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Technical Memorandum

To	Marc Rutten, CVRD	Page	1
CC			
Subject	Pump Siting Study		
From	Michael Celli, AECOM Ken Moysiuk, AECOM		
Date	December 22, 2015	Project Number	60333483

1. Introduction

Flow from the Courtenay Pump Station and Jane Place Pump Station is currently discharged to a shared forcemain. The forcemain is 750 mm diameter at the discharge of the Courtenay Pump Station and increases in size to 860 mm downstream of the tie-in of the Jane Place Pump Station. After the tie-in, the forcemain runs past Goose Spit, along the Wilemar Bluffs, and discharges at the Comox Valley WPCC.

The Comox Valley Regional District is investigating options for constructing a new pump station to reroute the Courtenay Forcemain away from the Wilemar Bluffs. A new pump station is required to overcome the elevation gain within this overland route. More details on the forcemain routing can be found in the *Forcemain Re-alignment Study (2005)* prepared by CH2M Hill for the CVRD. The new pump station would also augment the capacity of the Courtenay Pump Station by reducing the forcemain length (i.e. less friction loss). The Courtenay Pump Station is currently operating near maximum capacity.

A previous pump station siting study completed by AECOM in January, 2014 identified two options: replacing the existing Jane Place Pump Station, and construction of a new pump station near the intersection of Docliddle and Croteau Road. This memorandum is intended to review a third option: construction of a new pump station near the intersection of Croteau Road and Midden Road, within the Croteau Road Right-of-Way (ROW).

1.1 Work to Date

This technical memorandum is intended to build upon work completed to date to address the re-routing of the Courtney PS forcemain around the Wilemar bluffs. The work completed includes the following:

- *Forcemain Re-alignment Study* (2005), CH2M Hill

- *CVRD Sanitary Sewerage Master Plan* (2011), OPUS DaytonKnight and McElhanney
- *Courtney Pump Station Sewerage Systems Upgrading and Staging Plan* (2013), AECOM
- *Pump Station Siting Technical Memorandum* (2014), AECOM

2. Croteau ROW Pump Station Site

2.1 Scope of Project

The concept of construction of a pumping station near the intersection of Docliddle and Croteau Road was identified by CH2M Hill in the 2005 *Forcemain Alignment Study*. This recommendation was carried through in the sewer master plan by Opus DaytonKnight and McElhanney. Under this concept, the Courtenay Pump Station Forcemain would be diverted up Croteau Road to a pumping station. The station would pump all flows from the Courtenay and Jane pump stations through the proposed overland forcemain route to the CVWPCC.

As an alternative to construction at Docliddle and Croteau Road, the pump station may be constructed within the undeveloped Croteau Road ROW south of Midden Road.

A photograph of Croteau road looking towards the area identified for the pumping station is provided in Figure 1.

Figure 1. Croteau Road and Midden Road – Facing South

Croteau Road ends at Midden Road as shown in Figure 1. However, the ROW continues to the south.

The scope of construction for the pump station would include the following:

- Construction of a new pumping station south of the intersection of Docliddle and Midden Road.
- Diversion of the existing Courtenay Pump Station forcemain up Croteau Road to the proposed pump station.
- Construction of the proposed landside forcemain realignment from the pump station to the CVWPCC
- Changes to pumps at the Courtenay and Jane Place pump stations to meet the changes to the forcemain hydraulics upon completion of the new pump station.

2.2 Pump Station Configuration

The pump station will receive flow from the Courtenay Pump Station, and operate in a series pumping arrangement. Adequate storage is required to account for a delay in start times between these two pumping stations. A 10 m diameter circular wet-well design has been selected to maximize storage. The design provides 15 minutes of storage from the pump start elevation to minimum freeboard, based on one pump running at the Courtenay Pump Station at 350 L/s.

The design standard for wet-well design is the Hydraulic Institute Standard for Pump Intake Design (ANSI/HI 9.8-2012). Further, Flygt guidelines for circular wet-well design have also been applied.

The wet-well would have access hatches at grade for removal of pumps. A building would be constructed at grade to house electrical equipment, diesel generator, controls and odour control equipment. A valve chamber would be constructed to the north of the wet-well to house the check valves and isolations valves for each pump.

Sketches 1, 2 and 3 are included as attachments to this memorandum that illustrate the proposed pump station configuration.

2.2.1 Site Elevation

The Croteau Road ROW site varies in elevation from 4 to 6 m geodetic. The conceptual pump station design includes a wet-well with an invert elevation of -0.2 m geodetic. The proposed operating water level for the pump station is 1.0 m geodetic. Grade elevation is approximately 4.0 m geodetic in the vicinity of the wet-well.

Previous studies had recommended an operating water level of 12.0 m geodetic. The proposed lower operating level will reduce the pressure in the Courtenay Forcemain, as well as the demand on the pumps at the Courtenay and Jane Place pump stations. AECOM has checked the pump curves for the existing pumps, and the reduced static head will cause the existing pumps to operate at run-out. This is illustrated in Figure 2 for the Courtenay Pump Station.

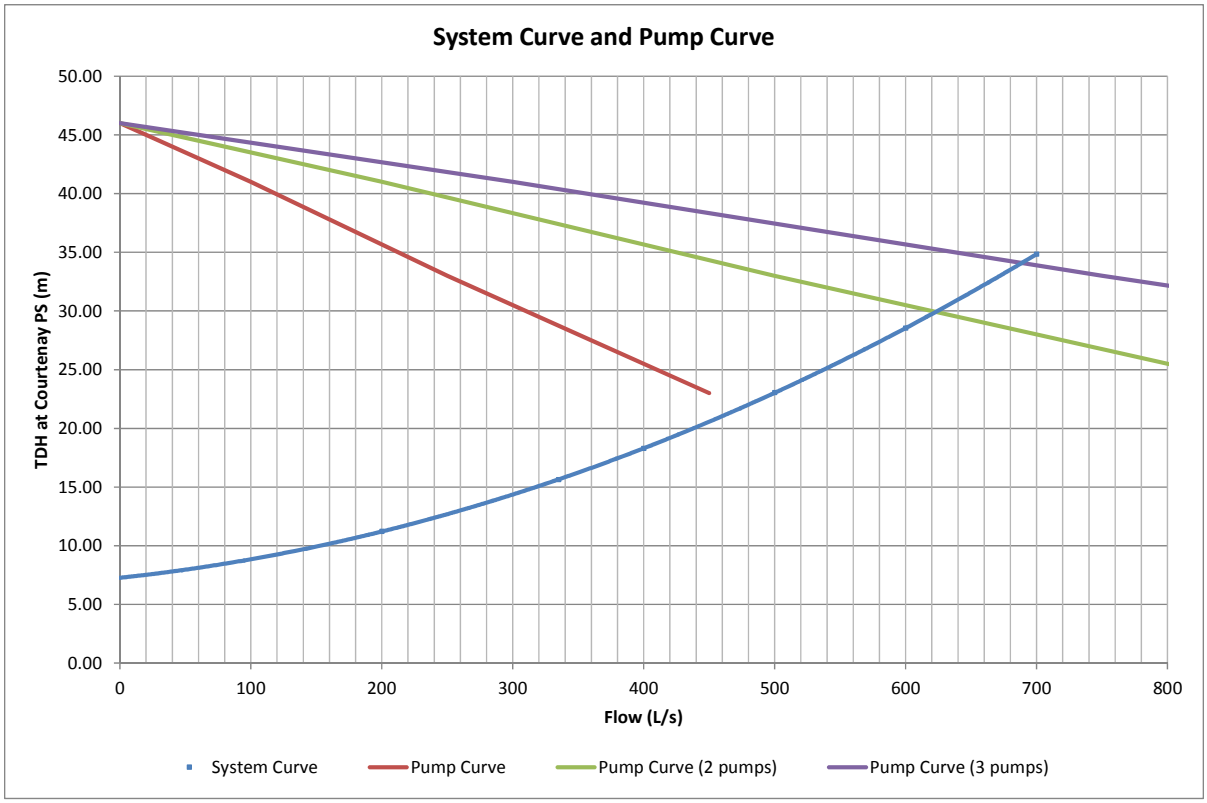


Figure 2. Courtenay Pump Station System and Pump Curve

Due to this run-out issue, the Courtenay and Jane Place pumps would need to be replaced if a pump station were constructed at the Croteau and Midden Road site. The replacement pumps would be lower horsepower than the existing pumps if selected for the same flow.

2.2.2 Pump Selection

The design flow for the proposed pumping station is 1000 L/s. AECOM has made a selection based on the installation of 4 pumps. Submersible pumps will be installed in the circular wet-well. The design characteristics for the pump selection are as follows:

- Number of pumps: 3 duty / 1 standby
- Flow per pump: 340 L/s.
- Head: 70 m
- Motor size: 500 hp

Pump selection details are included as an attachment to this memorandum.

2.3 Constructability Issues

2.3.1 Pump Station Construction

Given the depth and proximity to the shoreline, groundwater will be encountered during excavation. The circular wet-well design would allow for construction techniques such as a sinking caisson design. Alternatively, a cofferdam may also be constructed around the wet-well to dewater the site. The method of excavation and dewatering will be determined based on geotechnical considerations at the site.

The neighboring properties are connected to well water, septic tanks and overhead power; therefore utility conflicts are not expected to be a significant issue. Three phase power may be available on Croteau road, and if not, it is likely available on Lazo Road nearby. Due to the large power demand, BC Hydro would need to determine the best option for servicing the station.

2.3.2 Forcemain Tie-ins

Construction challenges will occur during tie-in to the existing Courtenay Forcemain. The nearest upstream isolation valve on the forcemain is near the Marina Park at Port Augusta St. The isolation valve would be closed to allow tie-in of a forcemain diversion chamber; however the long pipe length to the valve would mean significant time would be required to drain the forcemain in this area. The forcemain diversion chamber would allow flow to be redirected to the proposed pumping station. The chamber would be overbuilt on the Courtenay Forcemain, and the forcemain broken into once construction of the chamber and pumping station is complete.

The Courtenay Forcemain is Hyprescon pipe – a reinforced concrete pipe with tensioned steel reinforcement. Specific design and construction guidelines must be followed in accordance with the manufacturer's recommendations when cutting or otherwise breaking into this type of pipe. An engineer specializing in design of Hyprescon piping should be involved with the design of the forcemain tie-ins.

2.4 Aesthetic Impacts / Considerations

The pump station could be designed architecturally to fit in with the local area to limit aesthetic impacts. An attractively designed building and landscaped site would likely be better received by local residents. The site would be designed to maintain trail access to the foreshore.

Odour control would be a key consideration for the pumping station given proximity to residents. A carbon scrubber would likely be provided for odour control. Treated air could be discharged above the pump station building roofline through an architectural chimney. This would address any aesthetic issues with the treated air discharge, and allow for discharge of treated air away from residents.

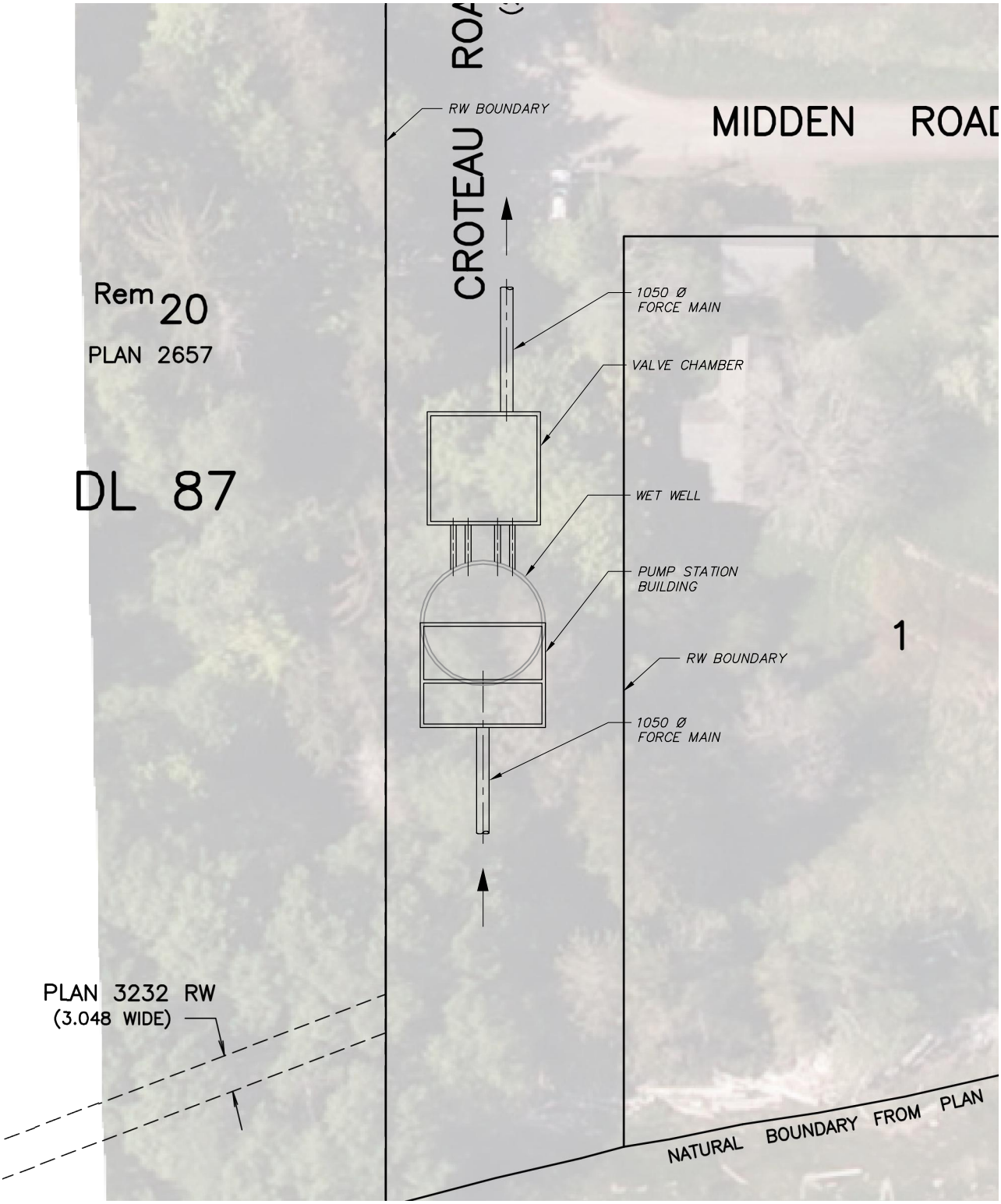
The pumping station would be constructed with acoustical panels and insulation to prevent noise impacts to surrounding properties. An acoustical engineer would specify materials and construction details to ensure that the total noise emission is within the bylaw requirements.

2.4.1 Construction

There will be significant noise impacts to the neighbourhood around the proposed site during construction of the pump station. The contract documents would need to place limitations on timing and methods of construction to meet bylaw requirements.

An environmental assessment would be required for the project, and this would identify a sediment control plan to prevent sediment being carried to the foreshore during rain events. The environmental assessment would also identify any potential impacts to species habitat, and the required mitigative measures. The environmental assessment should be performed as a first step during the preliminary design. Given that the properties along Croteau Rd. are already developed, significant mitigative measures are not expected to be required.

Figures

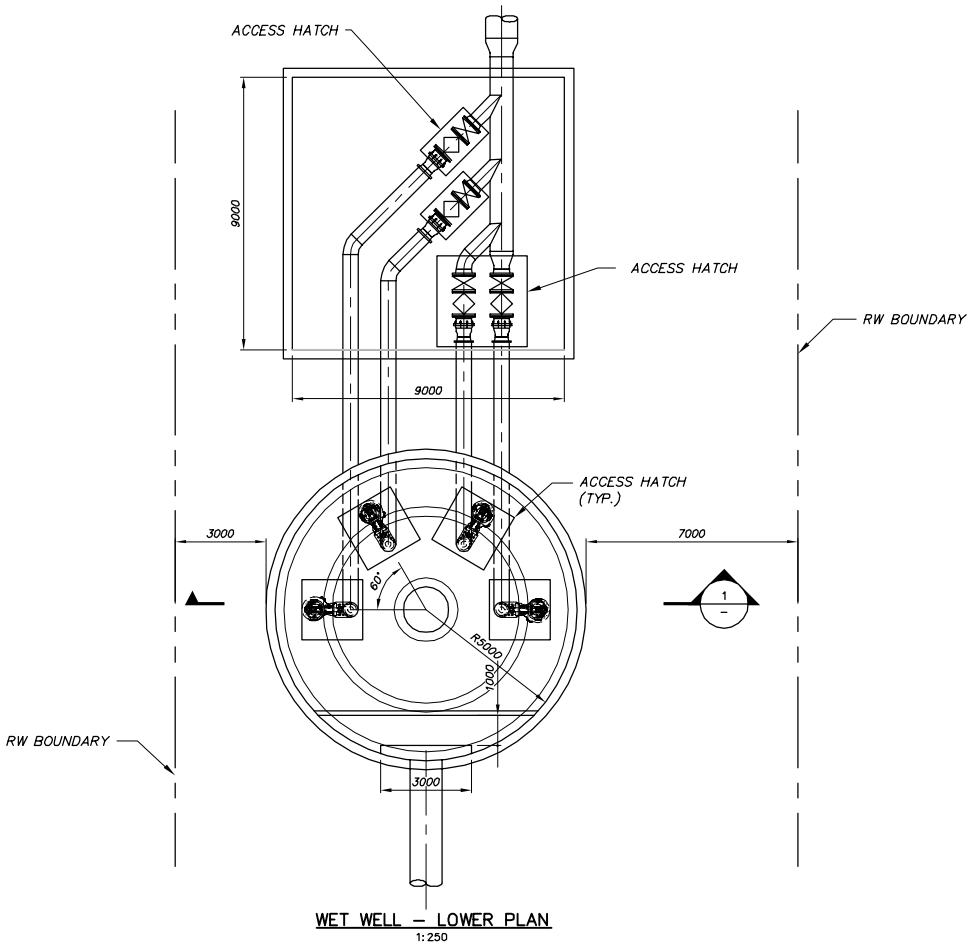


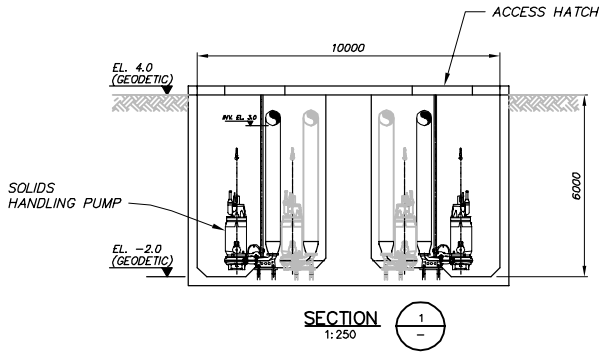
SITE PLAN
NTS

SKETCH: 01

COMOX No. 2 PUMP STATION
SITE PLAN
Comox Valley Regional District, Croteau Road, CVRD Area B
Project No. : 60333483

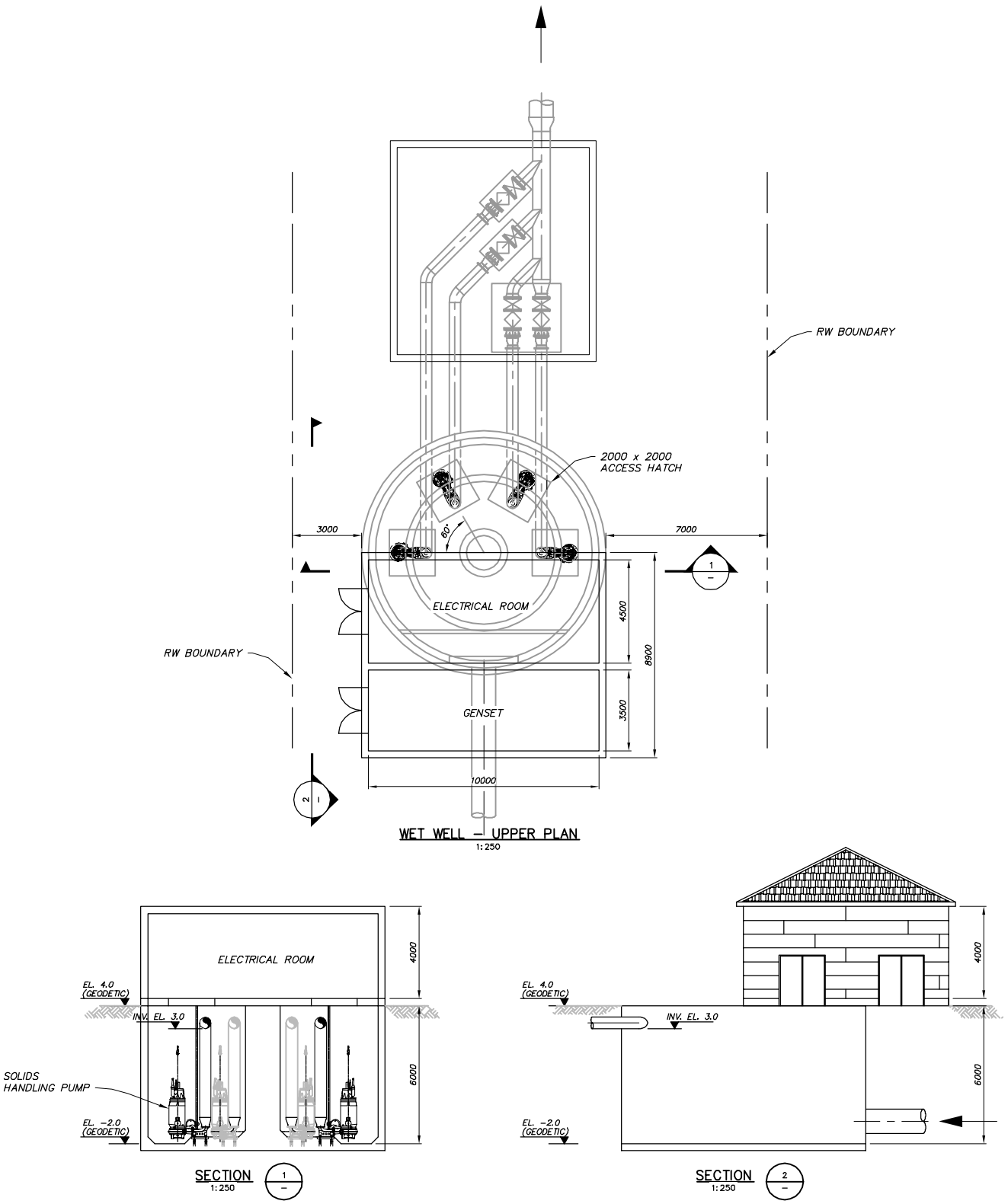
AECOM





SKETCH: 02

COMOX No. 2 PUMP STATION
PUMP STATION - LOWER PLAN
Comox Valley Regional District, Croteau Road, CVRD Area B
Project No. : 60333483



SKETCH: 03

COMOX No. 2 PUMP STATION
PUMP STATION - UPPER PLAN
Comox Valley Regional District, Croteau Road, CVRD Area B
Project No. : 60333483

AECOM

Pump Selection

Product specification

Receiver	From
AECOM	Xylem

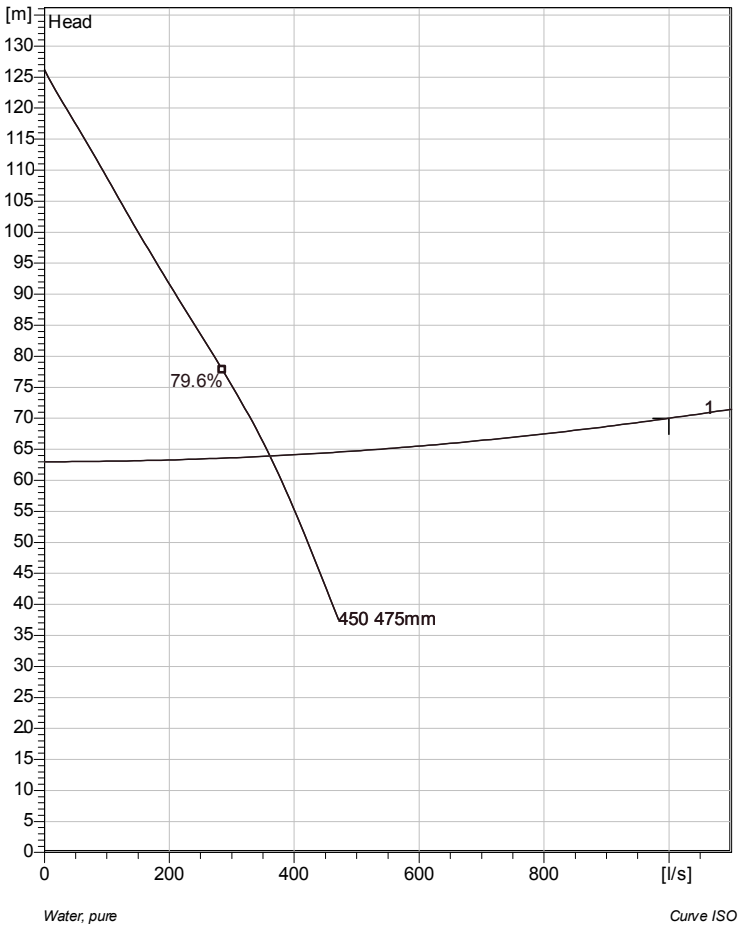
Quant.	Item no.	Description
4		**With 475mm Impeller** ***Shrouded single or multi-channel impeller pumps with large throughlets*** *and single volute pump casing for liquids containing solids and fibres.* *Cast iron design with double sealing technology.* *DUTY POINT* *- Fluid:Water, pure* *- Flow:1000 l/s* *- Head:70 m* *- Fluid temperature:277 K* *- Motor : 3~600V/60Hz* *- Rated power : 455 hp* *- Speed : 1790 1/min* *- Total Moment of Inertia : 6.31 kg m²* *- Degree of protection : --* *- Motor design : 3 PH STD W*
		Subtotal:
4		**With 480mm Impeller** ***Shrouded single or multi-channel impeller pumps with large throughlets*** *and single volute pump casing for liquids containing solids and fibres.* *Cast iron design with double sealing technology.* *DUTY POINT* *- Fluid:Water, pure* *- Flow:1000 l/s* *- Head:70 m* *- Fluid temperature:277 K* *- Motor : 3~600V/60Hz* *- Rated power : 455 hp* *- Speed : 1790 1/min* *- Total Moment of Inertia : 6.31 kg m²* *- Degree of protection : --* *- Motor design : 3 PH STD W*
		Subtotal:

Total price excl. VAT	VAT in %	Total price incl. VAT
0.00 CAD	16	0.00 CAD

Project	Project ID	Created by	Created on	Last update
	Comox No. 2 PS	**Felix Lung**	**2015-12-17 20:35:26**	**2015-12-17 20:48:35**

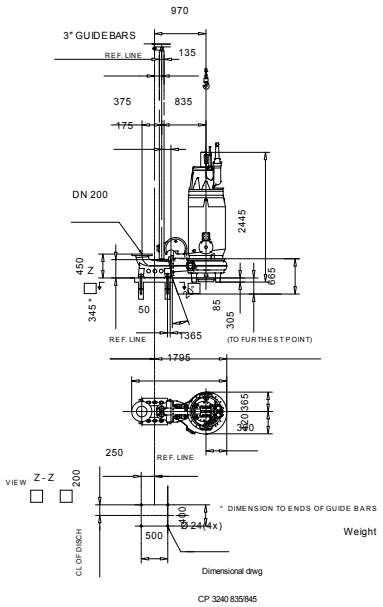
CP 3240/835 3~ 450

Technical specification



Note: Picture might not correspond to the current configuration.

Installation: P - Semi permanent, Wet



General

Shrouded single or multi-channel impeller pumps with large throughlets and single volute pump casing for liquids containing solids and fibres. Cast iron design with double sealing technology.

Impeller

Impeller material	Grey cast iron
Discharge Flange Diameter	200 mm
Inlet diameter	250 mm
Impeller diameter	475 mm
Number of blades	2
Throughlet diameter	78 mm

Motor

Motor #	C0835.000 54-52-4AA-W 455hp
Stator variant	2
Frequency	60 Hz
Rated voltage	600 V
Number of poles	4
Phases	3~
Rated power	455 hp
Rated current	410 A
Starting current	3950 A
Rated speed	1790 1/min
Power factor	
1/1 Load	0.84
3/4 Load	0.79
1/2 Load	0.68
Efficiency	
1/1 Load	94.5 %
3/4 Load	94.0 %
1/2 Load	92.5 %

Configuration

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	Comox No. 2 PS	**Felix Lung**	**2015-12-17 20:35:26**	**2015-12-17 20:48:35**

CP 3240/835 3~ 450

Performance curve

Pump

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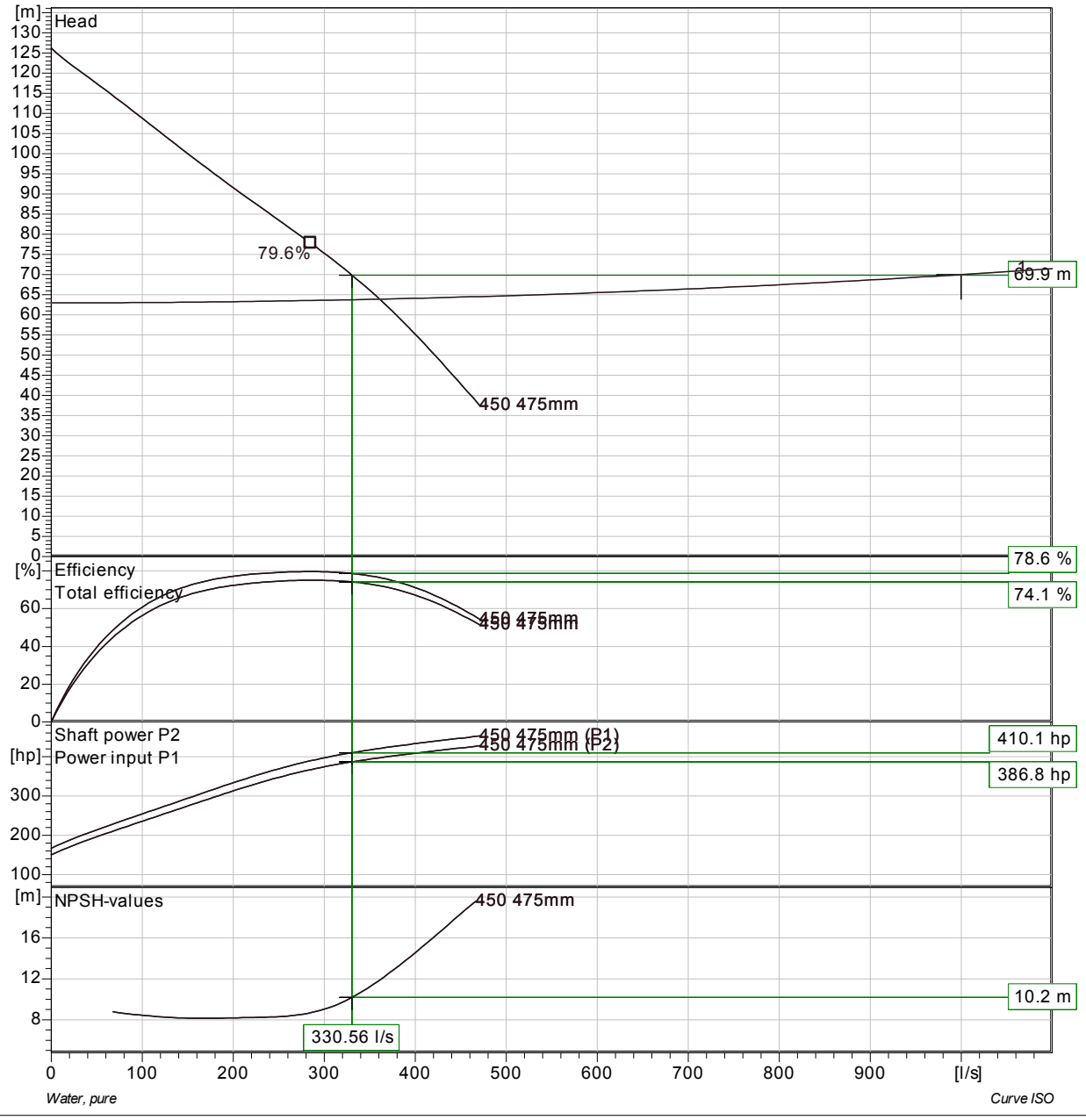

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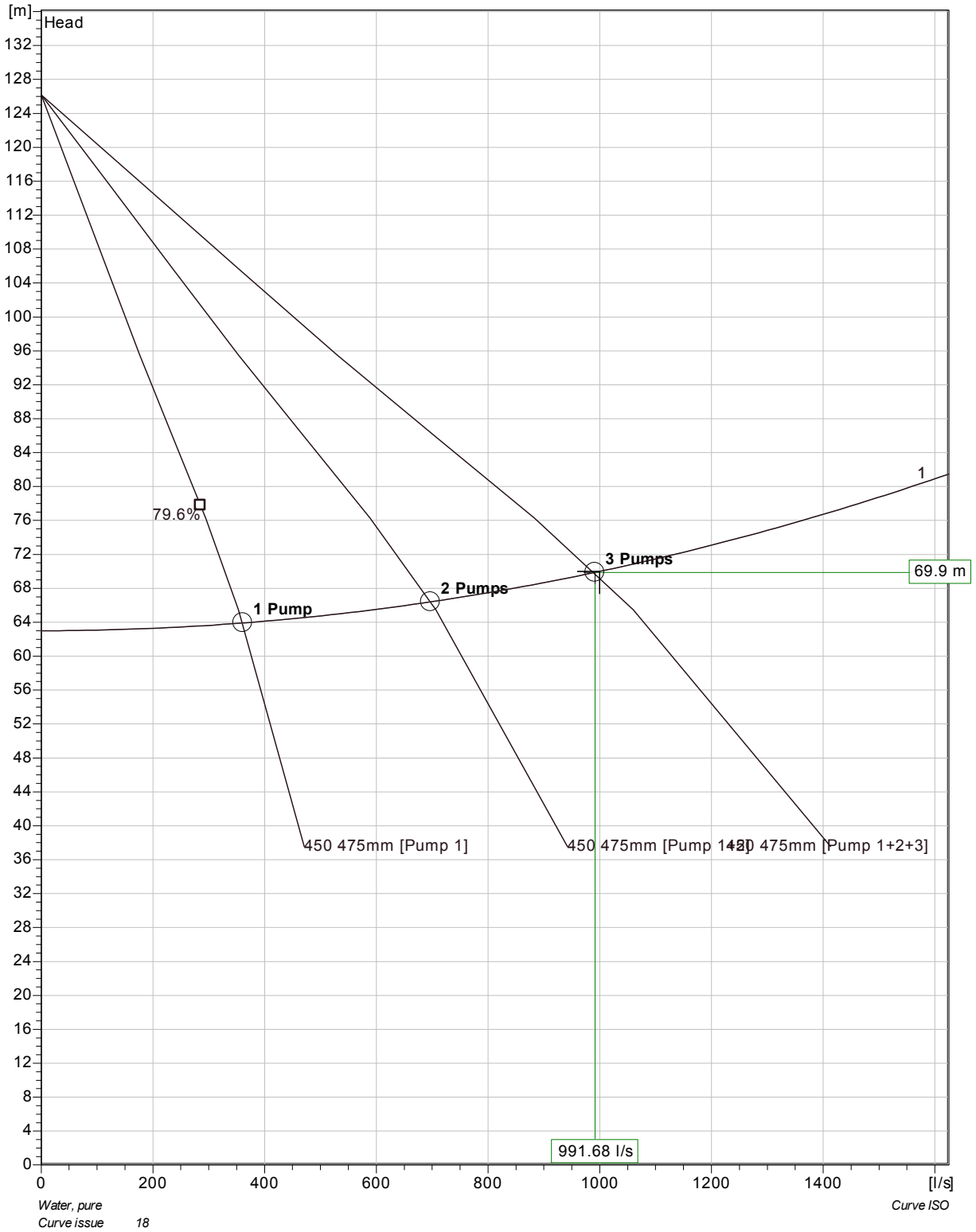
CP 3240/835 3~ 450

Duty Analysis



Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
3 / 1	331 l/s	69.9 m	387 hp	992 l/s	69.9 m	1160 hp	78.6 %	0.257 kWh/m³	10.2 m
2 / 1	349 l/s	66.4 m	393 hp	697 l/s	66.4 m	787 hp	77.4 %	0.249 kWh/m³	11.1 m
1 / 1	361 l/s	63.9 m	397 hp	361 l/s	63.9 m	397 hp	76.4 %	0.245 kWh/m³	11.9 m

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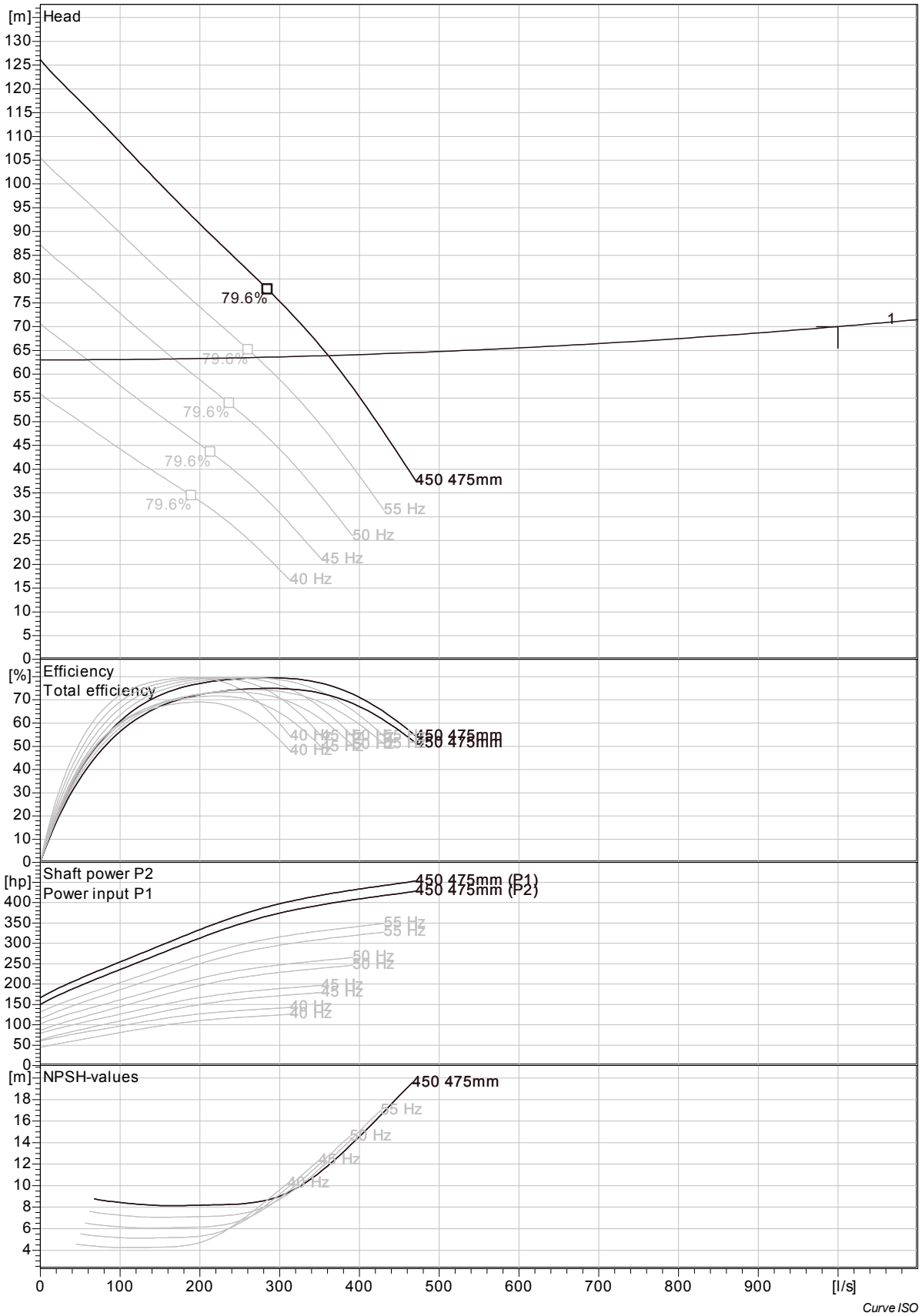
VFD Curve



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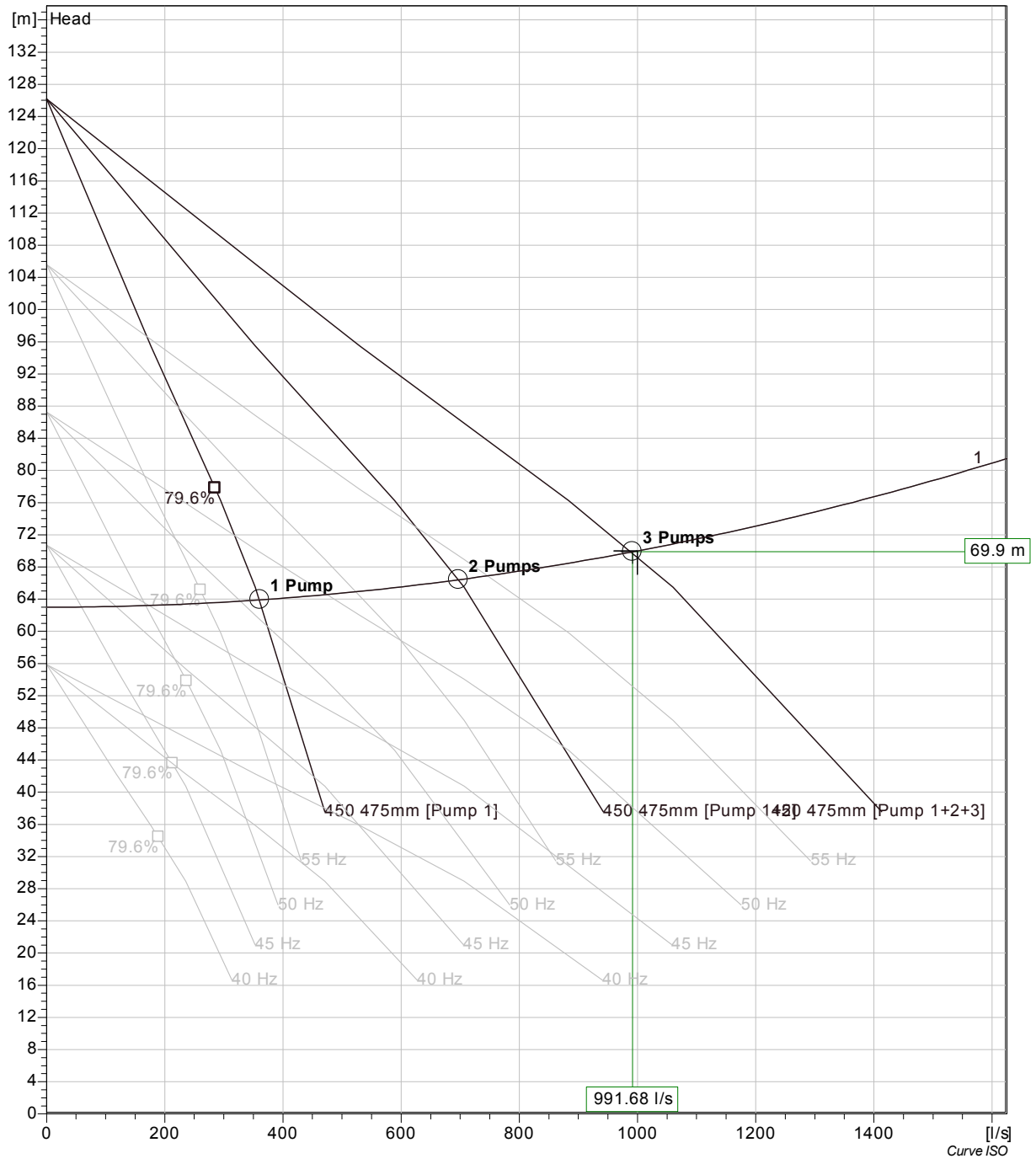
CP 3240/835 3~ 450

VFD Analysis



Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
3 / 1	60 Hz	331 l/s	69.9 m	387 hp	992 l/s	69.9 m	1160 hp	78.6 %	0.257 kWh/m³	10.2 m
3 / 1	55 Hz	249 l/s	66.9 m	276 hp	747 l/s	66.9 m	828 hp	79.5 %	0.246 kWh/m³	7.36 m
3 / 1	50 Hz	158 l/s	64.6 m	175 hp	473 l/s	64.6 m	526 hp	76.3 %	0.253 kWh/m³	6.08 m
3 / 1	45 Hz	57.8 l/s	63.2 m	91.3 hp	173 l/s	63.2 m	274 hp	52.6 %	0.386 kWh/m³	5.44 m
3 / 1	40 Hz									
2 / 1	60 Hz	349 l/s	66.4 m	393 hp	697 l/s	66.4 m	787 hp	77.4 %	0.249 kWh/m³	11.1 m
2 / 1	55 Hz	262 l/s	64.9 m	282 hp	525 l/s	64.9 m	563 hp	79.6 %	0.24 kWh/m³	7.56 m
2 / 1	50 Hz	164 l/s	63.7 m	179 hp	327 l/s	63.7 m	357 hp	76.8 %	0.252 kWh/m³	6.09 m
2 / 1	45 Hz	58.7 l/s	63.1 m	91.7 hp	117 l/s	63.1 m	183 hp	53.1 %	0.387 kWh/m³	5.43 m
2 / 1	40 Hz									
1 / 1	60 Hz	361 l/s	63.9 m	397 hp	361 l/s	63.9 m	397 hp	76.4 %	0.245 kWh/m³	11.9 m
1 / 1	55 Hz	271 l/s	63.5 m	285 hp	271 l/s	63.5 m	285 hp	79.5 %	0.239 kWh/m³	7.75 m
1 / 1	50 Hz	168 l/s	63.2 m	181 hp	168 l/s	63.2 m	181 hp	77.2 %	0.254 kWh/m³	6.1 m
1 / 1	45 Hz	59.3 l/s	63 m	92 hp	59.3 l/s	63 m	92 hp	53.4 %	0.393 kWh/m³	5.42 m
1 / 1	40 Hz									

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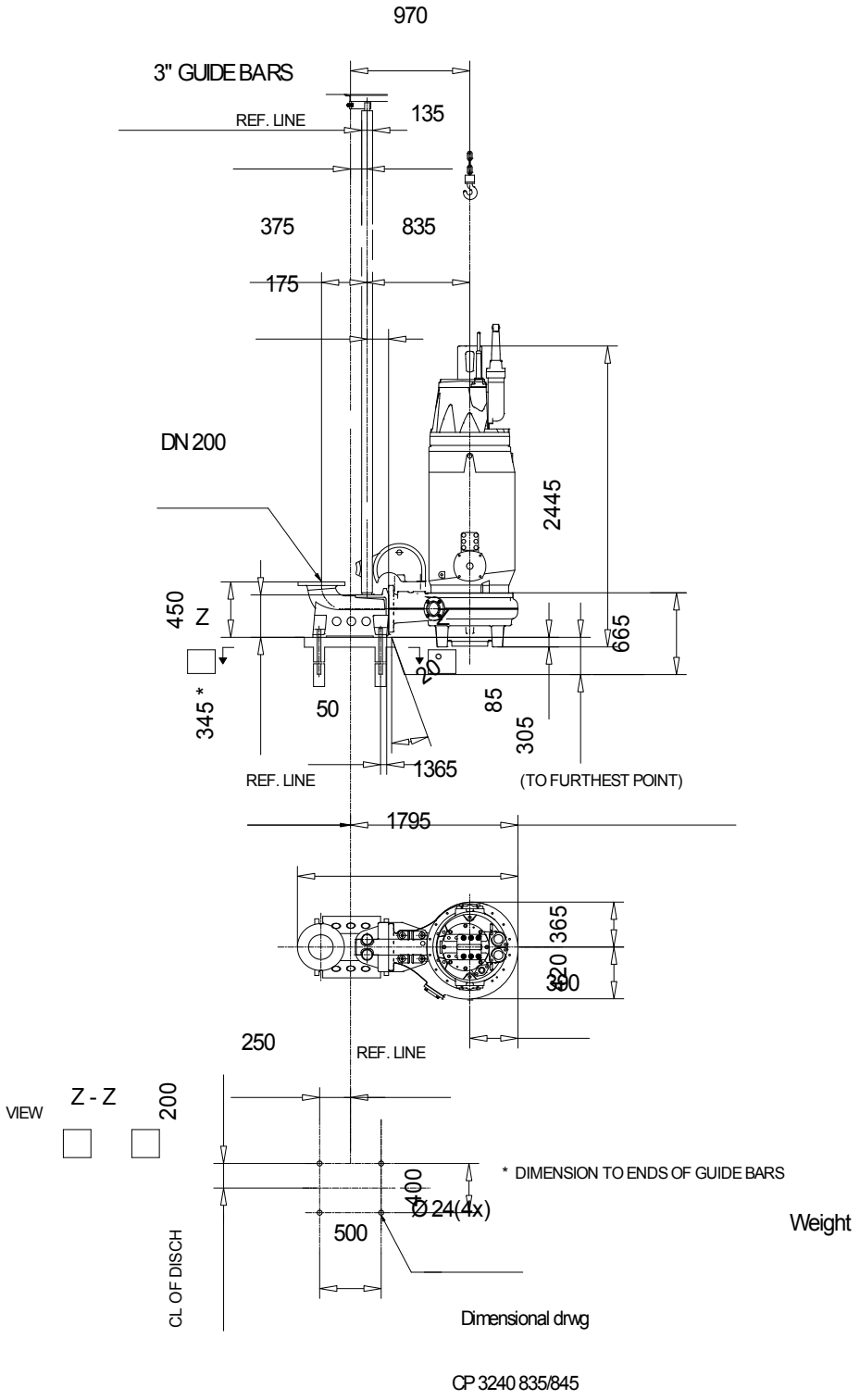
Dimensional drawing



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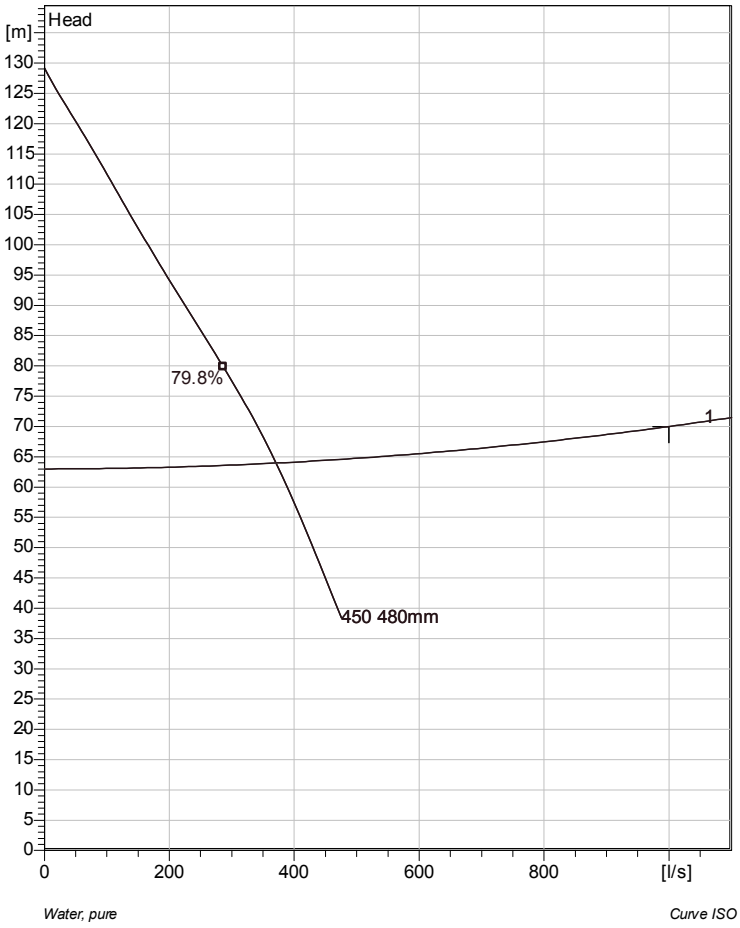
Technical specification



Water, pure *Curve ISO*

Note: Picture might not correspond to the current configuration.

General

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Throughlet diameter	78 mm

Motor

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Stator variant	2
Frequency	60 Hz
Rated voltage	600 V
Number of poles	4
Phases	3~
Rated power	455 hp
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Starting current	3950 A
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Efficiency	
1/1 Load	94.5 %
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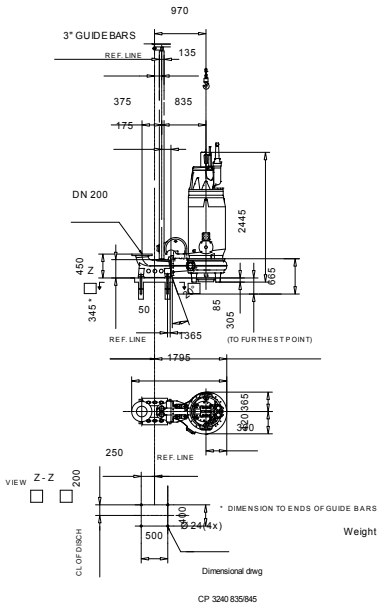
Configuration

Installation: P - Semi permanent, Wet



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Performance curve

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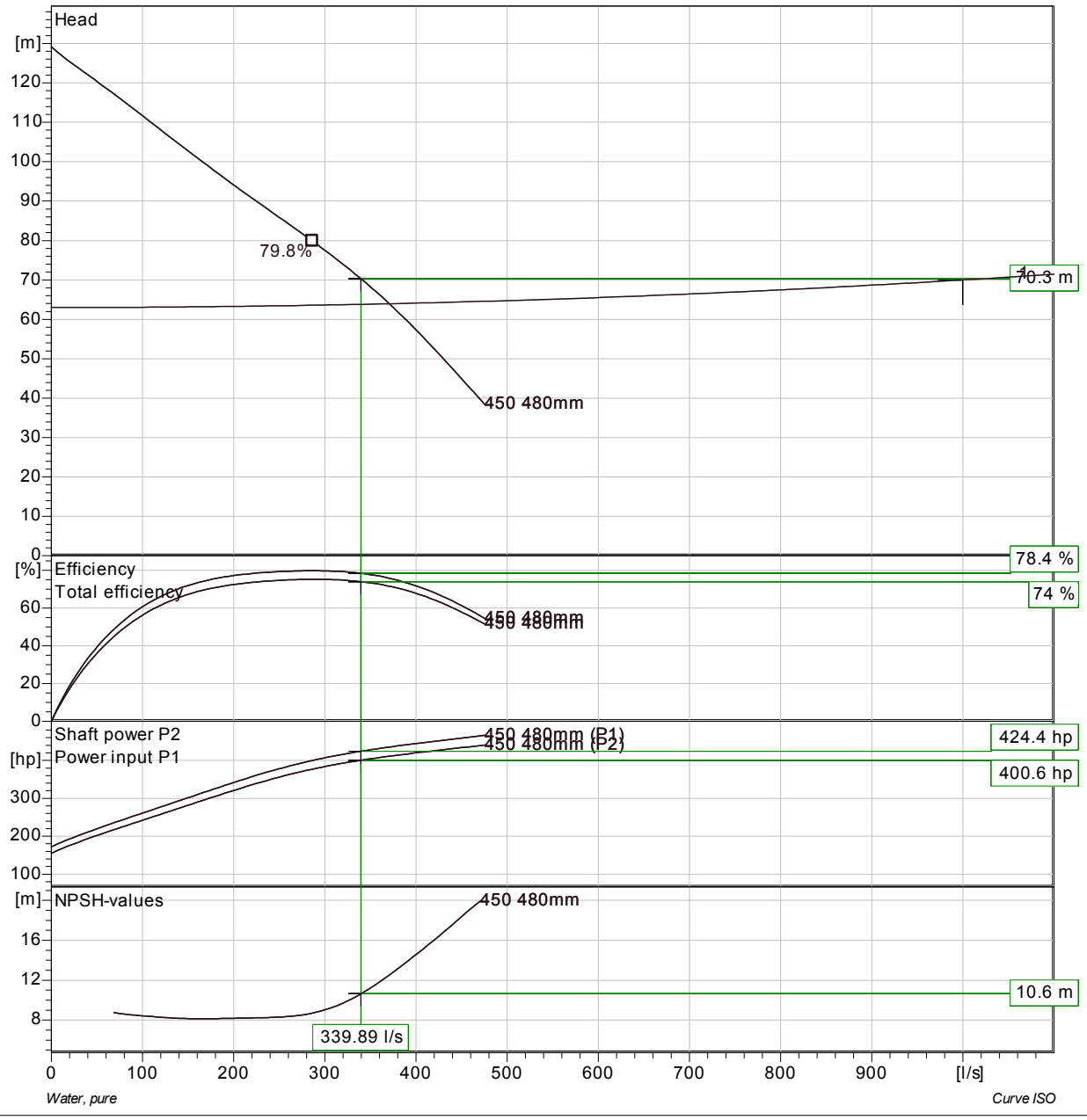

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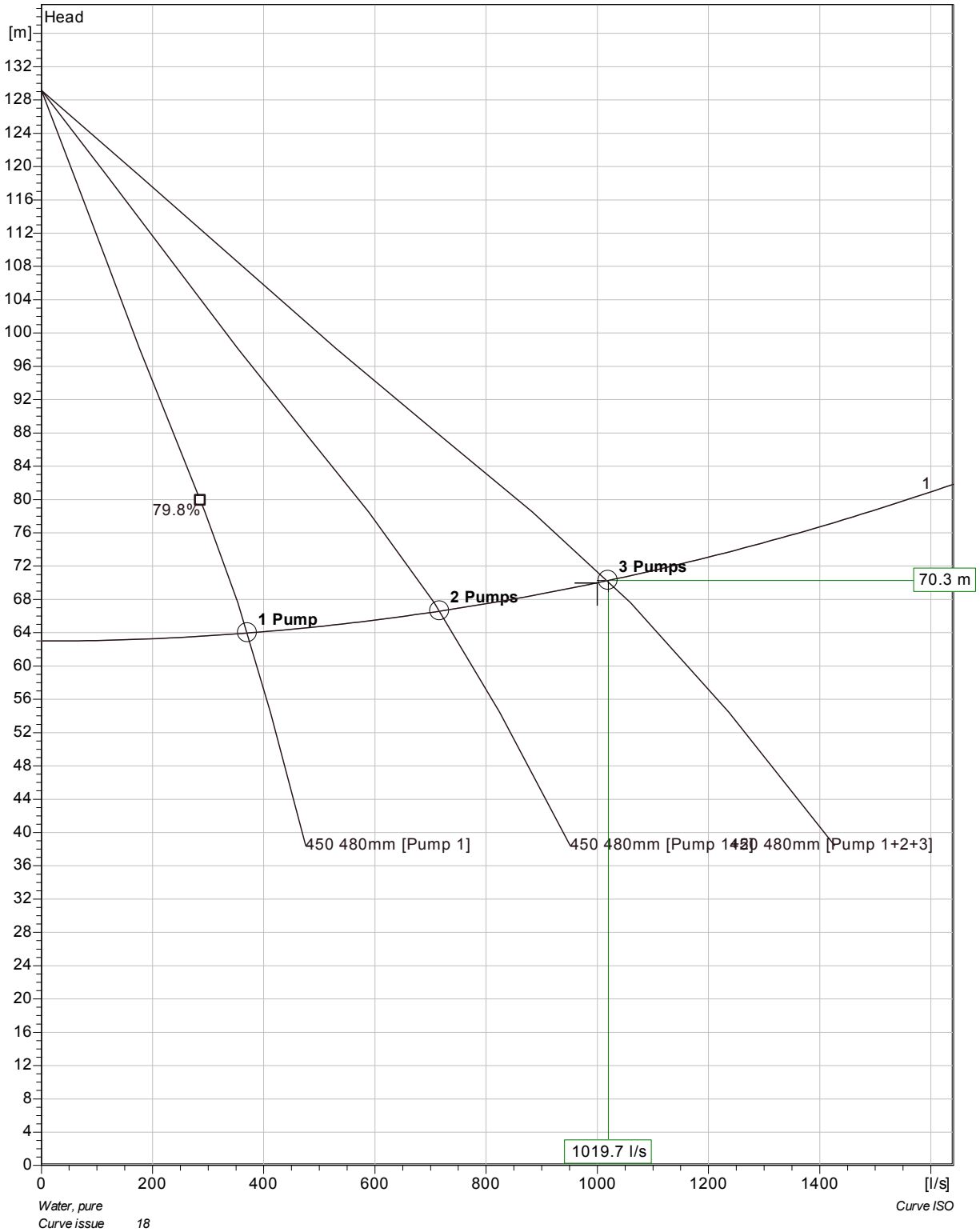
Duty Analysis



Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
3 / 1	340 l/s	70.3 m	401 hp	1020 l/s	70.3 m	1200 hp	78.4 %	0.259 kWh/m³	10.6 m
2 / 1	358 l/s	66.6 m	407 hp	717 l/s	66.6 m	814 hp	77.1 %	0.25 kWh/m³	11.7 m
1 / 1	371 l/s	64 m	411 hp	371 l/s	64 m	411 hp	75.9 %	0.247 kWh/m³	12.5 m

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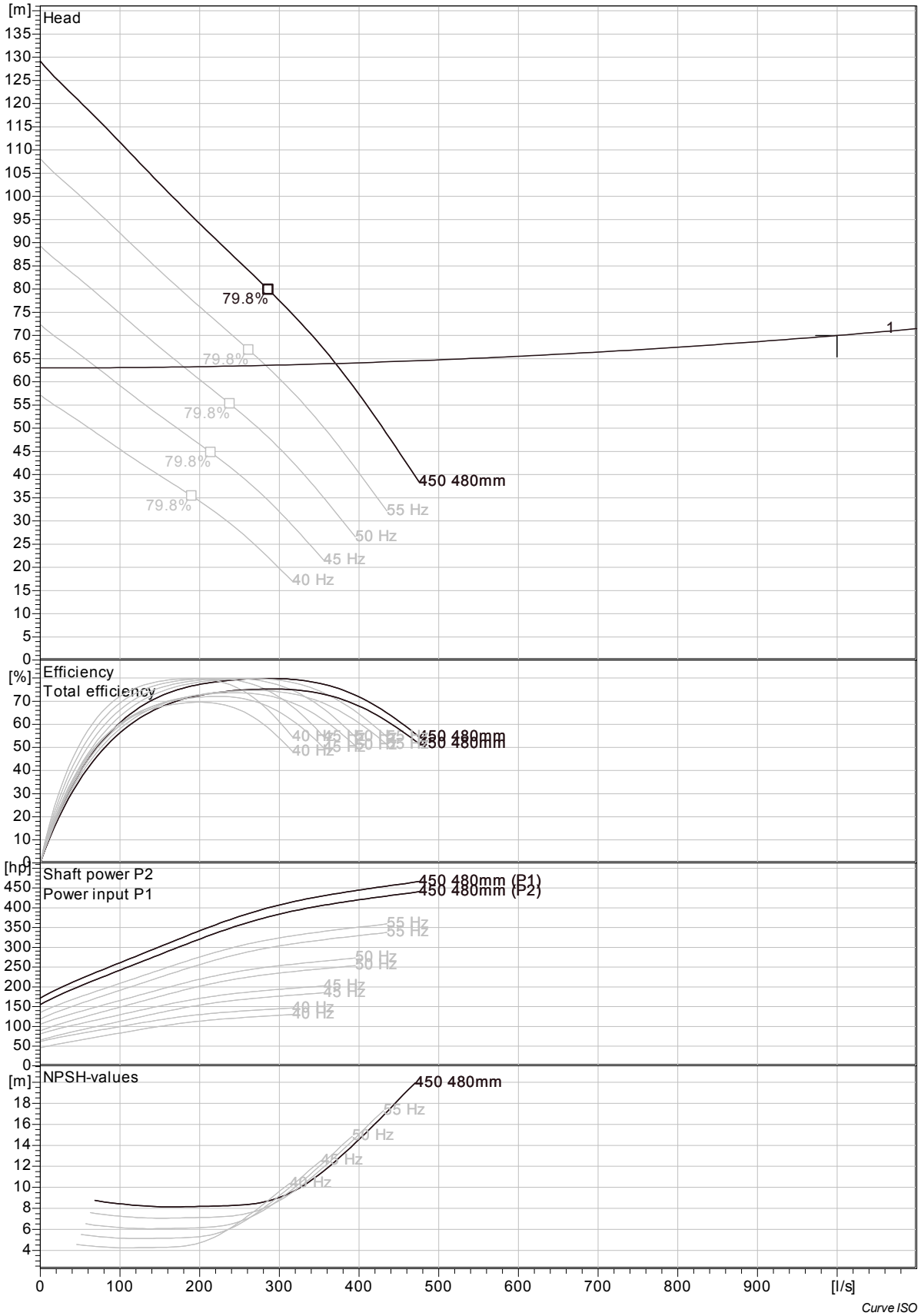
VFD Curve



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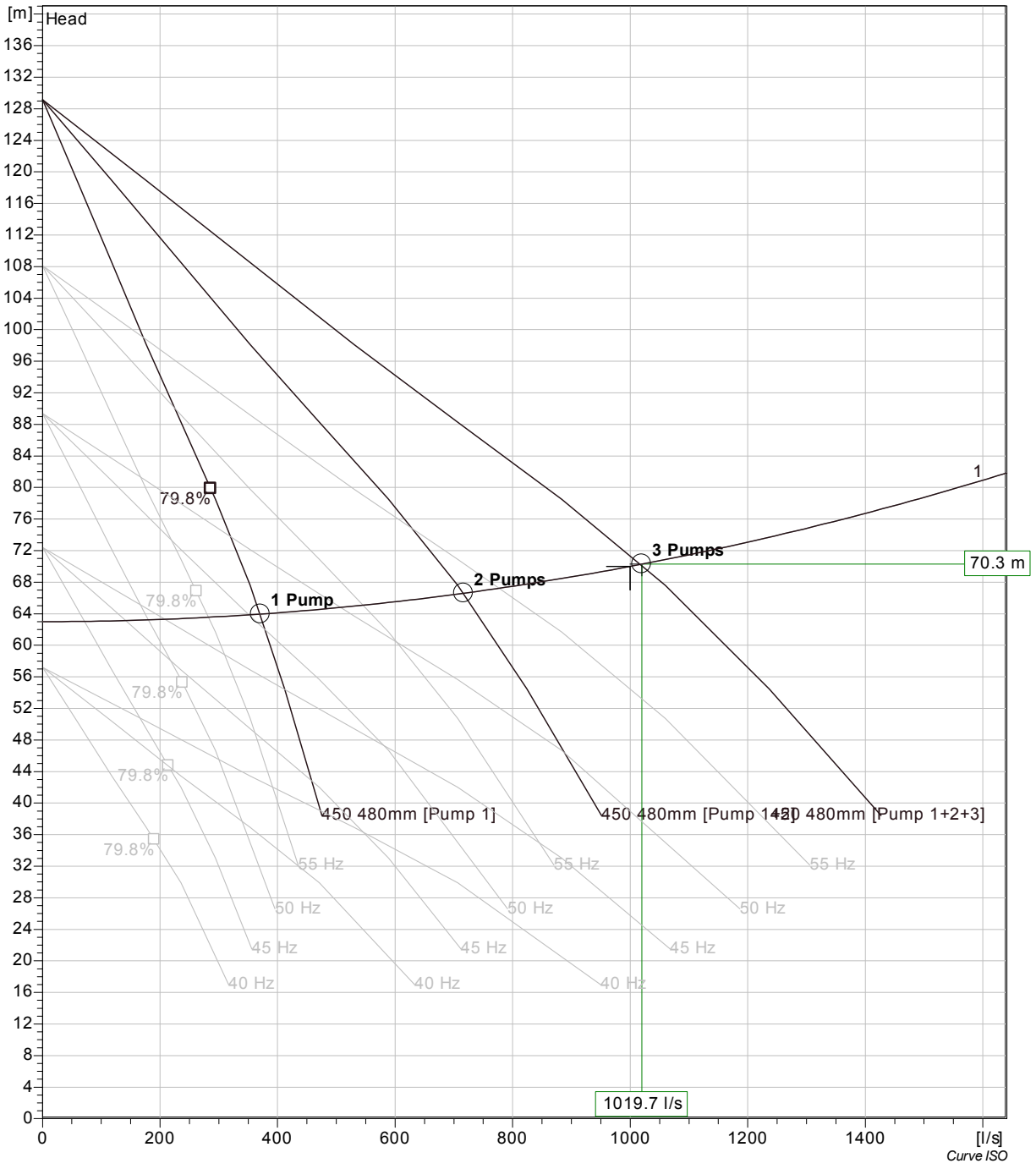
VFD Analysis

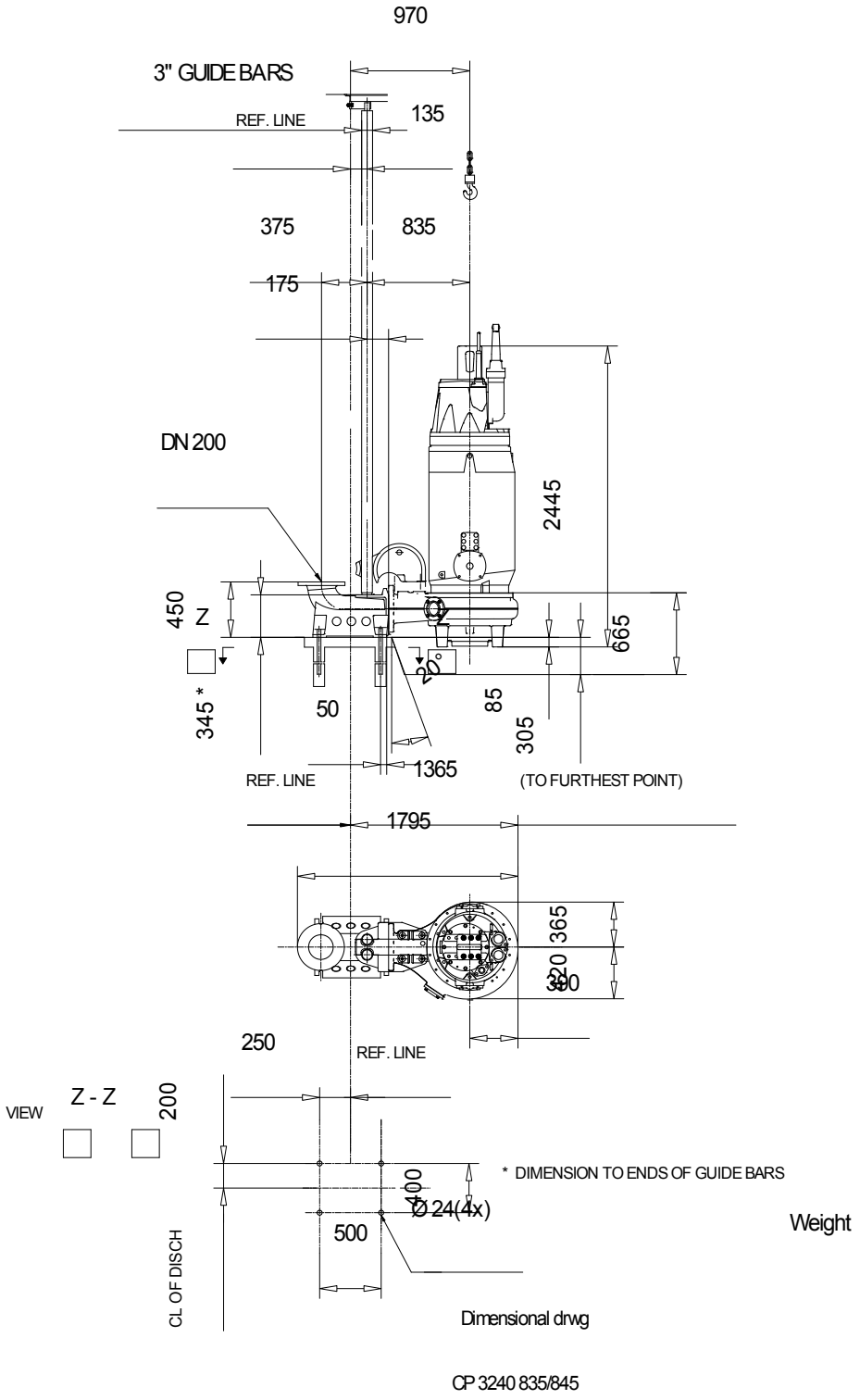


Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
3 / 1	60 Hz	340 l/s	70.3 m	401 hp	1020 l/s	70.3 m	1200 hp	78.4 %	0.259 kWh/m³	10.6 m
3 / 1	55 Hz	260 l/s	67.2 m	288 hp	779 l/s	67.2 m	863 hp	79.8 %	0.246 kWh/m³	7.51 m
3 / 1	50 Hz	169 l/s	64.8 m	186 hp	507 l/s	64.8 m	557 hp	77.5 %	0.25 kWh/m³	6.1 m
3 / 1	45 Hz	69.6 l/s	63.3 m	99.2 hp	209 l/s	63.3 m	298 hp	58.4 %	0.344 kWh/m³	5.34 m
3 / 1	40 Hz									
2 / 1	60 Hz	358 l/s	66.6 m	407 hp	717 l/s	66.6 m	814 hp	77.1 %	0.25 kWh/m³	11.7 m
2 / 1	55 Hz	273 l/s	65.1 m	294 hp	547 l/s	65.1 m	587 hp	79.8 %	0.24 kWh/m³	7.8 m
2 / 1	50 Hz	176 l/s	63.9 m	189 hp	351 l/s	63.9 m	379 hp	77.9 %	0.247 kWh/m³	6.11 m
2 / 1	45 Hz	70.8 l/s	63.1 m	99.8 hp	142 l/s	63.1 m	200 hp	58.9 %	0.346 kWh/m³	5.33 m
2 / 1	40 Hz									
1 / 1	60 Hz	371 l/s	64 m	411 hp	371 l/s	64 m	411 hp	75.9 %	0.247 kWh/m³	12.5 m
1 / 1	55 Hz	283 l/s	63.6 m	297 hp	283 l/s	63.6 m	297 hp	79.6 %	0.238 kWh/m³	8.07 m
1 / 1	50 Hz	180 l/s	63.2 m	192 hp	180 l/s	63.2 m	192 hp	78.2 %	0.249 kWh/m³	6.12 m
1 / 1	45 Hz	71.6 l/s	63 m	100 hp	71.6 l/s	63 m	100 hp	59.3 %	0.35 kWh/m³	5.33 m
1 / 1	40 Hz									

Project	Project ID	Created by	Created on	Last update
	Comox No. 2 PS	Felix Lung	2015-12-17 20:35:26	2015-12-17 20:48:35

CP 3240/835 3~ 450

Dimensional drawing

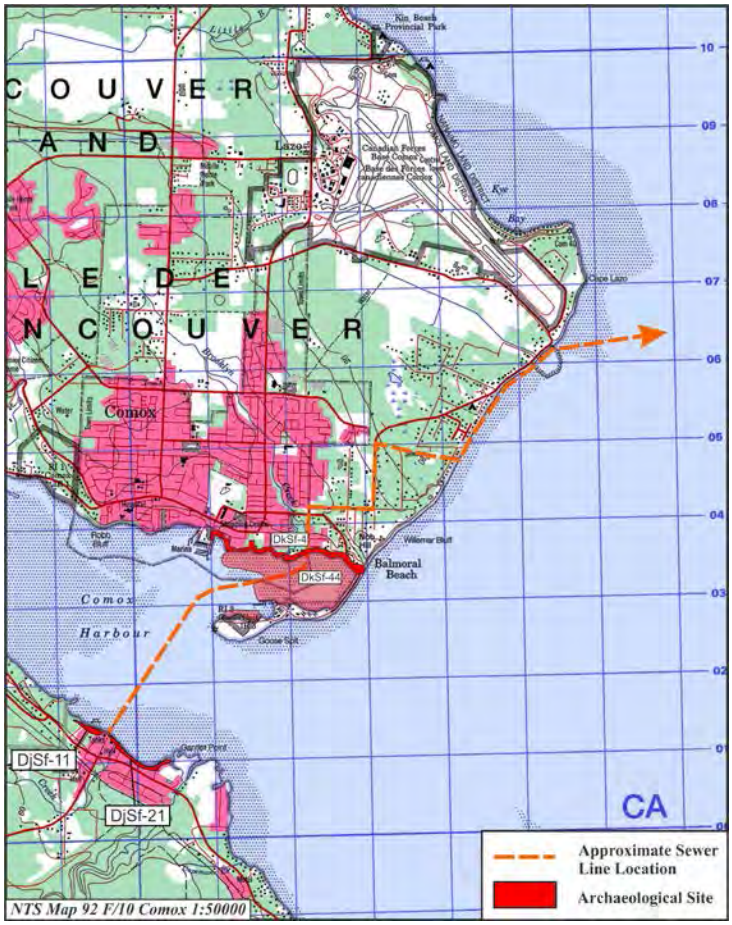


Project	Project ID	Created by	Created on	Last update
	Comox No. 2 PS	**Felix Lung**	**2015-12-17 20:35:26**	**2015-12-17 20:48:35**

Report For
The Archaeological Overview Assessment and Preliminary Field Reconnaissance of the Proposed South Sewer Project Royston to Cape Lazo Outflow Segment

Prepared For:

Comox Valley Regional District
South Sewer Project Office



Prepared By:

Baseline archaeological services ltd.
556 Harmston Avenue
Courtenay, BC
V9N 2X5

December 2015

Management Summary

This report summarizes the results and recommendations of an archaeological overview assessment (AOA) and preliminary field reconnaissance (PFR) conducted by Baseline Archaeological Services Ltd. (Baseline) of the portion of the proposed South Sewer Project (SSP), located between Royston and the Cape Lazo outfall.

The proposed south sewer project (SSP) phase 1 includes a waste water treatment facility (WTF), collection and conveyance system for the Union Bay and Royston Areas, and an outfall to Cape Lazo. For the purposes of this report, the focus will be on the portion of the SSP outfall pipeline from Royston Road to the outfall at Cape Lazo. The wastewater will be treated within the CVRD south region, and the effluent will then be pumped across the estuary/ Comox Harbour, through a 14 inch pipeline from the base of Royston Road. The effluent pipeline will run next to the planned Comox Pump Station #2 to be built at the base of Croteau Road. Once past the pump station, the smaller effluent pipeline from the SSP will follow the sewer main (a much larger pipe) across the Comox Peninsula to the Comox Valley Water Pollution Control Centre (CVWPCC). Both the sewer main and effluent pipeline will travel inland along Croteau Road, generally following Lazo and Brent Roads to the CVWPCC. From the CVWPCC a single combined effluent pipeline would cross Curtis Road and run along the intertidal area to the Cape Lazo outflow in the vicinity of Point Holmes before heading out to the sea.

The AOA included background research of the development area to determine which archaeological sites were potentially in conflict with the project. The PFR involved pedestrian and vehicular traverses of the development and related archaeological sites. The PFR was conducted by Chris Engisch (Baseline) and Ron Mitchell (Komox First Nation) in September and November 2015.

The AOA identified four archaeological sites in potential conflict with the proposed development.

Royston: Shell midden site **DjSf-21** is located at the base of Royston Road, with **DjSf-11** being located immediately to the northwest (*Figure 1 & 2*). It is likely the finalized location of the effluent line will be within the boundary of one of these sites.

Comox Harbour: Fish weir site **DkSf-44** (Goose Spit Fish Trap Site) is located within the intertidal area below Croteau Road (*Figure 1 & 3*). The proposed development will take place within the boundary of the site, but the finalized location may or may not impact actual archaeological features within the site.

Comox: Shell midden site **DkSf-4** is located within the backshore of Comox Harbour and in the development area of the effluent line and pump station (*Figure 1 & 3*).

Recommendations for the development of this project would include obtaining a Section 12, Site Alteration Permit (SAP) from the BC Archaeology Branch. The permit would include conditions for further archaeological work relating to the impact of archaeological material during the construction process, dependent on the condition and volume and type of material being impacted.

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Introduction

Alexandra Hitchcock of the Comox Valley Regional District (CVRD) South Sewer Project (SSP) contacted Baseline Archaeological Services Ltd. (Baseline) and requested that an AOA and PFR be undertaken for the portion of the project linking Royston to the Cape Lazo outflow. This was requested to determine which archaeological sites were in conflict with the proposed development and what type of further archaeological work and permitting would be required for the project.

The work reported herein consists of an AOA and PFR as defined in the *British Columbia Archaeological Impact Assessment Guidelines* (1998). This report is concerned with identifying any known archaeological sites in conflict with the development area, and making management recommendations on how to proceed in the event of conflict between existing archaeological materials and proposed ground altering activities. It is also concerned with determining the potential for any unrecorded archaeological material. This report does not address any First Nations interest in the land. The study was conducted without prejudice to First Nations treaty negotiations, aboriginal rights, or title.

Archaeological sites are defined as locations which contain physical evidence of past human activity, such as artifacts or features. A list of expected site types that would likely be identified on the subject properties is provided later in the report under Expected Site Type. Archaeological remains which predate, or are likely to predate 1846 are automatically protected from any form of alteration, excavation, damage or desecration in British Columbia under the *Heritage Conservation Act (HCA).* Other sites protected under the *HCA* include aboriginal rock art sites with historical or archaeological value, burial places and historical shipwrecks.

The proposed south sewer project (SSP) phase 1 includes a wastewater treatment facility (WTF), collection and conveyance system for the Union Bay and Royston areas, and an outfall to Cape Lazo. For the purposes of this report, the focus will be on the portion of the SSP outfall pipeline from Royston Road to the outfall at Cape Lazo. The wastewater will be treated within the CVRD south region, and the effluent will then be pumped across the estuary/Comox Harbour, through a 14 inch pipeline from the base of Royston Road. The effluent pipeline will run next to the planned Comox Pump Station #2 to be built at the base of Croteau Road. Once past the pump station, the smaller effluent pipeline from the SSP will follow the sewer main (a much larger pipe) accross the Comox Peninsula to the Comox Valley Water Pollution Control Centre (CVWPCC). Both the sewer main and effluent pipeline will travel inland along Croteau Road, generally following Lazo and Brent Roads to the CVWPCC. From the CVWPCC a single combined effluent pipeline would cross Curtis Road and run along the intertidal area to the Cape Lazo outflow in the vicinity of Point Holmes before heading out to the sea.