
CHLORINE CONTACT BASIN
PRIMARY EFFLUENT DISTRIBUTION BOX
MAINT SHOP
BLOWER BLDG
CONTROL BLDG
FUEL STORAGE
GASOLINE
WASTE OIL
EFF PUMP STATION
BISULFITE
DIESEL
OIL
PAINT
FENCE
ASPH.
AC PATH
AC PARKING
SHALLOW WATER OUTFALL
WALL
TANK
EMERGENCY OUTFALL STRUCTURE
WPCP PROPERTY LINE
EFFLUENT PUMP STATION
24" OUTFALL PIPELINE
TO DEEP WATER OUTFALL
PIPE CASING

0 1" 2"

# PINOLE/HERCULES WPCP PROJECT

## EXISTING EFFLUENT PUMPING STATION AT THE PINOLE/HERCULES WPCP SITE

Figure 14–1

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N

30" DEEP WATER OUTFALL AND DIFFUSERS

SAN PABLO BAY

RODEO SANITARY DISTRICT

RODEO VAULT STRUCTURE (LOCATION OF RODEO FLOW ENTRANCE)

REPLACEMENT SECTION (PVC, 165 PSI)

24" OUTFALL PIPELINE (ASBESTOS CEMENT, 100 PSI)

GRAVITY MANHOLE LOCATION

REPLACEMENT SECTION (PVC, 165 PSI)

PINOLE/ HERCULES WPCP

PINOLE

HERCULES

RODEO

RR

SAN PABLO AVE

PARKER AVE

WILLOW AVE

CUMMINGS SKYWAY

SYCAMORE AVENUE

SANTA FE AVE

80

4

0 1" 2"

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# PINOLE/HERCULES WPCP PROJECT

## 24" OUTFALL PIPELINE AND 30" DEEP WATER OUTFALL

HDR

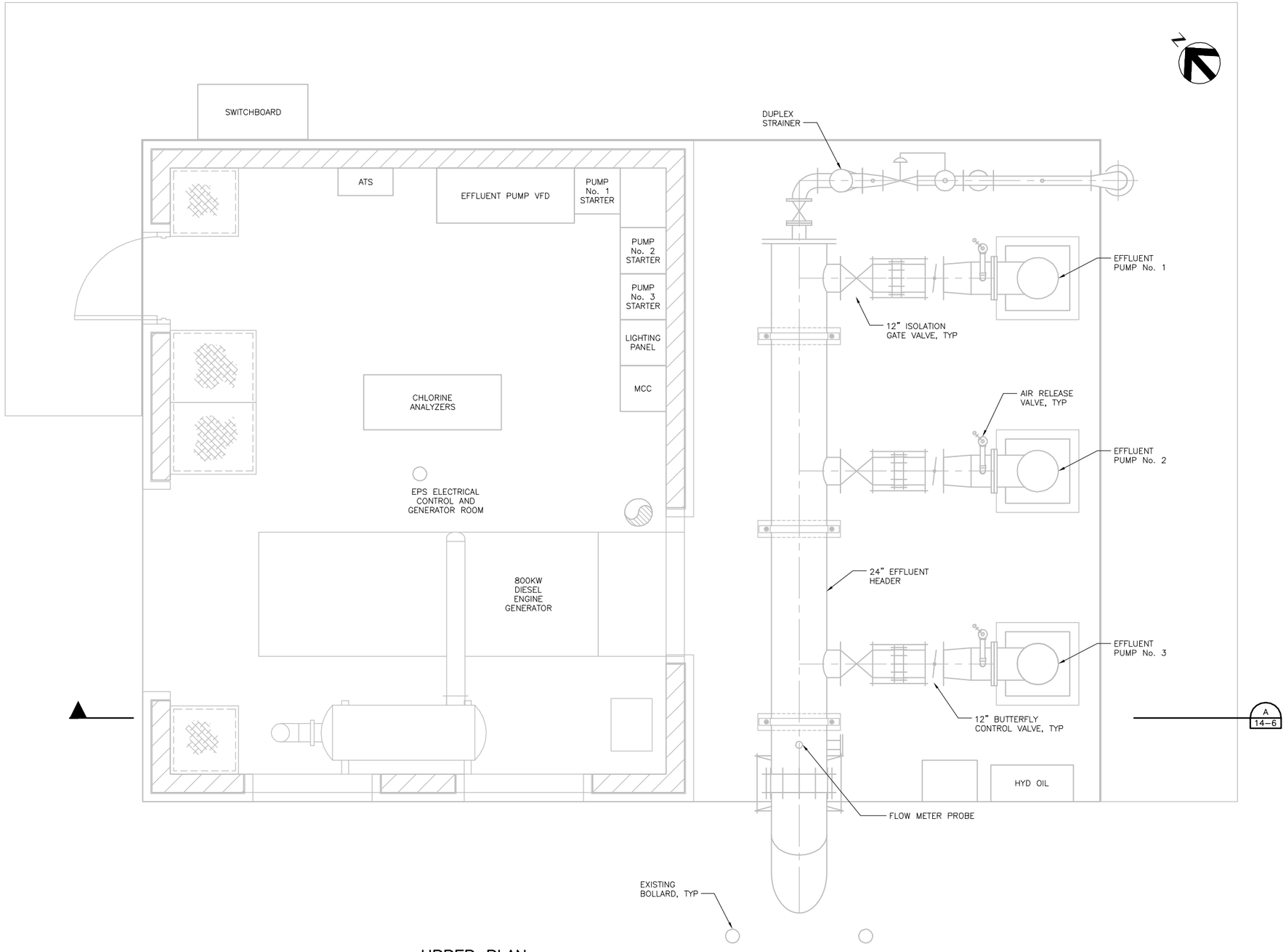
Figure 14-2

Photographs of the existing pumps and discharge piping, and the interior of the above-grade electrical building are shown in Figure 14-3.


*Figure 14-3. WPCP's Effluent Pump Station*

The invert of the wetwell is at elevation 97 and the top of the wetwell slab is at elevation 109. The pumps in the wetwell operate with a water surface elevation between 104 and 106.5. If the wetwell water surface elevation exceeds 107.8, flow above this elevation bypasses to the Emergency Outfall. For the purposes of this TM, 100 feet has been added to the elevations used on the Outfall Pipeline drawings, the drawings at the Rodeo WWTP, and the mean sea level elevations used within San Pablo Bay to be consistent with the datum used at the WPCP.

The existing pump station is shown in Figures 14-4, 14-5, and 14-6.




UPPER PLAN
1/4" = 1'-0"

0 1" 2"

PINOLE/HERCULES WPCP PROJECT

EXISTING EFFLUENT PUMPING STATION
UPPER PLAN

Figure 14-4

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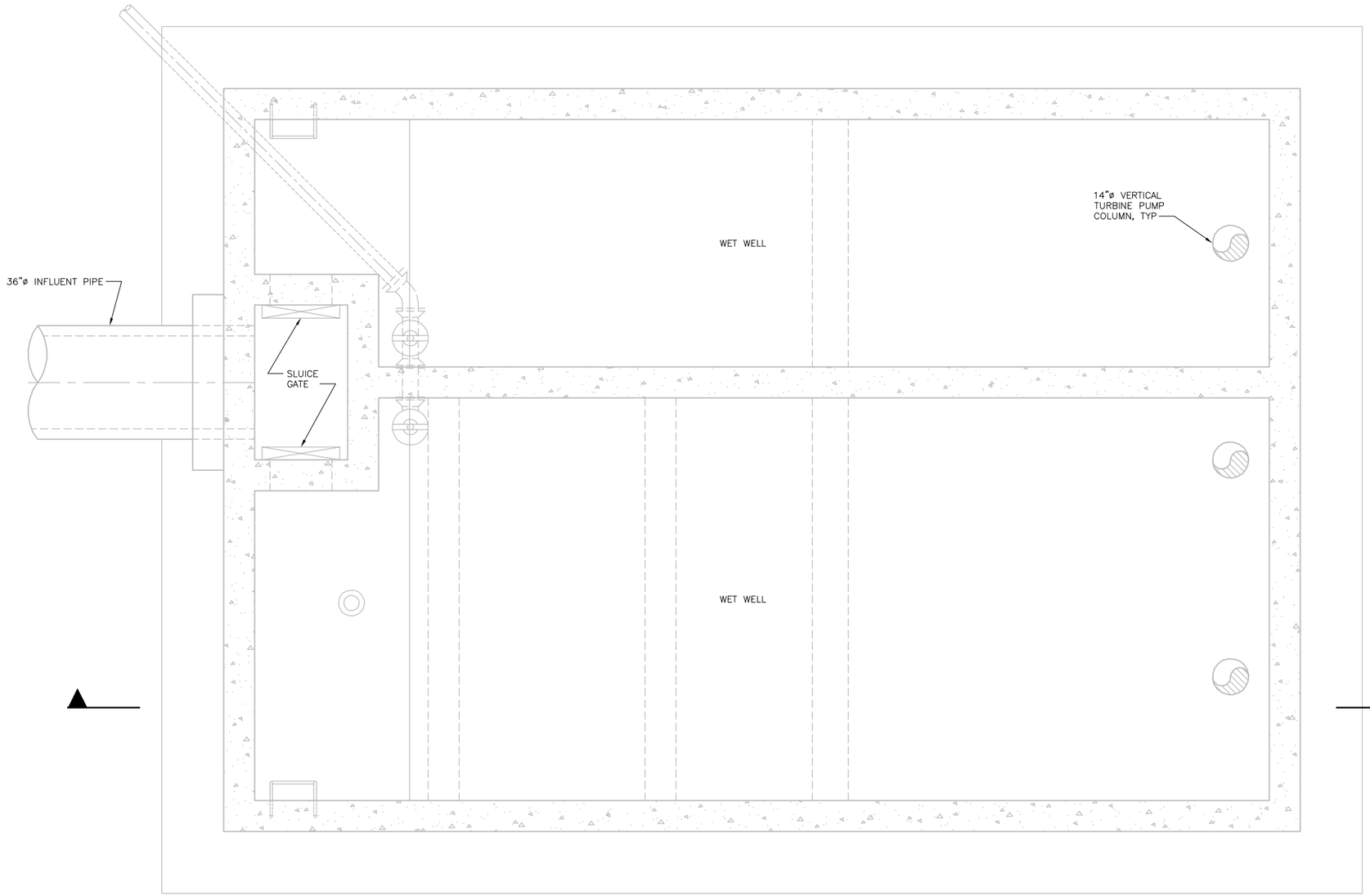


LOWER PLAN
1/4" = 1'–0"

0 1" 2"

PINOLE/HERCULES WPCP PROJECT

EXISTING EFFLUENT PUMPING STATION
LOWER PLAN

Figure 14–5

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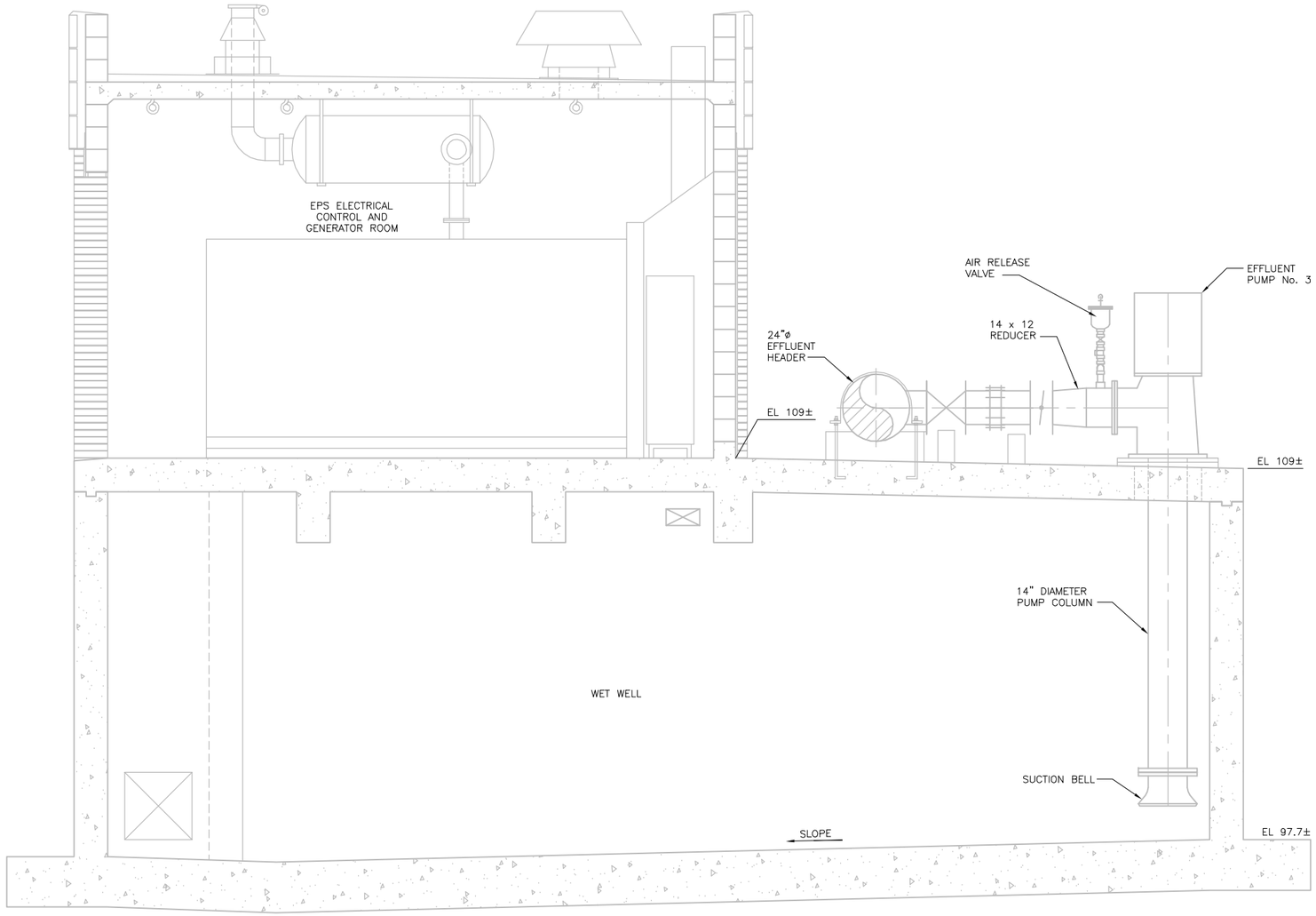


SECTION
1/4" = 1'-0"

A
14-4
14-5

0 1" 2"

PINOLE/HERCULES WPCP PROJECT

EXISTING EFFLUENT PUMPING STATION
SECTION

Figure 14-6

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## Outfall Pipeline

The Outfall Pipeline is a single 24-inch pipeline between the Effluent Pump Station located at the WPCP and the Rodeo Sanitary District's site. The Outfall Pipeline passes through the Cities of Pinole, Hercules, and Rodeo before reaching the Deep Water Outfall. The Outfall Pipeline is shown in Figure 14-2 and is located within Railroad Avenue, Sycamore Avenue, San Pablo Avenue, and Parker Avenue. The original pipe installed in 1977 is asbestos cement with a pressure rating of 100 psi. Select portions of the Outfall Pipeline have been replaced since its original installation under the Santa Fe Avenue Forcemain Replacement Project designed by Rugger Jensen Azar in 2008 and the Parker Avenue 24-inch sewer Forcemain Relocation in Contra Costa County, CA designed by Willdan in 2006. Both projects replaced portions of the Outfall Pipeline with 24-inch PVC C905 DR 25 pipe rated for 165 psi. These replaced sections are shown in Figure 14-2.

The Outfall Pipeline exits the Effluent Pump Station site at approximately elevation 103. The pipeline contains an intermediate high point at invert elevation 216 (includes 100-foot elevation adjustment to match WPCP datum) at station 118+50 (approximately 11,850 feet from the effluent pump station). Station 119+00 contains a gravity manhole. The original design allows flow to transition from pressure to gravity at this location. This is currently the case, but at flows above 13 mgd, the effluent must be pumped all the way to San Pablo Bay. In the past, before the eductor station was removed at the Rodeo WWTP, flows less than approximately 8 mgd had to be pumped all the way to San Pablo Bay. This resulted in popping the manhole cover at this high point at high flows. At that time the manhole cover was bolted down to prevent overflows. If flows above 13 mgd are pumped through the Outfall Pipeline in its current configuration, modifications at this location are required which include replacing the manhole with forcemain piping and adding a combination air release/vacuum valve.

After this intermediate highpoint, the Outfall Pipeline continues to Rodeo Sanitary District's WWTP where the Rodeo effluent enters the pipe and the combined flow is discharged into San Pablo Bay through the 30-inch diameter Deep Water Outfall.

## Facilities at Rodeo Sanitary District

The effluent pumping station and Outfall Pipeline upstream of Rodeo Sanitary District's WWTP was constructed under the Effluent Pumping and Forcemain to Rodeo project designed by Metcalf & Eddy Engineers in 1977. The portion of the Outfall Pipeline on the Rodeo WWTP site and the Deep Water Outfall were constructed under the Rodeo, Pinole and Hercules Effluent Disposal Facility project designed by Camp Dresser & McKee, Inc. in 1979. These facilities include a continuation of the 24-inch Outfall Pipeline, a vault structure where the flow from Rodeo enters the Outfall Pipeline, and the 30-inch Deep Water Outfall within San Pablo Bay.

Upstream of the vault structure, the 24-inch Outfall Pipeline transitions to parallel 14-inch and 18-inch steel pipelines. Originally, the 14-inch pipeline contained an eductor which allowed the

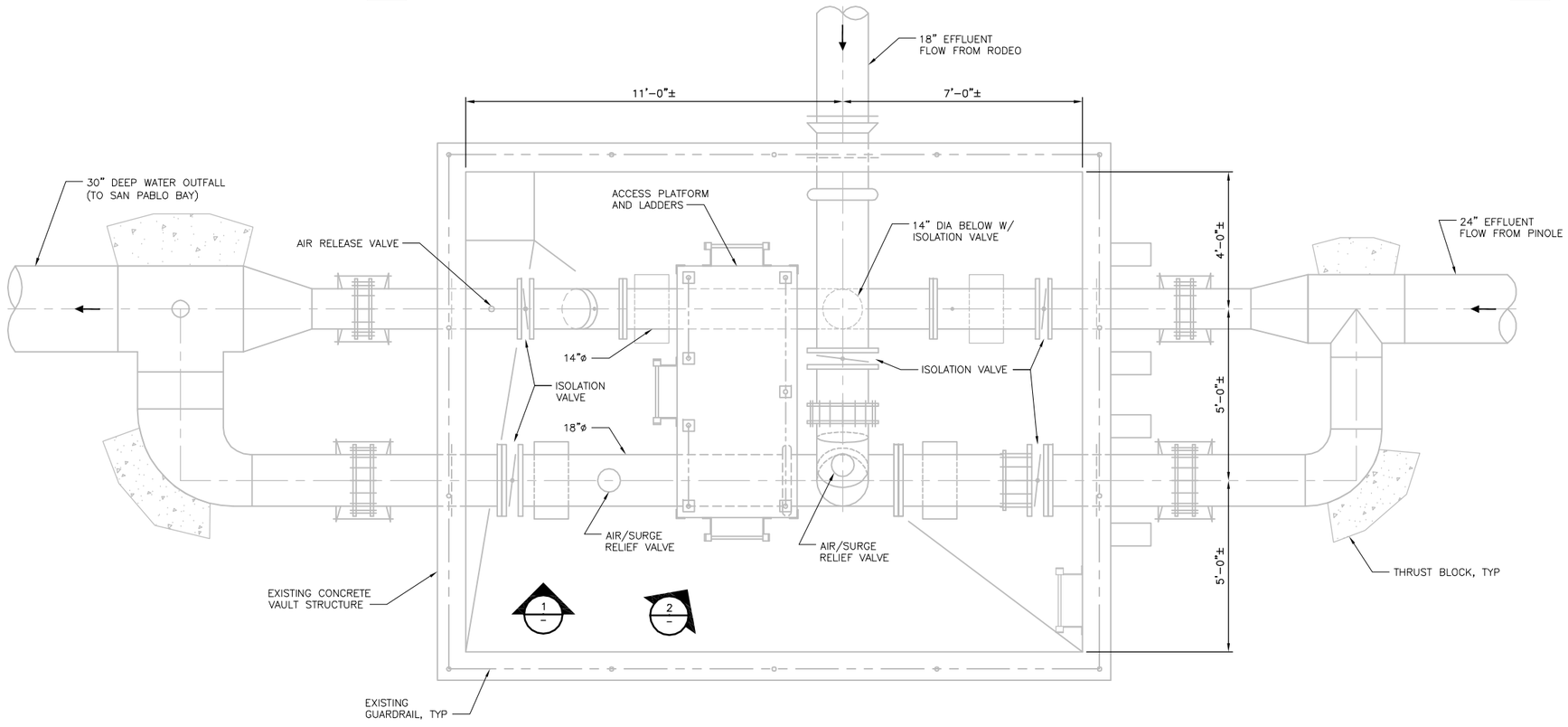
Rodeo flow to enter the pipeline without being pumped. This resulted in significantly more head at the WPCP's effluent pump station. The eductor station was removed and an effluent pump station was added at Rodeo under the Effluent Pump Station project designed by Whitley Burchett in 2003. This project added a new pump station at Rodeo to pump into the Outfall Pipeline at high flows. The pump station is located adjacent to the Rodeo WWTP's chlorine contact basin and dechlorination tank. It contains two small pumps and two large pumps. See Figure 14-7 for photographs of the pump station. One of the large pumps is used during high flows to pump Rodeo WWTP's effluent into the Outfall Pipeline carrying the peak effluent flows from the WPCP. During low flows, the Rodeo flow can enter the Outfall Pipeline by gravity.

*Figure 14-7. Rodeo Sanitary District's Effluent Pumping Station*

The current configuration of the vault structure at Rodeo Sanitary District is shown in Figure 14-8. The 14-inch and 18-inch pipelines each contain two butterfly isolation valves where the pipes enter and exit the vault. These valves are normally kept in the open position. The flow from the WPCP passes through both the 14-inch and 18-inch pipelines and the flow from Rodeo enters the vault through an 18-inch pipe. The pipe has a valved connection to both the 14-inch and 18-inch pipelines within the vault. Under normal conditions both valves are in the open position and flow from Rodeo enters both the 14-inch and 18-inch pipelines, where it is combined with the flow from the WPCP. Prior to entering the vault, the 18-inch pipeline from the Rodeo WWTP has a pneumatic butterfly valve that is normally open to allow gravity flow at low flows, but closes at high flows when the Rodeo pumps are operating to prevent backflow of the Pinole-Hercules effluent into the Rodeo WWTP.


PHOTOGRAPH 1
NONE


PHOTOGRAPH 2
NONE




VAULT STRUCTURE PLAN
1/4" = 1'-0"

0 1" 2"

PINOLE/HERCULES WPCP PROJECT

RODEO SANITARY DISTRICT
VAULT STRUCTURE

Figure 14-8

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The Outfall Pipeline contains three air/surge relief valves installed under the Outfall Air Release/Surge Relief Project designed by HDR Engineers in 2004. See Figure 14-9 for a photograph of the air/surge relief valves. Two of these valves are located within the vault structure, one on the 18-inch pipeline entering from Rodeo (upstream of the Rodeo/Pinole tee) and the other on the 18-inch pipeline (downstream of Rodeo tie-in) just prior to exiting the vault. The third valve is located downstream of the structure on the 30-inch Deep Water Outfall prior to entering the Bay.

***Figure 14-9. Air/Surge Relief Valves at Rodeo Sanitary District's Vault Structure***

After exiting the vault, the 14-inch and 18-inch pipelines combine into the 30-inch Deep Water Outfall. The pipeline extends approximately 3,900 linear feet into San Pablo Bay. The 30-inch Deep Water Outfall is installed below the bottom of the bay with a minimum of 2.5 feet of cover. The last 120 feet of the Deep Water Outfall is partially buried at the bottom of the bay and contains thirty 2.5-inch diffuser ports. Fifteen ports are located on each side of the outfall, 8 feet apart on center at 30 degrees above the centerline.

The facilities located at the Rodeo Sanitation District are owned and operated by Rodeo Sanitation District. The WPCP and Rodeo Sanitation District collectively use the outfall under a Joint Powers Authority (JPA) where an agreement is in place to discharge effluent through the outfall facilities and split maintenance costs based on the proportion of flows from each party. This agreement may require revision to allow increased peak wet weather effluent flows from the WPCP. Further review and discussion of the agreement will be required prior to design and construction of any improvements.

### San Pablo Bay Water Elevations

Mean sea level elevation of 100 for the San Pablo Bay was used in the analysis for consistency with the WPCP datum and consistency between TMs. A max high water level of 106.10 and a low water level (mean lower low water [MLLW]) of 97.10 for the San Pablo Bay were used for the hydraulic analysis in this TM.

The Bay elevations used in this TM are consistent with the San Pablo Bay water surface elevations used in the Effluent Pump Station project designed by Whitley Burchett in 2003.

## Existing Hydraulic Conditions

The existing reliable capacity of the WPCP's Effluent Pump Station is 10.3 mgd. The capacity obtained through the hydraulic analysis performed by HDR was confirmed with the operations staff at the City. A Hazen Williams C-value of 100 was used for the original Outfall Pipeline and the Deep Water Outfall and a C-value of 120 was used for the locations where the existing Outfall Pipeline was replaced with PVC piping. These are reasonable assumptions based on the material of construction and age of the pipelines. The pump and system curves for the existing station and outfall forcemain piping are shown in Figure 14-10.

Figure 14-10 illustrates the following:

- The reliable capacity of the station is 10.3 mgd when using two duty pumps.
- Flows below 13.0 mgd are pumped only to the localized high point in the Outfall Pipeline and flows greater than 13.0 mgd will be pumped all the way to San Pablo Bay.
- The current operation does not exceed the 100-psi pressure limitation of the Outfall Pipeline. (Note: The shutoff head of the pumps is greater than 100 psi so care should be taken to avoid pumping against a closed valve within the pipeline system.)

## Design Criteria

The following design criteria are applicable to the effluent pumping facilities at the WPCP.

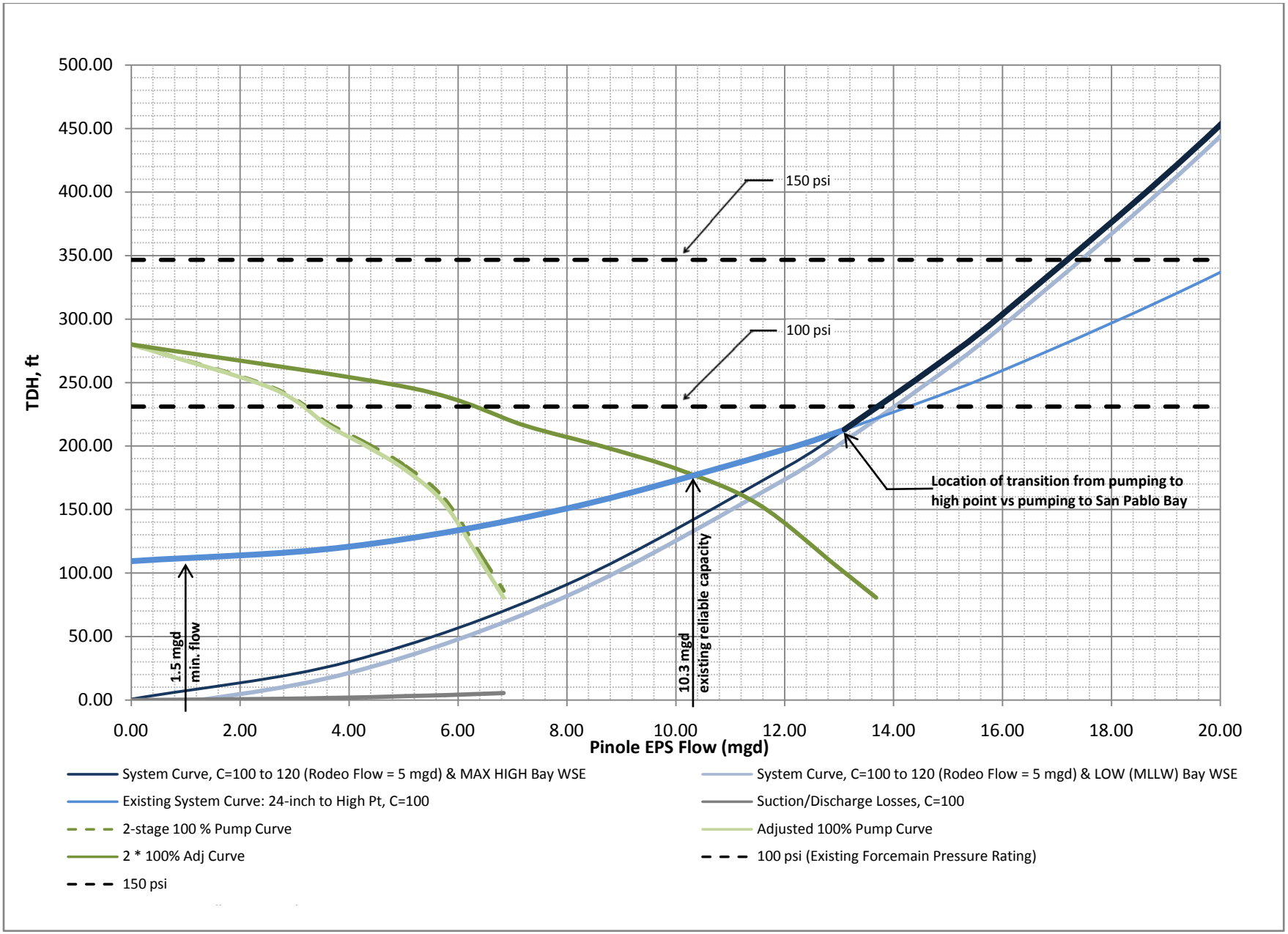
### Flow

The WPCP will be designed to operate at the projected buildout flows listed in Table 14-1 below. These design flows are discussed in detail in TM 1 – Flows and Loads.

***Table 14-1. Pinole/Hercules Buildout Flow Criteria***

| Flow Criteria | Flow Rate (mgd) |
|---|---|
| Peak Wet Weather Flow (PWWF) | 20.00 |
| Average Dry Weather Flow (ADWF) | 4.06 |
| Minimum Day Flow (MDF) | 1.75 |

*Figure 14-10. Pinole-Hercules WPCP Effluent Pumping Station Existing Pump and System Curves*




Notes:
1. Max High bay WSE = 106.10
2. MLLW = 97.10
3 Ex C Value=100 to high point and 108 (100/120) from high point to Bay
4. Use both 14" and 18" at Rodeo Structure

The WPCP was issued a revised NPDES permit in August 2012. Based on the permit compliance schedule, plant upgrades must be operational by June 1, 2017. The revised permit requires that plant effluent flows up to 14.6 mgd be discharged through the Deep Water Outfall prior to any discharge through the Emergency Outfall. Therefore the reliable PWWF that must be pumped by the Effluent Pump Station is 14.6 mgd. The minimum flow required to be pumped by the effluent pump station will be 1.75 mgd. These values are outlined in Table 14-2. Flows in excess of 14.6 mgd may be pumped through the existing Emergency Outfall.

***Table 14-2. Pinole/Hercules Effluent Pump Station Flow Criteria***

| Flow Criteria through the Deep Water Outfall | Flow Rate (mgd) |
|---|---|
| Peak Flow | 14.6 |
| Average Dry Weather Flow | 4.06 |
| Minimum Day Flow | 1.75 |

## Reliability and Redundancy

Reliability and redundancy minimizes the probability of wastewater overflows to the Emergency Outfall for plant effluent flows less than 14.6 mgd. Redundant pumping capacity is defined as the pumping capacity with one pump of each size out of service. The equipment design will meet the following reliability requirements:

- Ability to pump peak design flow rate of 14.6 mgd with one pump, motor, and variable frequency drive (VFD) out of service.
- Ability to reliably handle the entire range of flows between minimum flow and peak flow.
- Efficiently pump plant effluent at normal operating conditions.
- Monitoring, supervisory control and data acquisition (SCADA) equipment, and alarms for equipment failures and process conditions. Alarms will be viewable locally in the pumping station control room and remotely.
- Modify the Outfall Pipeline at the localized high point to prevent spills at high flows.
- Do not exceed the 100-psi pressure limitation of the Outfall Pipeline. (Note: The shutoff head of the pumps will be greater than 100 psi so care should be taken to avoid pumping against a closed valve within the pipeline system.)
- Perform a surge analysis (including analysis of the existing air/surge relief valves at the Rodeo vault structure) and implement surge protection facilities, if required to protect the Outfall Pipeline from damaging transient conditions.

## Operations and Maintenance

Operation and maintenance (O&M) design criteria include items and components necessary to provide safe and effective operation and maintenance of the pumps. The existing site has

limited space available for equipment removal, parking, and access. The following items have been identified and shall be incorporated in the design of the effluent pumping facility.

- Space will be provided for equipment removal, maintenance, and parking.
- Paved access will be provided.
- Recommended spare parts for all equipment will be included in the specification requirements.
- Effluent flow metering will be maintained.

### Other Design Criteria

In addition to the design criteria outlined above, other design criteria required for the effluent pumping facilities includes the following:

- Do not adversely impact the operations of the Rodeo Sanitary District to pump peak effluent flows into the Outfall Pipeline.

## Design Alternatives

Design alternatives for the effluent pumping facilities were developed in coordination with WPCP staff. Based on cost, permit requirements, site space and layout considerations, and the decision to continue to use the existing chlorine contact basin at its current location, a decision was made to reuse the existing Effluent Pump Station rather than constructing a new facility as previously recommended in the 2009 Facilities Plan prepared by Dodson Psomas. The report recommended construction of a new effluent pump station as well as construction of a parallel effluent Outfall Pipeline from the WPCP to the Deep Water Outfall located at the Rodeo Sanitary District. The facilities plan assumed that no discharge would be allowed through the Emergency Outfall and the effluent pumping facilities would be required to handle flows up to 20 mgd.

The following design alternatives were developed for the effluent pumping facilities.

- Alternative 1 - Retrofit the existing Effluent Pump Station and do not construct a new parallel Outfall Pipeline.
- Alternative 2 - Retrofit the existing Effluent Pump Station and modify a portion of the existing Outfall Pipeline.
- Alternative 3 - Reuse the existing Effluent Pump Station without modifications and construct a new parallel Outfall Pipeline.
- Alternative 4 - Retrofit the existing Effluent Pump Station and construct a new parallel Outfall Pipeline.

## Alternative 1 - Retrofit the existing Effluent Pump Station and do not construct a new parallel Outfall Pipeline

Alternative 1 includes retrofitting the existing Effluent Pump Station at the WPCP site. The retrofit includes reuse of the existing concrete wetwell building; demolition and replacement of three vertical turbine pumps with larger capacity pumps; modifications to the existing concrete deck for installations of larger pumps; and demolition and replacement of existing motors, VFDs, electrical equipment, and instrumentation to accommodate the larger pumps and motors. Based on discussions with WPCP O&M staff, the existing structures, piping, gates, valves, and flowmeter at the station are in good condition and will be reused.

### Hydraulics

HDR performed a hydraulic analysis for retrofit of the existing Effluent Pump Station using the existing Outfall Pipeline and Deep Water Outfall. This analysis uses the same system curve as developed for the existing hydraulic conditions as outlined in Figure 14-10. However, larger pumps were selected to obtain additional reliable capacity at the station. The pump and system curves for Alternative 1 are shown in Figure 14-11.

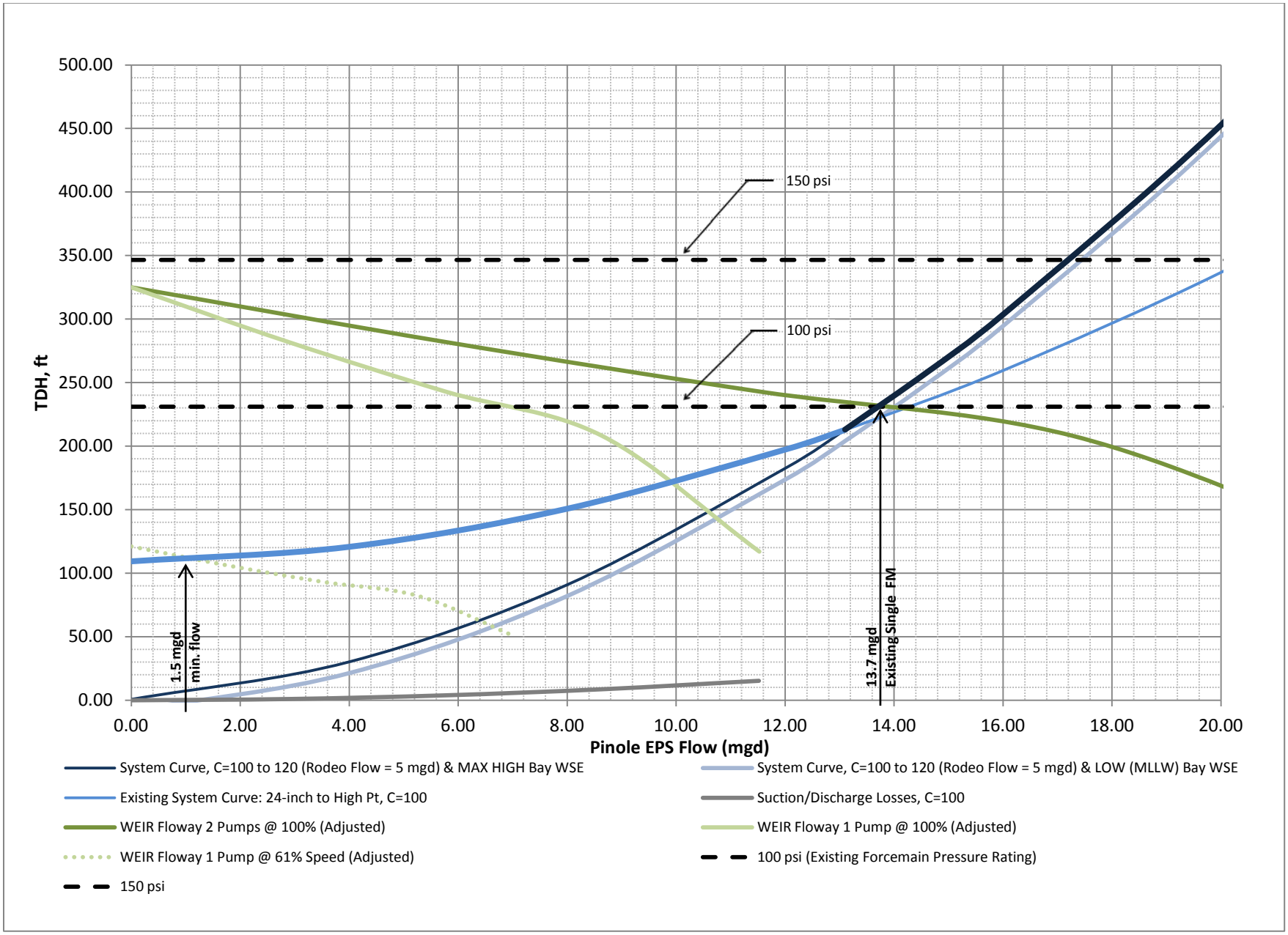
As indicated in Figure 14-11, the reliable capacity of the retrofitted Effluent Pump Station (13.7 mgd) is lower than the required reliable capacity of 14.6 mgd as indicated in the plant's current NPDES permit. The capacity of the station is limited by the 100-psi design pressure rating of the existing Outfall Pipeline. Larger pumps are available, but if used the pressure limitation of the Outfall Pipeline would be exceeded.

The three pumps at the station will be replaced with two-stage, 1770-rpm, vertical turbine pumps with 450-horsepower, 460-volt motors, and operated on VFDs. Two pumps will serve as duty pumps and the third pump will serve as the standby unit. The pumps shown in Figure 14-11 are manufactured by Weir Floway, model number 19FKH. This allows the two duty pumps to pump flows of 13.7 mgd at a head of 100 psi. The cut sheets of the Weir Floway Pumps are included in Appendix B.

Figure 14-11 illustrates the following:

- The reliable capacity of the station is 13.7 mgd when using two duty pumps.
- Flows above 13.0 mgd are pumped beyond the localized high point in the Outfall Pipeline to San Pablo Bay. Therefore modifications are required at the localized highpoint.
- The operation does not exceed the 100 psi pressure limitation of the Outfall Pipeline. (Note: The shutoff head of the pumps is greater than 100 psi so care should be taken to avoid pumping against a closed valve within the pipeline system.)

*Figure 14-11. Alternative 1 - Pump and System Curves*




Notes:
1. Max High bay WSE = 106.10
2. MLLW = 97.10
3 Ex C Value=100 to high point and 108 (100/120) from high point to Bay
4. Use both 14" and 18" at Rodeo Structure

### Cost

The total estimated construction cost for Alternative 1 is $1,413,000. It includes $1,213,000 for improvements at the Effluent Pump Station and $200,000 for improvements to the Outfall Pipeline. The Outfall Pipeline improvements for Alternative 1 include modifications to the Outfall Pipeline at the localized high point and an allowance for surge protection facilities.

The estimated construction cost estimates for the Effluent Pump Station and Outfall Pipeline improvements are included in Appendix A.

### Advantages and Disadvantages

The advantages and disadvantages of Alternative 1 are included in Table 14-3.

***Table 14-3. Alternative 1 Advantages and Disadvantages***

| Advantages | Disadvantages |
|---|---|
| Lowest capital cost | Reliable capacity does not meet the requirements of the current NPDES permit of 14.6 mgd. |
| Plant staff is familiar with facilities and O&M. | Reuse of existing equipment including piping, valves, gates, and flowmeter. |
| Equipment can be removed from the operating floor without entry into the wetwell. | |
| Multiple manufacturers available to provide competitive bids and 5-year warrantees. | |
| Variable speed operation can be matched to flow rate. | |
| Surge protection facilities can be implemented if required. | |
| Parallel Outfall Pipeline can be added in the future to obtain additional capacity and redundancy (see Alternative 4) | |
| Note: Significant advantages and disadvantages are shown in bold text. | |

There are a number of manufacturers of vertical turbine pumps for this application. Cut sheets for the Weir Floway pumps are provided in Appendix B. Additional manufacturers will be included during design for competitive bidding.

## Alternative 2 - Retrofit the existing Effluent Pump Station and modify a portion of the existing Outfall Pipeline

Alternative 2 is similar to Alternative 1 with one exception. Alternative 2 includes replacement of the 14-inch piping with 24-inch piping at the vault structure location at Rodeo Sanitary District. The 14-inch piping outside and within the structure will be removed and a connection will be made between the 18-inch pipeline from Rodeo and the 18-inch bypass pipeline within the vault. The isolation valves at the vault are not replaced under this alternative. If this alternative is selected, detailed construction constraints shall be developed during the design phase for replacement of the piping at the vault structure to prevent the San Pablo Bay from backing up into the structure during construction and to minimize impacts to the WPCP and

Rodeo WWTP. As with Alternative 1, Alternative 2 includes retrofitting the existing Effluent Pump Station at the WPCP site.

Retrofit of the Effluent Pump Station includes reuse of the existing concrete wetwell building; demolition and replacement of three vertical turbine pumps with larger capacity pumps; modifications to the existing concrete deck for installations of larger pumps; and demolition and replacement of existing motors, VFDs, electrical equipment and instrumentation to accommodate the larger pumps and motors. Based on discussions with plant O&M staff, the existing structures, piping, gates, valves, and flowmeter at the station are in good condition and will be reused.

## Hydraulics

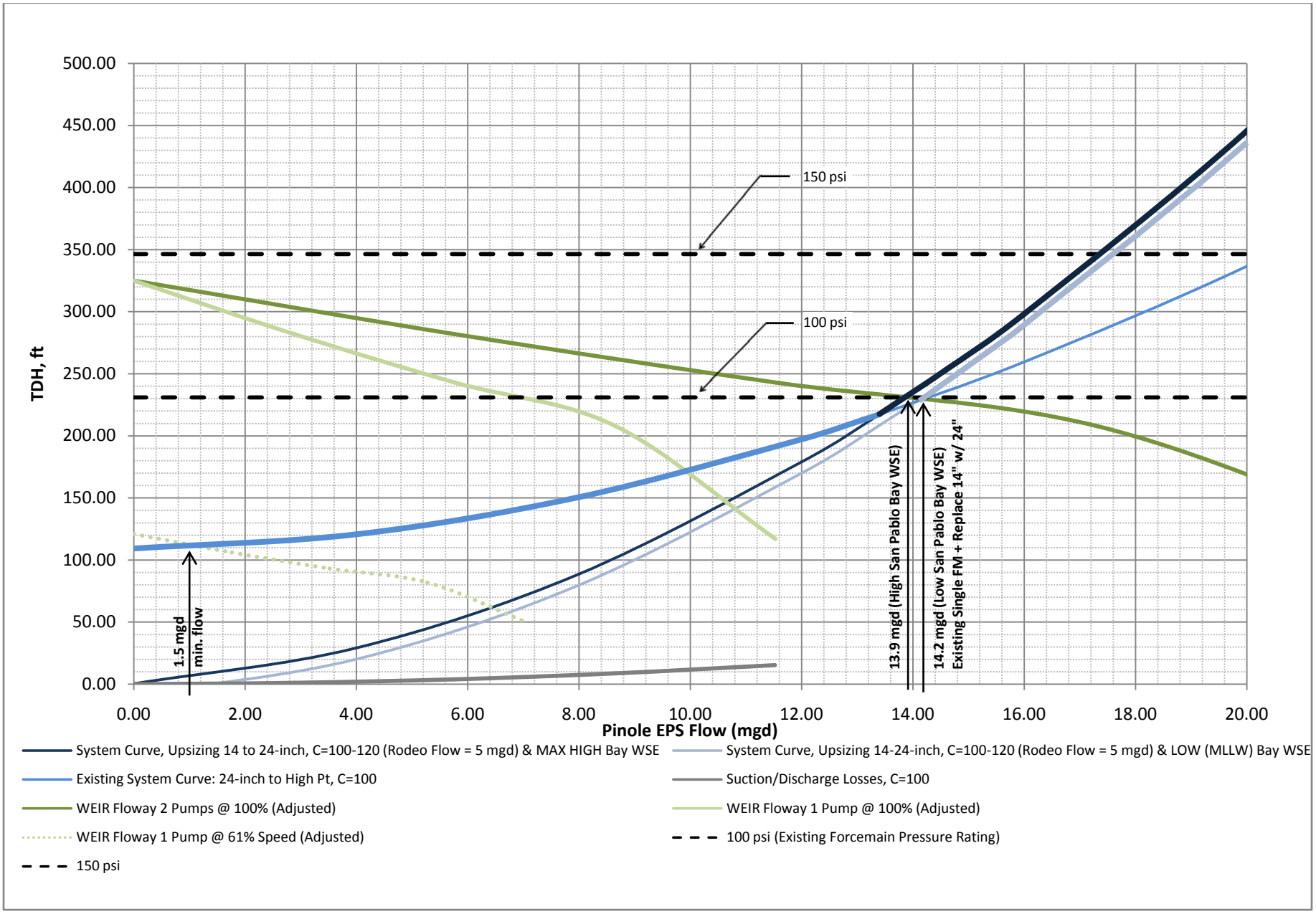
HDR performed a hydraulic analysis for retrofit of the existing Effluent Pump Station using the existing Outfall Pipeline and Deep Water Outfall. This analysis uses a similar system curve as developed for the existing hydraulic conditions as outlined in Figures 14-10 and 14-11 but replaces the 14-inch portion of the pipeline at the Rodeo vault structure with a 24-inch pipeline. As with Alternative 1, larger pumps were selected to obtain additional reliable capacity at the station. The pump and system curves for Alternative 2 are shown in Figure 14-12.

As indicated in Figure 14-12, the reliable capacity of the retrofitted Effluent Pump Station (13.9 to 14.2 mgd based on San Pablo bay tide level) is lower than the required reliable capacity of 14.6 mgd as indicated in the plant's current NPDES permit. However, it is greater than the capacity of the station under Alternative 1. The reliable capacity range is based on sea water elevation at the time of discharge. The Effluent Pump Station's capacity of 13.9 mgd will occur under the worst case conditions when the San Pablo Bay's water surface elevation is 106.10. At anything less than the maximum San Pablo Bay water surface elevation, additional reliable capacity up to 14.2 mgd can be pumped to the Deep Water Outfall.

The piping modifications at the vault structure at Rodeo allow additional capacity to be obtained without exceeding the 100 psi design pressure rating of the existing Outfall Pipeline. All improvements to the Effluent Pump Station are the same as under Alternative 1.

As with Alternative 1, the three pumps at the station will be replaced with two-stage, 1770-rpm, vertical turbine pumps with 450-horsepower, 460-volt motors, and operated on VFDs. Two pumps will serve as duty pumps and the third pump will serve as the standby unit. The pumps shown in Figure 14-12 are manufactured by Weir Floway, model number 19FKH. This allows the two duty pumps to pump flows of 13.9 mgd at a head of 100 psi. The cut sheets for the Weir Floway Pumps are shown in Appendix B.

*Figure 14-12. Alternative 2 - Pump and System Curves*




Notes:
1. Max High bay WSE = 106.10
2. MLLW = 97.10
3 Ex C Value=100 to high point and 108 (100/120) from high point to Bay
4. Replace 14" w/ 24" at Rodeo Structure

Figure 14-12 illustrates the following:

- The reliable capacity of the station is 13.9 to 14.2 mgd when using two duty pumps.
- Flows above 13.0 mgd are pumped beyond the localized high point in the Outfall Pipeline to San Pablo Bay. Therefore modifications are required at the localized highpoint.
- The operation does not exceed the 100 psi pressure limitation of the Outfall Pipeline. (Note: The shutoff head of the pumps is greater than 100 psi so care should be taken to avoid pumping against a closed valve within the pipeline system.)

## Cost

The total estimated construction cost for Alternative 2 is $1,512,000. It includes $1,213,000 for the improvements at the Effluent Pump Station and $299,000 for improvements required to the outfall. The Outfall Pipeline improvements for Alternative 2 include modifications to the Outfall Pipeline at the localized high point, removal and replacement of the 14-inch piping and fittings with 24-inch piping and fittings at the Rodeo vault structure and an allowance for surge protection facilities.

The estimated construction cost estimates for the Effluent Pump Station and Outfall Pipeline improvements are included in Appendix A.

## Advantages and Disadvantages

The advantages and disadvantages of Alternative 2 are included in Table 14-4.

***Table 14-4. Alternative 2 Advantages and Disadvantages***

| Advantages | Disadvantages |
|---|---|
| Low capital cost (slightly higher than Alternative 1) | Reliable capacity does not meet the requirements of the current NPDES permit of 14.6 mgd. (Note: Higher slightly reliable capacity than Alternative 1) |
| Plant staff is familiar with facilities and O&M. | Reuse of existing equipment including piping, valves, gates, and flowmeter. |
| Equipment can be removed from the operating floor without entry into the wetwell. | |
| Multiple manufacturers available to provide competitive bids, 5-year warrantees. | |
| Variable speed operation can be matched to flow rate. | |
| Surge protection facilities can be implemented if required. | |
| Parallel Outfall Pipeline can be added in the future to obtain additional capacity and redundancy | |
| Note: Significant advantages and disadvantages are shown in bold text. | |

There are a number of manufacturers of vertical turbine pumps for this application. Cut sheets for the Weir Floway pumps are provided in Appendix B. Additional manufacturers will be included during design for competitive bidding.

## Alternative 3 - Reuse the existing Effluent Pump Station without modifications and construct a new parallel Outfall Pipeline

Alternative 3 includes reuse of the existing Effluent Pump Station at the WPCP site without any modifications or equipment replacement. Under Alternative 3, the existing Effluent Pump Station will be reused in its existing state and a new a parallel 24-inch PVC C905 DR 25 Outfall Pipeline rated for a working pressure of 165 psi will be added adjacent to the existing Outfall Pipeline. If this alternative is selected, an analysis of proposed routing alternatives should be conducted to determine the best route for the parallel Outfall Pipeline. The hydraulic analysis performed for the alternative assumes the same alignment as the existing Outfall Pipeline. The new parallel Outfall Pipeline and existing Outfall Pipeline would tie together downstream of the vault structure at Rodeo Sanitary District and all flow would pass through the existing 30-inch Deep Water Outfall for discharge into San Pablo Bay. Under this alternative the existing structures, pumps, motors, VFDs, piping, gates, valves, flowmeter and electrical and instrumentation equipment at the existing Effluent Pump Station would be reused.

### Hydraulics

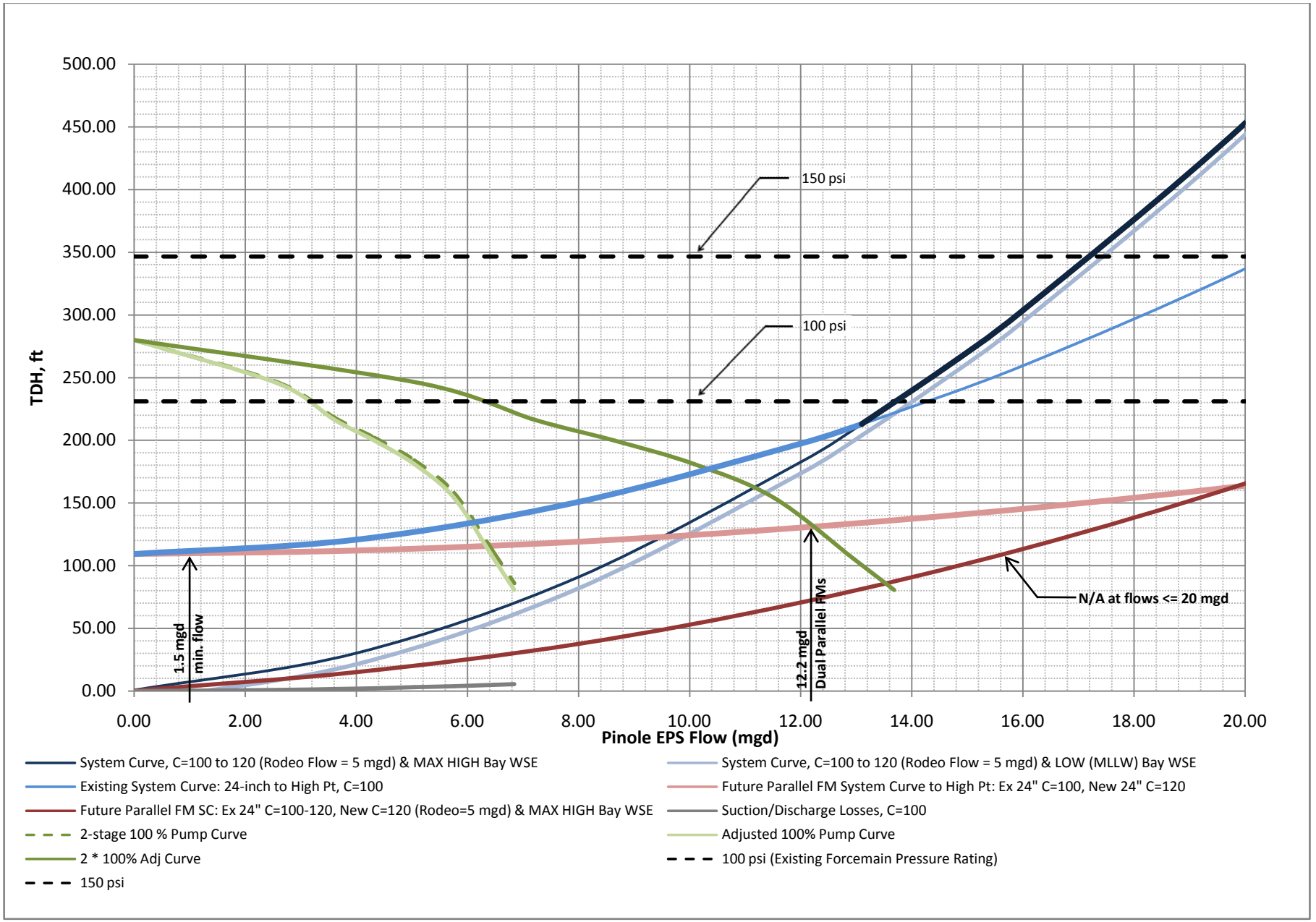
HDR performed a hydraulic analysis for the existing Effluent Pump Station using the existing Outfall Pipeline and Deep Water Outfall. This analysis uses the same system curve as developed for the existing hydraulic conditions as outlined in Figures 14-10 and 14-11 but adds a parallel PVC 24-inch Outfall Pipeline. The pump and system curves for Alternative 3 are shown in Figure 14-13.

As indicated in Figure 14-13, the reliable capacity of the existing Effluent Pump Station with a parallel 24-inch PVC Outfall Pipeline is 12.2 mgd which is less than the required reliable capacity of 14.6 mgd as indicated in the plant's current NPDES permit. Alternative 3 also provides less reliable capacity than Alternatives 1 or 2.

Figure 14-13 illustrates:

- The reliable capacity of the station is 12.2 mgd when using two duty pumps.
- Flows will not exceed 13.0 mgd so no flow will be pumped beyond the localized high point in the Outfall Pipeline to San Pablo Bay. Therefore no modifications are required at the localized highpoint.
- The operation does not exceed the 100-psi pressure limitation of the Outfall Pipeline. (Note: The shutoff head of the pumps is greater than 100 psi so care should be taken to avoid pumping against a closed valve within the pipeline system.)

*Figure 14-13. Alternative 3 - Pump and System Curves*




Notes:
1. Max High bay WSE = 106.10
2. MLLW = 97.10
3 Ex C Value=100 to high point and 108 (100/120) from high point to Bay
4. Use both 14" and 18" at Rodeo Structure

### Cost

The total estimated construction cost for Alternative 3 is $7,644,500. It includes no improvements at the Effluent Pump Station. The Outfall Pipeline improvements for Alternative 3 include $7,464,500 for construction of the parallel Outfall Pipeline as outlined in the Engineering Report for the Pinole-Hercules Water Pollution Control Plant Facilities Plan prepared by Dodson Psomas in 2009 plus an allowance of $180,000 for surge protection facilities.

The estimated construction cost estimates for the outfall improvements are shown in Appendix A.

### Advantages and Disadvantages

The advantages and disadvantages of Alternative 3 are included in Table 14-5.

***Table 14-5. Alternative 3 Advantages and Disadvantages***

| Advantages | Disadvantages |
|---|---|
| WPCP staff is familiar with facilities and operation and maintenance. | **Reliable capacity does not meet the requirements of the current NPDES permit of 14.6 mgd. (Less than Alternatives 1 and 2)** |
| Equipment can be removed from the operating floor without entry into the wetwell. | **Significantly higher capital cost than Alternatives 1 and 2** |
| Variable speed operation can be matched to flowrate | **Reuse of all existing facilities at the existing Effluent Pump Station including pumps, motors, VFDs, piping, valves, gates, flowmeter, electrical equipment and instrumentation equipment.** |
| Surge protection facilities can be implemented if required. | |
| Note: Significant advantages and disadvantages are shown in bold text. | |

Alternative 3 has no advantages over Alternatives 1 or 2. It has a significantly higher construction cost and provides less reliable capacity. In addition, it requires continued use of the existing pumps, motors, and VFDs as well as the existing electrical and instrumentation equipment.

## Alternative 4 - Retrofit the existing Effluent Pump Station and construct a new parallel Outfall Pipeline

Alternative 4 combines Alternatives 1 and 3 to meet the WPCP's revised NPDES permit requirements. Based on the permit requirements, the plant effluent flows up to 14.6 mgd must be discharged through the Deep Water Outfall prior to any discharge through the Emergency Outfall. Therefore the reliable peak flow that must be pumped by the Effluent Pump Station is 14.6 mgd.

Like Alternative 1, Alternative 4 includes retrofitting the existing Effluent Pump Station at the WPCP site. This retrofit includes reuse of the existing concrete wetwell building; demolition and replacement of three vertical turbine pumps with larger capacity pumps; modifications to

the existing concrete deck for installations of larger pumps; and demolition and replacement of existing motors, VFDs, electrical equipment and instrumentation to accommodate the larger pumps and motors. Based on discussions with plant O&M staff, the existing structures, piping, gates, valves, and flowmeter at the station are in good condition and will be reused.

As with Alternative 3, Alternative 4 includes a new parallel 24-inch PVC C905 DR 25 Outfall Pipeline rated for a working pressure of 165 psi to parallel the existing Outfall Pipeline. If this alternative is selected, an analysis of proposed routing alternatives should be conducted to determine the best route for the parallel Outfall Pipeline. The hydraulic analysis performed for this alternative assumes the same alignment as the existing Outfall Pipeline. The new parallel Outfall Pipeline and existing Outfall Pipeline would tie together downstream of the vault structure at Rodeo Sanitary District and all flow would pass through the existing 30-inch Deep Water Outfall for discharge into San Pablo Bay

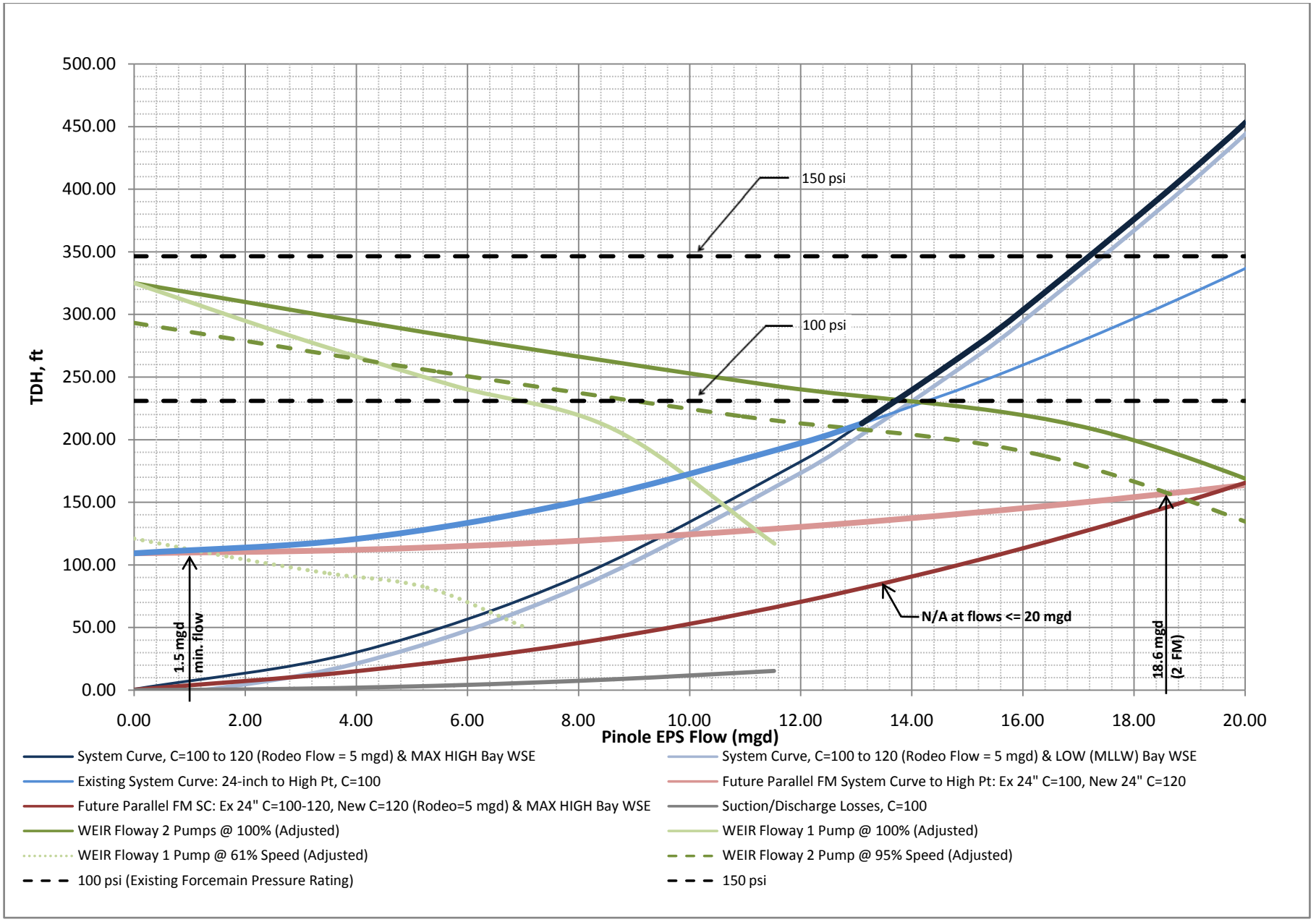
## Hydraulics

HDR performed a hydraulic analysis for retrofit of the existing Effluent Pump Station using the existing Outfall Pipeline and Deep Water Outfall. This analysis uses the same system curve as developed for the existing hydraulic conditions as outlined in Figures 14-10 and 14-11 but adds a parallel PVC 24-inch Outfall Pipeline like under Alternative 3 as shown in Figure 14-13. The pump and system curves for Alternative 4 are shown in Figure 14-14.

As indicated in Figure 14-14, the reliable capacity of the retrofitted Effluent Pump Station with a parallel 24-inch PVC Outfall Pipeline is 18.6 mgd and could be as high as 20 mgd if a pump with sufficient net positive suction head can be identified during the design phase. Regardless, the required reliable capacity of 14.6 mgd as indicated in the plant's current NPDES permit can be met under Alternative 4. The parallel 24-inch Outfall Pipeline decreases the headloss within the system and allows the 100 psi design pressure rating of the existing Outfall Pipeline to not be exceeded.

Under Alternative 4, similar to Alternatives 1 and 2, the three pumps at the station will be replaced with two-stage, 1770-rpm, vertical turbine pumps with 450-horsepower, 460-volt motors, and operated on VFDs. Two pumps will serve as duty pumps and the third pump will serve as the standby unit. The pumps shown in Figure 14-14, are manufactured by Weir Floway, model number 19FKH. This allows the two duty pumps to pump flows of 18.6 mgd at a head of 68 psi. The cut sheets for the Weir Floway Pumps are shown in Appendix B.

*Figure 14-14. Alternative 4 - Pump and System Curves*




Notes:
1. Max High bay WSE = 106.10
2. MLLW = 97.10
3 Ex C Value=100 to high point and 108 (100/120) from high point to Bay
4. Use both 14" and 18" at Rodeo Structure

Figure 14-14 illustrates the following:

- The reliable capacity of the station is 18.6 mgd when using two duty pumps and both Outfall Pipelines.
- Flows above 13.0 mgd can be pumped beyond the localized high point in the Outfall Pipeline to San Pablo Bay when two duty pumps are used through a single forcemain, therefore modifications are recommended at the localized highpoint.
- The operation does not exceed the 100 psi pressure limitation of the Outfall Pipeline. (Note: The shutoff head of the pumps is greater than 100 psi so care should be taken to avoid pumping against a closed valve within the pipeline system.)

## Cost

The total estimated construction cost for Alternative 4 is $8,877,500. It includes $1,213,000 for the improvements at the Effluent Pump Station and $200,000 for modifications to the Outfall Pipeline at the localized high point and an allowance for surge protection facilities and $7,464,500 for construction of the of the parallel Outfall Pipeline as outlined in the Engineering Report for the Pinole-Hercules Water Pollution Control Plant Facilities Plan prepared by Dodson Psomas in 2009.

The construction cost estimates for the Effluent Pump Station retrofit and outfall improvements are shown in Appendix A.

## Advantages and Disadvantages

The advantages and disadvantages of Alternative 4 are included in Table 14-6.

***Table 14-6. Alternative 4 Advantages and Disadvantages***

| Advantages | Disadvantages |
|---|---|
| **Reliable capacity meets the requirements of the current NPDES permit of 14.6 mgd.** | **Highest capital construction cost of all Alternatives** |
| Plant staff is familiar with facilities and O&M. | Parallel Outfall Pipeline is required at this time. |
| Equipment can be removed from the operating floor without entry into the wetwell. | Reuse of existing equipment including piping, valves, gates, and flowmeter. |
| Multiple manufacturers available to provide competitive bids, 5-year warrantees. | |
| Variable speed operation can be matched to flow rate. | |
| Surge protection facilities can be implemented if required. | |
| Note: Significant advantages and disadvantages are shown in bold text. | |

There are a number of manufacturers of vertical turbine pumps for this application. Cut sheets for the Weir Floway pumps are provided in Appendix B. Additional manufacturers will be included during design for competitive bidding.

## Comparison of Alternatives

The four design alternatives developed for the effluent pumping facilities are compared in Table 14-7.

***Table 14-7. Comparison of Alternatives***

| Alternative | Description | Reliable Capacity (mgd) | Total Construction Cost | Advantages/Disadvantages |
|---|---|---|---|---|
| 1 | Retrofit the existing Effluent Pump Station and do not construct a new parallel Outfall Pipeline at this time. | 13.7 | $1,413,000 | Advantages:<br>Lowest Construction Cost<br>Disadvantages:<br>Reliable capacity does not meet the requirements of the current NPDES permit of 14.6 mgd. |
| 2 | Retrofit the existing Effluent Pump Station and modify a portion of the existing Outfall Pipeline at the Rodeo vault structure. Do not construct a new parallel Outfall Pipeline at this time. | 13.9 | $1,512,000 | Advantages:<br>Low Construction Cost (slightly higher than Alternative 1).<br>Disadvantages:<br>Reliable capacity does not meet the requirements of the current NPDES permit of 14.6 mgd (Slightly higher than Alternative 1). |
| 3 | Reuse the existing Effluent Pump Station without modifications and construct a new parallel Outfall Pipeline at this time. | 12.2 | $7,644,500 | Advantages:<br>None<br>Disadvantages:<br>Reliable capacity does not meet the requirements of the current NPDES permit of 14.6 mgd. (Lowest reliable capacity of all alternatives)<br>High construction cost<br>Reuse of all existing facilities at the existing Effluent Pump Station including pumps, motors, VFDs, electrical equipment and instrumentation equipment. |
| 4 | Retrofit the existing Effluent Pump Station and construct a new parallel Outfall Pipeline at this time. | 18.6 | $8,877,500 | Advantages:<br>Only alternative that meets reliable capacity requirements of the current NPDES permit of 14.6 mgd.<br>Disadvantages:<br>Highest construction cost. |

Based on the comparison of alternatives outlined in Table 14-7, Alternative 4 is the only alternative that meets the WPCP's current NPDES permit.

Alternative 2 provides the best overall reliable effluent pumping capacity at the lowest cost. Alternative 2 only provides a reliable capacity of 13.9 to 14.2 mgd and does not meet the plant's current NPDES permit condition of pumping 14.6 mgd to the Deep Water Outfall prior to discharging any effluent to the Emergency Outfall. However, Alternative 2 would result in a cost savings to the WPCP rate payers of $7,365,500 over Alternative 4.

An analysis of historical effluent discharges from January 2008 to January 2013 was conducted to review the number of Emergency Outfall discharges and volume of each discharge that occurred (Figure 14-15). Over the 5-year period, there were three discharges that exceeded 13.9 mgd, of which one exceeded 14.6 mgd. The peak hour effluent flows on the days of the discharge events were 14.2, 14.2, and 14.8 mgd with total secondary treated effluent discharges of 0.69, 0.95 and 0.44 million gallons respectively (Figure 14-15). It should be noted the historical discharge volumes shown are based on the existing Effluent Pump Station's capacity and not representative of potential discharge volumes after the proposed improvements. It should also be noted that the Effluent Pump Station's reliable capacity of 13.9 mgd will occur under the worst case conditions when the San Pablo Bay's water surface elevation is 106.10. At a low tide water level (mean lower low water) of 97.10 in San Pablo Bay, the Effluent Pump Station will have a reliable capacity of 14.2 mgd (figure 14-12).

Based on the construction cost savings of Alternative 2 over Alternative 4, and the frequency and additional volume of effluent that would be discharged through the Emergency Outfall rather than the Deep Water Outfall, the WPCP O&M staff and outside consultant recommend proceeding with Alternative 2 and attempting to negotiate a decrease in the discharge limit to the Deep Water Outfall from 14.6 mgd to 13.9 mgd prior to discharge to the Emergency Outfall.

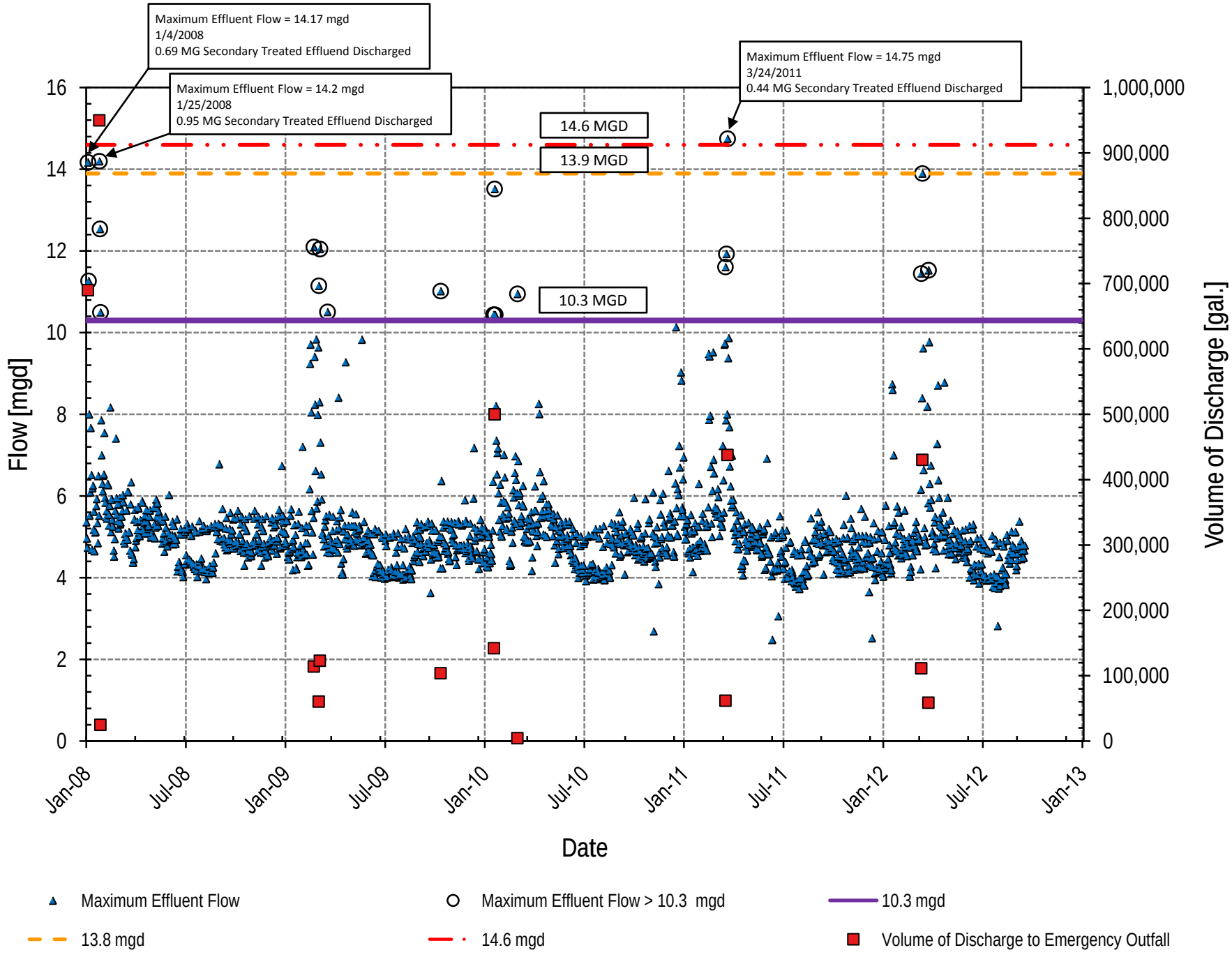
# Recommended Alternative

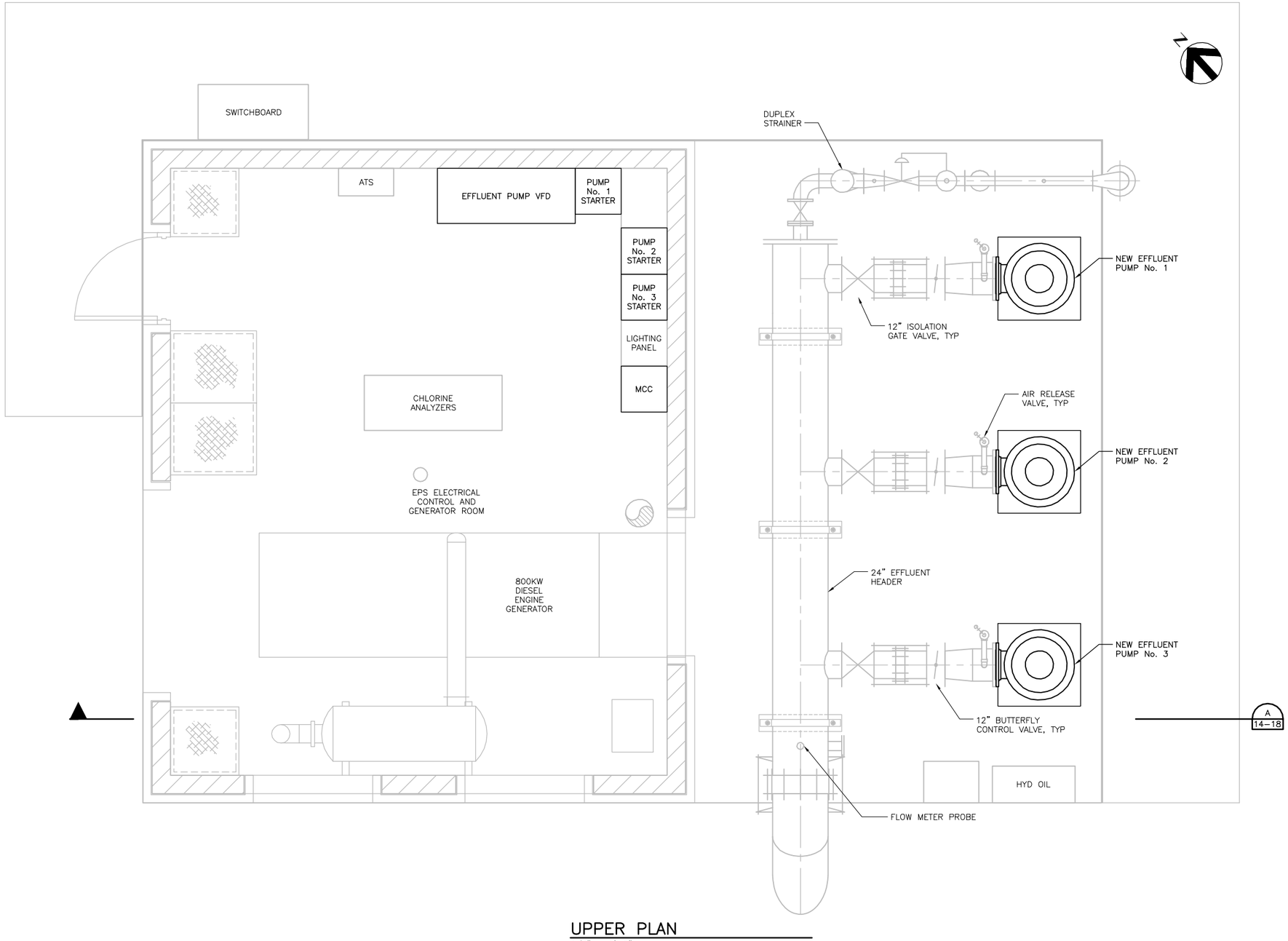
## Proposed Facilities

The proposed design for the recommended alternative (Alternative 2) includes the following:

- Prior to implementation of Alternative 2, discussions shall be held with the RWQCB and a revised NPDES permit must be obtained to allow effluent discharge to the Emergency Outfall for effluent flows above 13.9 mgd.
- Retrofit of the effluent pump station includes reuse of the existing concrete wetwell building; demolition and replacement of the three existing vertical turbine pumps with larger capacity pumps; modification of the existing concrete deck for installations of larger pumps; and demolition and replacement of existing motors, VFDs, electrical equipment, and instrumentation to accommodate the larger pumps and motors. Based on discussions with plant O&M staff, the existing structures, piping, gates, valves, and flowmeter are in good condition and will be reused. Rehabilitation of the existing Effluent Pump Station is shown in Figures 14-16, 14-17, and 14-18.

*Figure 14-15. Analysis of Historic Effluent Discharges from 2008 to 2013*






UPPER PLAN
1/4" = 1'-0"

PINOLE/HERCULES WPCP PROJECT

RETROFITTED EFFLUENT PUMPING STATION
UPPER PLAN

0 1" 2"

Figure 14-16

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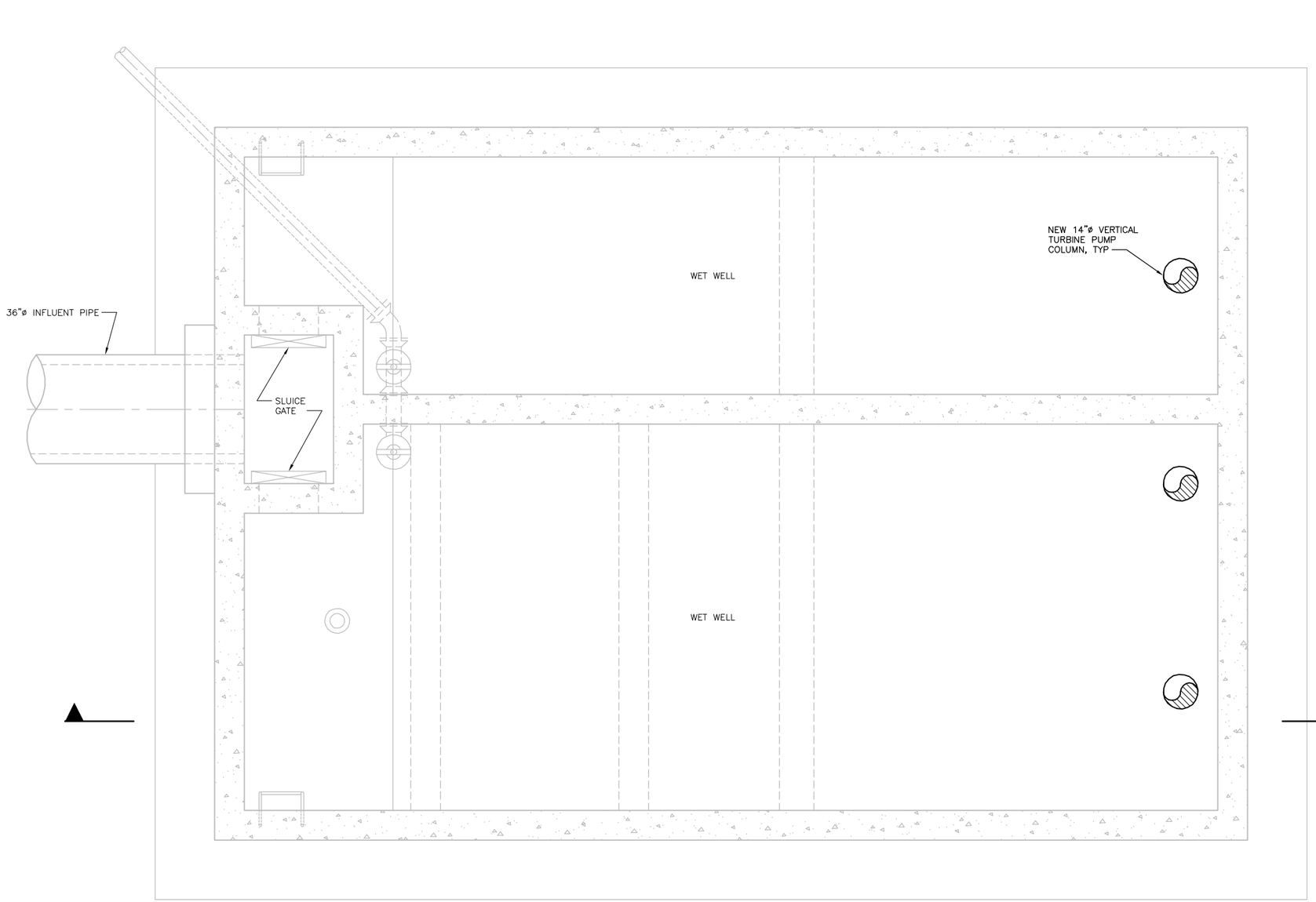


LOWER PLAN
1/4" = 1'–0"

0 1" 2"

PINOLE/HERCULES WPCP PROJECT

RETROFITTED EFFLUENT PUMPING STATION
LOWER PLAN

Figure 14–17

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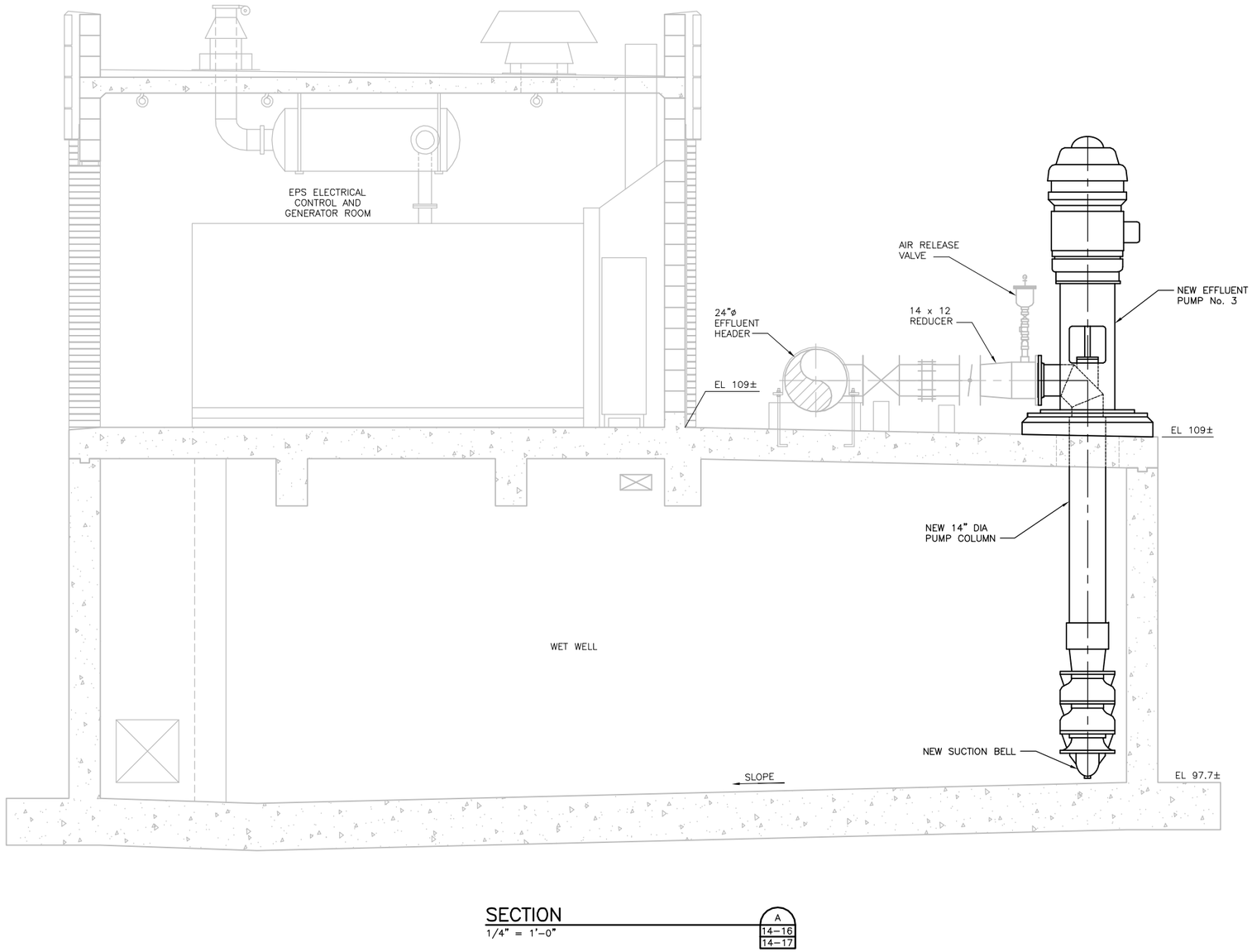


SECTION
1/4" = 1'-0"

A
14-16
14-17

PINOLE/HERCULES WPCP PROJECT

RETROFITTED EFFLUENT PUMPING STATION
SECTION

0 1" 2"

Figure 14-18

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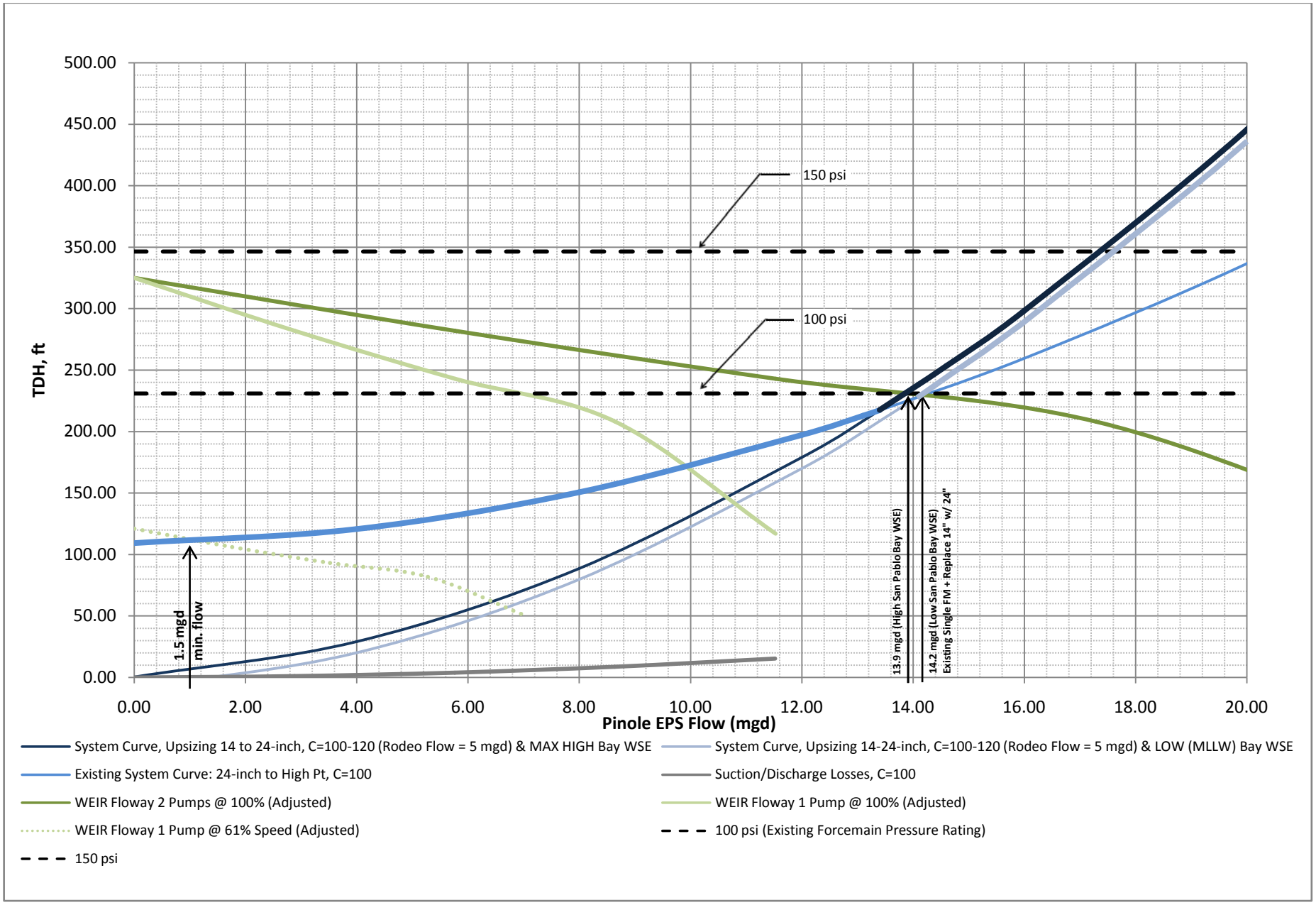
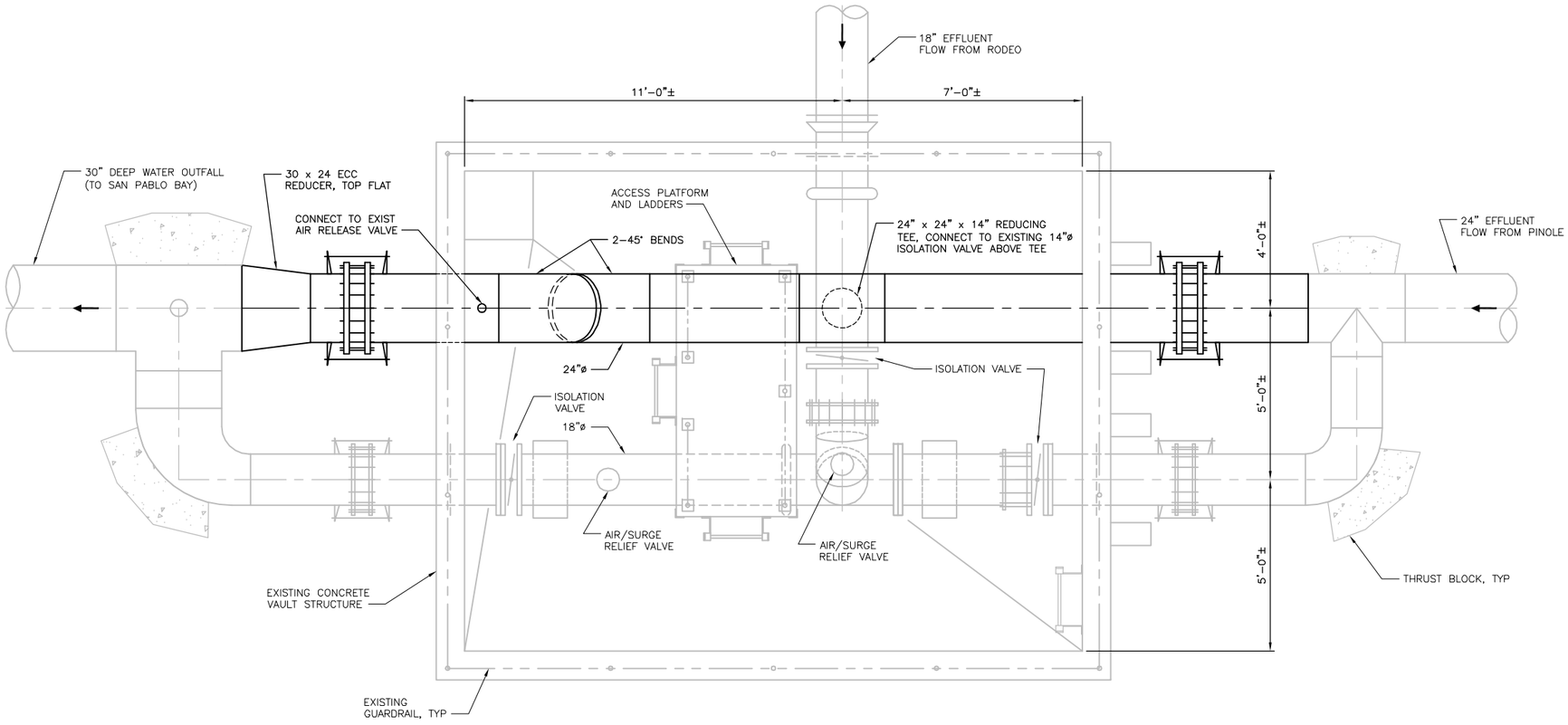
- The three pumps at the station will be replaced with vertical turbine pumps. Two duty pumps shall be capable of pumping flows of 13.9 mgd at a head of 100 psi at full speed. Two pumps will serve as duty pumps and the third pump will serve as the standby unit. The pumps will be provided with VFDs. One pump shall be capable of pumping minimum flows of 1.5 mgd. The pumps shown in Figure 14-19, are manufactured by Weir Floway, model number 19FKH. They are two-stage, 1770-rpm, have 11.22-inch diameter impellers and are provided with 450-horsepower, 460-volt motors. The cut sheets and pump curves for the Weir Floway Pumps are shown in Appendix B.
- During detailed design, a surge analysis shall be performed for the retrofitted pump station and Outfall Pipeline/Deep Water Outfall system. The analysis shall include the existing air/surge relief valves at the Rodeo vault structure to determine if damaging transient forces can occur. If so, surge protection shall be designed to protect the Outfall Pipeline/Deep Water Outfall.
- Modifications shall be performed at the localized highpoint within the 24-inch Outfall Pipeline to replace the gravity manhole with pressure rated piping and to install a combination air release/vacuum valve at the high point location.
- The 14-inch piping located within and just upstream and downstream of the Rodeo vault structure will be replaced with 24-inch piping. The new piping will be reconnected to the 18-inch pipeline from Rodeo and the 18-inch bypass pipeline within the vault. The 14-inch isolation valves will not be replaced. See Figure 14-20 for modifications. This piping modification allows increased capacity of the WPCP's Effluent Pump Station. Detailed construction sequencing and constraints shall be developed for this work during the design phase. The proposed improvements at the Rodeo Vault Structure shall be performed when San Pablo Bay levels are below the invert of the 30-inch Deep Water Outfall just downstream of the vault structure ($\cong$ elevation 103.83 $\pm$ field verify) to prevent backflow of the Bay into the vault structure. In addition, construction sequencing and constraints shall be developed in conjunction with Rodeo Sanitary District and the WPCP staff for discharge of plant effluent.
- The air/surge relief valves located on the Outfall Pipeline within the vault structure and just downstream will need to be included in the surge analysis to verify sizing as a result of increased flows and pressures. Two of these valves are located within the vault structure. One of the valves is located on the 18-inch pipeline entering from Rodeo (upstream of the Rodeo/Pinole tee) and the other is located on the 18-inch pipeline just prior to it exiting the vault (downstream of Rodeo tie-in). The third valve is located downstream of the structure on the 30-inch outfall prior to entering the Bay. See Figure 14-20 for additional details.

*Figure 14-19. Recommended Alternative (Alternative 2) - Pump and System Curves*




Notes:
1. Max High bay WSE = 106.10
2. MLLW = 97.10
3 Ex C Value=100 to high point and 108 (100/120) from high point to Bay
4. Replace 14" w/ 24" at Rodeo Structure




VAULT STRUCTURE PIPING MODIFICATIONS PLAN
1/4" = 1'-0"



0 1" 2"

PINOLE/HERCULES WPCP PROJECT

RODEO SANITARY DISTRICT
VAULT STRUCTURE PIPING MODIFICATIONS

Figure 14-20

## Construction Sequencing and Constraints

The retrofit to the WPCP's Effluent Pump Station shall be performed during the dry weather season, one pump at a time. Detailed construction sequencing and constraints shall be developed during the detailed design phase of the project to allow pumps, electrical, and instrumentation equipment to be replaced without jeopardizing reliable pumping of effluent to the Deep Water Outfall.

In addition, significant planning is required for replacement of the 14-inch piping located upstream, downstream, and within the vault structure at Rodeo Sanitary District. This work requires development of detailed construction sequencing and constraints during the detailed design phase to allow for replacement of piping and tie-ins, and ensure uninterrupted discharge of wastewater effluent from Pinole and Rodeo. The work may require temporary use of the Emergency Outfall by the WPCP and bypass pumping by Rodeo Sanitary District.

## Construction Cost Estimate

The total estimated construction cost for the recommended alternative (Alternative 2) is $1,512,000. This includes $1,213,000 for the improvements at the Effluent Pump Station and $299,000 for improvements to the outfall. The estimated construction cost for the Effluent Pump Station and outfall improvements are included in Appendix A.

## Other Considerations

Additional items which should be noted are included below:

- If at a future date, the parallel Outfall Pipeline (forcemain) as discussed under Alternatives 3 and 4 is added, additional redundancy and capacity to the Deep Water Outfall system will be achieved. The additional capacity is expected to be 18.6 to 20 mgd.
- The existing Outfall Pipeline is 35 years old and it will be subjected to its rated working pressure (100 psi) when both duty pumps are operating at full speed.
- Pumping against a closed valve on the Outfall Pipeline is currently possible and would result in pressures in the Outfall Pipeline above its pressure rating which could result in damage to the Outfall Pipeline. Precautions should be taken to prevent such a situation such as chaining the valves located in the Rodeo vault structure in their open position. The WPCP staff should also be aware that a 24-inch Outfall Pipeline isolation gate valve was placed into the 24-inch Outfall Pipeline under the Santa Fe Avenue Forcemain Replacement Project designed by Rugger Jensen Azar in 2008.
- Rodeo Sanitary District and the City of Pinole have a JPA in place for joint use of the Deep Water Outfall. The City of Pinole will need to coordinate with Rodeo Sanitary District to update the JPA to reflect the additional discharge that the WPCP will pump to the Deep Water Outfall. It is also recommended that in the future, the

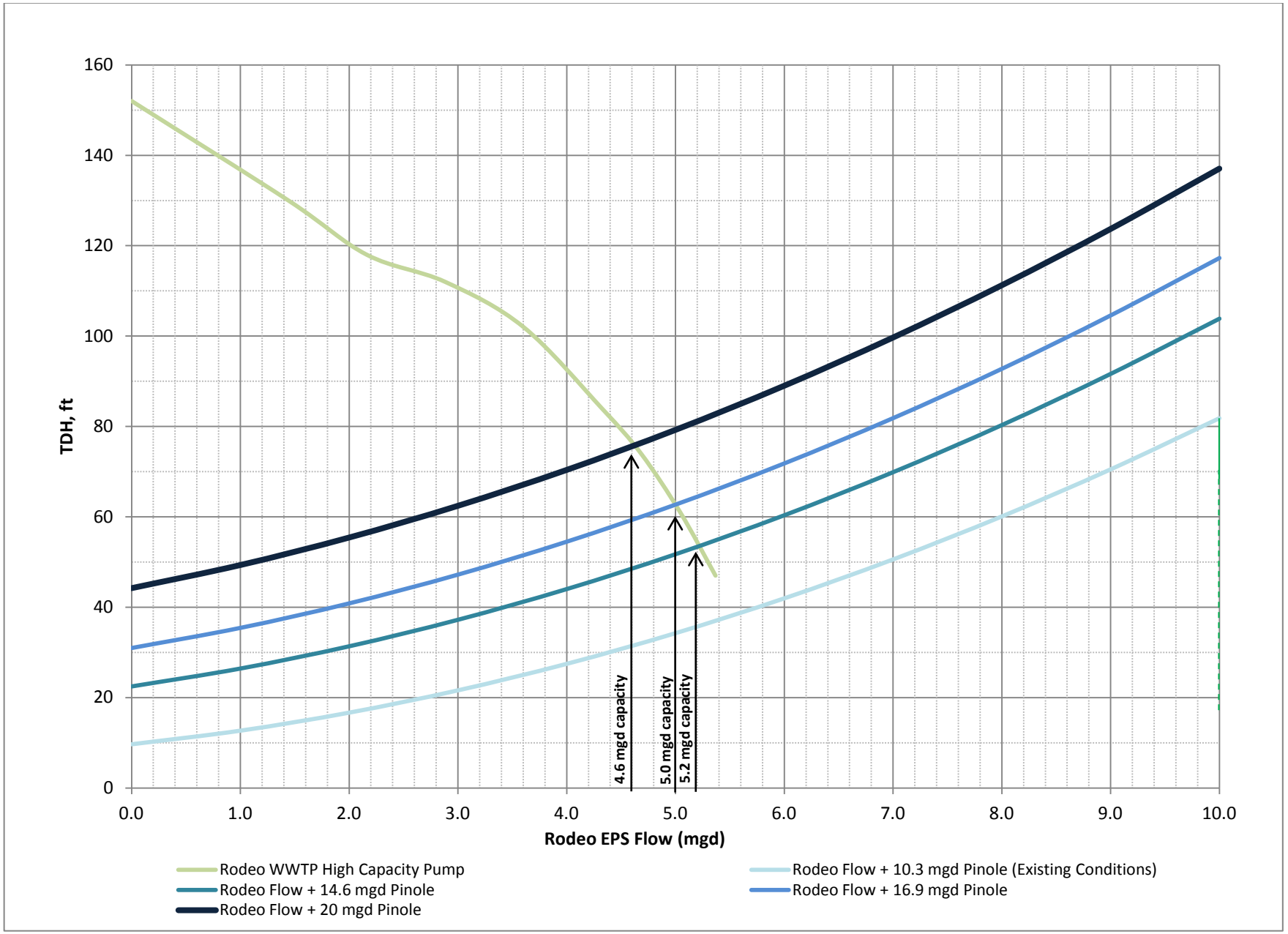
WPCP coordinates with Rodeo Sanitary District on: 1) any improvements or modifications to these facilities under the recommended alternative and 2) any future improvements or modifications to these facilities proposed by Rodeo Sanitary District that could adversely impact the WPCP's Effluent Pump Station capacity (such as the addition of duckbill check valves on the outfall diffuser ports).

- The Rodeo Sanitary District's WWTP effluent pump station was reviewed to ensure that it has sufficient capacity and head to enter the forcemain with the higher flows pumped by the WPCP. Analysis shows that one large Rodeo pump can pump flows greater than 5 mgd at current WPCP flows, 5.2 mgd with a flow of 14.6 mgd from the WPCP, 5.0 mgd at a flow of 16.9 mgd from the WPCP, and 4.6 mgd at a flow of 20.0 mgd from the WPCP. This analysis shows that pump station modifications at Rodeo are not required for Rodeo to pump 5.0 mgd into the system for flows less than 16.9 mgd from Pinole and therefore no improvements are needed at this time. This analysis is shown in Figure 14-21.
- The analysis performed under this TM did not account for future sea level rise impacts to San Pablo Bay. Sea level rise would result in less pumping capacity at the WPCP's Effluent Pump Station.
- If the Emergency Outfall is prohibited from use in the future and 20 mgd is required through the Deep Water Outfall, a parallel Outfall Pipeline and potentially a new effluent pump station will be required.

## Conclusions

Based on the construction cost savings of Alternative 2 over Alternative 4 and the frequency and additional volume of effluent that would be discharged through the Emergency Outfall rather than the Deep Water Outfall, the WPCP O&M staff and outside consultant recommend proceeding with Alternative 2. Prior to implementation of Alternative 2, discussions shall be held with the RWQCB to obtain a revised NPDES permit to allow effluent discharge to the Emergency Outfall for effluent flows greater than 13.9 mgd.

*Figure 14-21. Rodeo WWTP's Effluent Pump Station Capacity with Flows from the Pinole-Hercules WPCP.*



# Appendix A. Opinion of Probable Construction Cost

# Alternative 1

# Retrofit of existing Effluent Pump Station with no parallel Outfall Pipeline

# Opinion of Probable Construction Cost

# Alternative 1 Effluent Pump Station

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $118,900 |
| 2 - Site Work | $31,000 |
| 3 - Concrete | $13,000 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture protection | $0 |
| 8 - Doors and windows | $0 |
| 9 - Finishes | $10,000 |
| 10 - Specialties | $1,000 |
| 11 - Equipment | $360,000 |
| 13 - Instrumentation | $250,000 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $6,500 |
| 16 - Electrical | $240,000 |
| Subtotal Construction Cost | $1,030,400 |
| Construction Contingency (20%) | $182,300 |
| Total Construction Cost (2012 dollars) | $1,213,000 |
| Engineering and Administration (25%) | $303,300 |
| Total Project Cost (2012 dollars) | $1,516,000 |

# Alternative 1 Outfall Miscellaneous Improvements

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $19,600 |
| 2 - Site Work | $15,000 |
| 3 - Concrete | $0 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture Protection | $0 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $0 |
| 10 - Specialties | $0 |
| 11 - Equipment | $0 |
| 13 - Instrumentation | $0 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $135,000 |
| 16 - Electrical | $0 |
| Subtotal Construction Cost | $169,600 |
| Construction Contingency (20%) | $30,000 |
| Total Construction Cost (2012 dollars) | $200,000 |
| Engineering and Administration (25%) | $50,000 |
| Total Project Cost (2012 dollars) | $250,000 |

# Alternative 2

## Retrofit of existing Effluent Pump Station and replace 14” pipe with 24” pipe at the Rodeo Vault Structure. No parallel Outfall Pipeline

## Opinion of Probable Construction Cost

# Alternative 2 Effluent Pump Station

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $118,900 |
| 2 - Site Work | $31,000 |
| 3 - Concrete | $13,000 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture Protection | $0 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $10,000 |
| 10 - Specialties | $1,000 |
| 11 - Equipment | $360,000 |
| 13 - Instrumentation | $250,000 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $6,500 |
| 16 - Electrical | $240,000 |
| Subtotal Construction Cost | $1,029,800 |
| Construction Contingency (20%) | $182,300 |
| Total Construction Cost (2012 dollars) | $1,213,000 |
| Engineering and Administration (25%) | $303,300 |
| Total Project Cost (2012 dollars) | $1,516,000 |

# Alternative 2 Outfall Miscellaneous Improvements

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $29,400 |
| 2 - Site Work | $23,000 |
| 3 - Concrete | $15,000 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture Protection | $0 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $2,500 |
| 10 - Specialties | $500 |
| 11 - Equipment | $0 |
| 13 - Instrumentation | $0 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $183,800 |
| 16 - Electrical | $0 |
| Subtotal Construction Cost | $254,200 |
| Construction Contingency (20%) | $44,960 |
| Total Construction Cost (2012 dollars) | $299,000 |
| Engineering and Administration (25%) | $74,800 |
| Total Project Cost (2012 dollars) | $374,000 |

# Alternative 3

## Add parallel 24-inch Outfall Pipeline. Reuse existing effluent pumping station with no modifications.

## Opinion of Probable Construction Cost

# Alternative 3 Parallel Outfall Forcemain

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $1,542,100 |
| 2 - Site Work | $2,032,200 |
| 3 - Concrete | $27,500 |
| 4 - Masonry | $0 |
| 5 - Metals | $15,350 |
| 6 - Wood and Plastic | $4,800 |
| 7 - Thermal and Moisture Protection | $1,000 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $0 |
| 10 - Specialties | $0 |
| 11 - Equipment | $0 |
| 13 - Instrumentation | $0 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $2,854,470 |
| 16 - Electrical | $0 |
| Subtotal Construction Cost | $6,477,420 |
| Construction Contingency (20%) | $987,064 |
| Total Construction Cost (2012 dollars) | $7,464,000 |
| Engineering and Administration (25%) | $1,866,000 |
| Total Project Cost (2012 dollars) | $9,330,000 |

# Alternative 3 Outfall Miscellaneous Improvements

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $17,800 |
| 2 - Site Work | $0 |
| 3 - Concrete | $0 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture Protection | $0 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $0 |
| 10 - Specialties | $0 |
| 11 - Equipment | $0 |
| 13 - Instrumentation | $0 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $135,000 |
| 16 - Electrical | $0 |
| Subtotal Construction Cost | $152,800 |
| Construction Contingency (20%) | $27,000 |
| Total Construction Cost (2012 dollars) | $180,000 |
| Engineering and Administration (25%) | $45,000 |
| Total Project Cost (2012 dollars) | $225,000 |

# Alternative 4

## Retrofit existing Effluent Pumping Station and add parallel 24-Inch Outfall Pipeline.

## Opinion of Probable Construction Cost

# Alternative 4 Effluent Pump Station

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $118,900 |
| 2 - Site Work | $31,000 |
| 3 - Concrete | $13,000 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture Protection | $0 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $10,000 |
| 10 - Specialties | $1,000 |
| 11 - Equipment | $360,000 |
| 13 - Instrumentation | $250,000 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $6,500 |
| 16 - Electrical | $240,000 |
| Subtotal Construction Cost | $1,030,400 |
| Construction Contingency (20%) | $182,300 |
| Total Construction Cost (2012 dollars) | $1,213,000 |
| Engineering and Administration (25%) | $303,300 |
| Total Project Cost (2012 dollars) | $1,516,000 |

# Alternative 4 Parallel Outfall Forcemain

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $1,542,100 |
| 2 - Site Work | $2,032,200 |
| 3 - Concrete | $27,500 |
| 4 - Masonry | $0 |
| 5 - Metals | $15,350 |
| 6 - Wood and Plastic | $4,800 |
| 7 - Thermal and Moisture Protection | $1,000 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $0 |
| 10 - Specialties | $0 |
| 11 - Equipment | $0 |
| 13 - Instrumentation | $0 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $2,854,470 |
| 16 - Electrical | $0 |
| Subtotal Construction Cost | $6,477,420 |
| Construction Contingency (20%) | $987,064 |
| Total Construction Cost (2012 dollars) | $7,464,500 |
| Engineering and Administration (25%) | $1,866,100 |
| Total Project Cost (2012 dollars) | $9,331,000 |

# Alternative 4 Outfall Miscellaneous Improvements

| CSI Division | Cost |
|---|---|
| 1 - General Requirements | $19,600 |
| 2 - Site Work | $15,000 |
| 3 - Concrete | $0 |
| 4 - Masonry | $0 |
| 5 - Metals | $0 |
| 6 - Wood and Plastic | $0 |
| 7 - Thermal and Moisture Protection | $0 |
| 8 - Doors and Windows | $0 |
| 9 - Finishes | $0 |
| 10 - Specialties | $0 |
| 11 - Equipment | $0 |
| 13 - Instrumentation | $0 |
| 14 - Conveyance | $0 |
| 15 - Mechanical | $135,000 |
| 16 - Electrical | $0 |
| Subtotal Construction Cost | $169,600 |
| Construction Contingency (20%) | $30,000 |
| Total Construction Cost (2012 dollars) | $200,000 |
| Engineering and Administration (25%) | $50,000 |
| Total Project Cost (2012 dollars) | $250,000 |

# Appendix B. Pump Manufacturer's Cut Sheets

# Pump Performance Datasheet

| | | | |
|---|---|---|---|
| Customer | : HDR | Quote number | : 246223 |
| Customer reference | : | Size | : 19FKH |
| Item number | : 003 | Stages | : 2 |
| Service | : Option 1- Alternative Future Design Point | Based on curve number | : 19FKH 1770 |
| Quantity | : 3 | Date last saved | : 07 Nov 2012 10:28 AM |

## Operating Conditions

| | |
|---|---|
| Flow, rated | : 4,657 USgpm |
| Differential head / pressure, rated (requested) | : 240.0 ft |
| Differential head / pressure, rated (actual) | : 240.8 ft |
| Suction pressure, rated / max | : 0.00 / 0.00 psi.g |
| NPSH available, rated | : Ample |
| Frequency | : 60 Hz |

## Performance

| | |
|---|---|
| Speed, rated | : 1,770 rpm |
| Impeller diameter, rated | : 11.22 in |
| Impeller diameter, maximum | : 12.60 in |
| Impeller diameter, minimum | : 10.75 in |
| Efficiency (bowl / pump) | : 79.18 / 78.25 % |
| NPSH required / margin required | : 25.32 / 0.00 ft |
| Ns (imp. eye flow) / Nss (imp. eye flow) | : 3,715 / 10,205 US Units |
| MCSF | : 1,460 USgpm |
| Head, maximum, rated diameter | : 322.3 ft |
| Head rise to shutoff | : 33.21 % |
| Flow, best eff. point (BEP) | : 6,001 USgpm |
| Flow ratio (rated / BEP) | : 77.60 % |
| Diameter ratio (rated / max) | : 89.04 % |
| Head ratio (rated dia / max dia) | : 76.85 % |
| Cq/Ch/Ce [ANSI/HI 9.6.7-2010] | : 1.00 / 1.00 / 1.00 |
| Selection status | : Acceptable |

## Liquid

| | |
|---|---|
| Liquid type | : Water - Clean |
| Additional liquid description | : Fresh Water |
| Solids diameter, max | : 0.00 in |
| Solids concentration, by volume | : 0.00 % |
| Temperature, max | : 68.00 deg F |
| Fluid density, rated / max | : 1.000 / 1.000 SG |
| Viscosity, rated | : 1.00 cP |
| Vapor pressure, rated | : 0.00 psi.a |

## Material

| | |
|---|---|
| Material selected | : Cast Iron/Bronze |

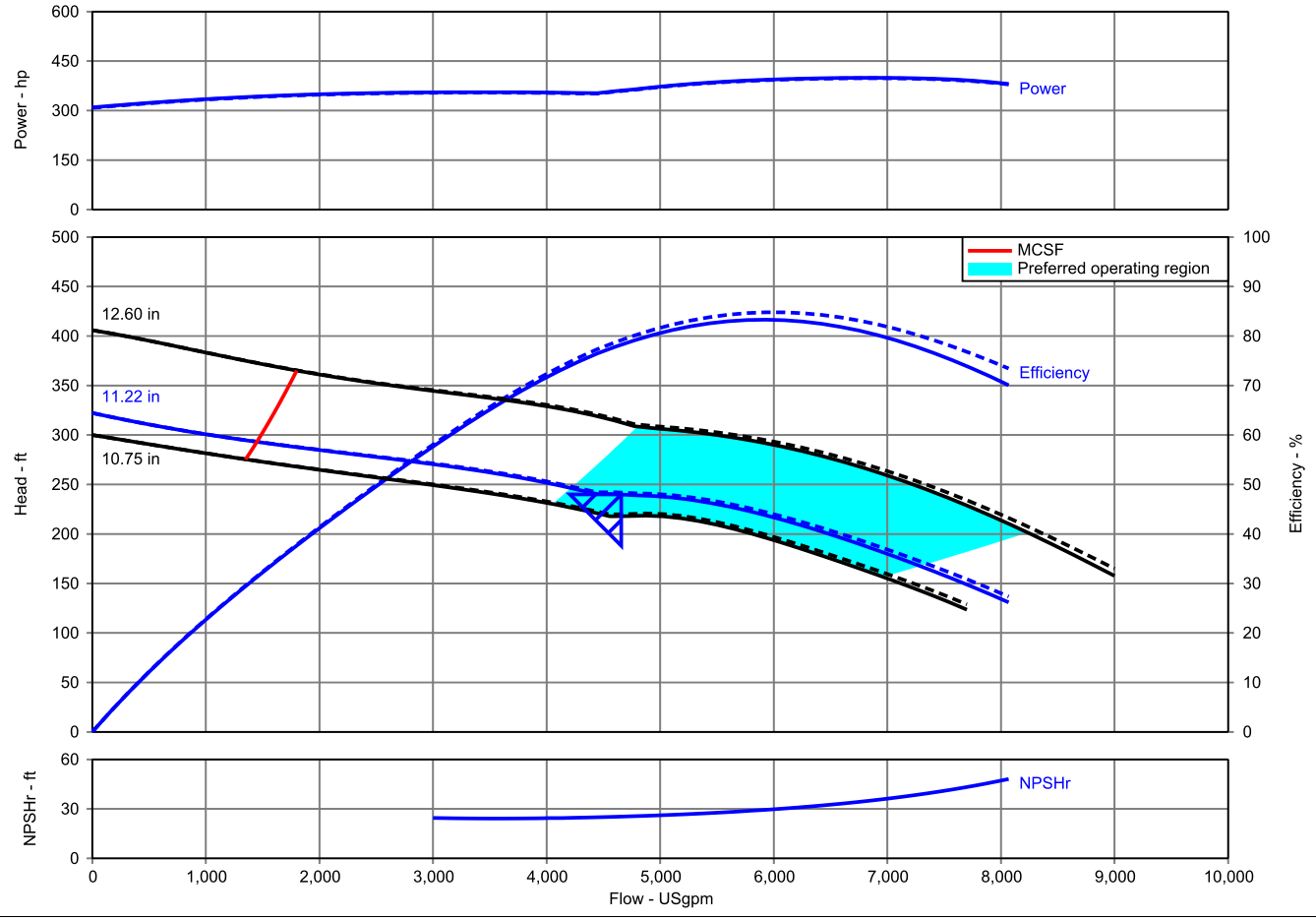
## Pressure Data

| | |
|---|---|
| Maximum working pressure | : See the Additional Data page |
| Maximum allowable working pressure | : See the Additional Data page |
| Maximum allowable suction pressure | : N/A |
| Hydrostatic test pressure | : See the Additional Data page |

## Driver & Power Data

| | |
|---|---|
| Driver sizing specification | : Max power + 5% |
| Margin over specification | : 0.00 % |
| Service factor | : 1.15 |
| Power, hydraulic | : 284 hp |
| Power (bowl / pump) | : 359 / 361 hp |
| Power, maximum, rated diameter | : 399 hp |
| Minimum recommended motor rating | : 450 hp / 336 kW |

Pump and bowl (dashed) performance. Bowl adjusted for construction and viscosity.
Pump further adjusted for friction and power losses of lineshaft and thrust bearings. Pump is not adjusted for any static lift.
The duty point represents the pump performance head.



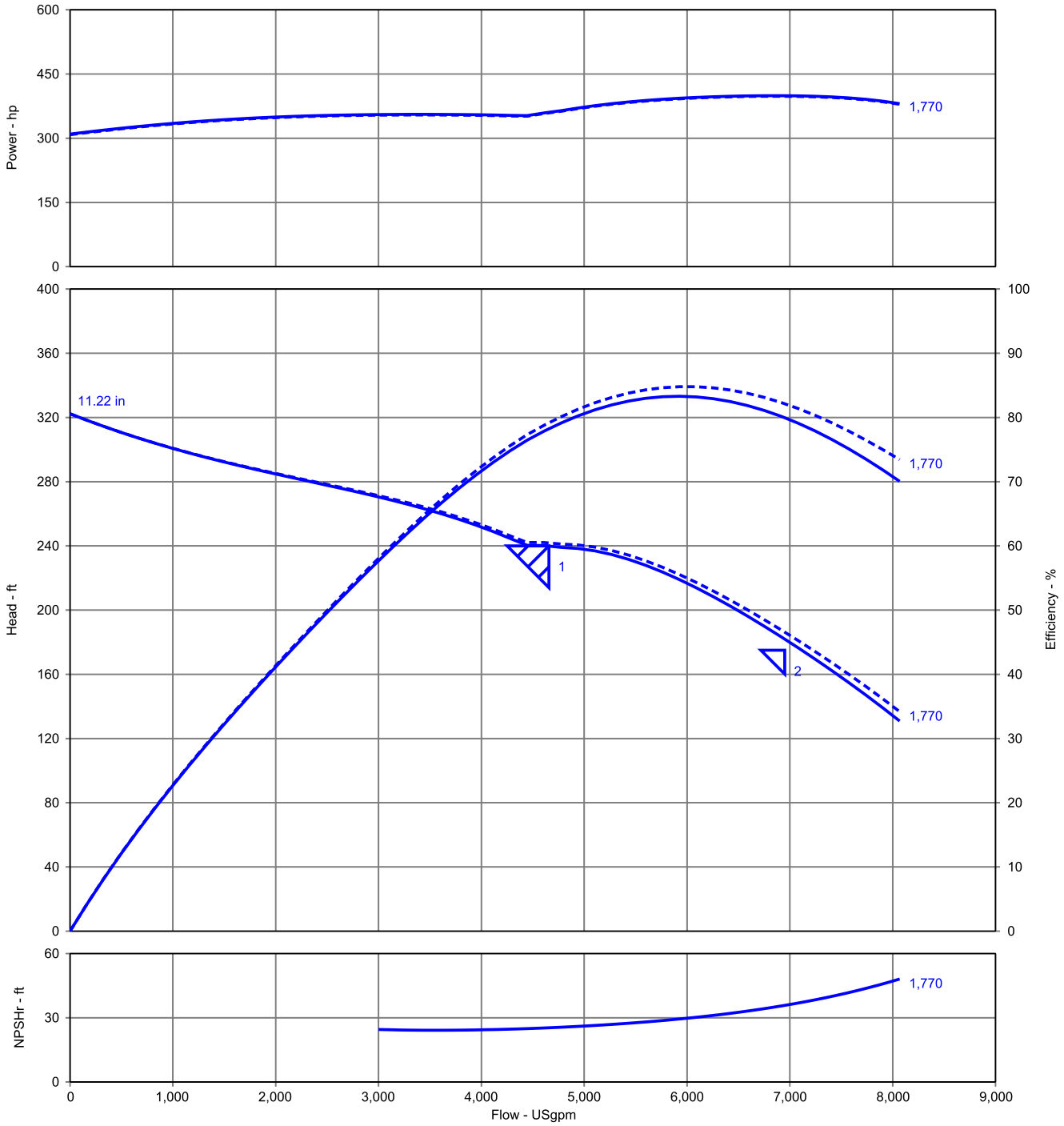
# Multiple Conditions Datasheet

| | | | | | |
|---|---|---|---|---|---|
| Customer | : HDR | Quantity | : 3 | Size | : 19FKH |
| Customer reference | : | Quote number | : 246223 | Stages | : 2 |
| Item number | : 003 | Date last saved | : 07 Nov 2012 10:28 AM | Speed, rated | : 1,770 |
| Service | : Option 1- Alternative Future Design Point | | | | |

| Condition # | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Description | | - | - | | | | | | |
| Temperature, max | deg F | 68.00 | 68.00 | | | | | | |
| Fluid density, rated / max | SG | 1.000 / 1.000 | 1.000 / 1.000 | | | | | | |
| Viscosity, rated | cP | 1.00 | 1.00 | | | | | | |
| Primary condition | | ◉ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Size | | 19FKH | | | | | | | |
| Stages | | 2 | | | | | | | |
| Impeller diameter, rated | in | 11.22 | | | | | | | |
| Flow, rated | USgpm | 4,657 | 6,950 | | | | | | |
| Head, rated (requested) | ft | 240.0 | 175.0 | | | | | | |
| Head, rated (actual) | ft | 240.8 | 175.9 | | | | | | |
| Suction pressure, rated / max | psi.g | 0.00 / 0.00 | 0.00 / 0.00 | | | | | | |
| NPSH available (system) | ft | Ample | Ample | | | | | | |
| Speed, rated | rpm | 1,770 | 1,751 | | | | | | |
| Selection status | | Acceptable | **Near miss** | | | | | | |
| Cq/Ch/Ce [ANSI/HI 9.6.7-2010] | | 1.00 / 1.00 / 1.00 | 1.00 / 1.00 / 1.00 | | | | | | |
| Efficiency | % | 78.25 | 79.53 | | | | | | |
| NPSH required | ft | 25.32 | 35.63 | | | | | | |
| Power, rated | hp | 361 | 386 | | | | | | |

# Multiple Conditions Curve

Pump and bowl (dashed) performance. Bowl adjusted for construction and viscosity.
Pump further adjusted for friction and power losses of lineshaft and thrust bearings. Pump is not adjusted for any static lift.
The duty point represents the pump performance head.

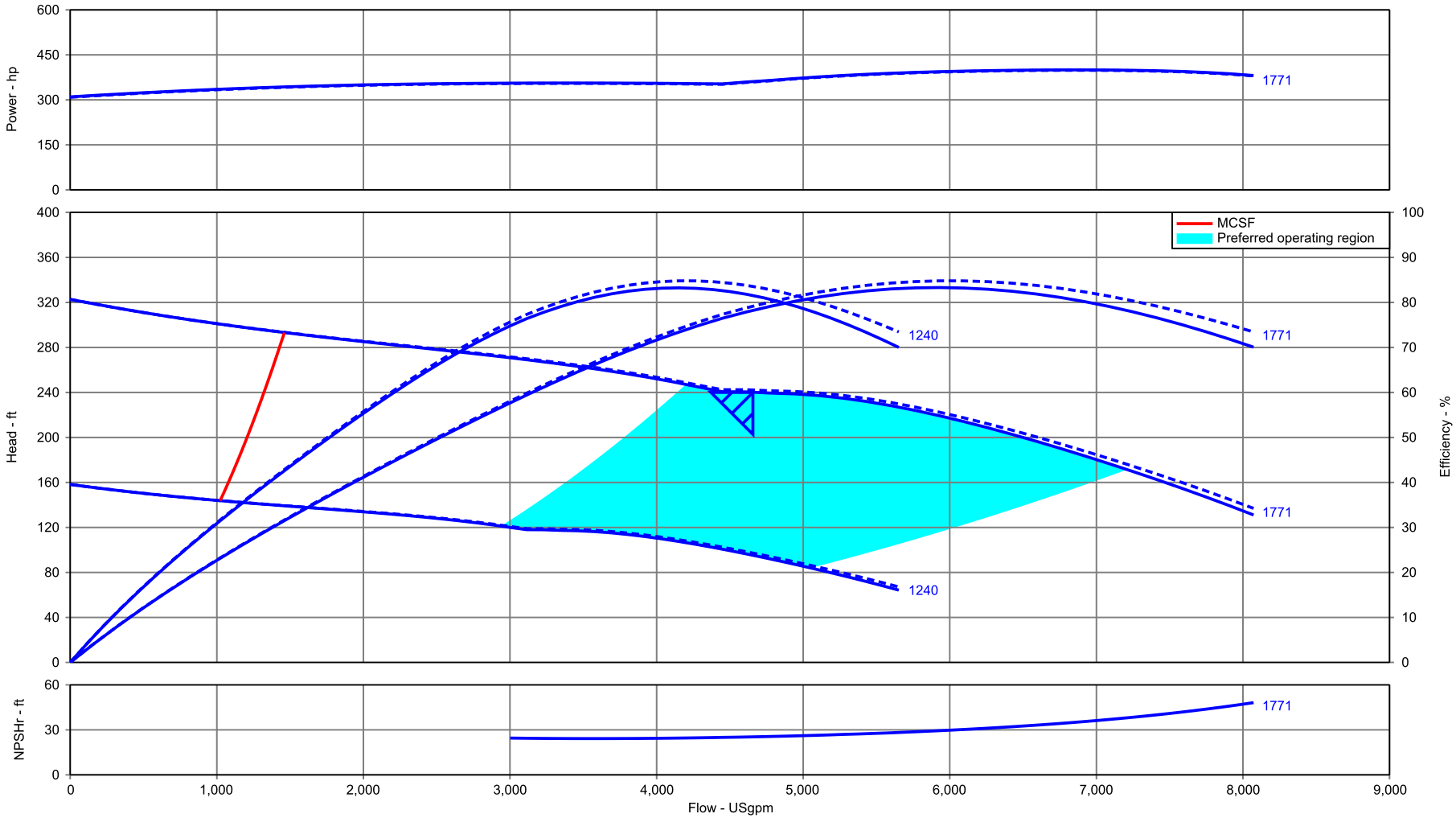



| | | | | | |
|---|---|---|---|---|---|
| Customer | : HDR | Pump Type | : 19FKH | Quote number | : 246223 |
| Address | : 2365 IRON POINT ROAD SUITE 300, FOLSOM , CA 95630 | # of Stages | : 2 | Customer PO # | : |
| Location | : | Quantity | : 3 | CO # | : |
| Project | : Pinole WWTP Effluent PS | Flow | : 4,657 USgpm | Item # | : 003 |
| Tag | : | Head | : 240.0 ft | JOL # | : |
| Bowl/Pump | : | Speed | : 1,770 rpm | Serial # | : |
| Eff (bowl/pump) | : 79.18 / 78.25 % | Fluid Density | : 1.000 / 1.000 SG | Drawing # | : |
| Power (bowl / pump) | : 359 / 361 hp | Viscosity | : 1.00 cP | Drawn By | : |
| NPSH required | : 25.32 ft | Impeller Trim | : 11.22 in | Last Modified | : 07 Nov 2012 10:28 AM |

The head and power may be different than that shown in accordance with Hydraulic Institute / API 610 Standards
Additional Notes:

# Multi-Speed Performance Curve

Pump and bowl (dashed) performance. Bowl adjusted for construction and viscosity.
Pump further adjusted for friction and power losses of lineshaft and thrust bearings. Pump is not adjusted for any static lift.
The duty point represents the pump performance head.




| | | | | | |
|---|---|---|---|---|---|
| Customer | : HDR | Pump Type | : 19FKH | Quote number | : 246223 |
| Address | : 2365 IRON POINT ROAD SUITE 300, FOLSOM , CA 95630 | # of Stages | : 2 | Customer PO # | : |
| Location | : | Quantity | : 3 | CO # | : |
| Project | : Pinole WWTP Effluent PS | Flow | : 4,657 USgpm | Item # | : 003 |
| Tag | : | Head | : 240.0 ft | JOL # | : |
| Bowl/Pump | : | Speed | : 1,770 rpm | Serial # | : |
| Eff (bowl / pump) | : 79.18 / 78.25 % | Fluid Density | : 1.000 / 1.000 SG | Drawing # | : |
| Power (bowl / pump) | : 359 / 361 hp | Viscosity | : 1.00 cP | Drawn By | : |
| NPSH required | : 25.32 ft | Impeller Trim | : 11.22 in | Last Modified | : 07 Nov 2012 10:28 AM |

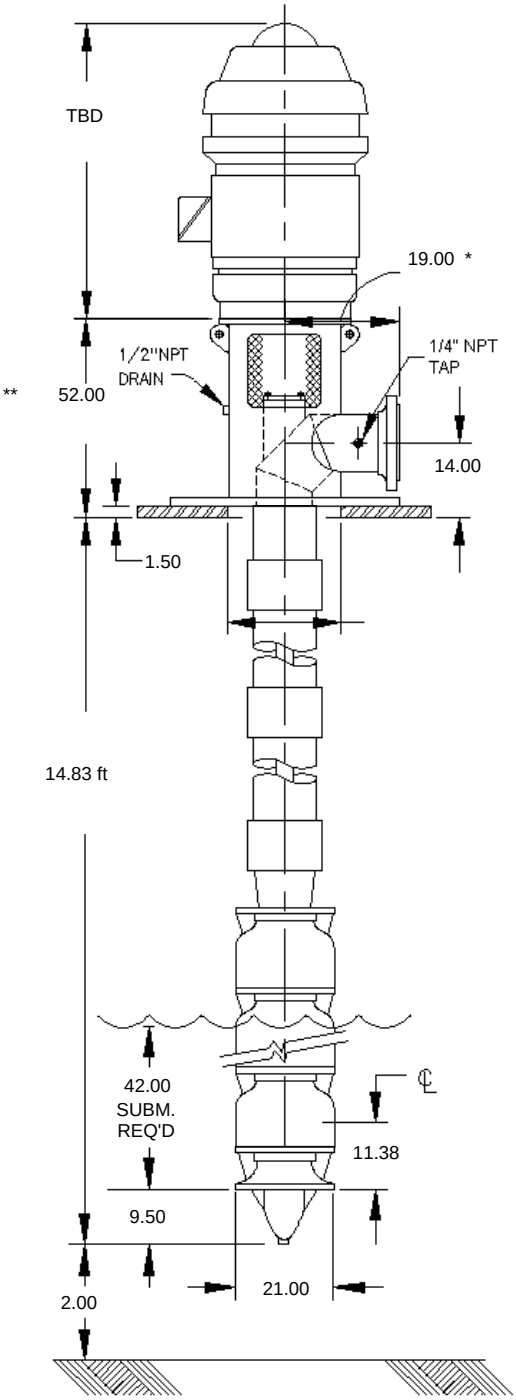
The head and power may be different than that shown in accordance with Hydraulic Institute / API 610 Standards



Additional Notes:

# VERTICAL TURBINE PUMP

## 4,657 USgpm 241.9 ft TDH
## 2 STAGE TYPE 19FKH
## 14x24.5FR DISCHARGE HEAD




Discharge

14 in. 150#RF - ANSI Flange
21 in. Dia. Flange
12 - 1.13 in. Dia. holes
18.75 in. Bolt circle

* TYPICAL LOCATION FOR DISCHARGE NOZZLE

** FINAL HEAD HEIGHT WILL BE DETERMINED BASED ON INTERNAL ANALYSIS AND SPECIFICATION REVIEW

NOT TO BE USED FOR CONSTRUCTION UNLESS CERTIFIED.

NOTES:
ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED.
DRAWING NOT TO SCALE.

| REV. | BY | DATE | DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Customer: HDR
Customer Reference:
Item Number: 003
Curve Number: 19FKH 1770
Date: 07 Nov 2012

OUTLINE DRAWING

DRAWING