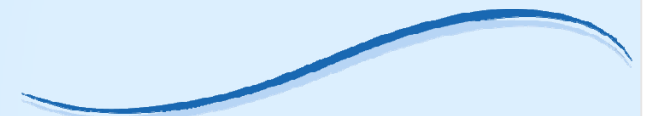


Introduction to Waste Water Pump Station Design

Knowing the Fundamentals Before You Begin

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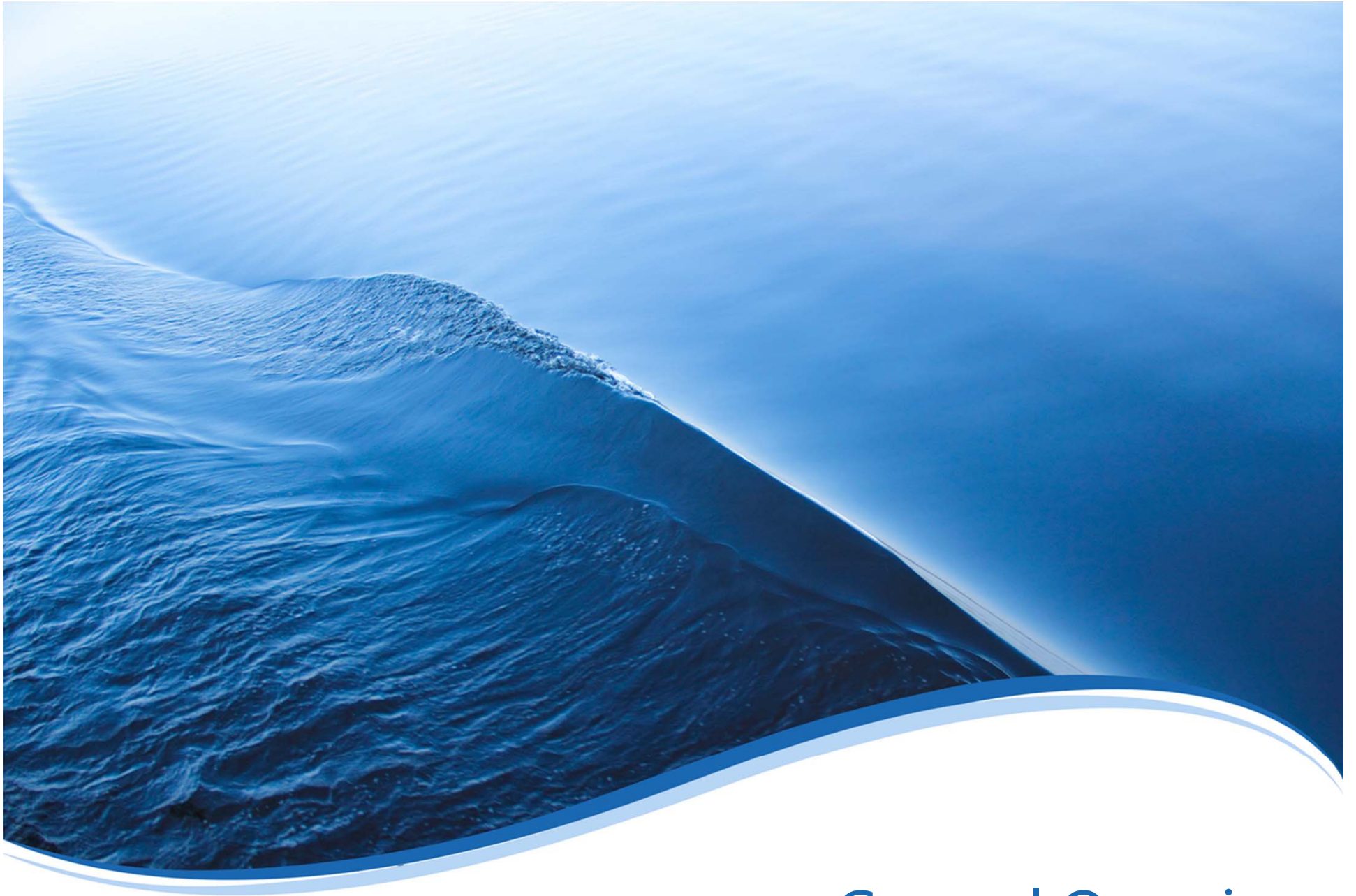
Introduction to Waste Water Pump Station Design

Knowing the Fundamentals Before You Begin

Agenda

- General Overview
- Pump Station Types
- Wet Well Configurations
- Pump Curves
- Pump Station Hydraulics
- Design Criteria



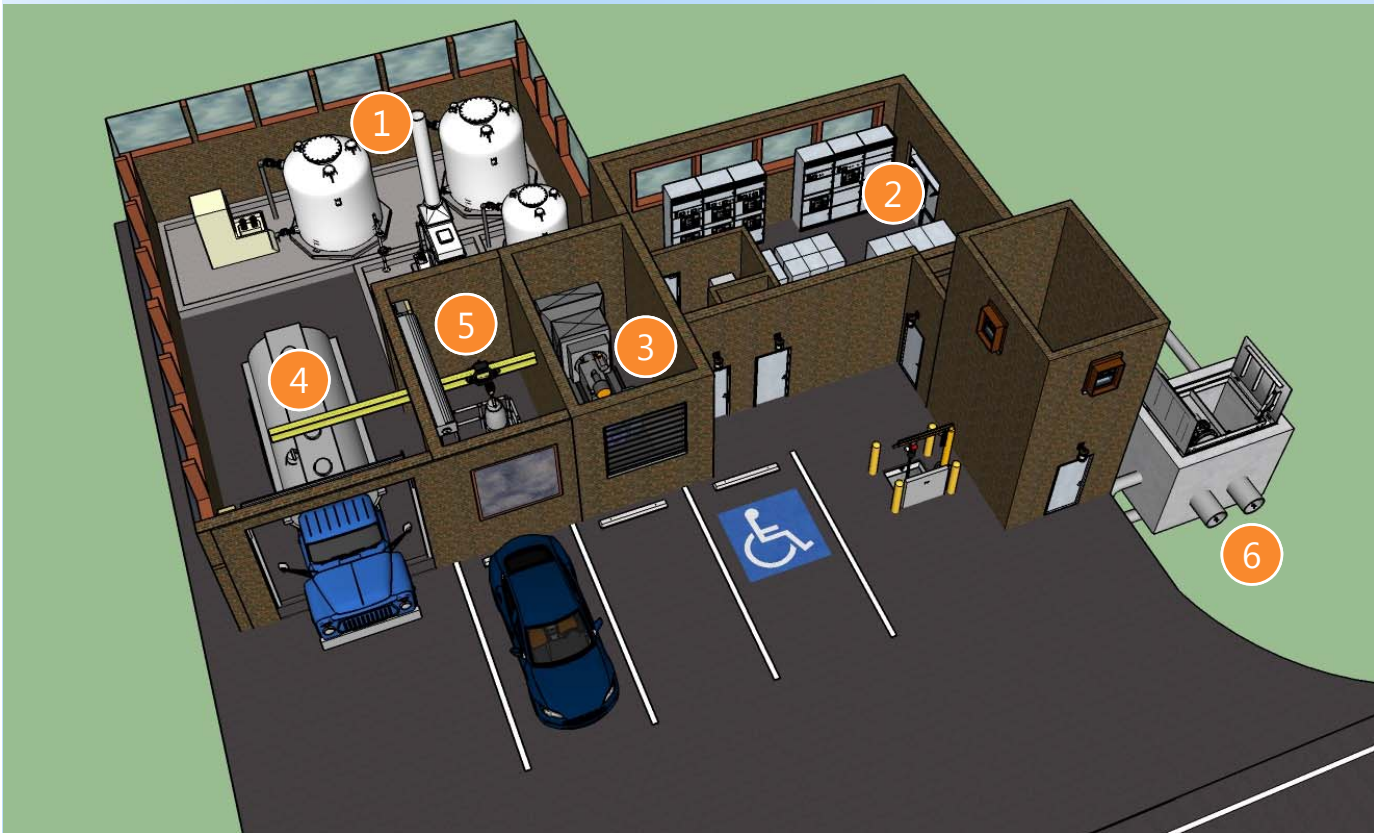


General Overview

Typical Pump Station Facility

Pump Station Features

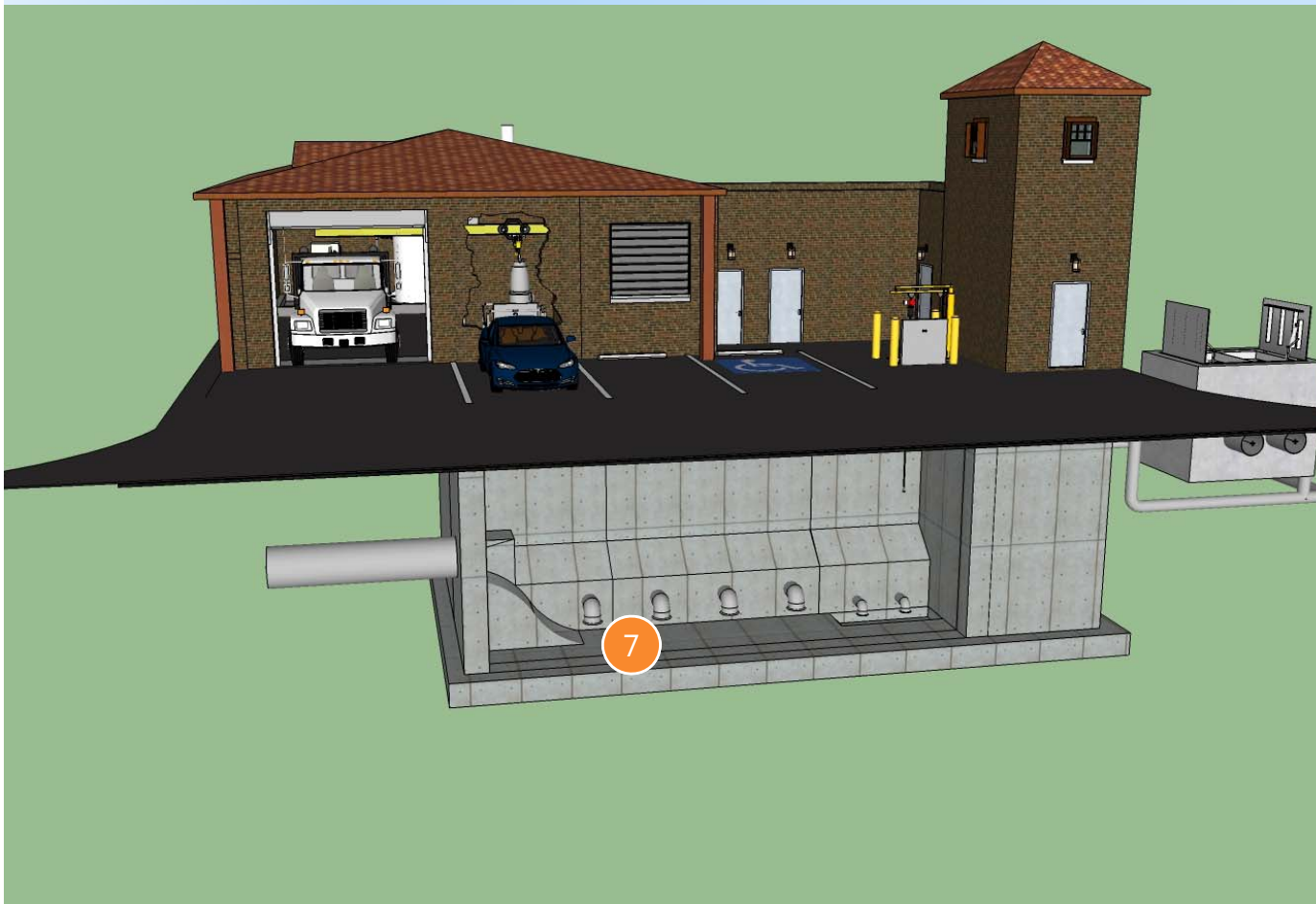
- 1 Odor Control
- 2 Electrical and Control Facilities
- 3 Standby Generator
- 4 Loading Bay
- 5 Equipment Handling Room
- 6 Force Main Valve Vault



Typical Pump Station Facility

Pump Station Features

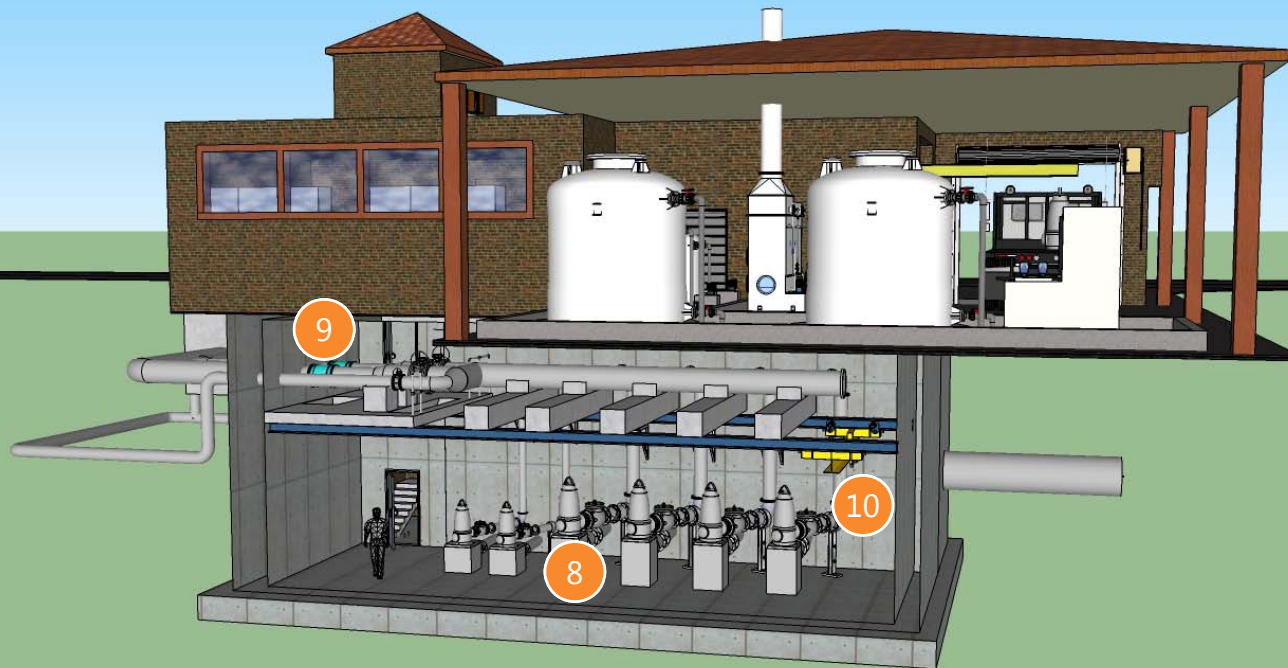
- 1 Odor Control
- 2 Electrical and Control Facilities
- 3 Standby Generator
- 4 Loading Bay
- 5 Equipment Handling Room
- 6 Force Main Valve Vault
- 7 Wet Well



Typical Pump Station Facility

Pump Station Features

- 1 Odor Control
- 2 Electrical and Control Facilities
- 3 Standby Generator
- 4 Loading Bay
- 5 Equipment Handling Room
- 6 Force Main Valve Vault
- 7 Wet Well
- 8 Pump Room
- 9 Valves & Flow Meters
- 10 Pump/Equipment Removal





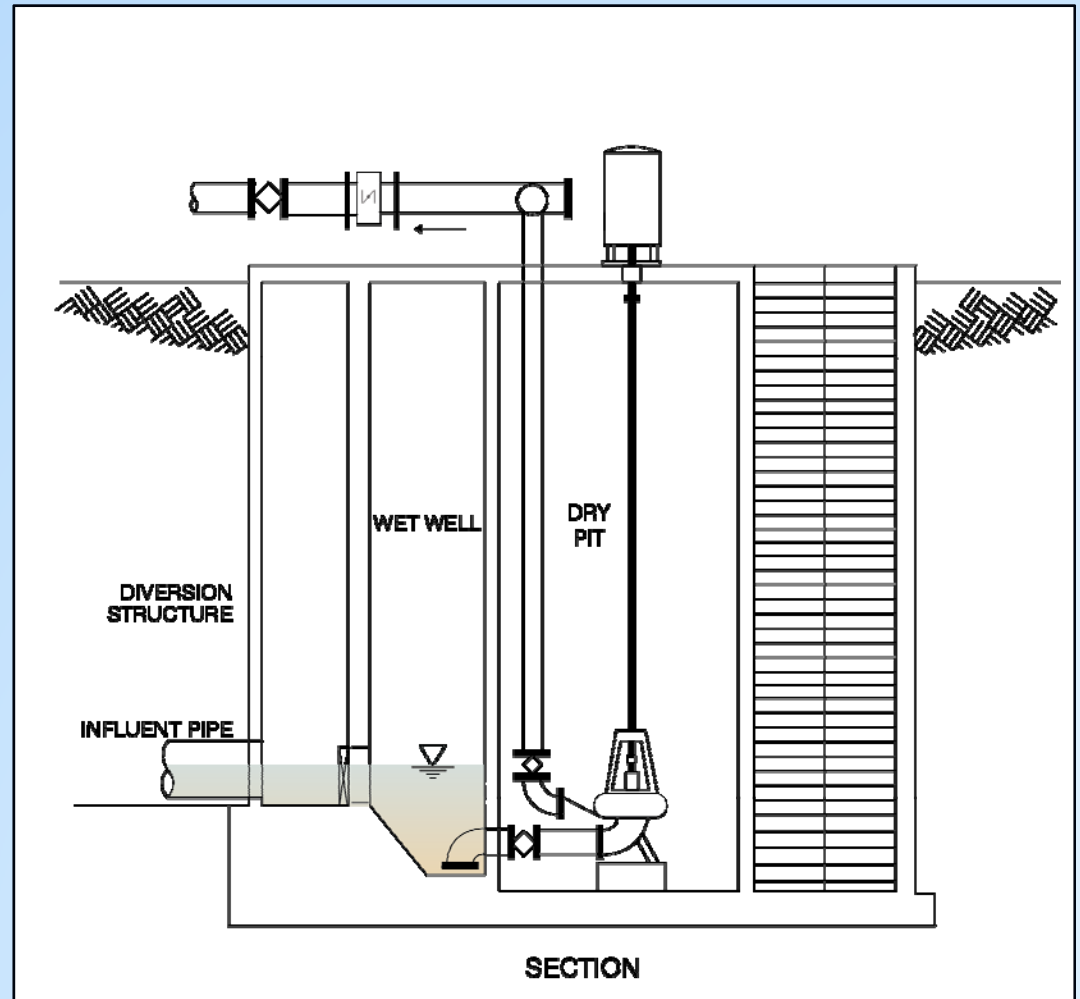
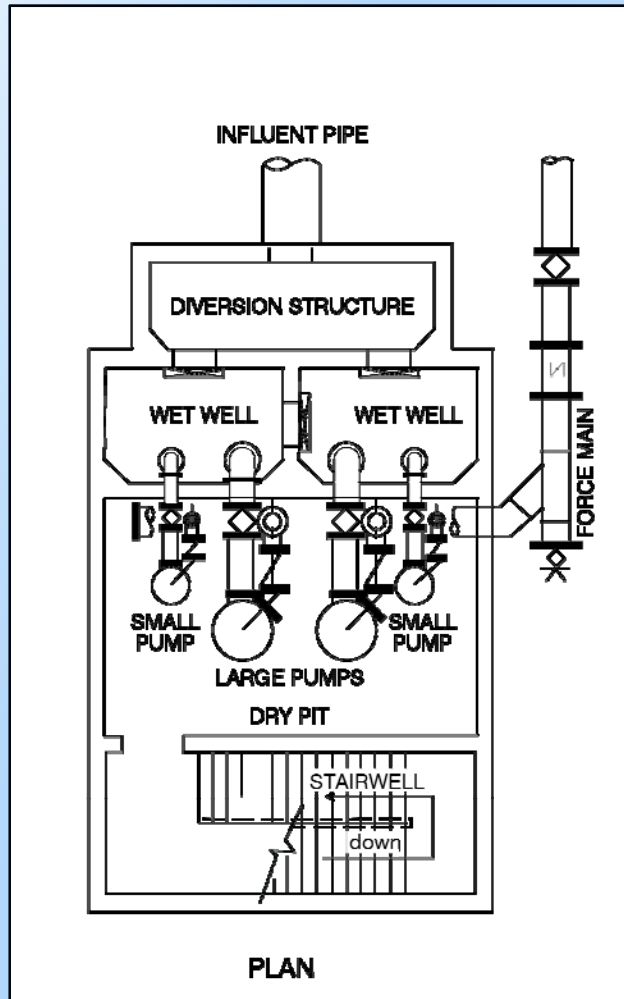
Pump Station Types

Common Pump Station Types

- Dry Pit / Wet Pit (Dry Well/Wet Well)
- Wet Pit Submersible
- Dry Pit Submersible



Dry Pit/Wet Pit



Dry Pit/Wet Pit



Vertical Dry Pit



Horizontal Dry Pit



Dry Pit / Wet Pit

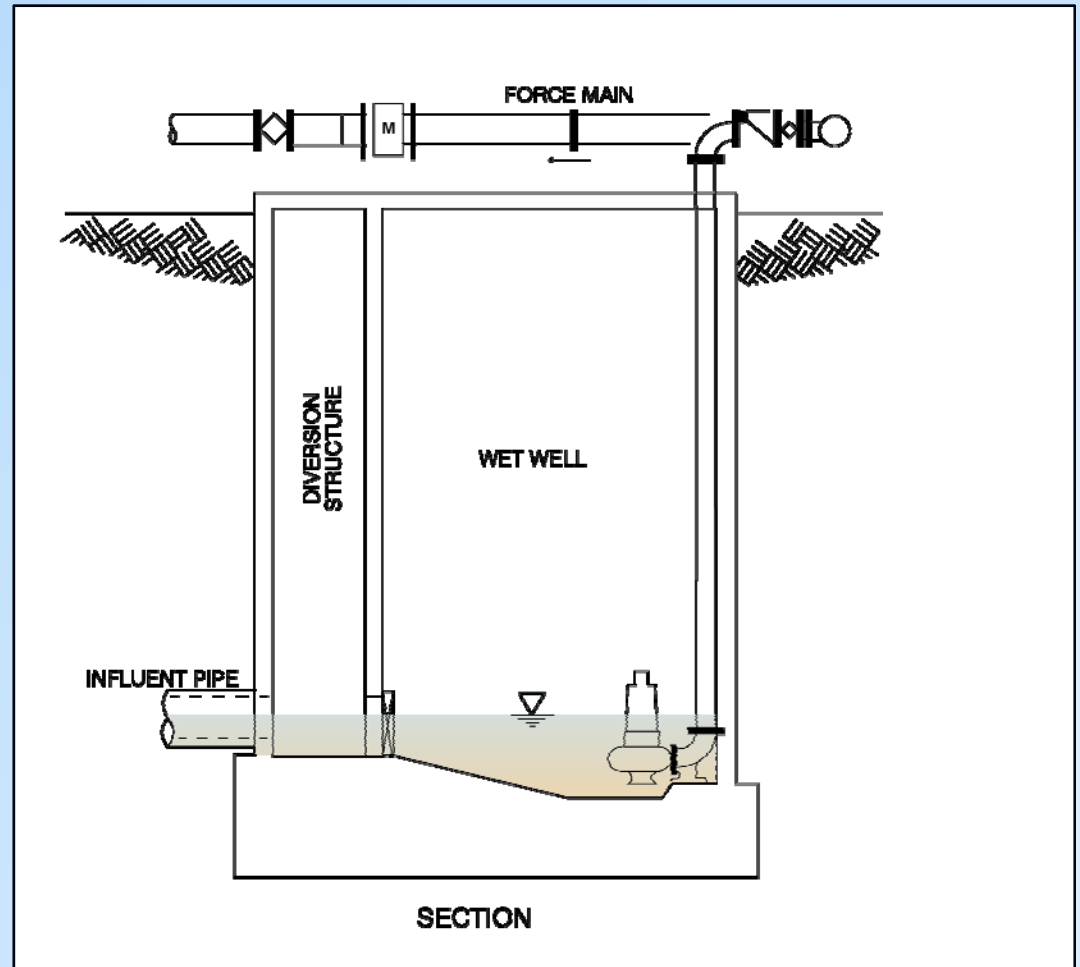
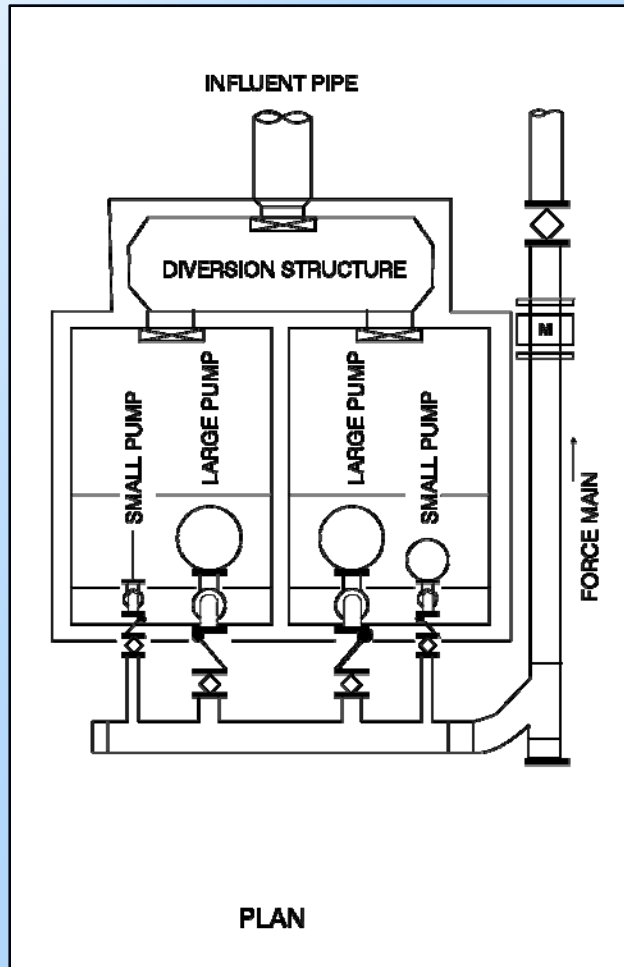
Benefits

- Visible inspection during operation
- Valves and appurtenances are accessible
- High efficiency pumps
- Multiple manufacturers

Limitations

- Large footprint
- Ventilation required
- Equipment handling can be extensive.
- High capital cost

Wet Pit Submersible



Wet Pit Submersible



**Screw Centrifugal
Submersible**



**Non-Clog
Submersible**

Wet Pit Submersible

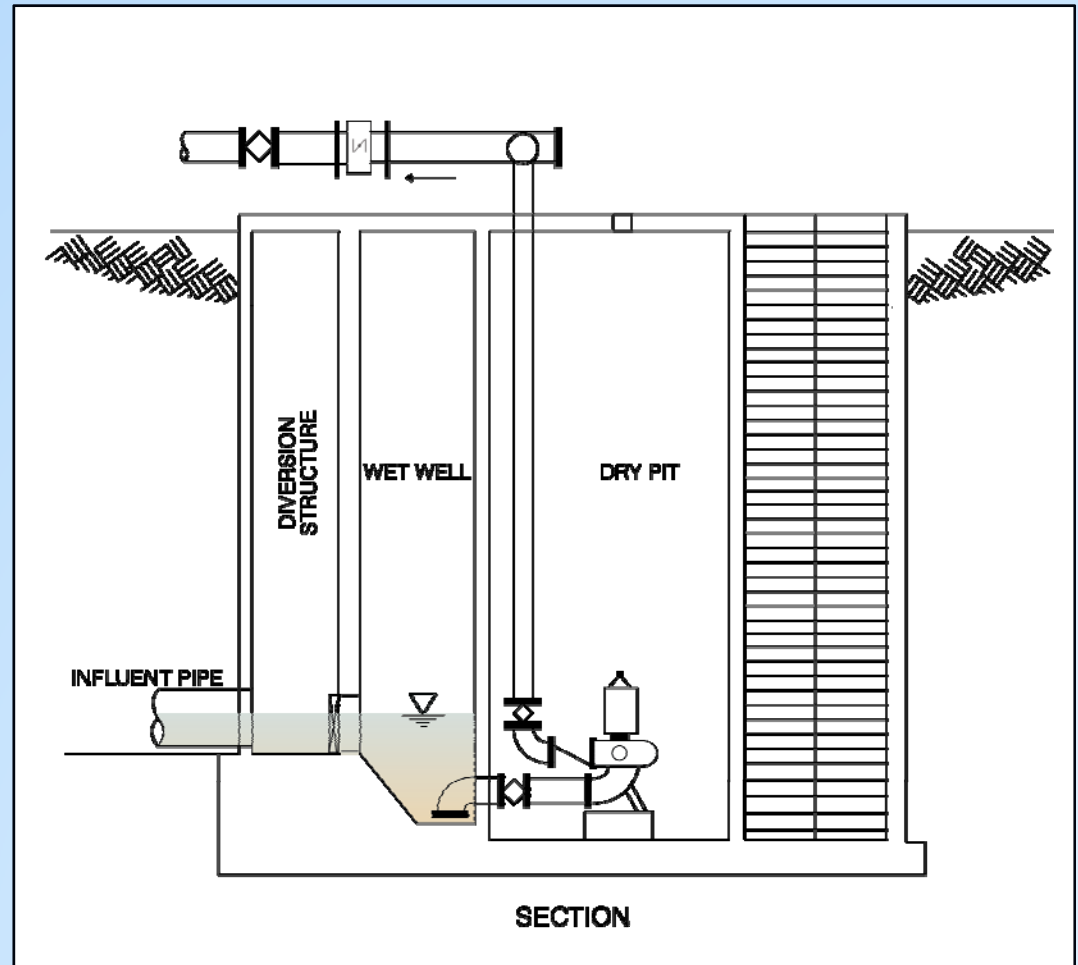
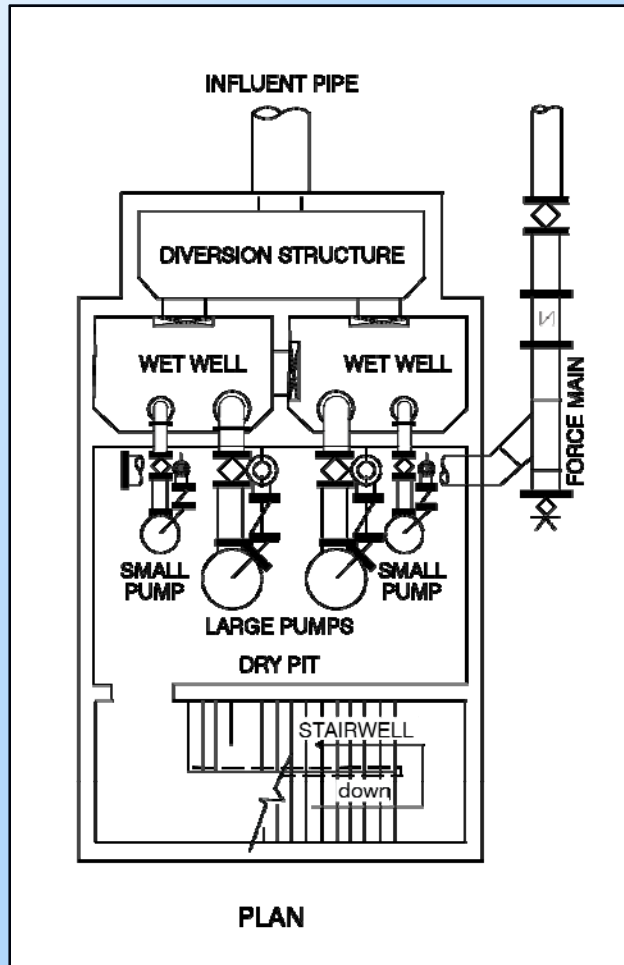
Benefits

- Small footprint
- Reduced capital cost
- Limited ventilation requirements

Limitations

- Cannot visually inspect pumps without removal
- Pumps must be removed from wet well for maintenance
- Pumps are expensive to replace

Dry Pit Submersible



Dry Pit Submersible – Stockholm, Sweden

OM- OCH TILLBYGGNAD AV AVLOPPSPUMPSTATIONEN VID KUNGSHOLMS HAMNPLAN

- Avloppspumpstationen byggdes 1962. Den pumpar avloppsvatten från hela Kungsholmen och Lilla Essingen till Henriksdals avloppsreningsverk
- Anledning till om- och tillbyggnad av pumpstationen är att förhindra driftstopp
- Stationens elsystem byts ut
- Fyra nya pumpar installeras
- Stationen byggs ut med fem meter för att ge plats åt en ny tryckavloppsledning under Riddarfjärden, som byggs vid en senare tidpunkt.

STOCKHOLM
Vatten
Tel: 522 120 00



Vertical



Horizontal

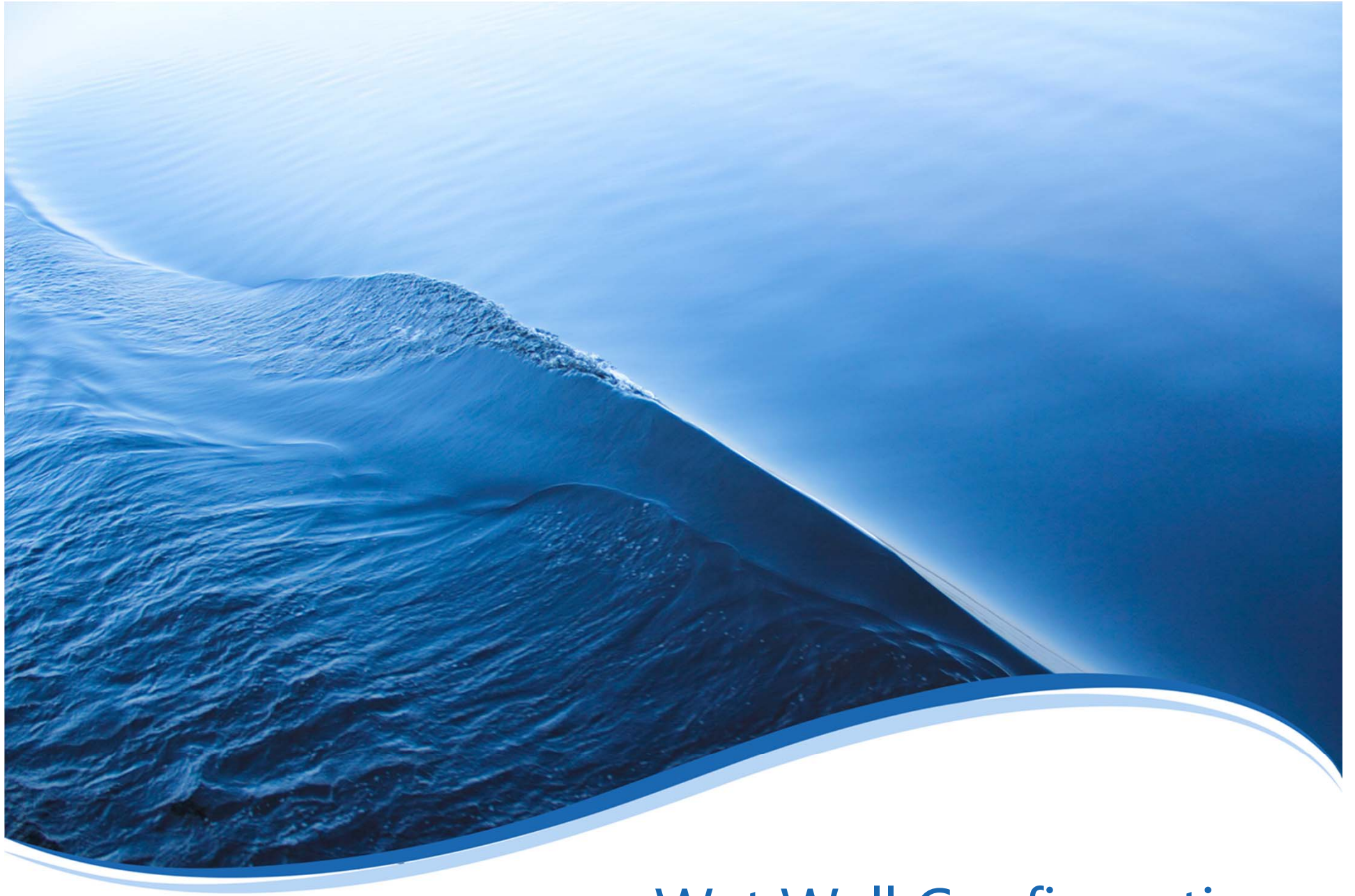
Dry Pit Submersible

Benefits

- Easy to maintain pumps
- Valves and appurtenances are accessible
- Visible inspection during operation
- Most suitable solution for dry pit retrofit.

Limitations

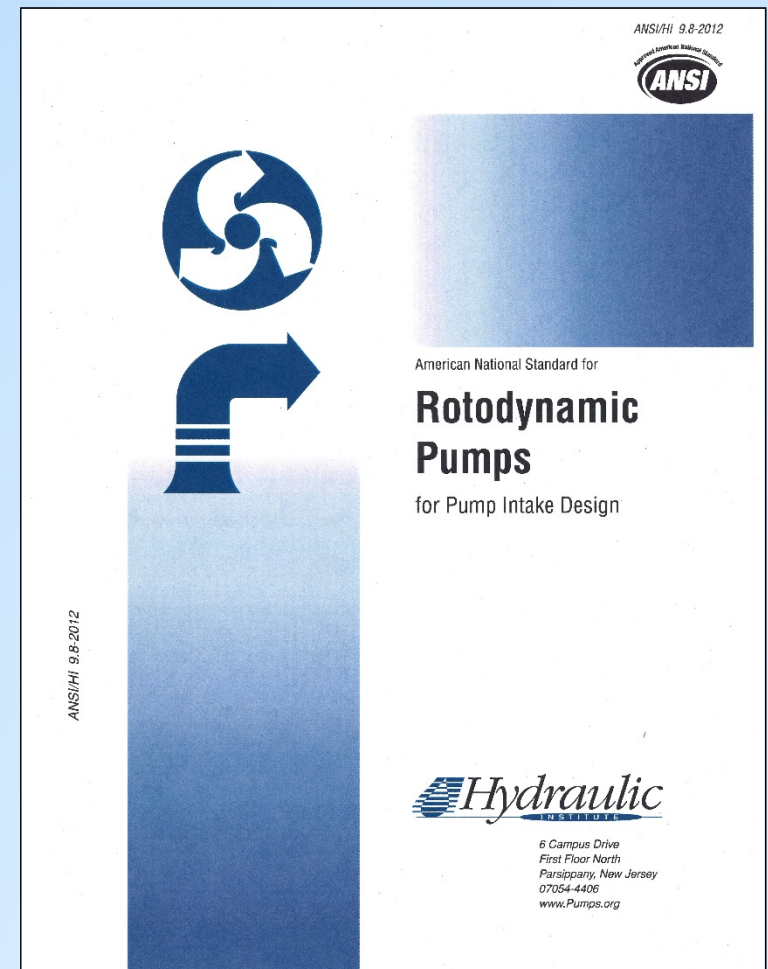
- Large footprint
- Ventilation Required
- High capital cost (new)
- Pumps are more expensive to replace
- Large pumps can require external cooling system



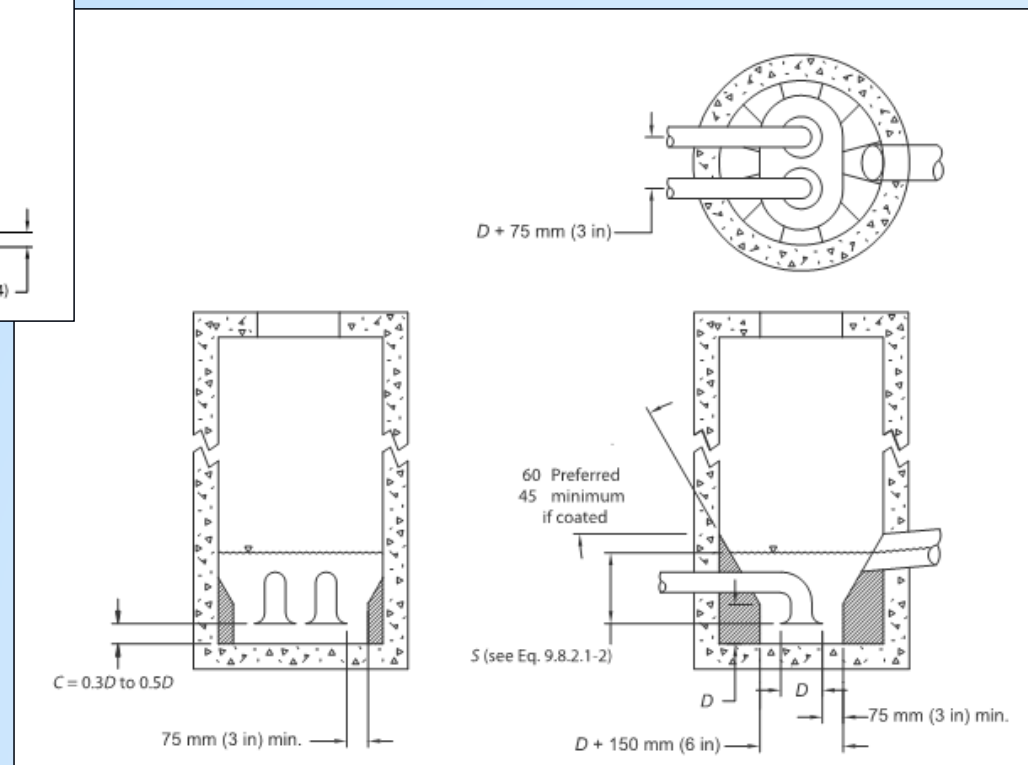
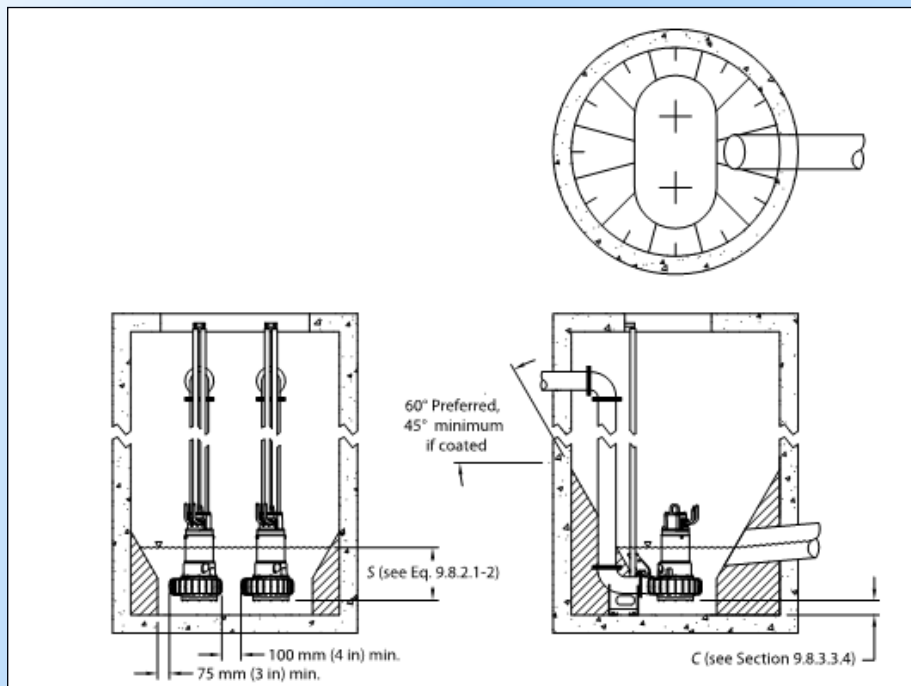
Wet Well Configurations

Common Wet Well Configurations

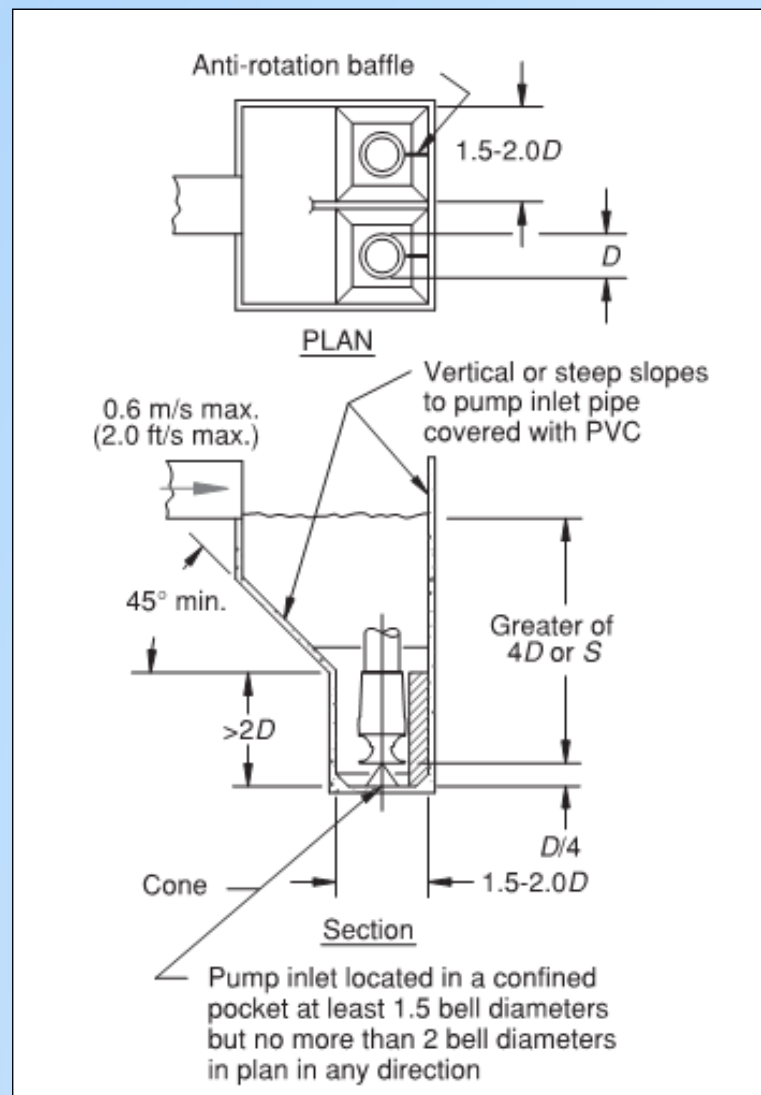
- Hydraulic Institute (HI)
 - Circular Intake (HI 9.8.3.3)
 - Rectangular Intake (HI 9.8.3.4)
 - Trench-Type Wet Well (HI 9.8.3.2)



Circular Wet Well



Rectangular Wet Well



Trench Type (Self-Cleaning) Wet Well

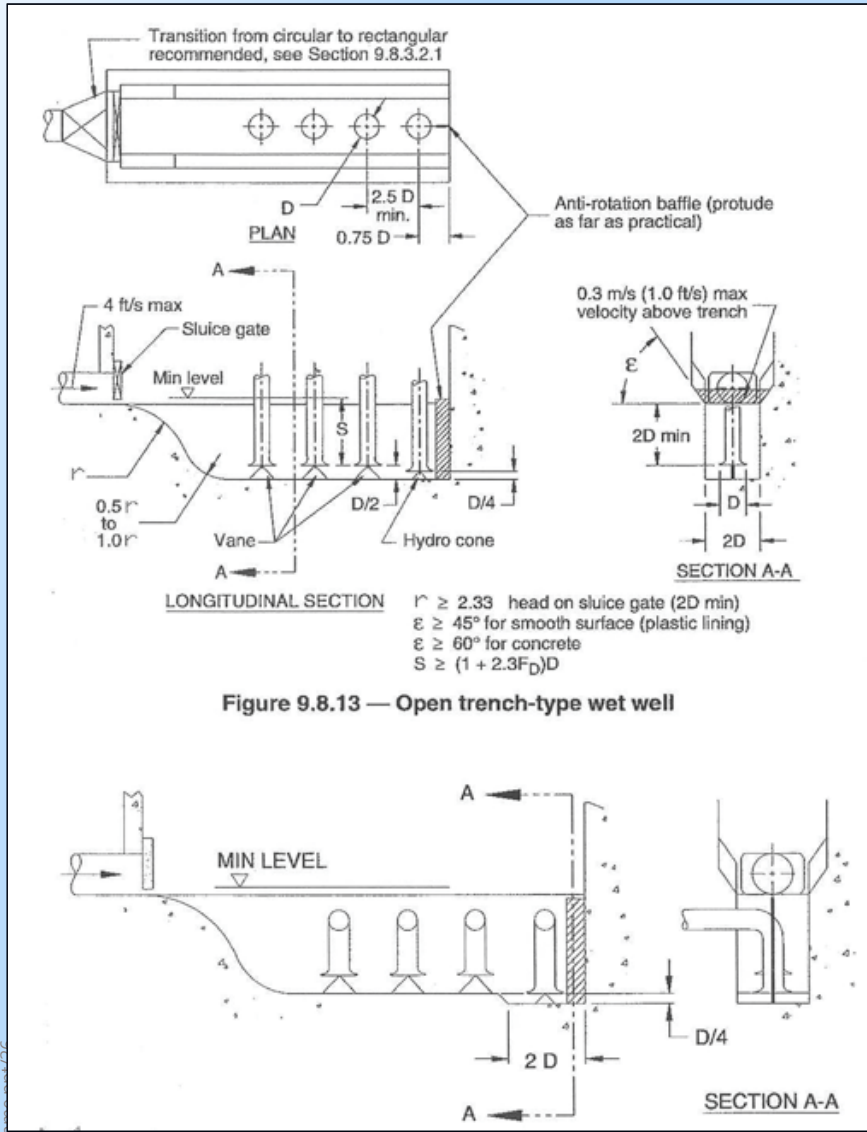
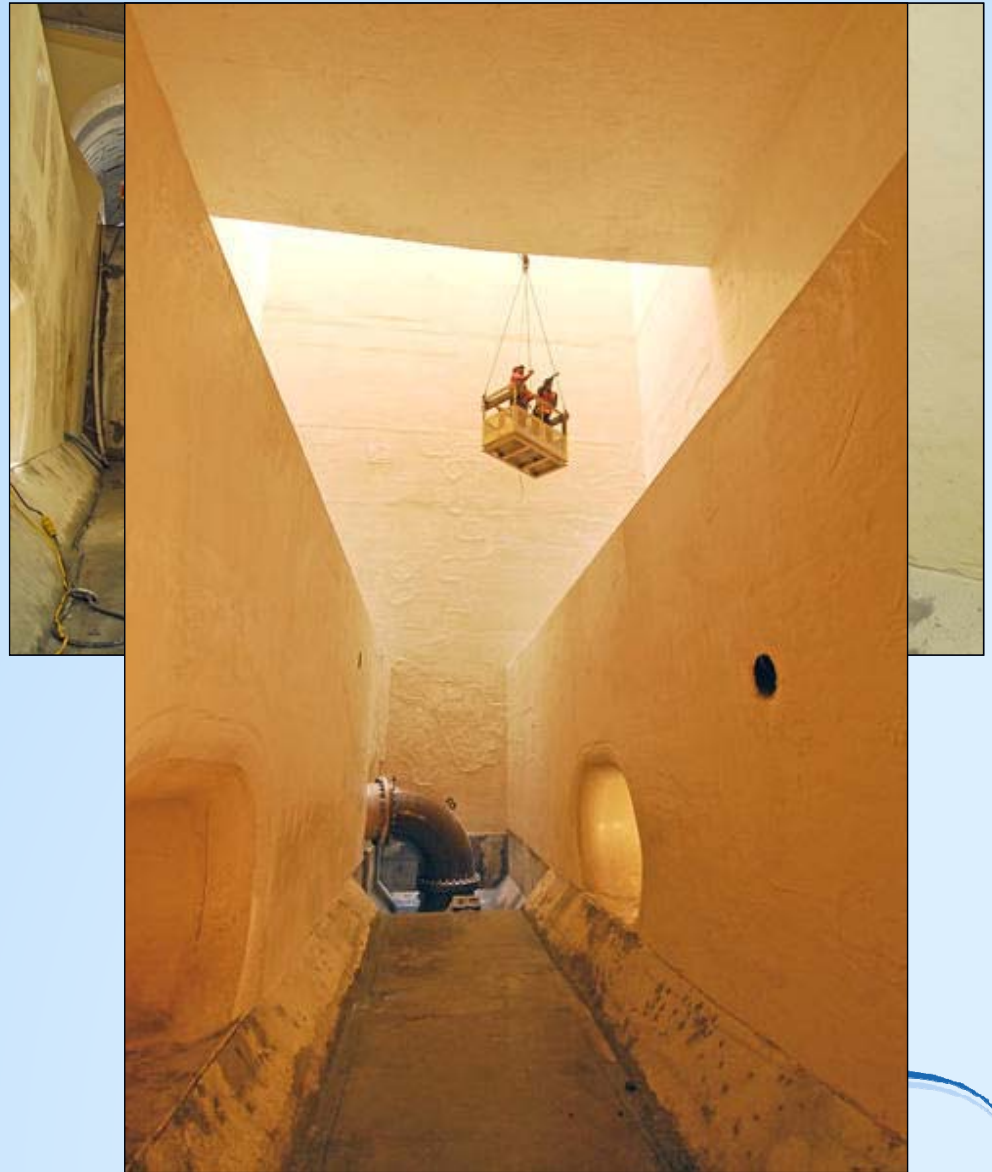
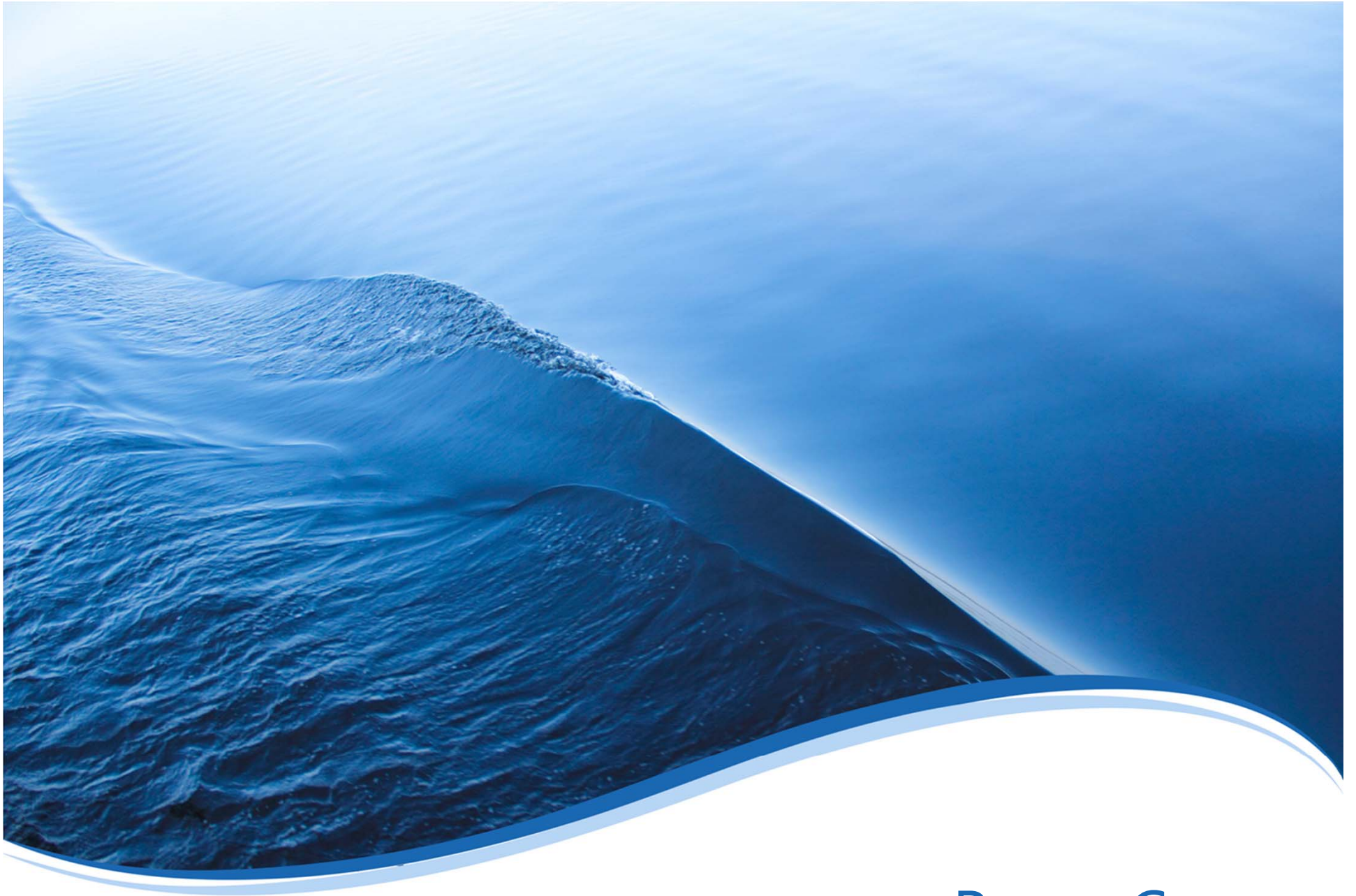


Figure 9.8.13 — Open trench-type wet well

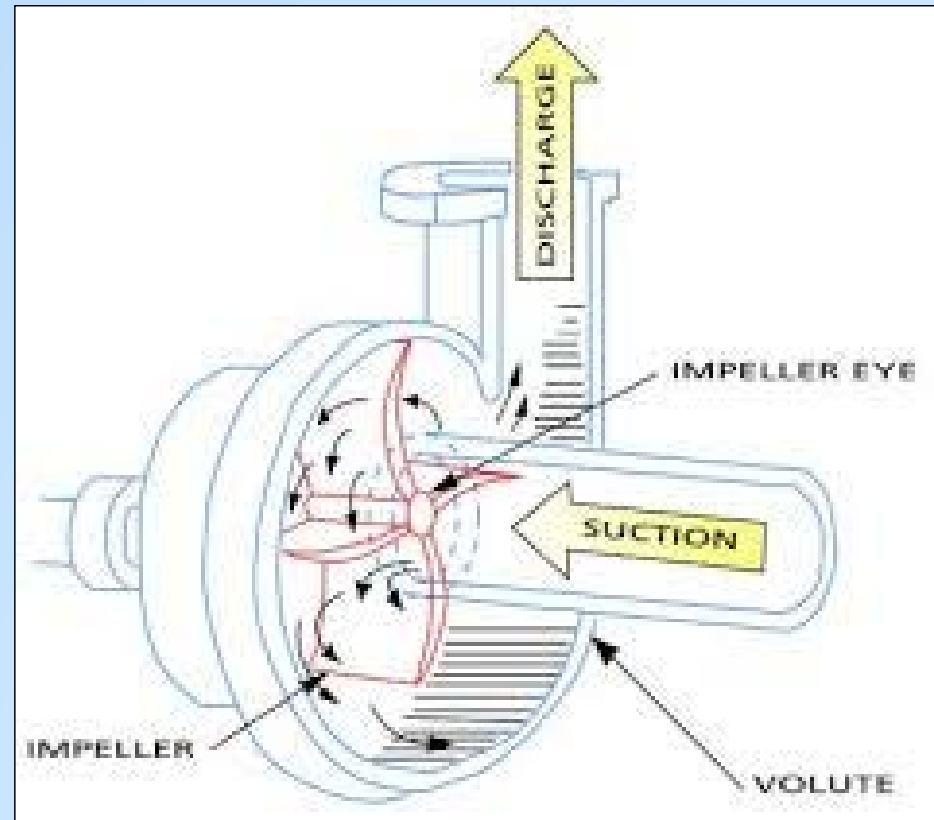




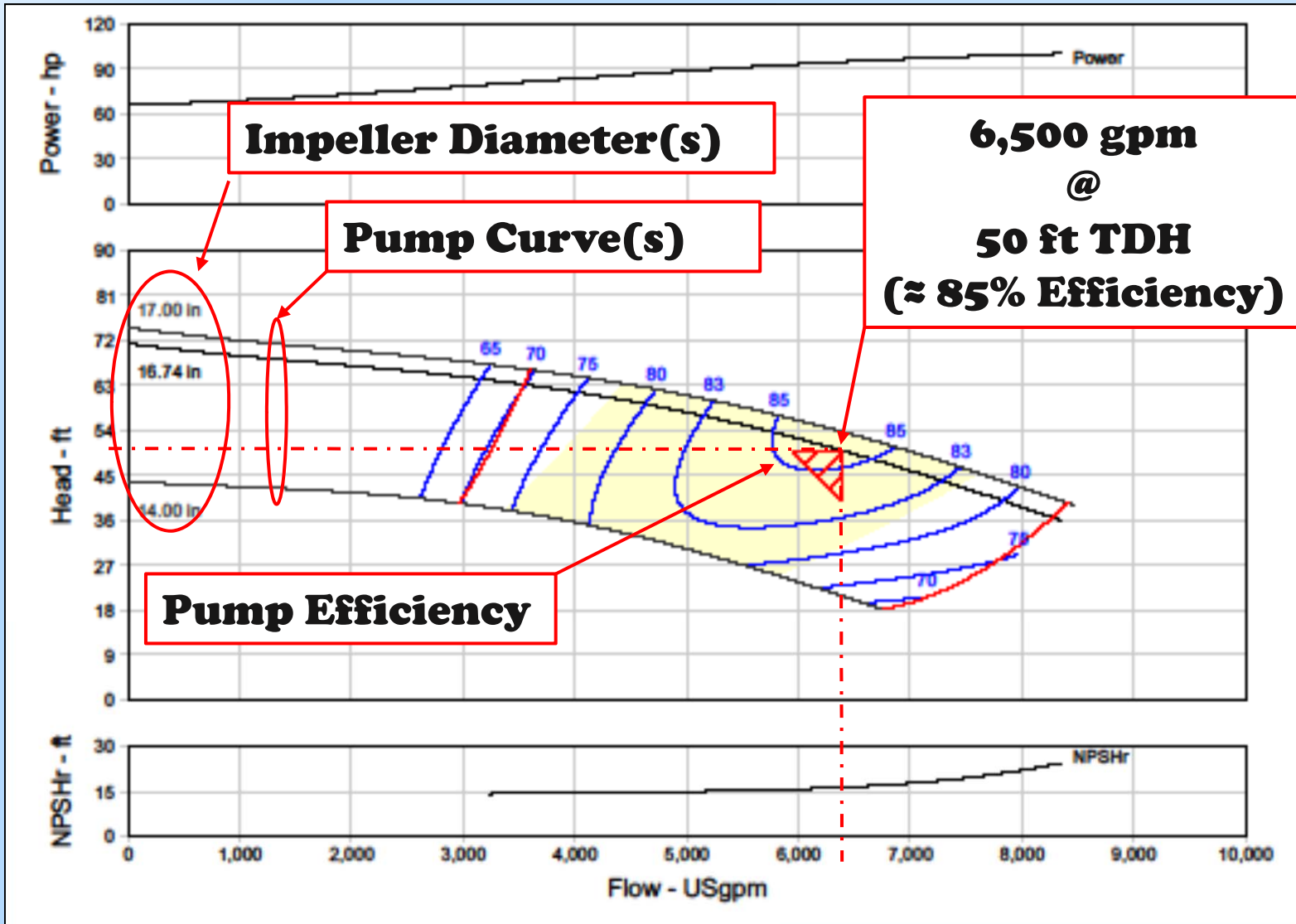
Pump Curves

How A Pump Works

- Liquid forced into impeller
- Vanes passes kinetic energy to liquid
- Liquid rotates and leaves impeller
- Volute casing converts kinetic energy into pressure energy



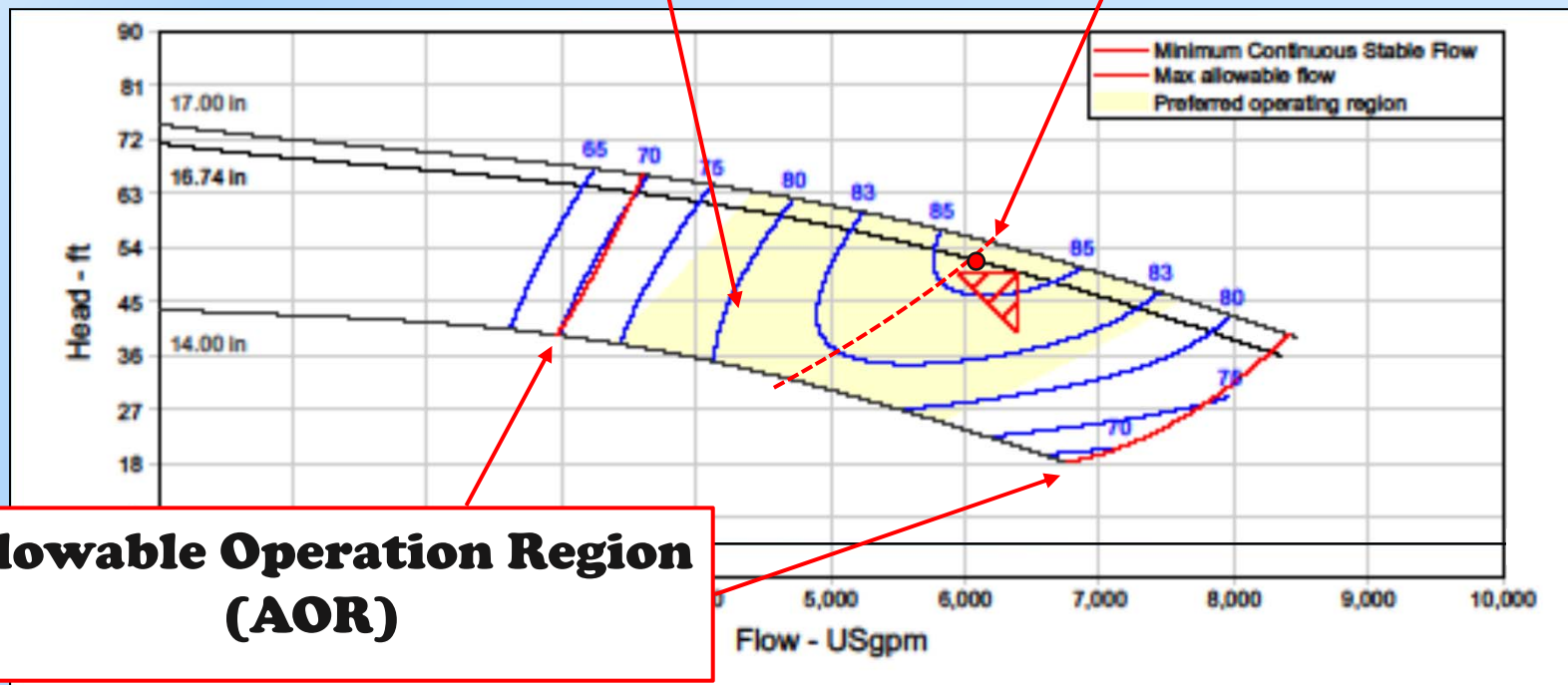
Manufacturer's Pump Performance Curves



Best Efficiency Point and Operating Range

Preferred Operating Region (POR)

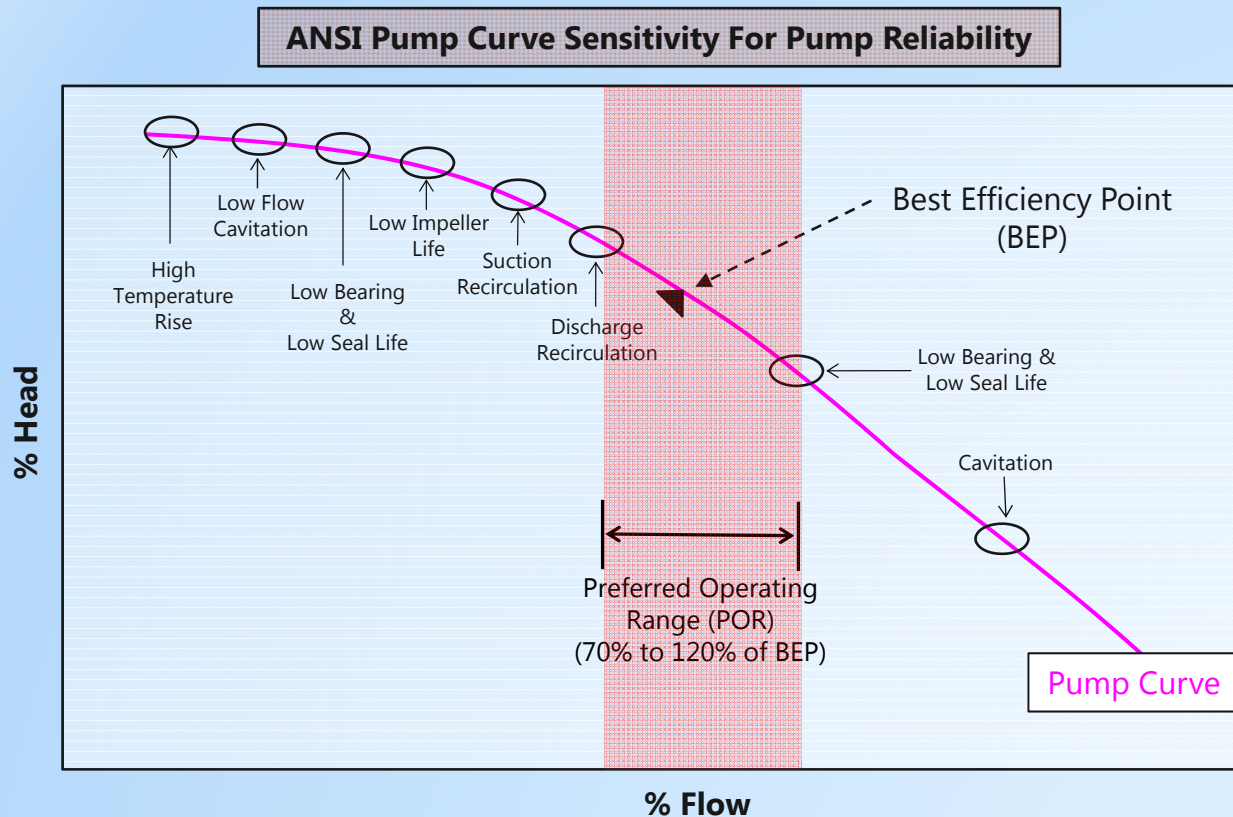
Best Efficiency Point (BEP)



Allowable Operation Region (AOR)

- **BEP** - The flow at which pump is operating at its highest efficiency
- **POR** - 70% - 120% of BEP flow
- **AOR** - Region set by the manufacturer

Pump Preferred Operating Range



.....Where you operate on the curve matters!



Pump Station Hydraulics

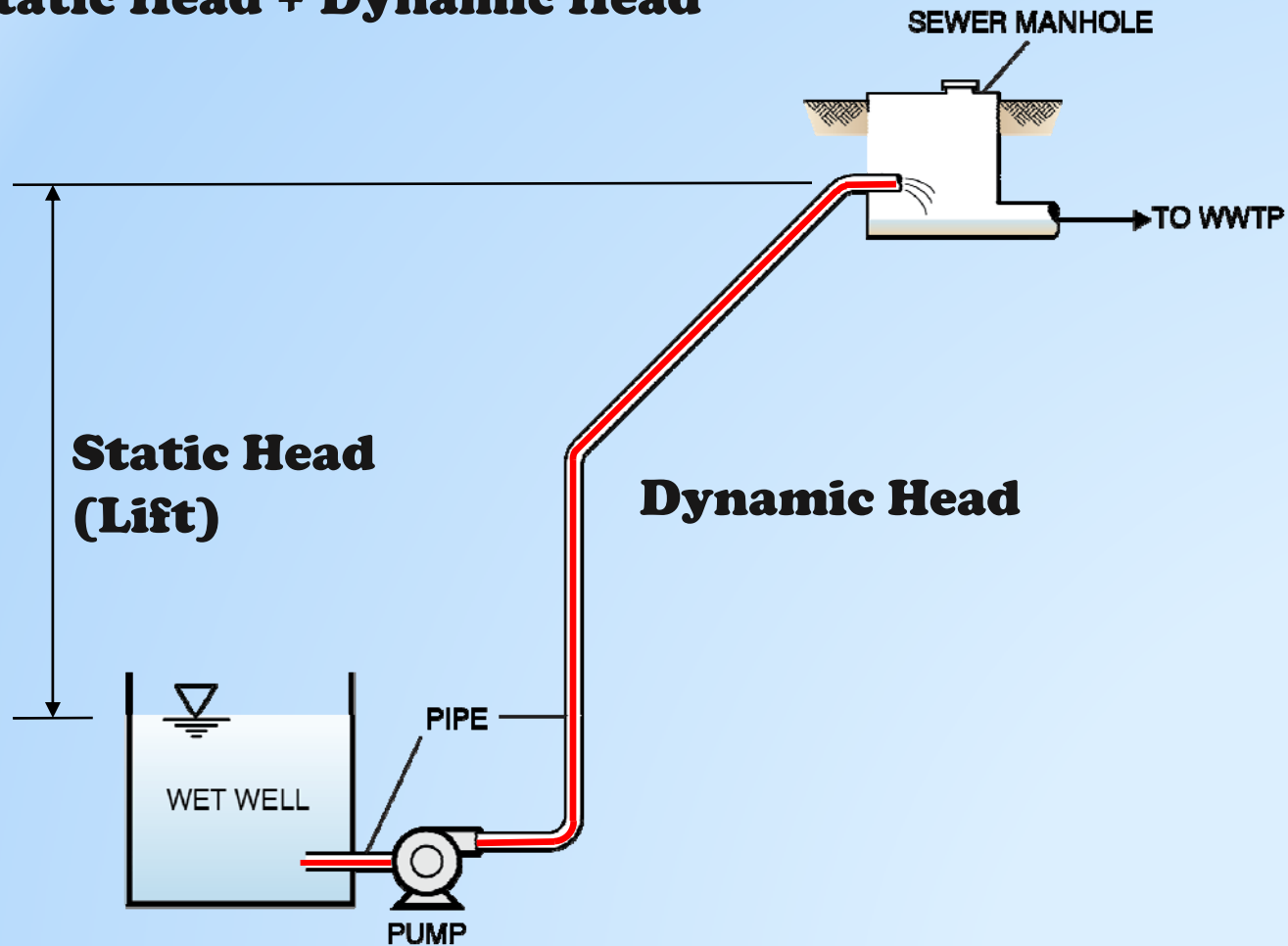
Pump Station Hydraulics

- Pump Total Dynamic Head (TDH)
- System-Head Curves
- Pump Selection
- Pump Efficiency
- Variable Speed Pumping

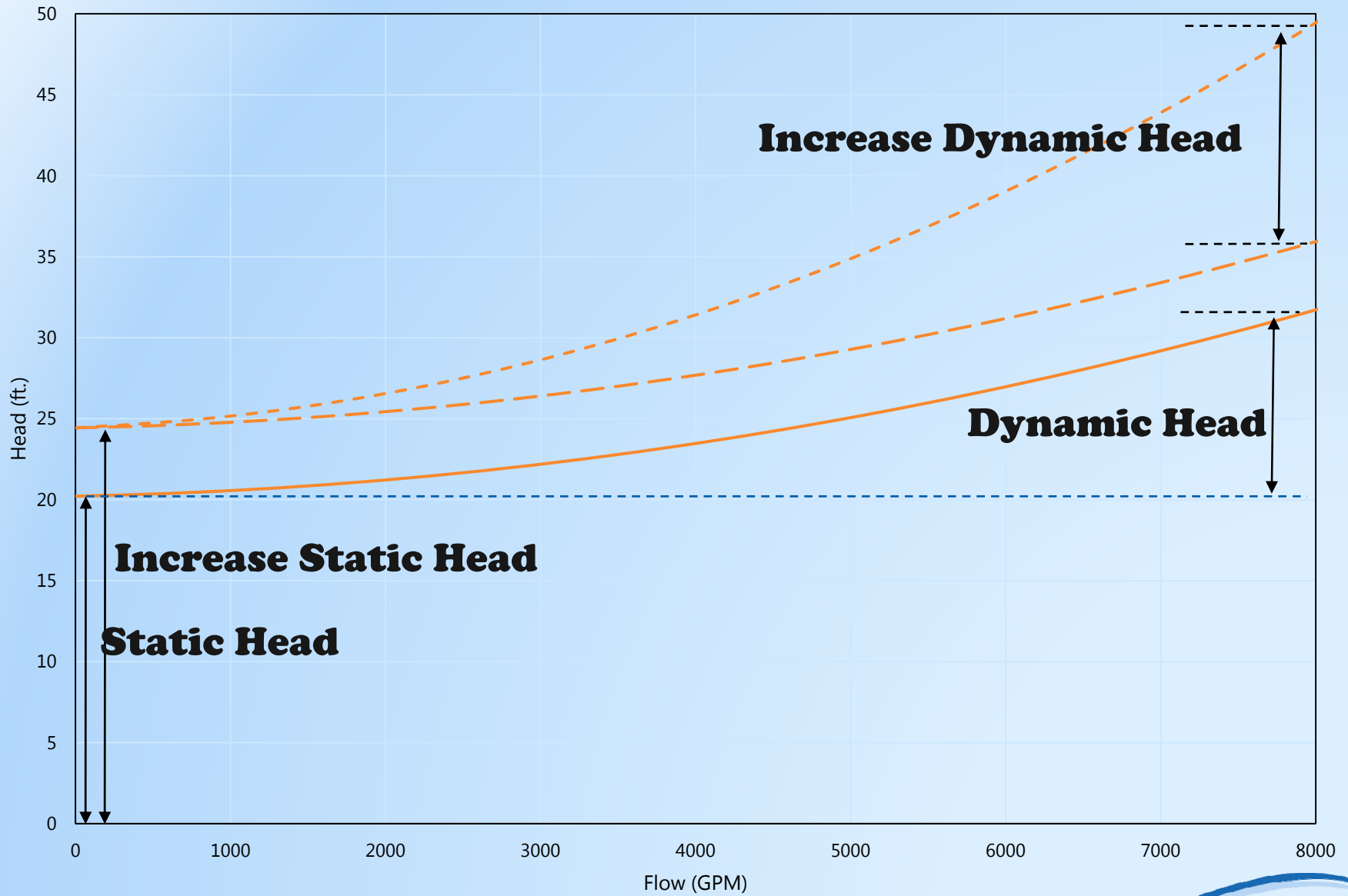


Pump Total Dynamic Head (TDH)

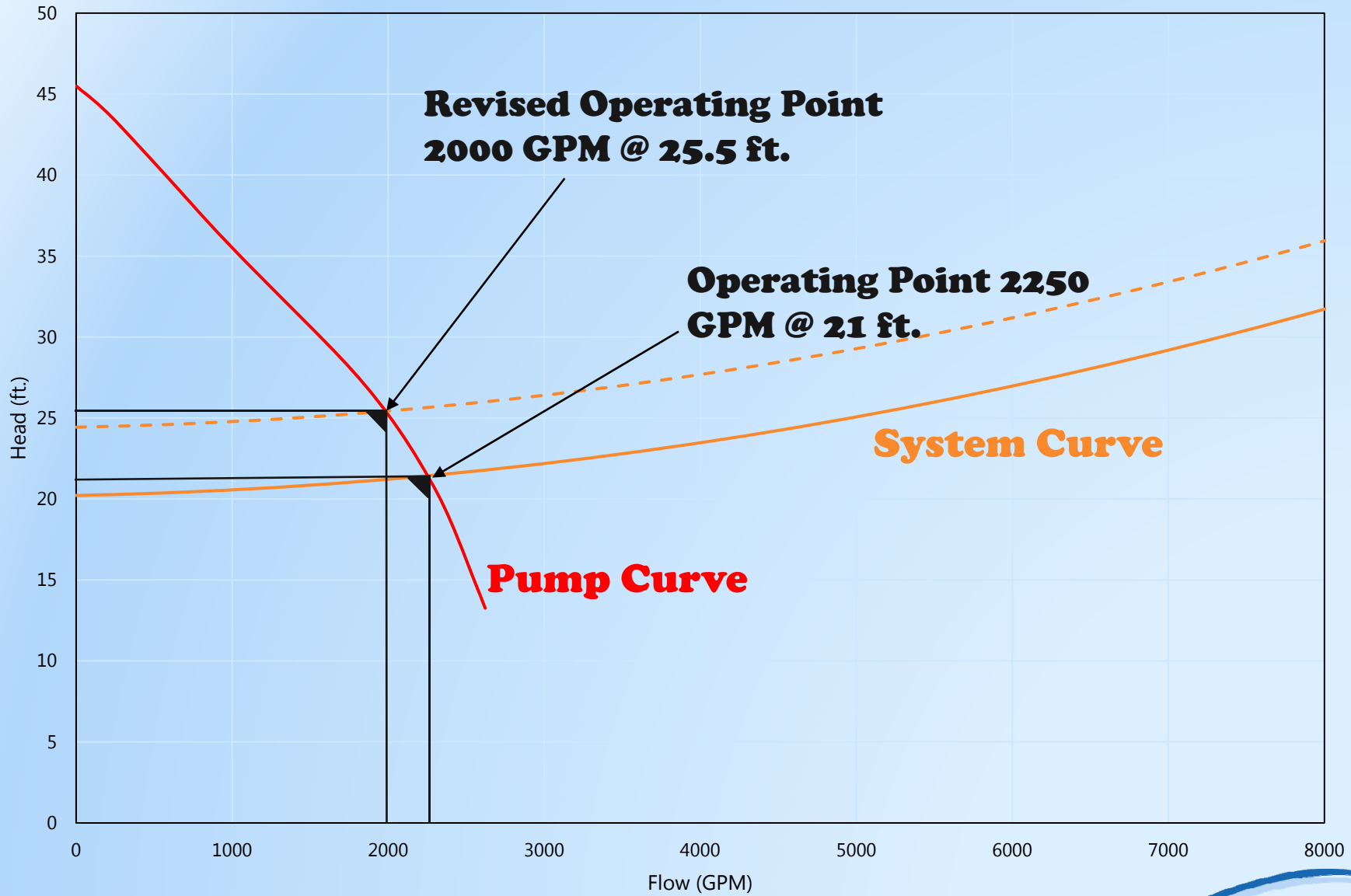
$$\text{TDH} = \text{Static Head} + \text{Dynamic Head}$$



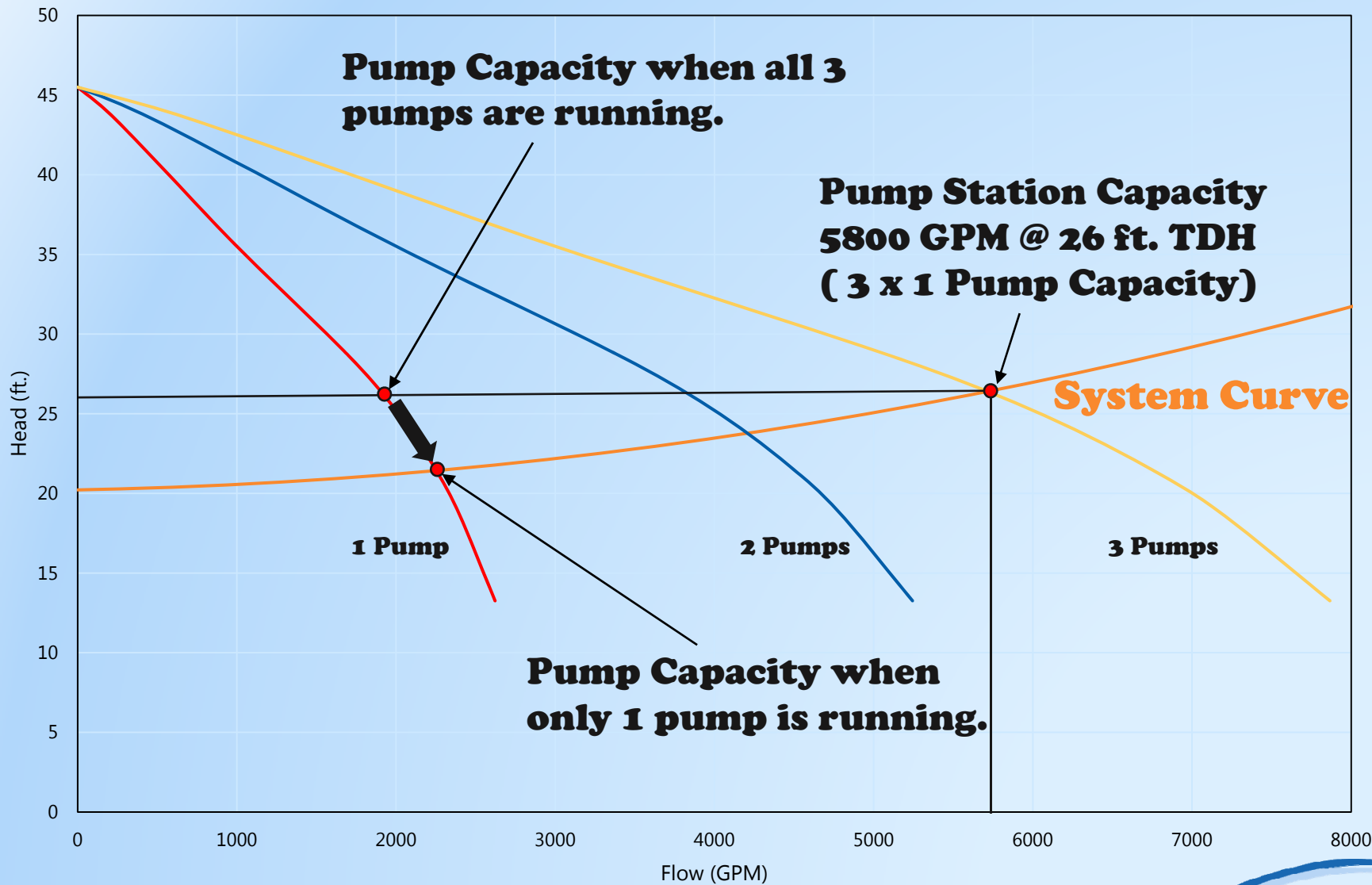
System Head Curves



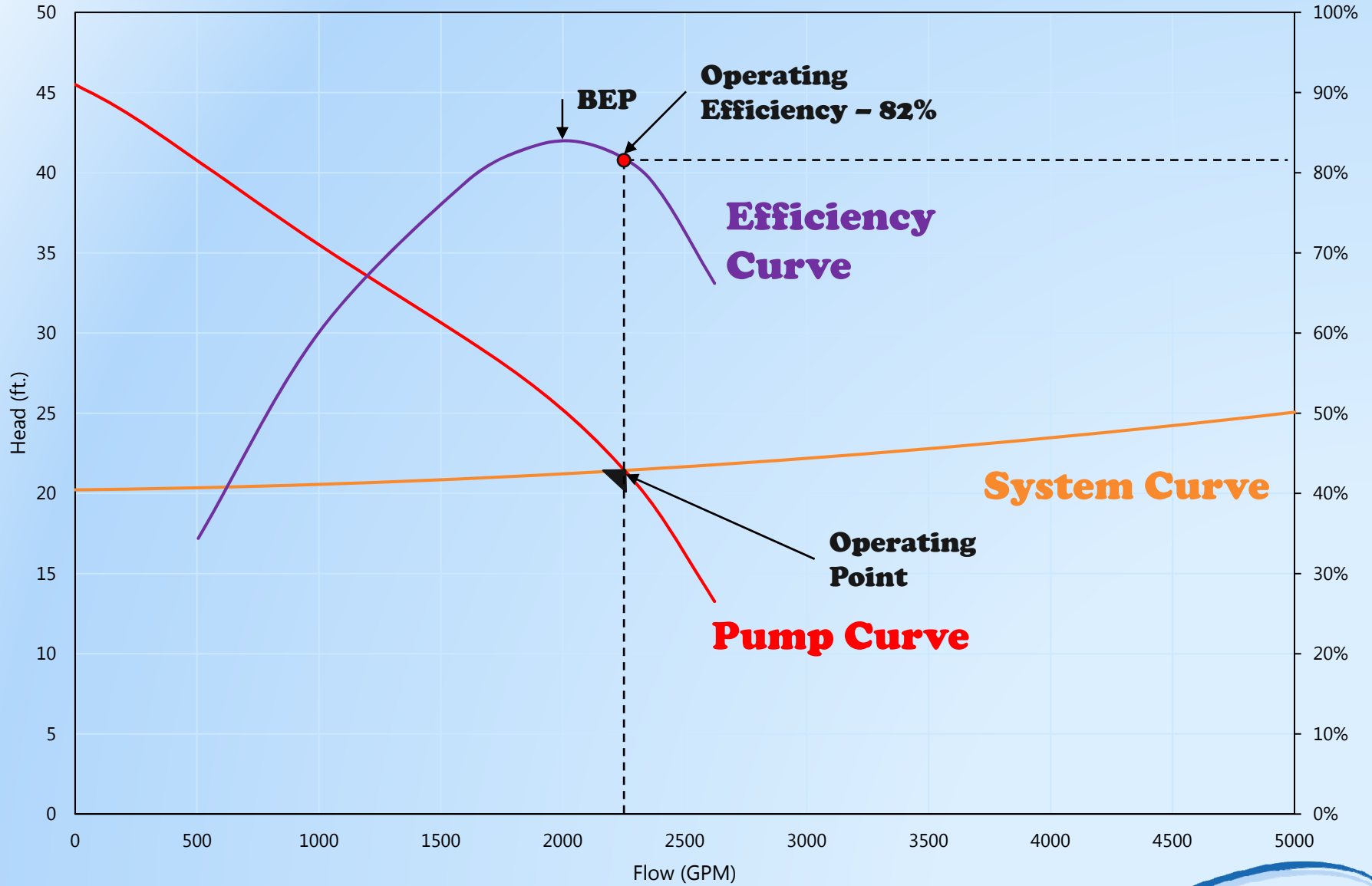
Pump Selection



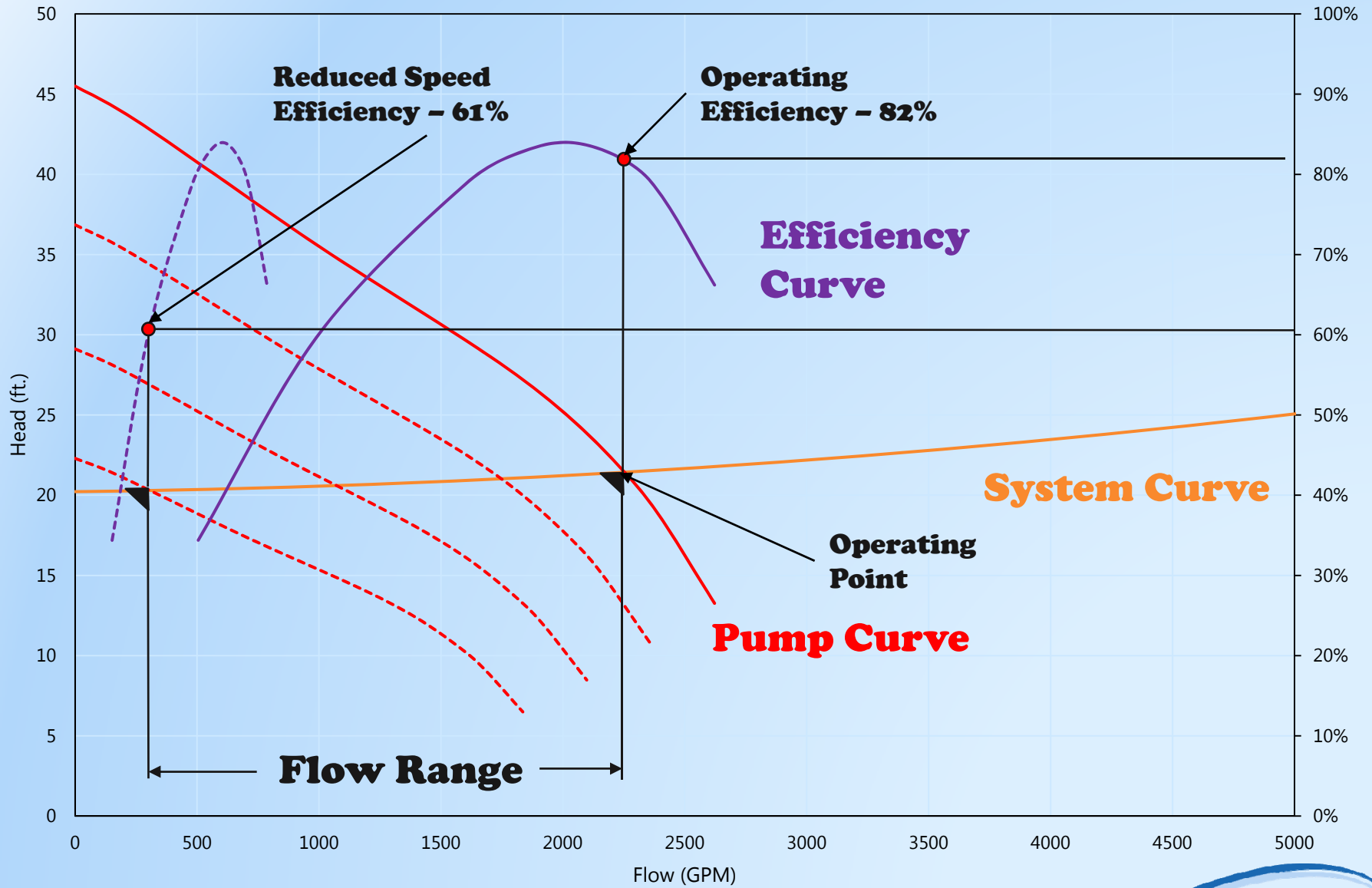
Multiple Pump Operation

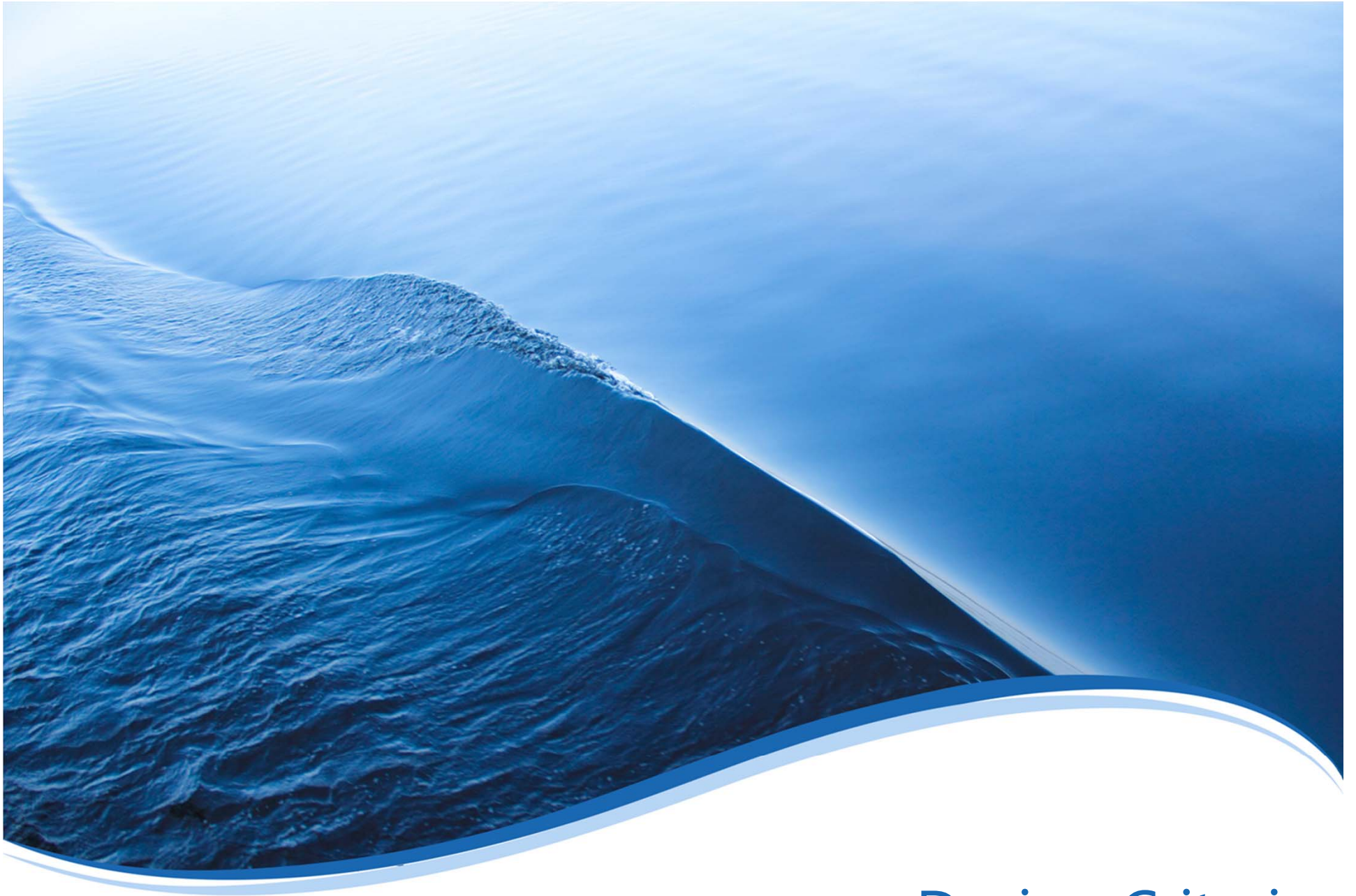


Pump Efficiency



Variable Speed Pumping





Design Criteria

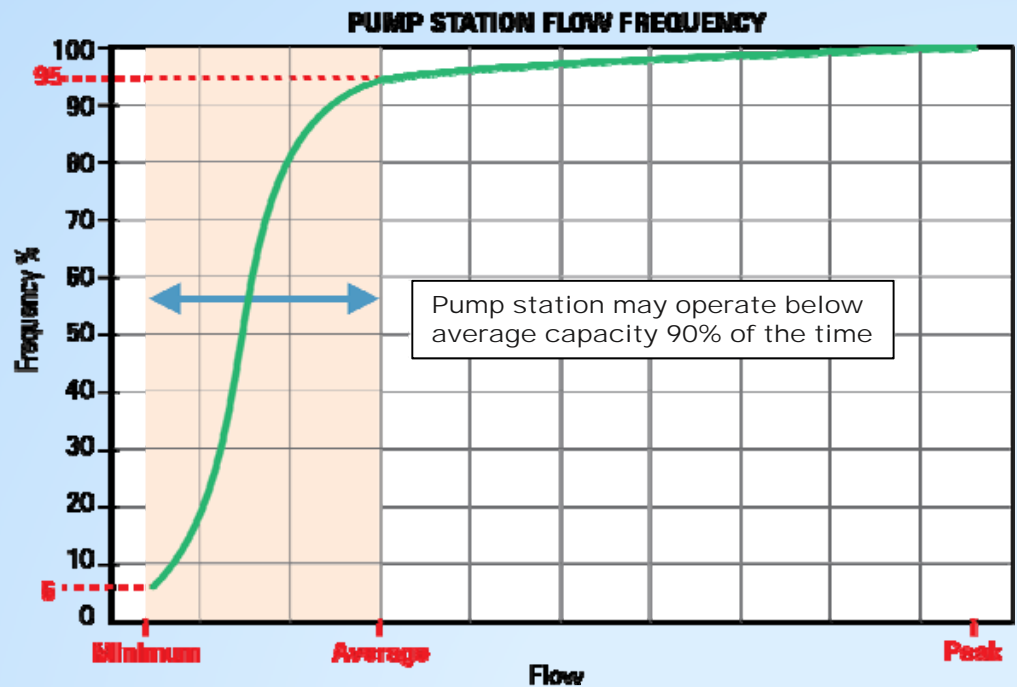
Topics of Discussion

- Determine Operating Flows
- Available Design Standards



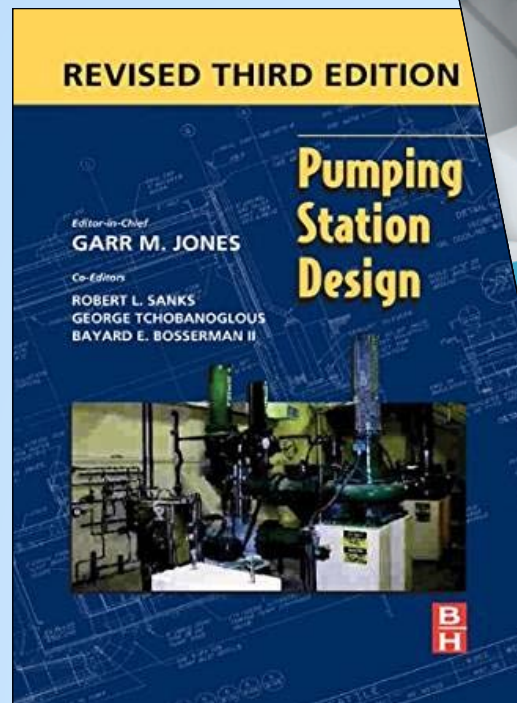
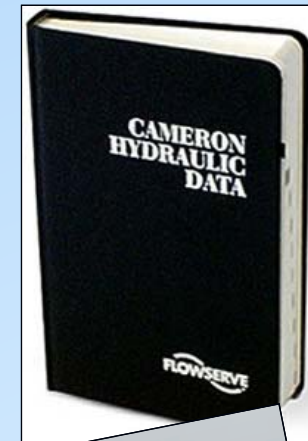
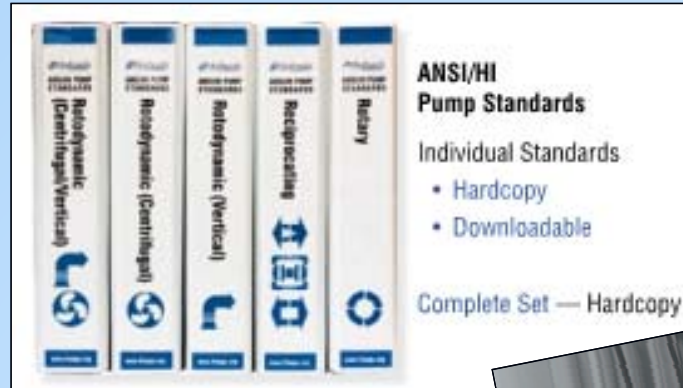
Frequency Curves – Know Your Flows

- Use of frequency curves to:
 - Identify “typical” operating flow
 - Optimize pump selection - efficiency
 - Minimize infrastructure
 - Save \$\$\$



Available Design Standards


- ANSI/HI Pump Standards
- Pumping Station Design
- Hydraulic Handbook
- Flygt Design Recommendations
- Many Others....




Intake Design – Critical to Station Performance

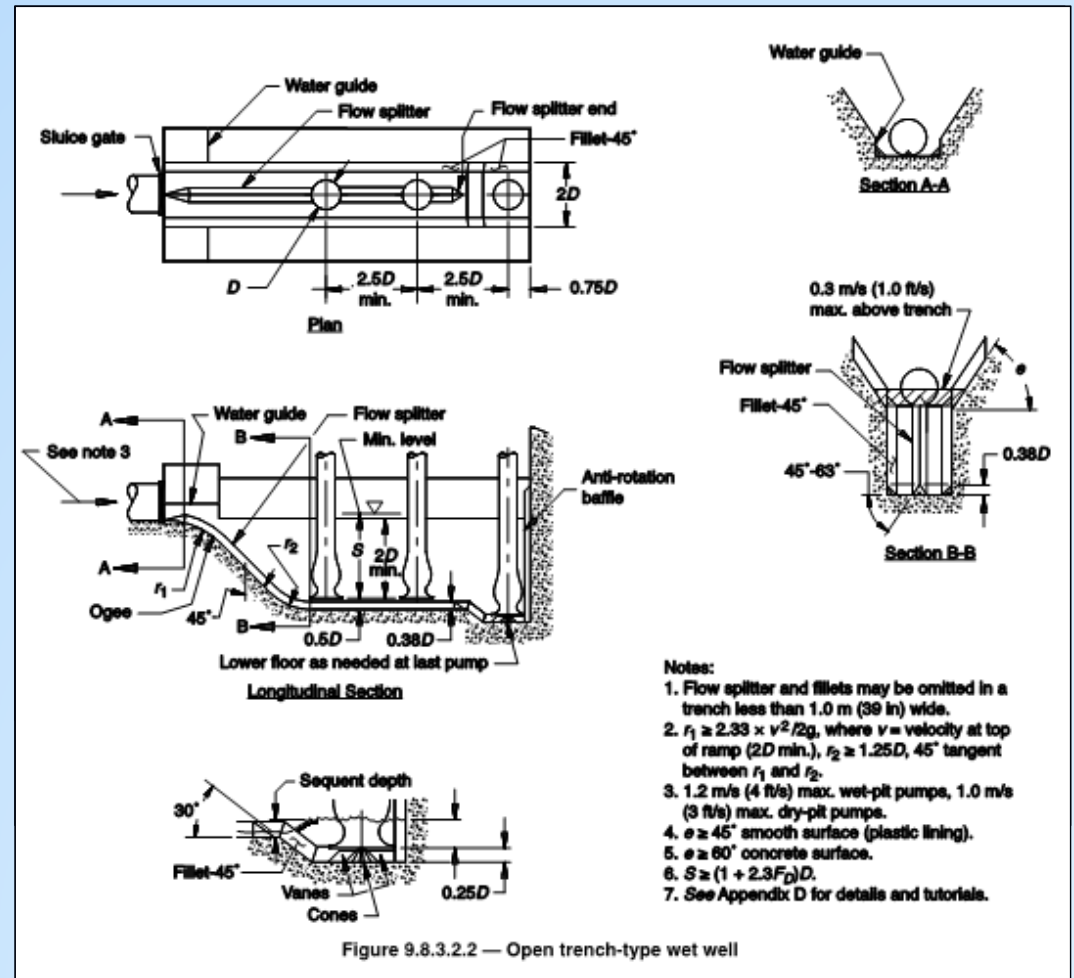
- Intake Structure Geometry

ANSI/HI 9.8-2012

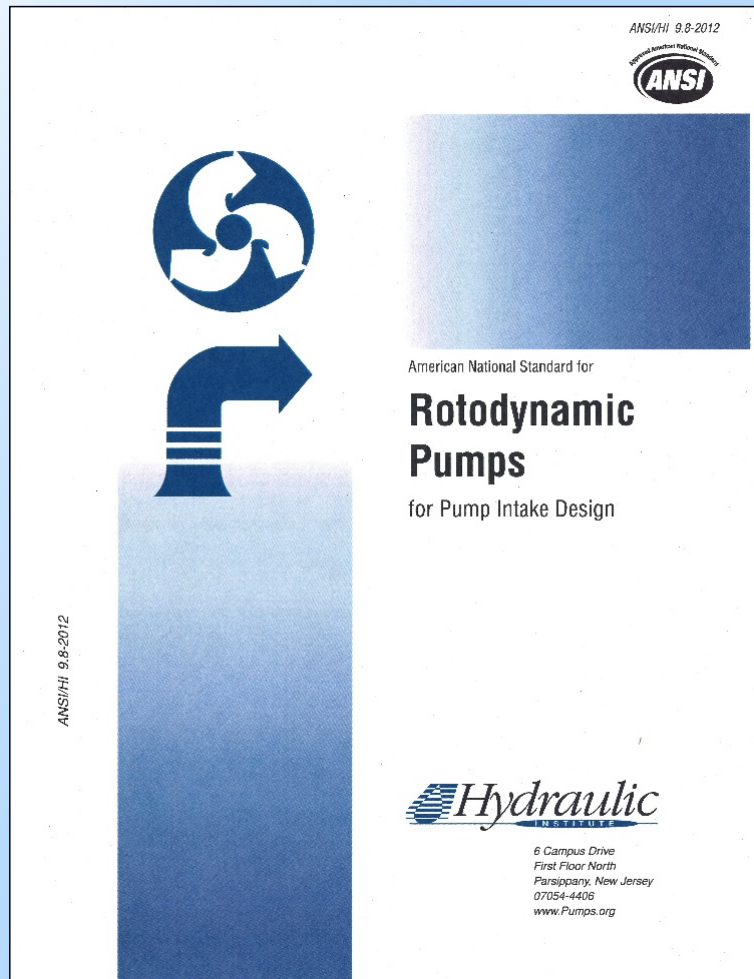

 American National Standard for
Rotodynamic Pumps
 for Pump Intake Design


 6 Campus Drive
 First Floor North
 Parsippany, New Jersey
 07054-4406
 www.Pumps.org

ANSI/HI 9.8-2012



Intake Design – Critical to Station Performance



- Intake Structure Geometry
- Inlet Bell Design
- Required Submergence
- Hydraulic Model Studies
 - Methods
 - Acceptance Criteria
- Much, much, more.....

Questions?

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