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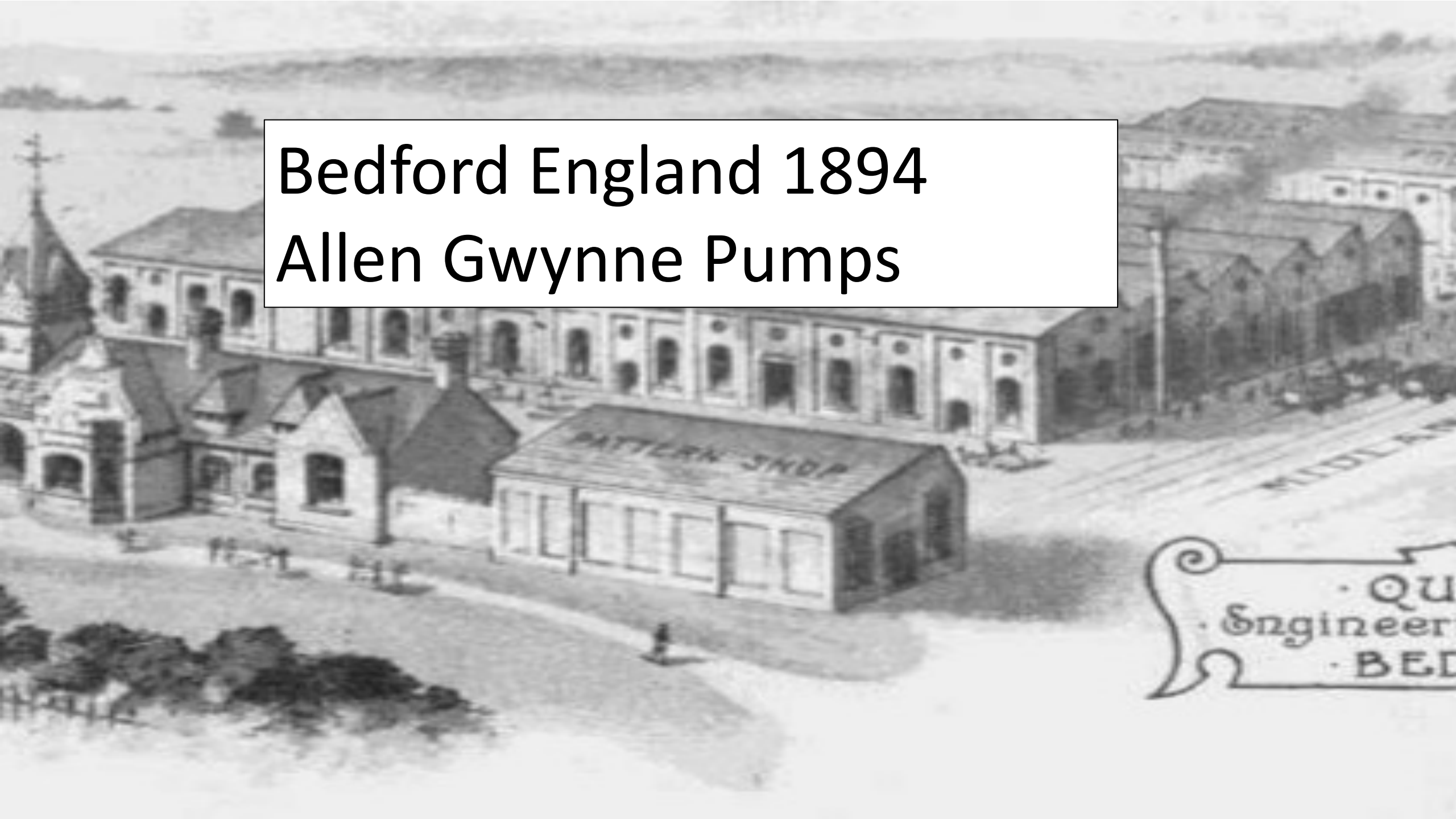
# Fish Friendly Pumping

## Land drainage/Flood protection

Gary Leatherbarrow




# Bedford England 1894
# Allen Gwynne Pumps

ain Offices, Machining, Erecting and Testing Departments at the Queen's Engineering Works, Bedford.
ttern Shop, Smiths' Shop, Iron Foundry, Brass Foundry, and Laboratory are situated at the Company's Branch Works at Bidde
near Bedford)

# 1980’s  Allen Pumps shut down

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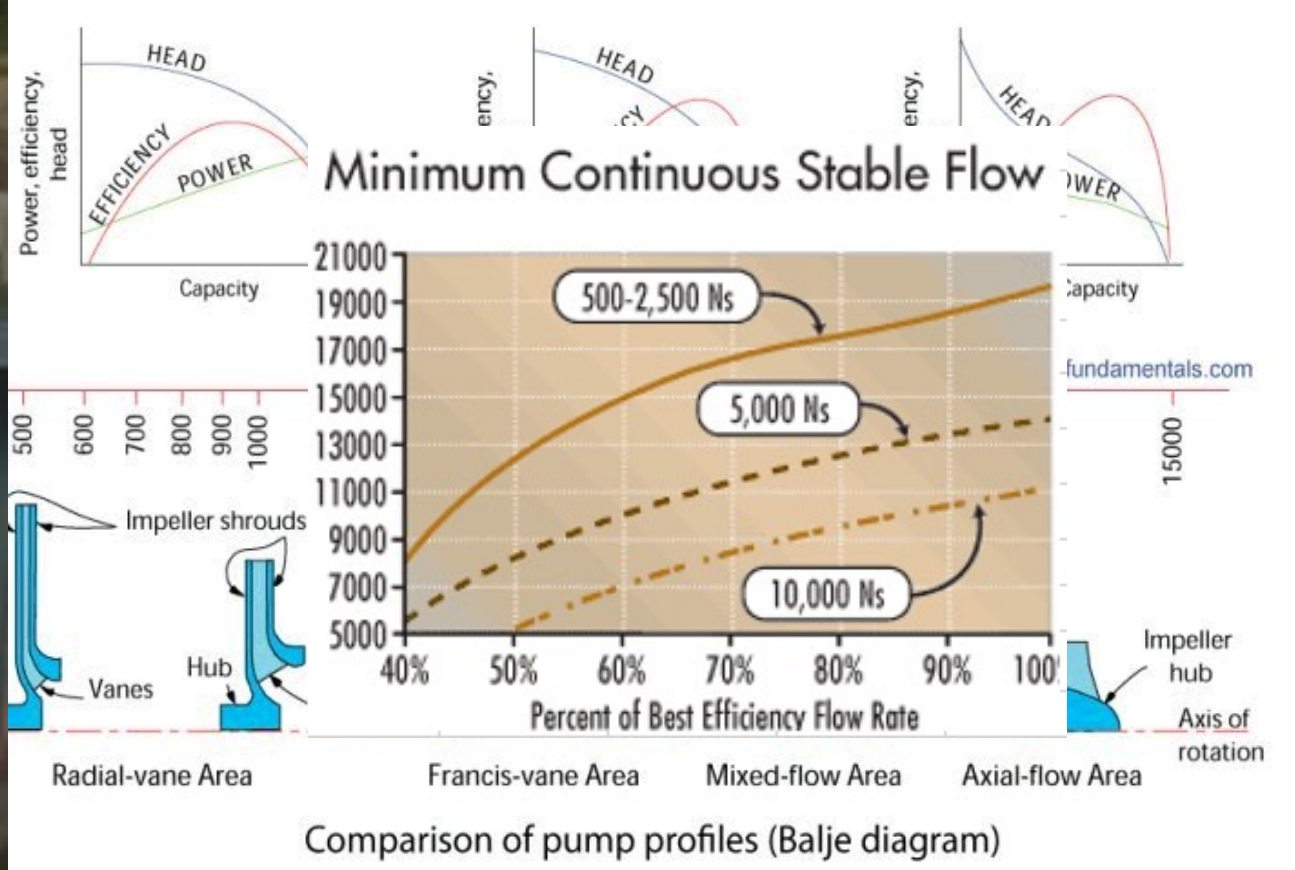
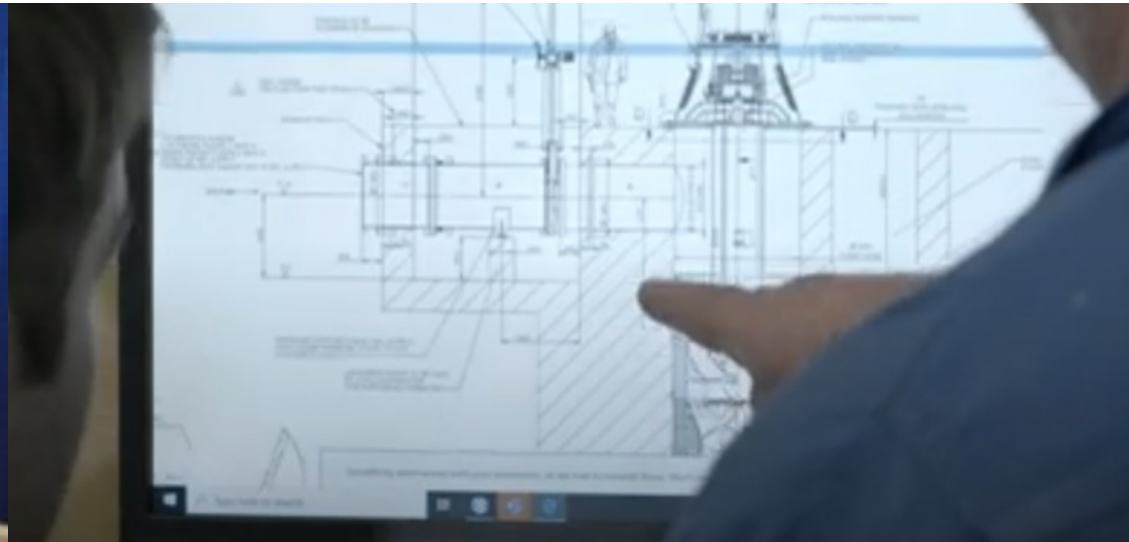
# Markets: Applications

| Land Drainage | Fish Friendly | Dock Water | Storm Water | Waste Water | Potable water |
|---|---|---|---|---|---|
|  |   |  |  |  |    |




Comparison of pump profiles (Balje diagram)



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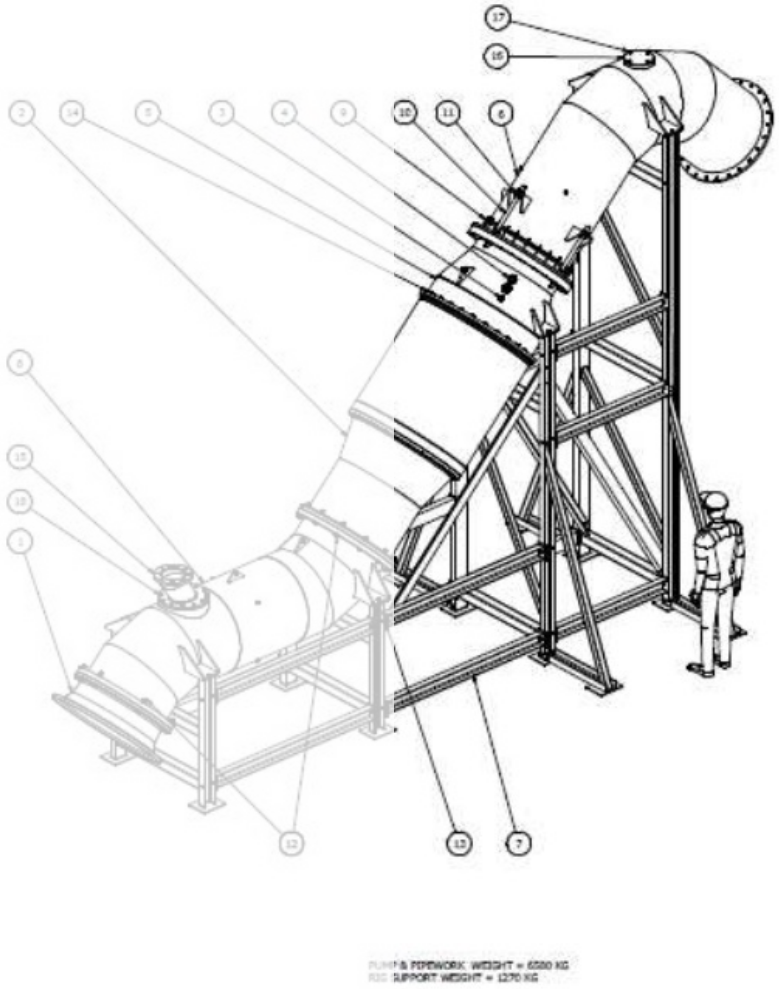
# Fish Friendly design/Test

# What makes a fish friendly pump?

# In practical terms: What features make a fish friendly pump?

- Axial impeller



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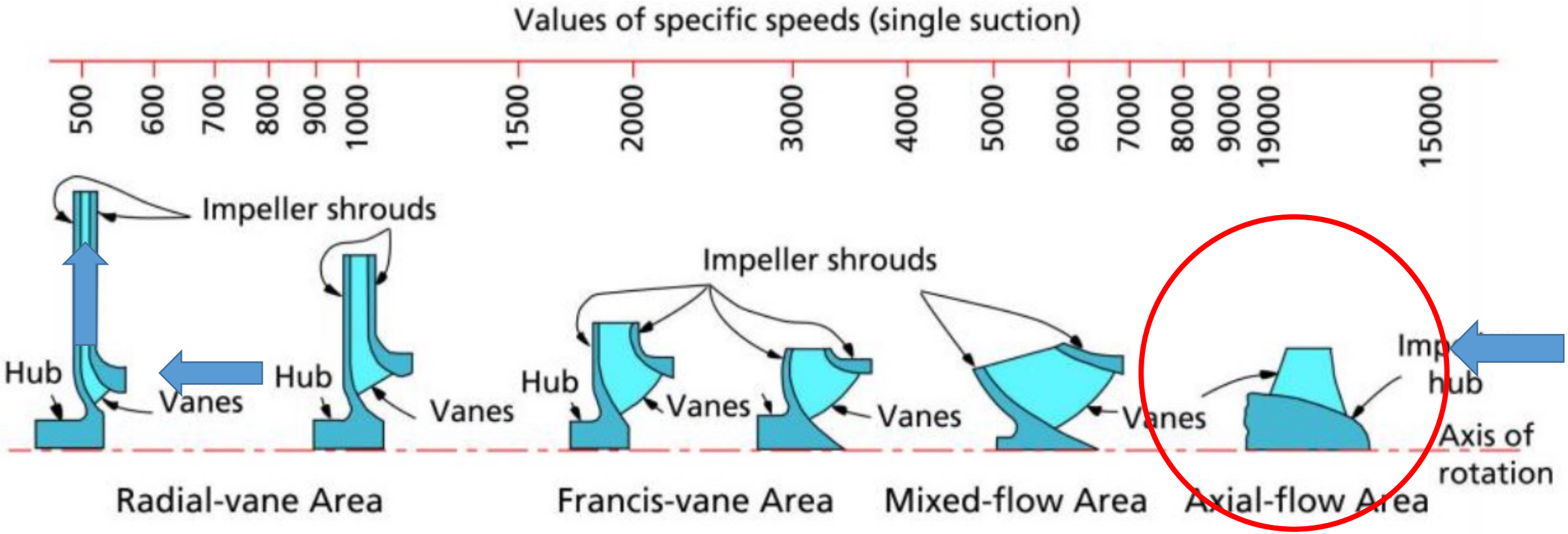
# Specific speed



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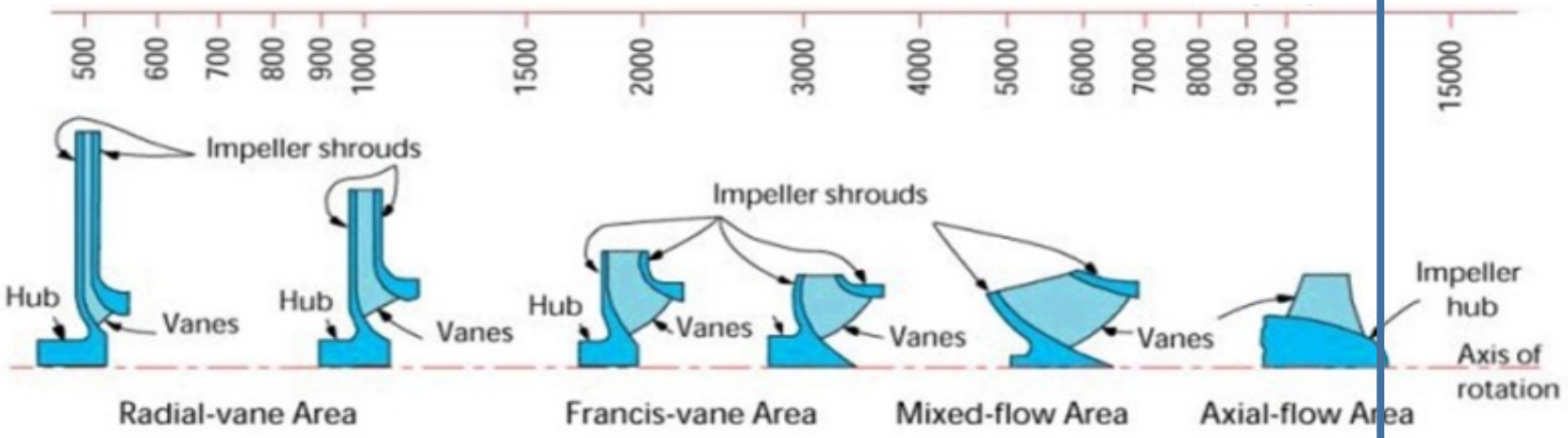
# Impeller design




**Comparison of pump profiles (Balje diagram)**

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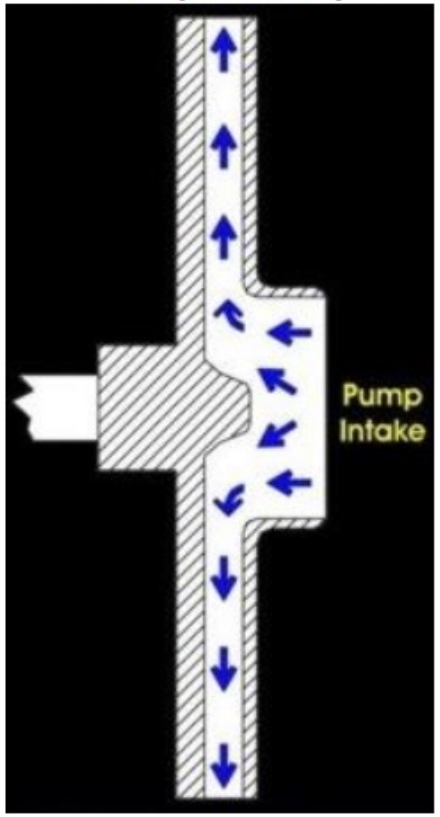
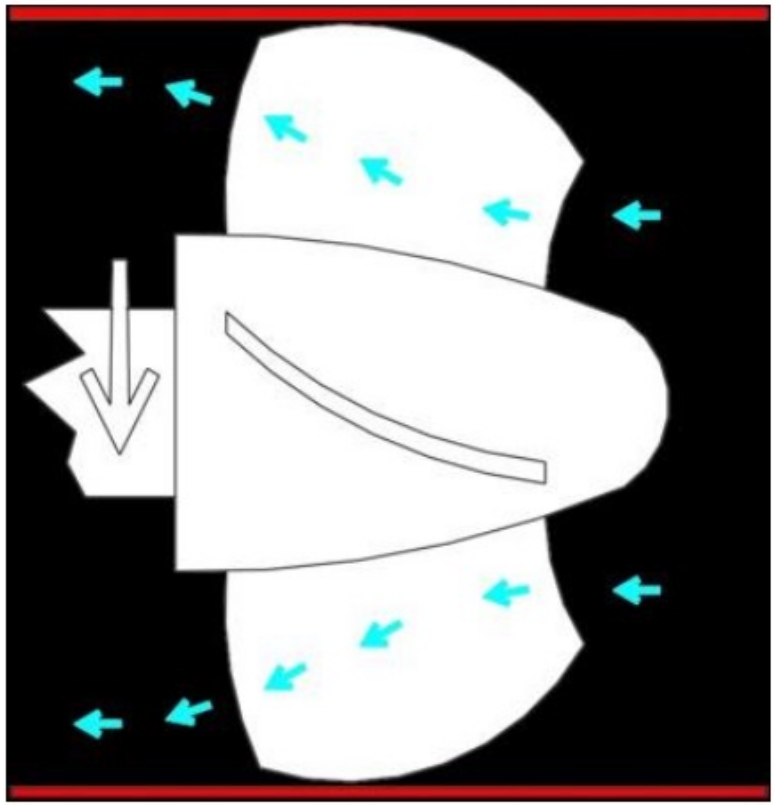
# Specific speed

Radial (Low Specific Speed) Impeller




Axial (High Specific Speed Impeller)

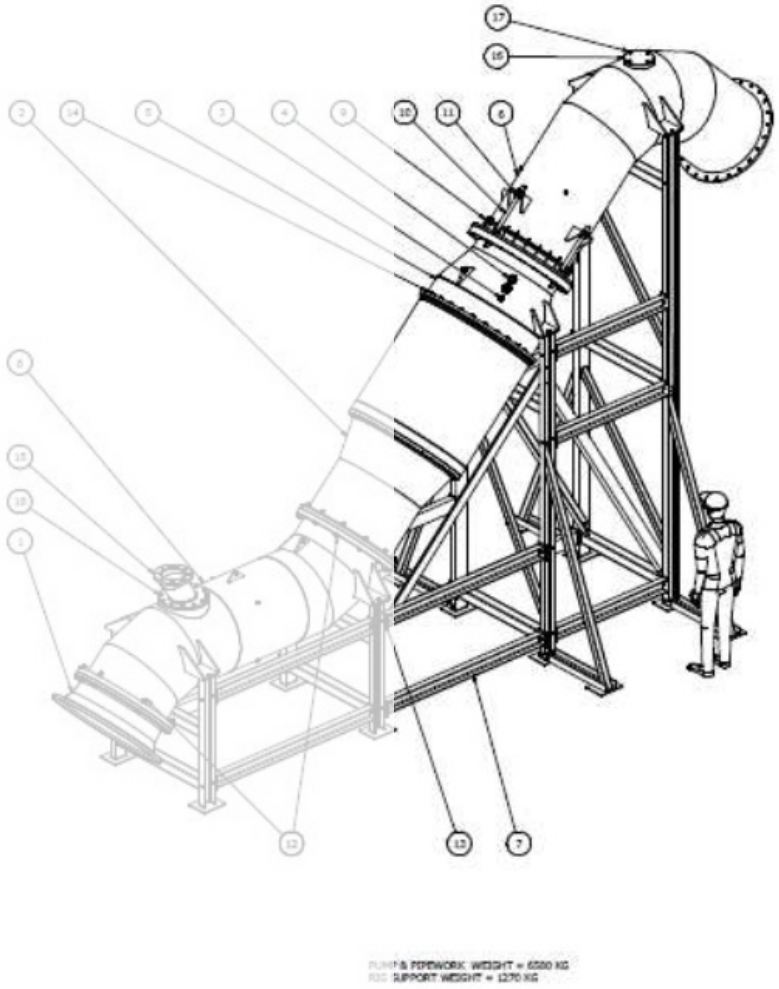


# Bedford twin Impeller design

1. Huge solids handling
2. Efficient hydraulic
3. Submersible or VTP
4. Developed for Flood protection/management
5. **Fish Friendly (eel)**

# In practical terms: What features make a fish friendly pump?

- Axial impeller
- Relatively low impeller peripheral speed.



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# Speed vs peripheral speed

- Limiting the peripheral speed of the rotating impeller is a critical factor.
- SAF90 initially tested and certified. All other pumps scaled from this test.

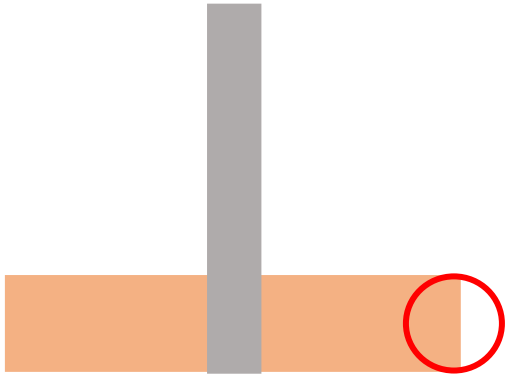
## SAF 90

Shaft speed = 494rpm

Impeller diameter 800mm
Peripheral speed = 20.7 m/s

## SAF 60

Shaft speed = 741rpm



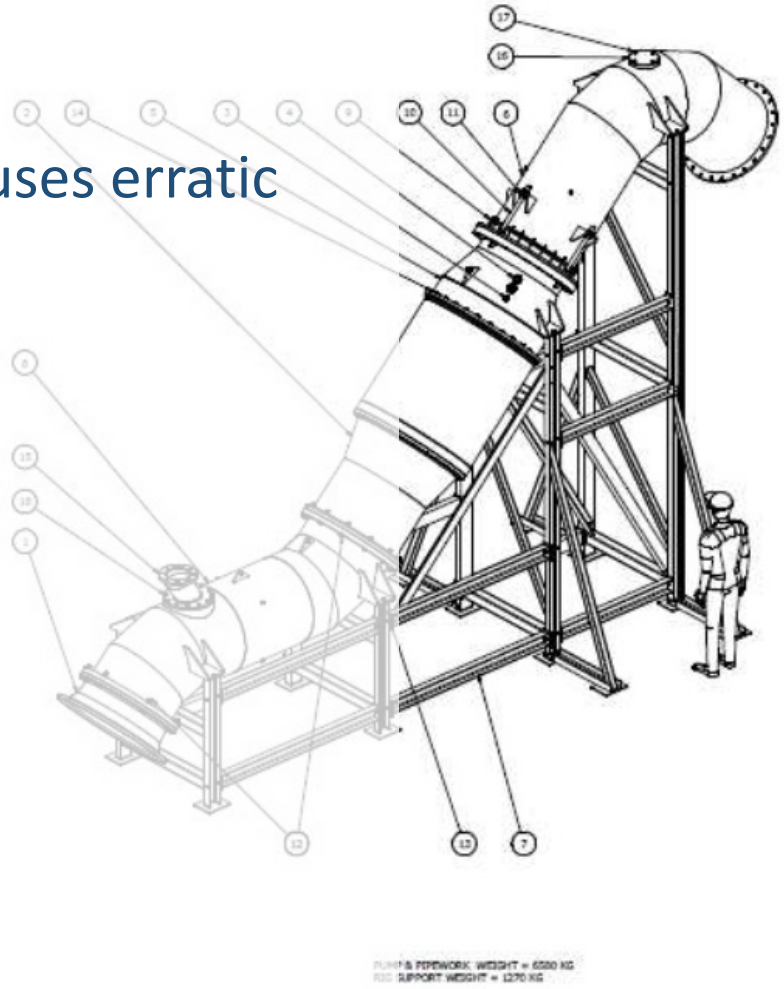
Impeller diameter 500mm
Peripheral speed = 19.4 m/s

## SAF 120

Shaft speed = 371rpm

Impeller diameter 1018mm
Peripheral speed = 19.8 m/s

- Axial impeller
- Relatively low impeller peripheral speed.
- High hydraulic-efficiency. Energy loss into the fluid causes erratic stream-lines, adverse pressure



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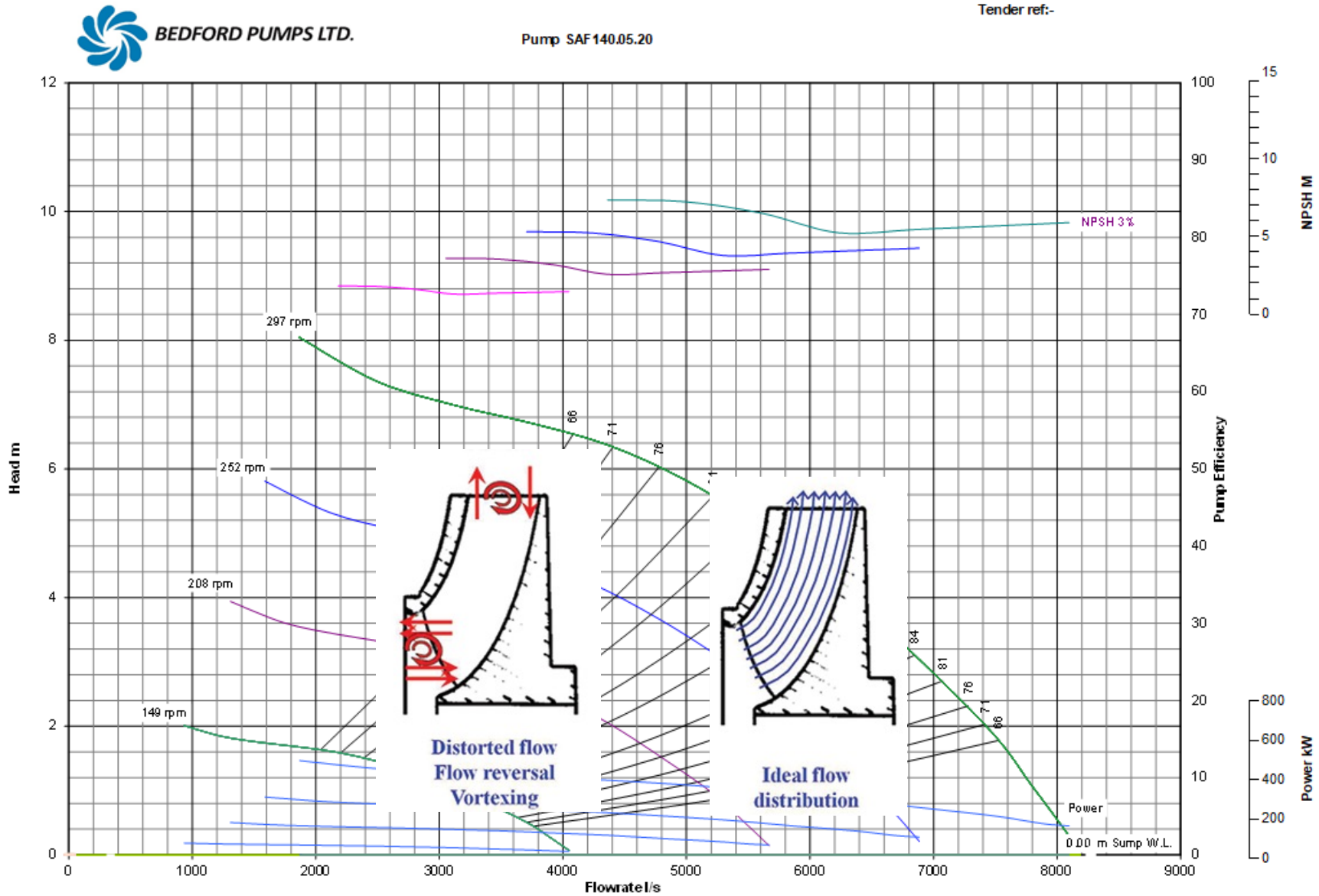
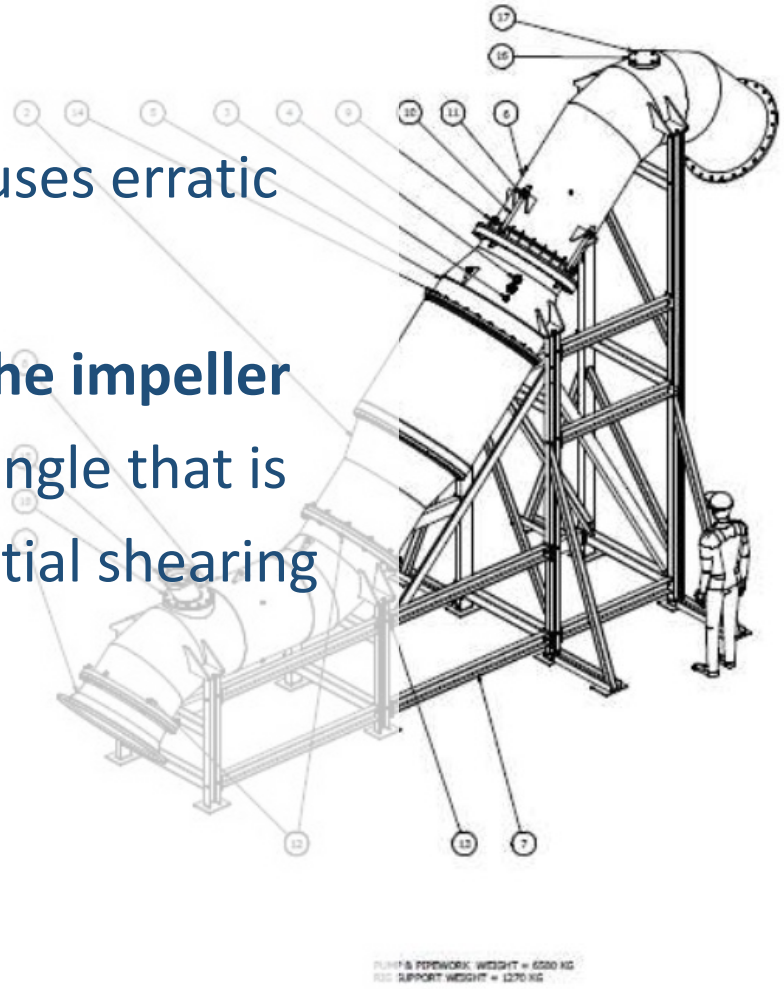
# High Hydraulic Efficiency



- Axial impeller
- Relatively low impeller peripheral speed.
- High hydraulic-efficiency. Energy loss into the fluid causes erratic stream-lines, adverse pressure
- **Substantially Increased spatial clearances between the impeller and guide-vane casing.** Any static vane, of whatever angle that is located closely behind the rotating impeller is a potential shearing surface and threat to fish.



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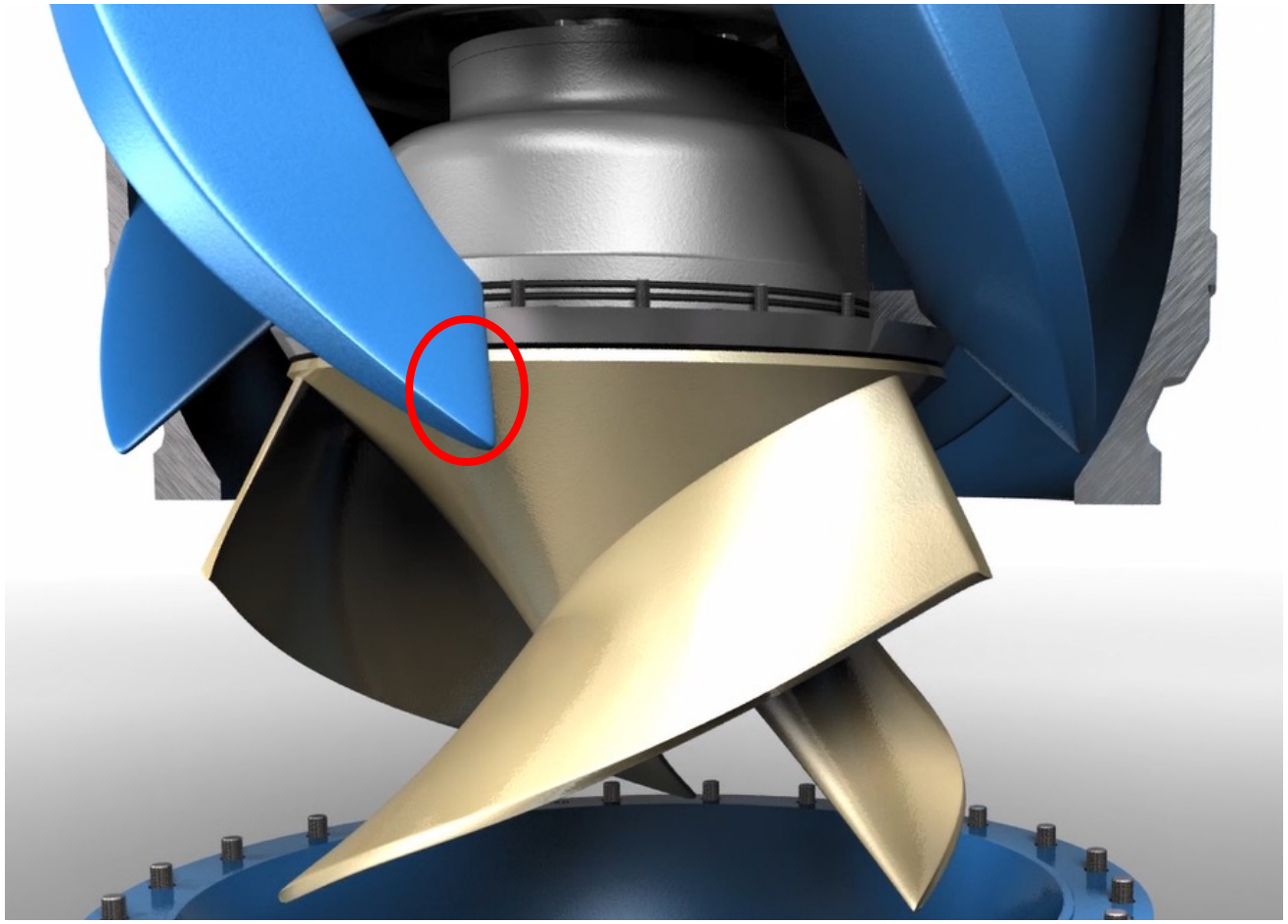
# Impeller diffuser design

## Traditional diffuser



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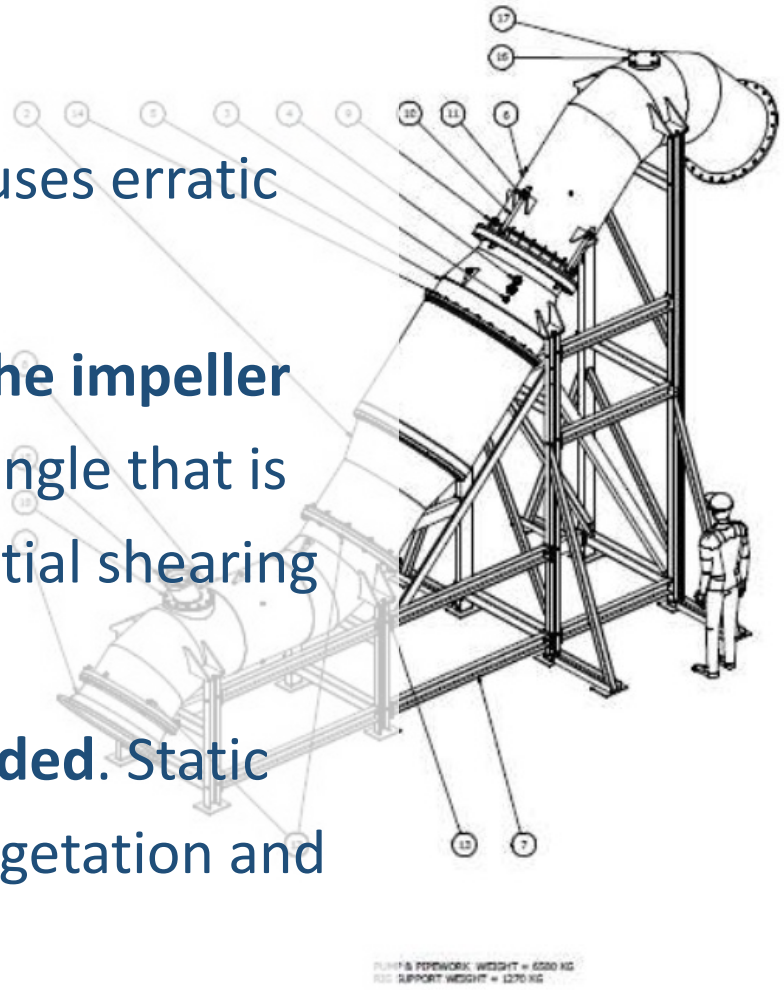
# Static and rotating parts

- Axial impeller
- Relatively low impeller peripheral speed.
- High hydraulic-efficiency. Energy loss into the fluid causes erratic stream-lines, adverse pressure
- **Substantially Increased spatial clearances between the impeller and guide-vane casing.** Any static vane, of whatever angle that is located closely behind the rotating impeller is a potential shearing surface and threat to fish.
- **Internal areas which might trap debris are to be avoided**. Static diffuser vanes should be so designed as to not trap vegetation and other suspended solids.



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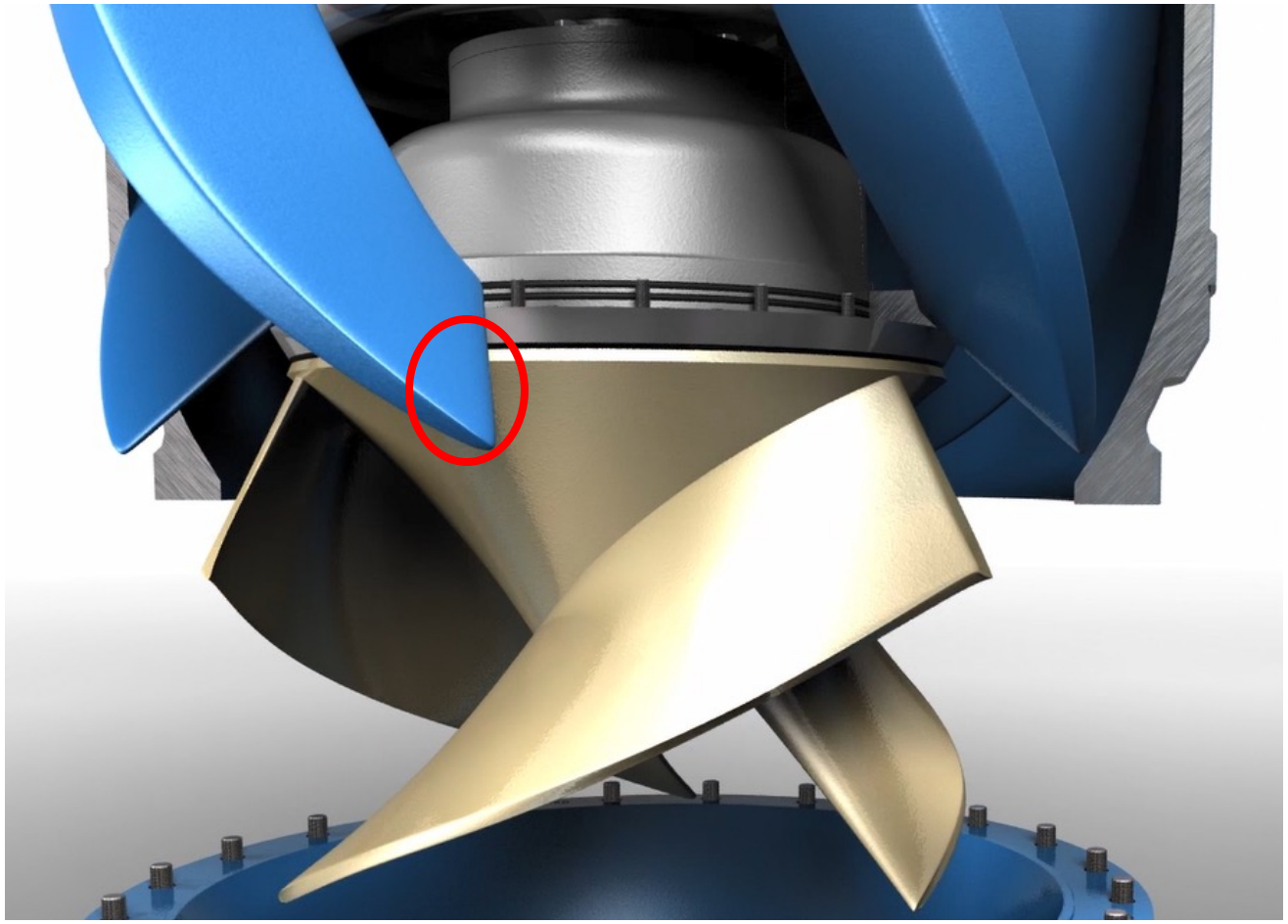
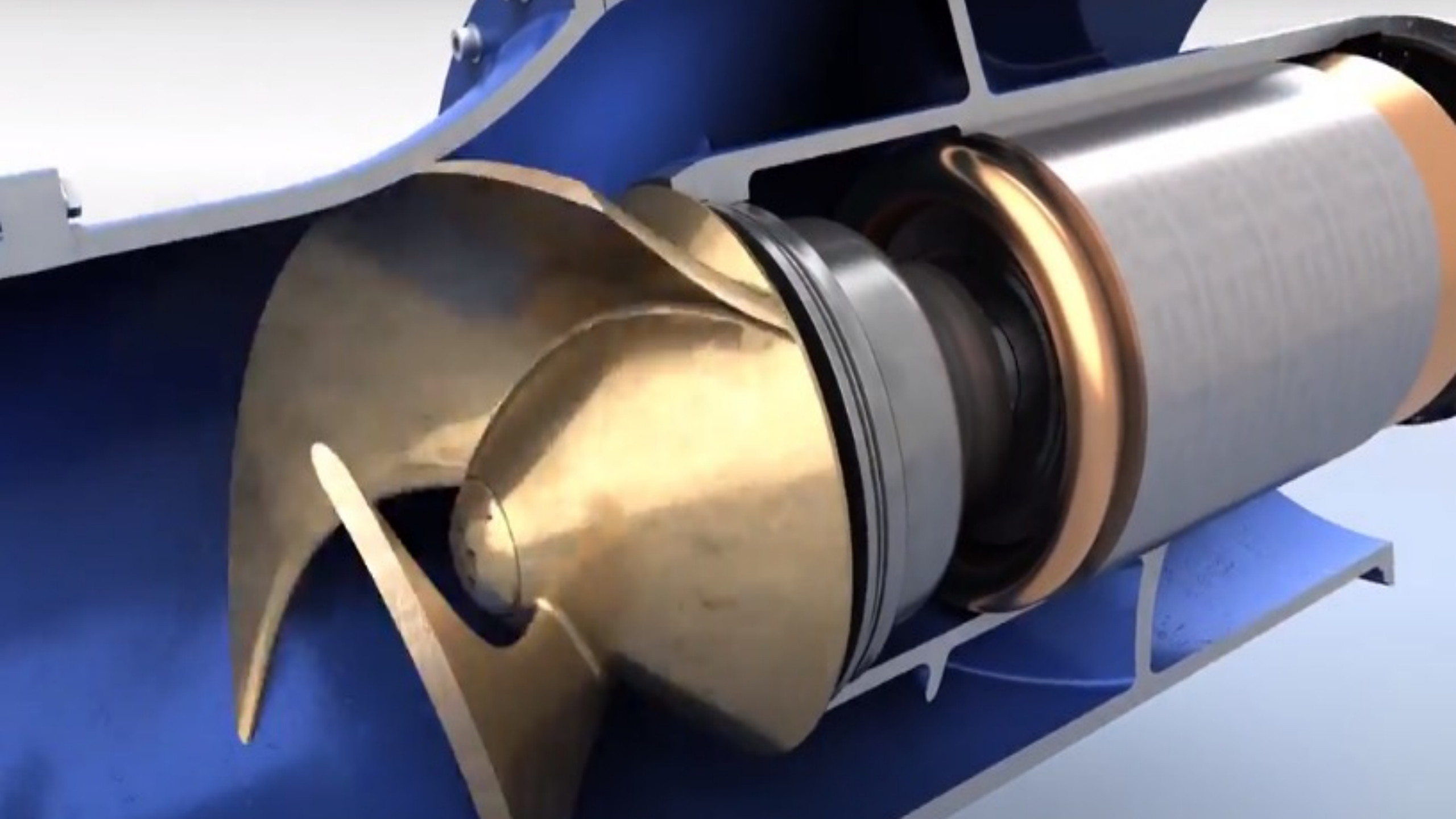
# Impeller diffuser design

## Traditional diffuser



## Enhanced diffuser



Vaipuhi

# Eel passage at the Orchard Rd Pump Station – Stage 2 (2018)

Prepared for the Waikato Regional Council

November 2018

VisAdvies

Ecological consultancy & research

# Test on fish survivability of Bedford Pumps model SAF 90.05.12

Report: VA2011_28

Prepared on behalf of:

Bedford Pumps Ltd

July 2012

Authors:
Spierts I.L.Y. & H. Vis

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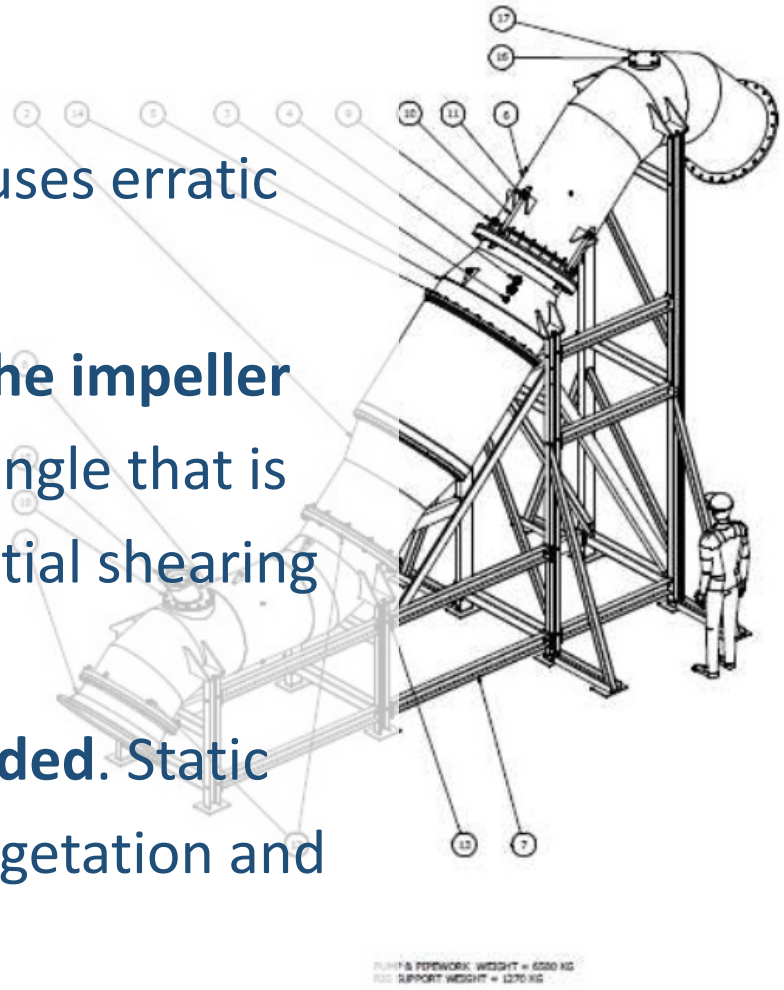

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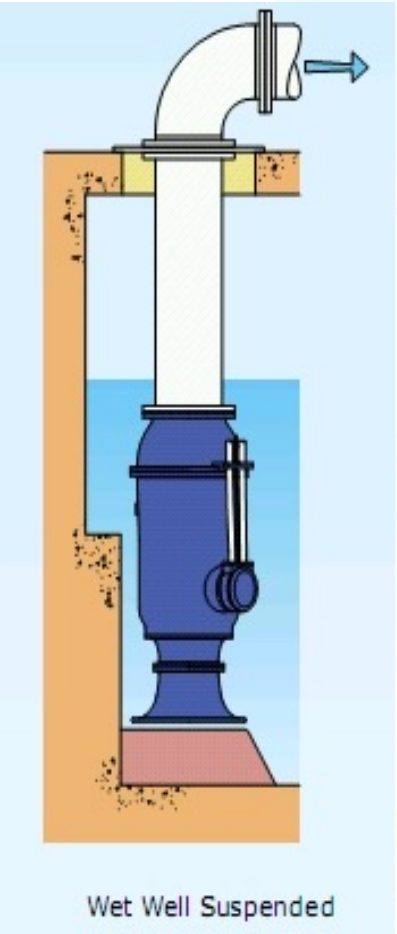
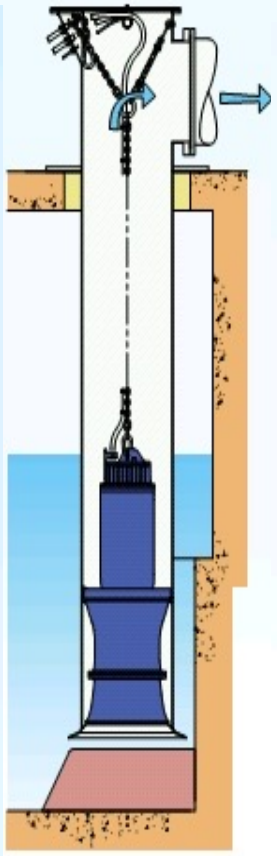
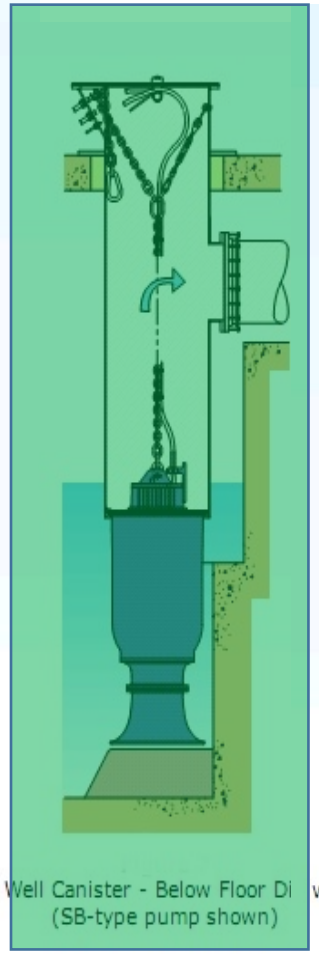
# Submersible Pumps



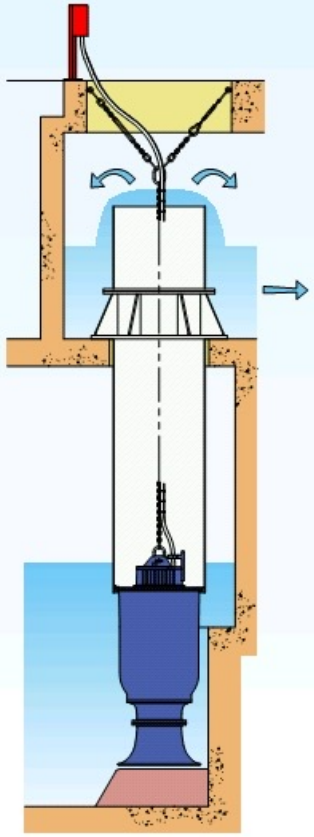
Wet Well Suspended



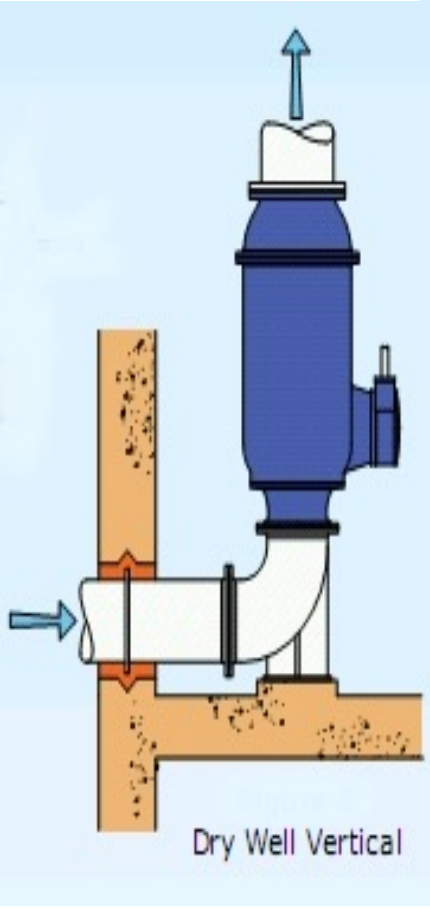
Canister - Above Floor Dis
(SA-type pump shown)



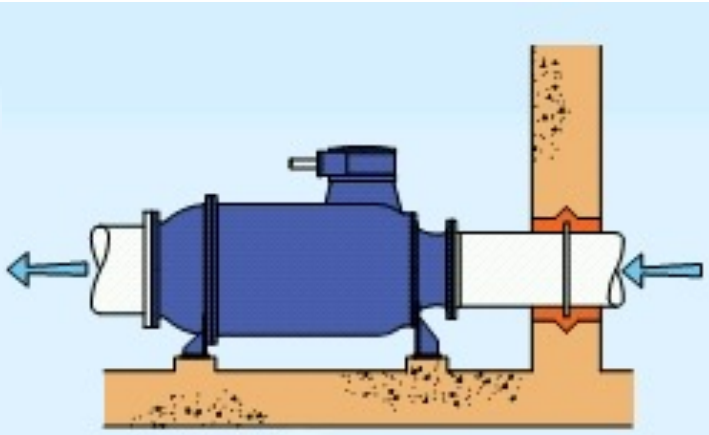
Wet Well Canister - Below Floor Di
(SB-type pump shown)



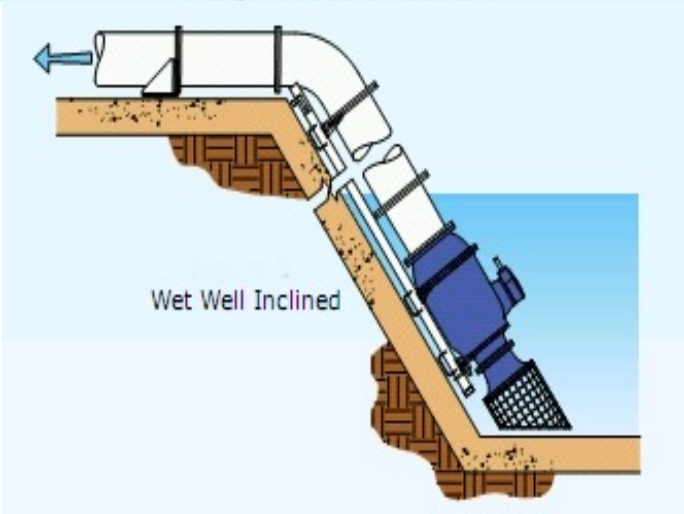
Wet Well Canister - Cascade Discharge
(SB-type pump shown)



Dry Well Vertical



Dry Well Horizontal



Wet Well Inclined

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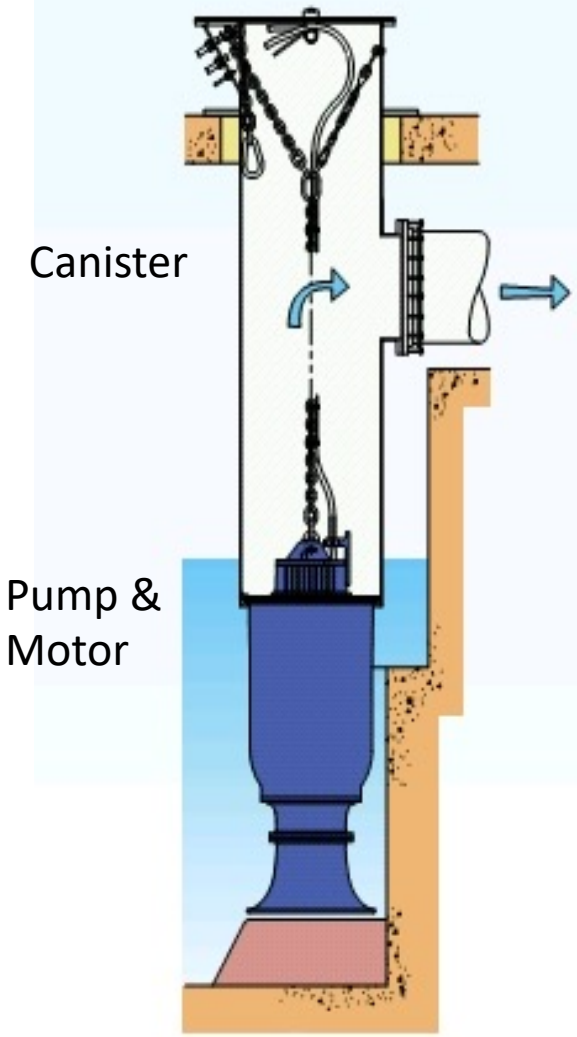
# Axial & Bowl pumps Canister

- Wet Well Canister
- Pipework remains in situ
- Smaller crane for lifting
- Operates submerged
- Low noise emission
- Lower running temperatures
- Easy to remove pump



Wet Well Canister - Below Floor Discharge
(SB-type pump shown)

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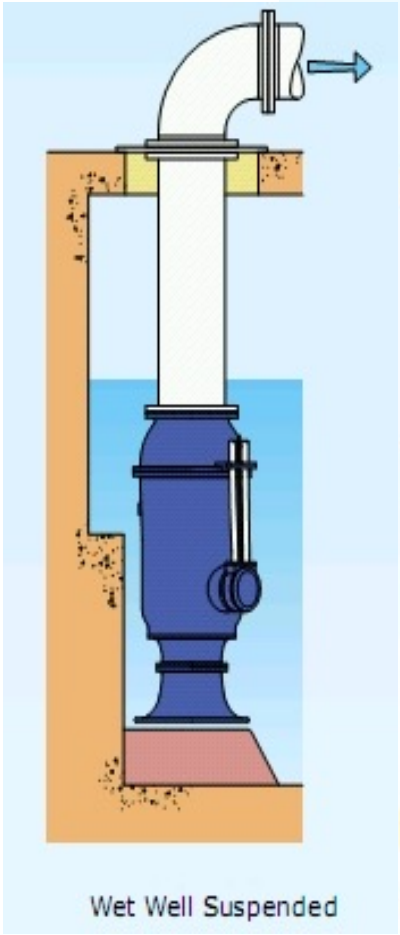
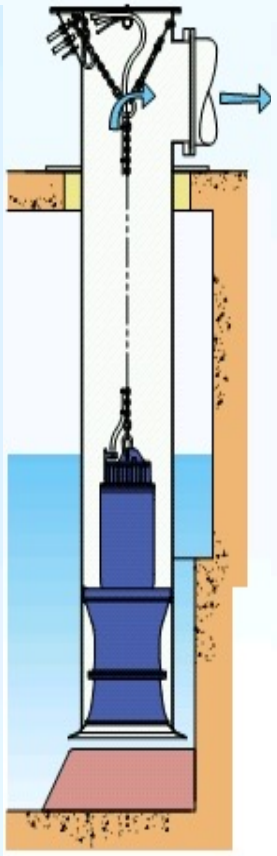
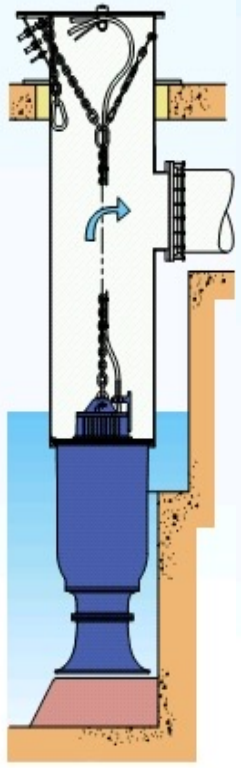
# Submersible Pumps



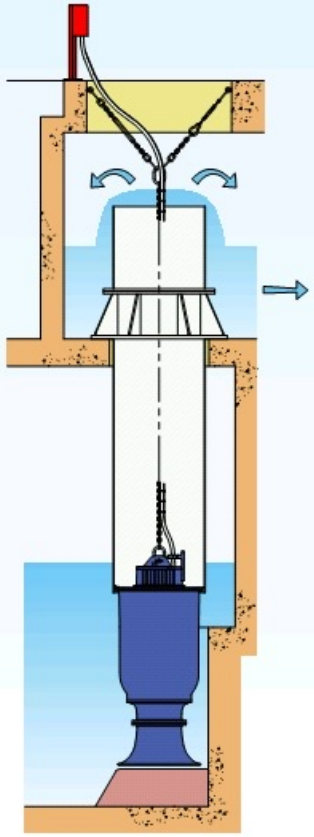
Wet Well Suspended



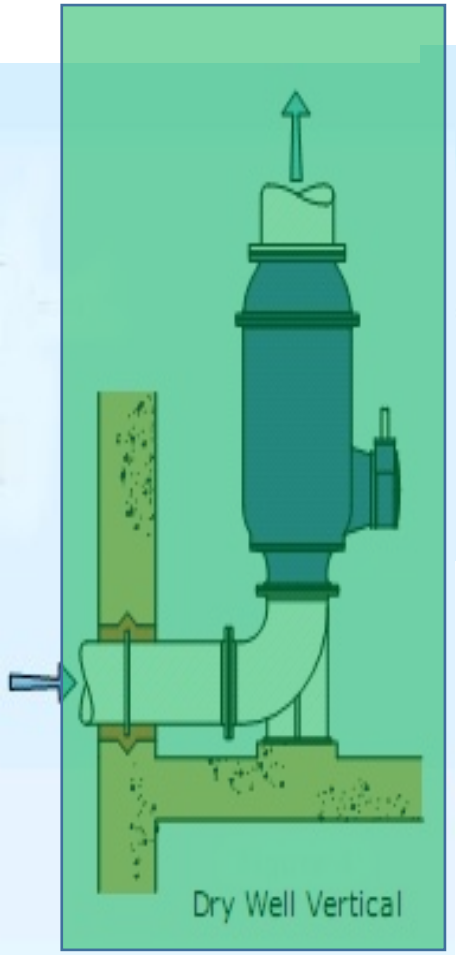
Canister - Above Floor Dis
(SA-type pump shown)



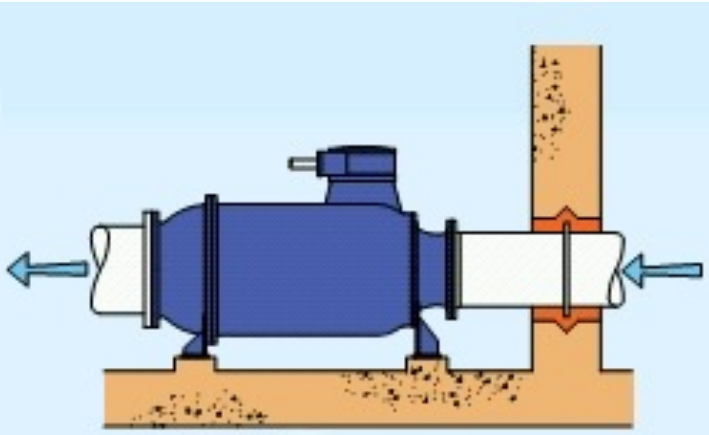
Wet Well Canister - Below Floor Di
(SB-type pump shown)



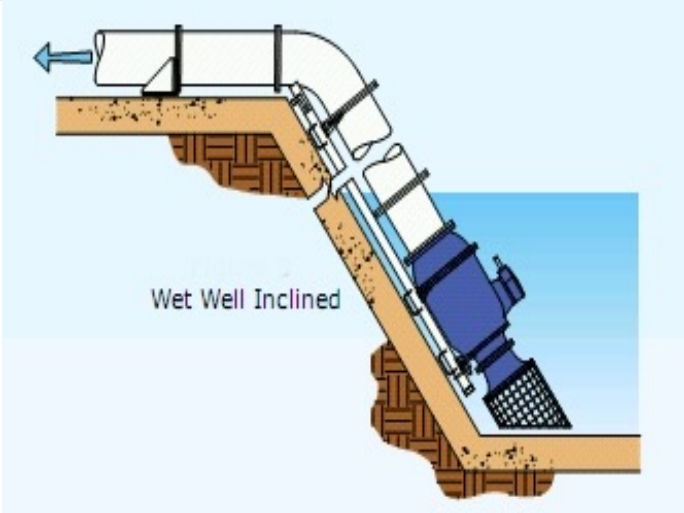
Wet Well Canister - Cascade Discharge
(SB-type pump shown)



Dry Well Vertical



Dry Well Horizontal



Wet Well Inclined

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# Axial & Bowl pumps Drywell

- Vertical Dry Well
- Very Compact
- Low Noise Levels (no motor fan)
- Motor heat dissipated by pumped flow
- High Efficiency
- No coupling (No alignment)
- No misalignment

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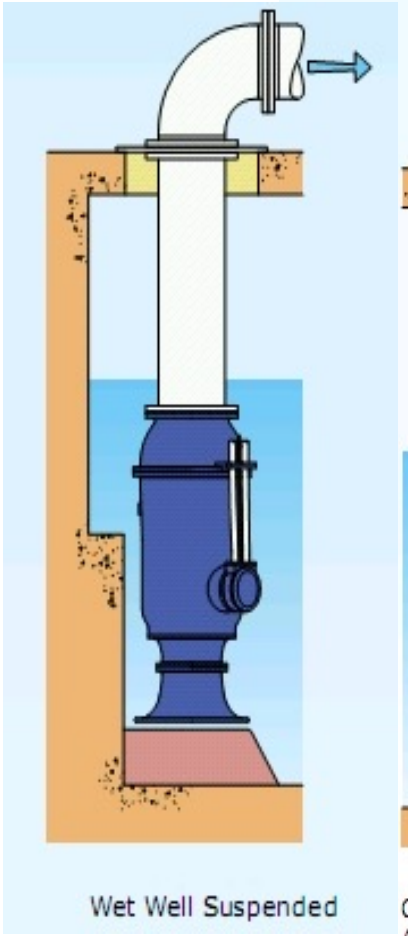
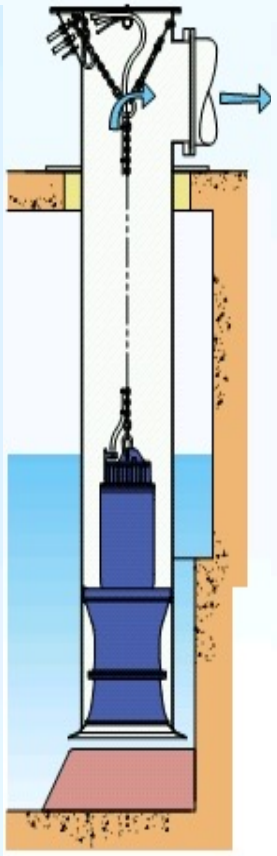
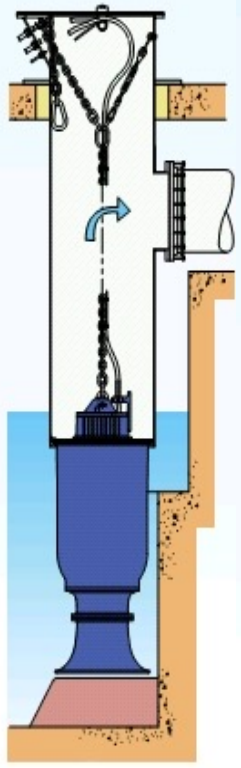
# Submersible Pumps



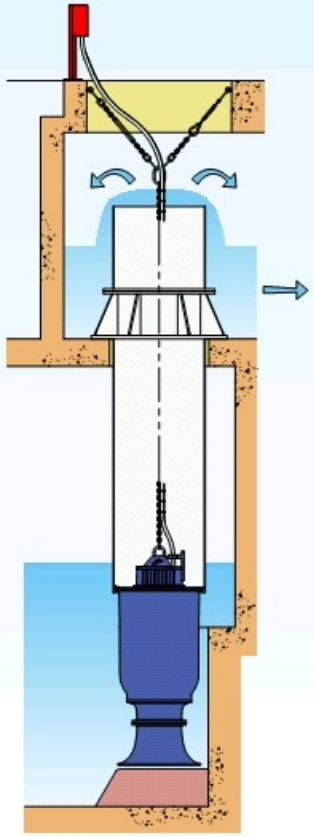
Wet Well Suspended



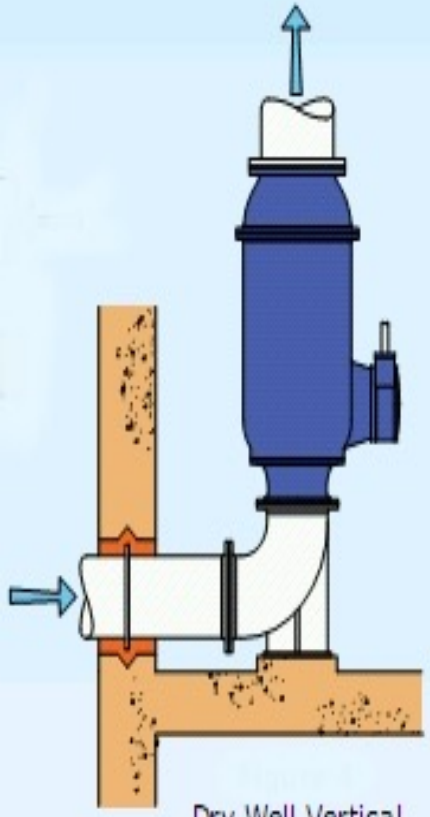
Canister - Above Floor Dis
(SA-type pump shown)



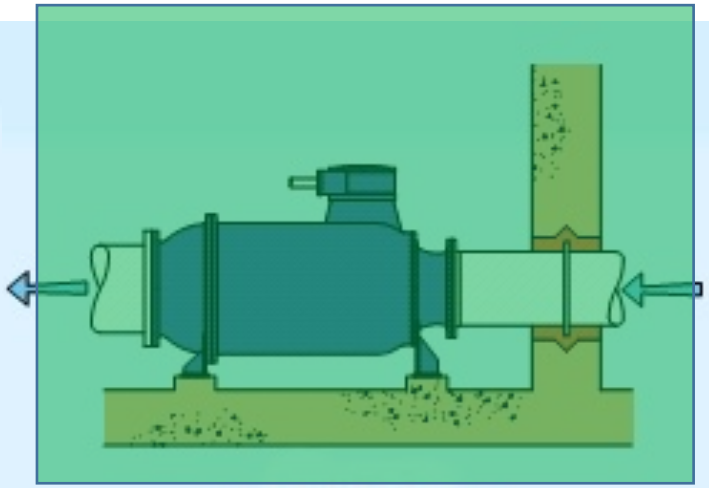
Wet Well Canister - Below Floor Di
(SB-type pump shown)



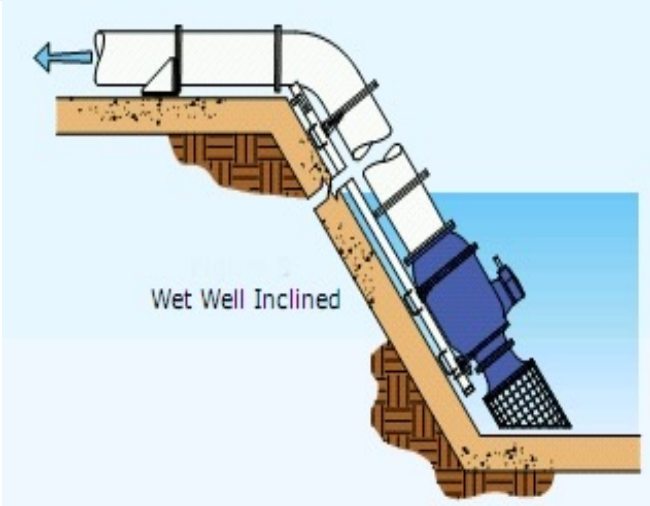
Wet Well Canister - Cascade Discharge
(SB-type pump shown)



Dry Well Vertical



Dry Well Horizontal



Wet Well Inclined

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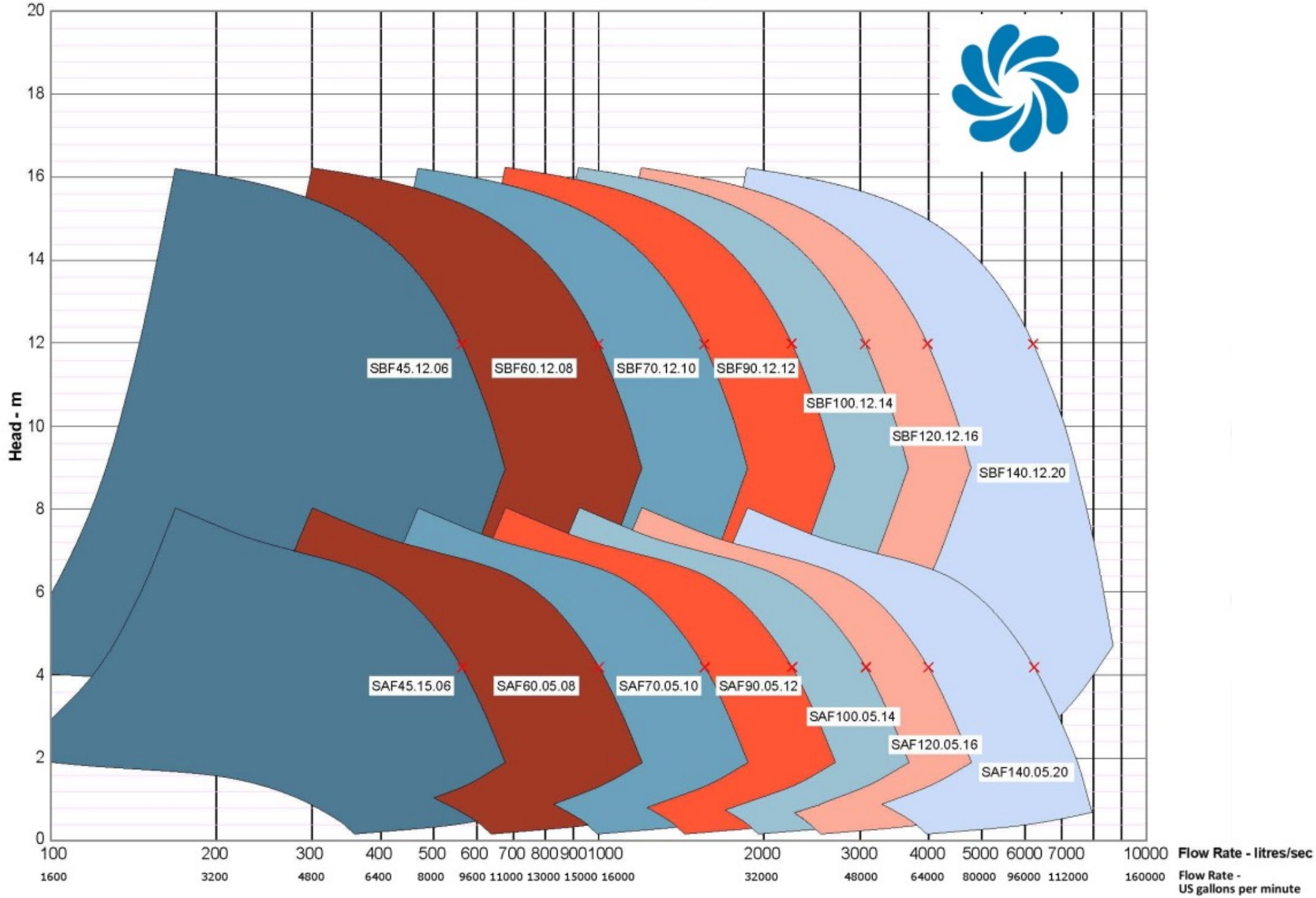
# Axial & Bowl pumps Drywell

- Horizontal Dry Well
- Very Compact
- Low Noise Levels (no motor fan)
- Motor heat dissipated by pumped flow
- Clean water
- No coupling (low maintenance)

# Fish Friendly Range Chart



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# Fish Friendly design wider scope

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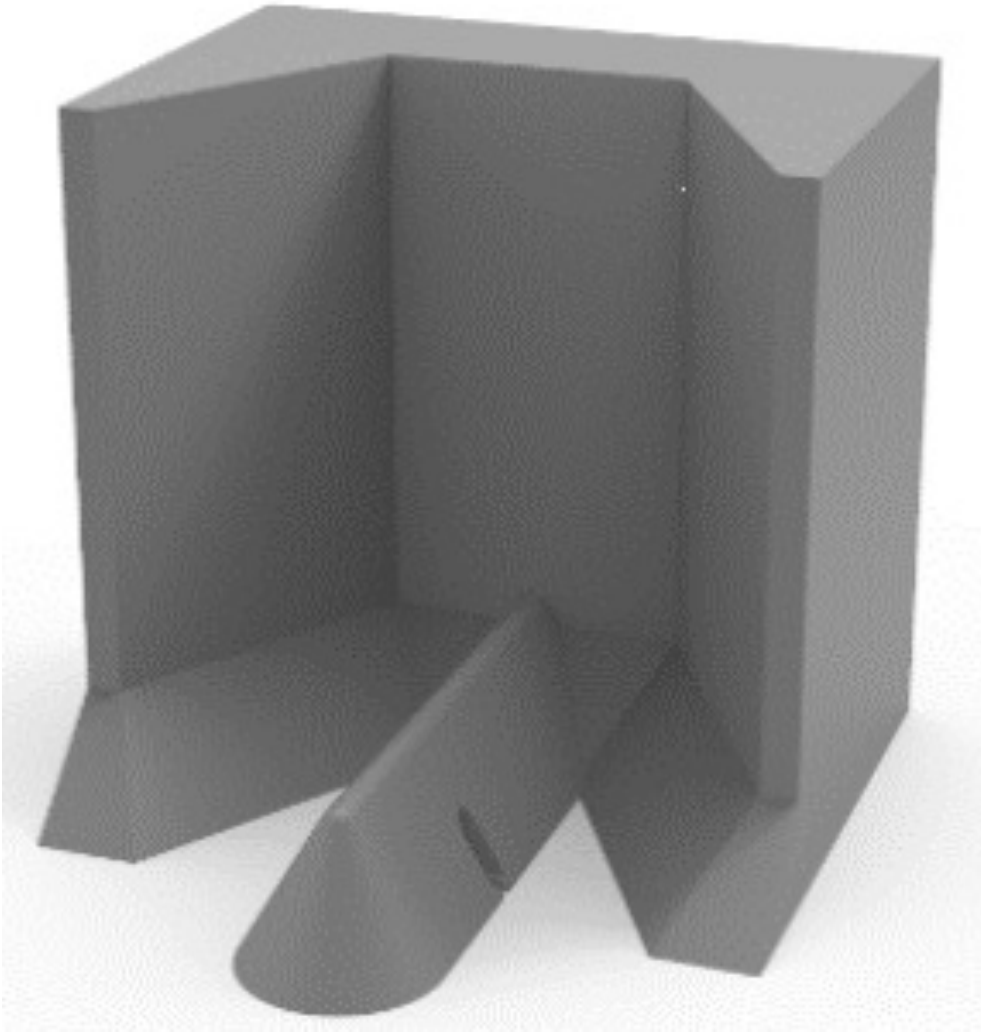
# Benching and suction splitters

- Optimum sump design.
- Pre swirl
- Vortices
- Turbulence
- Larger Stations above 6300 l/s model test recommended by Hydraulic Institute.
- Individual pump 2500 l/s
- Fish and eels in linear flow

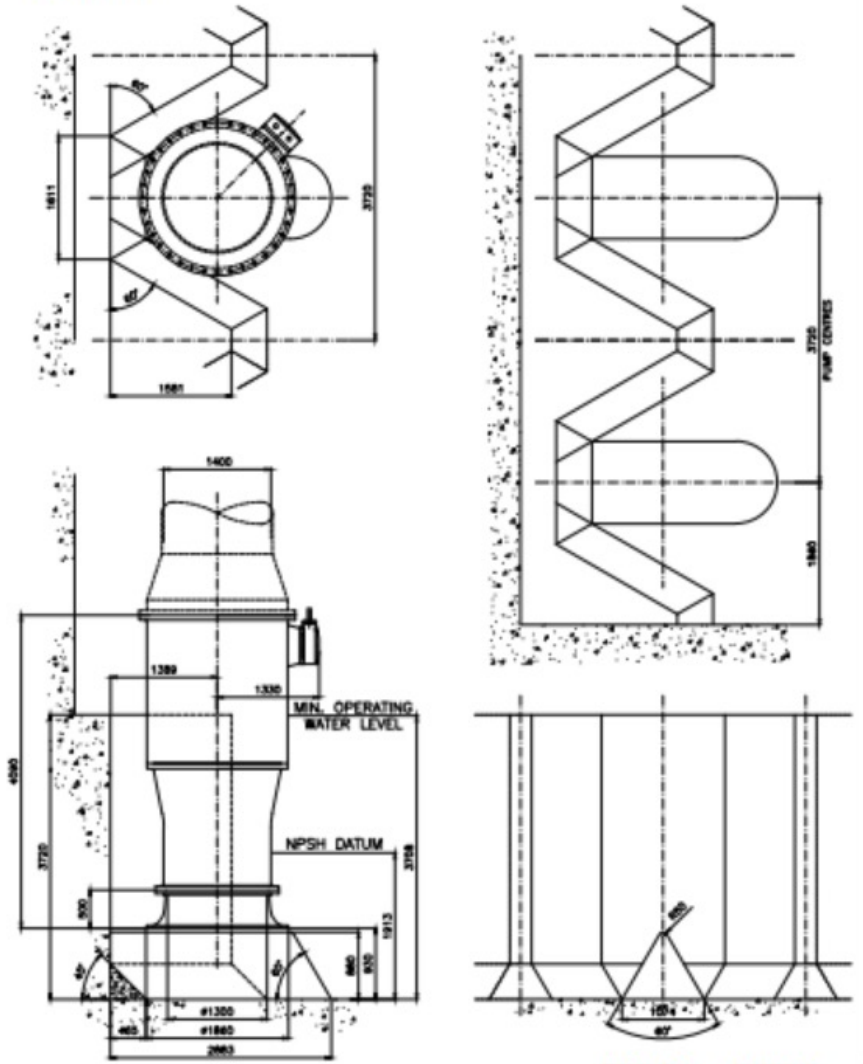


Pump Frame :

## SAF 140.05.20

Wet Well Vertical

## Pump Outline Dimensions




Drawing No. : Z14/13934 B

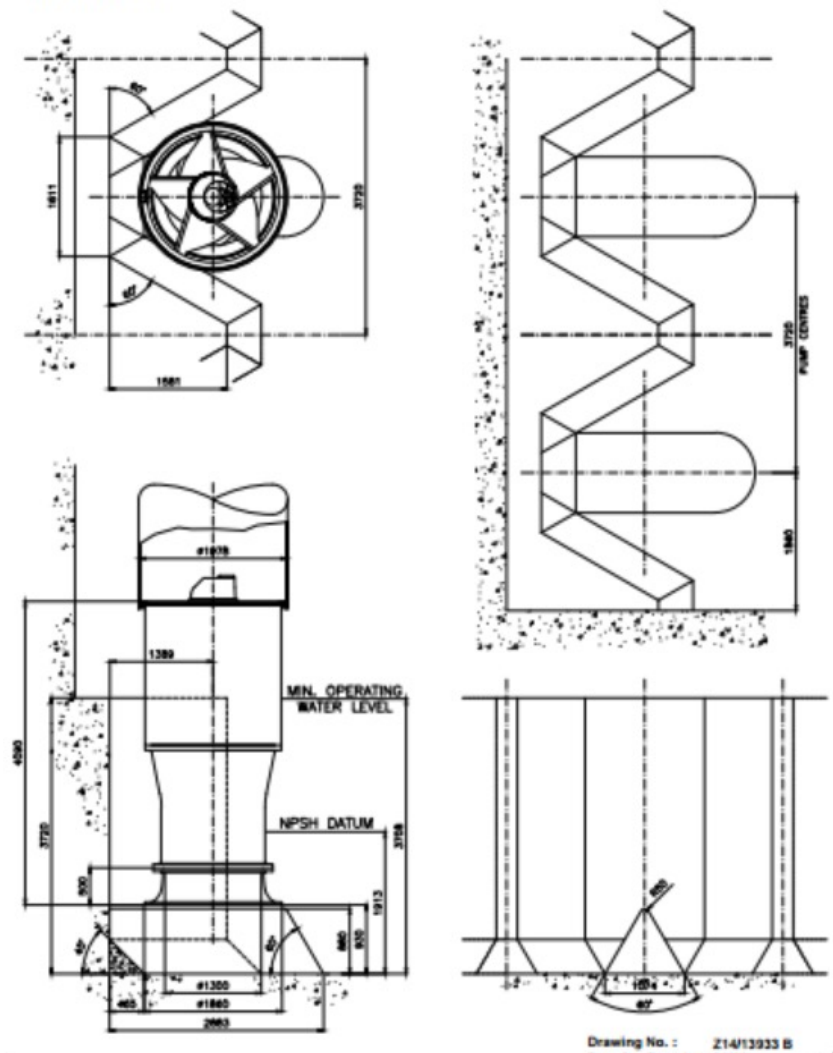
Data Set Revision: 06/15

Pump Frame :

## SAF 140.05.20C

Wet Well Canister

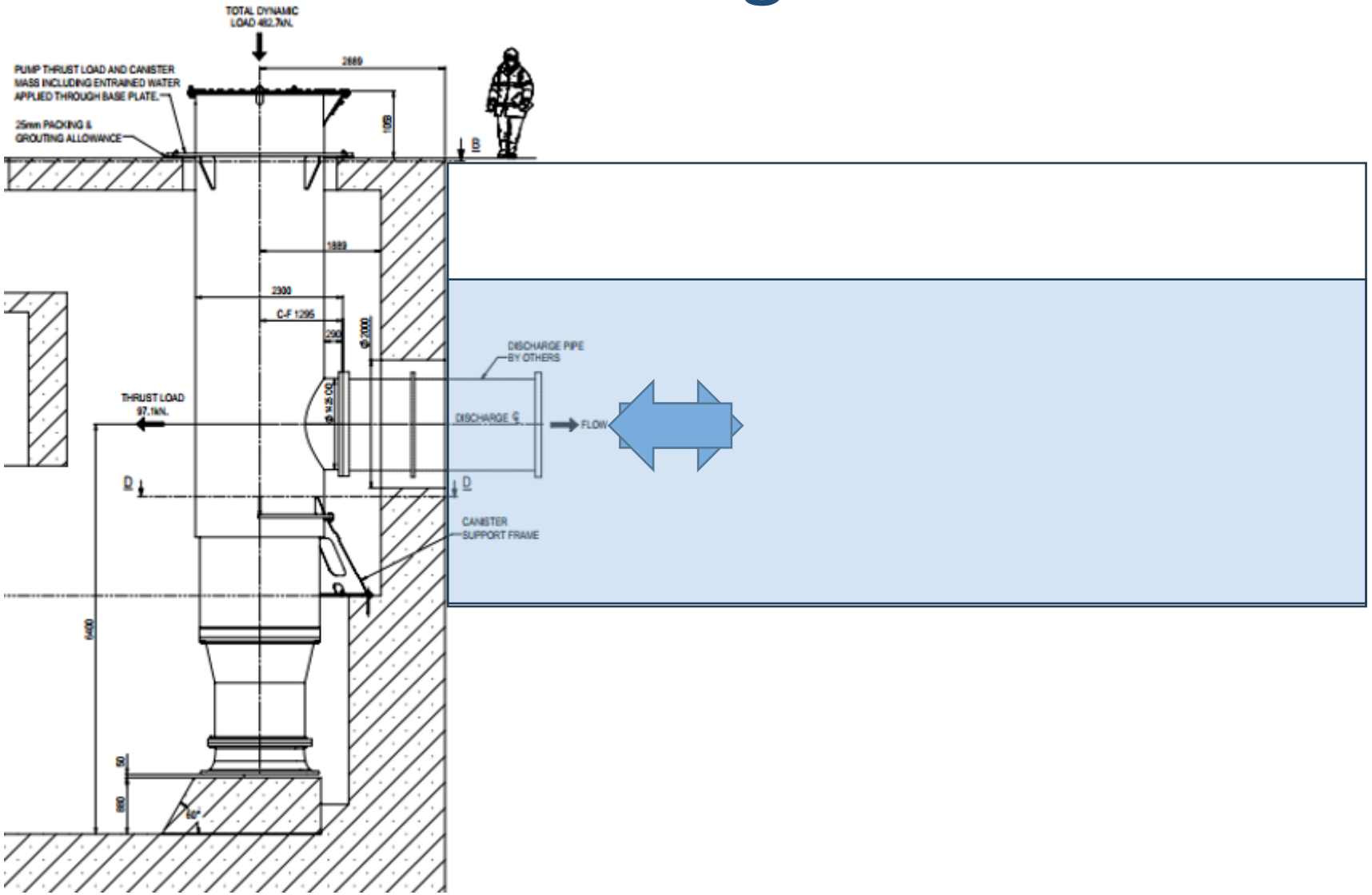
## Pump Outline Dimensions




Drawing No. : Z14/13933 B

Data Set Revision: 06/15

# Avoiding valves in discharge



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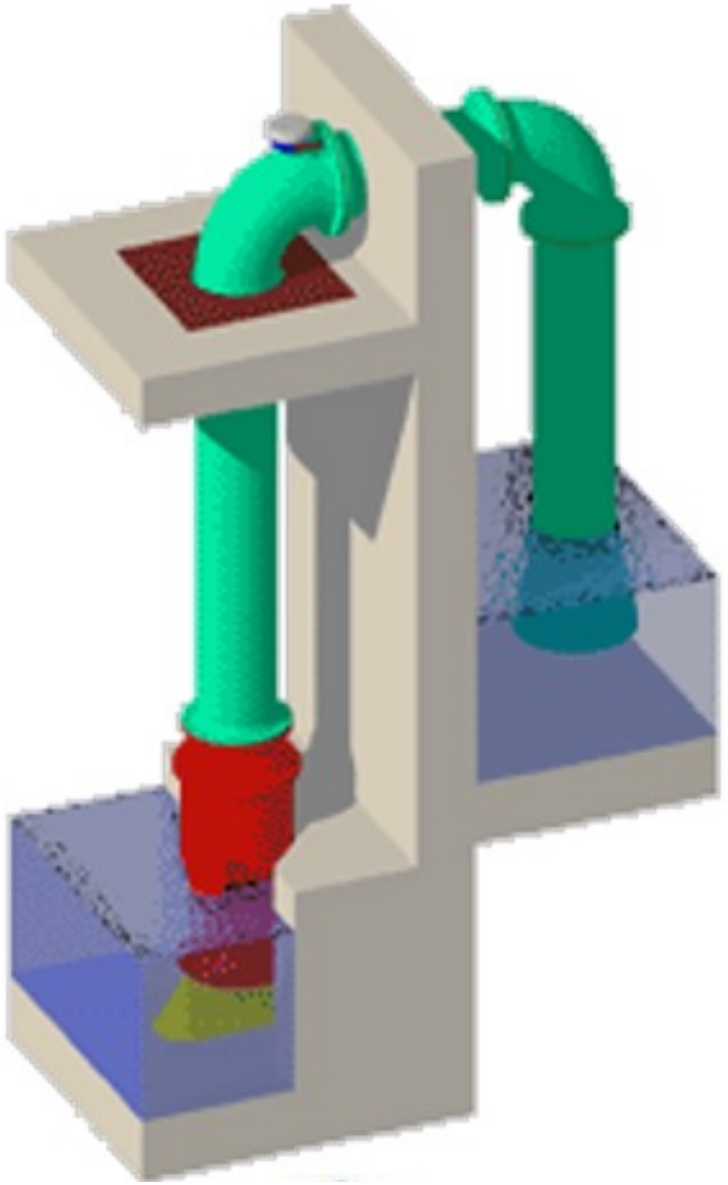

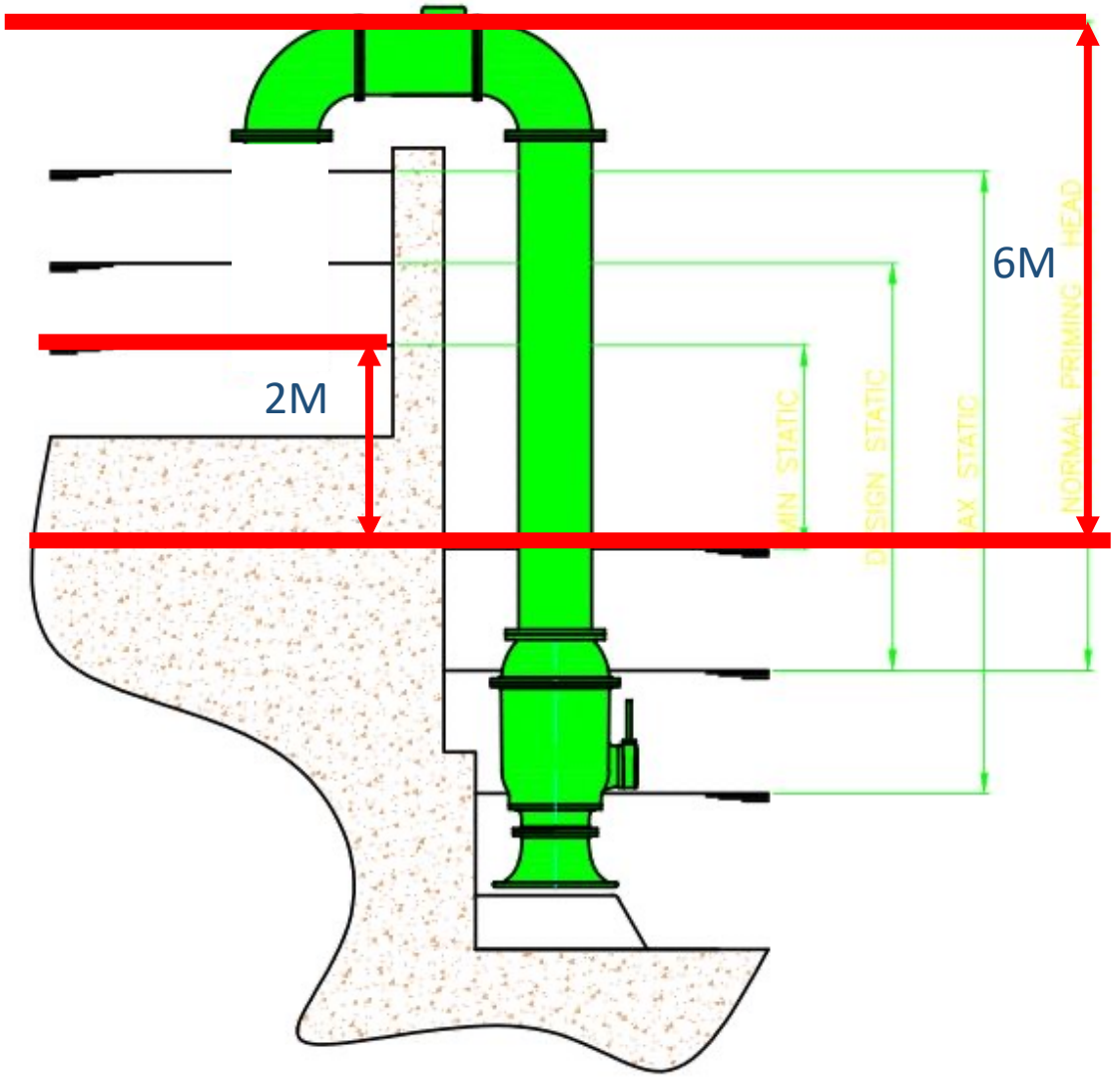

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# Fish Friendly pumps

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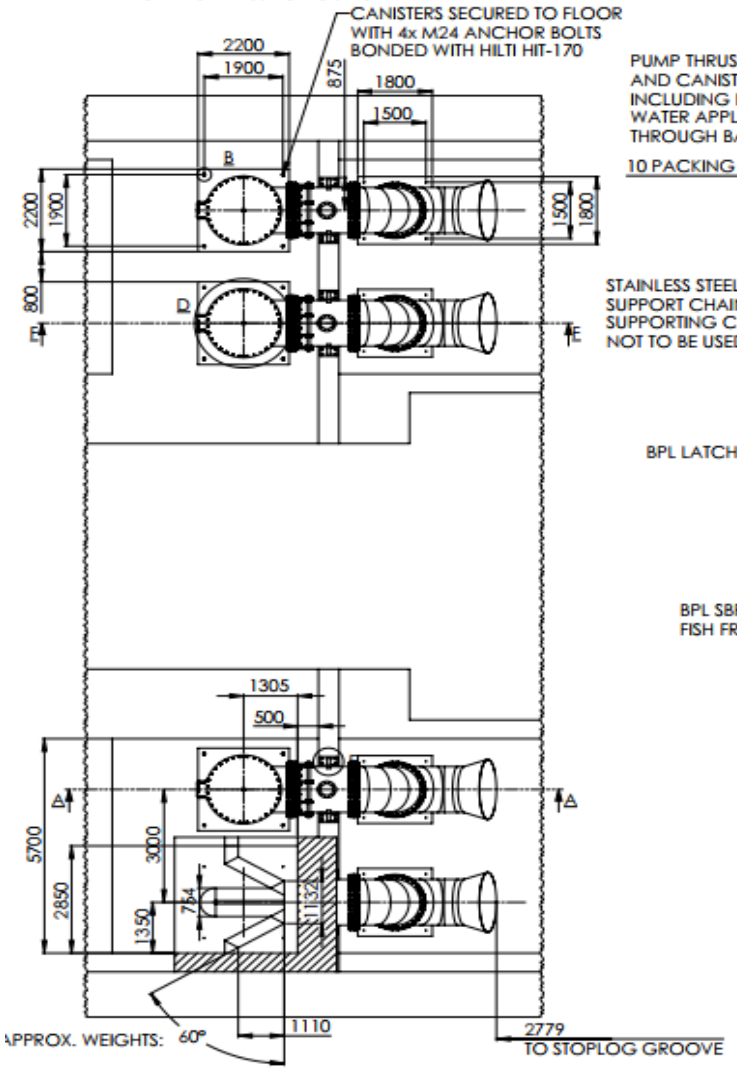
# SBF100.12.12

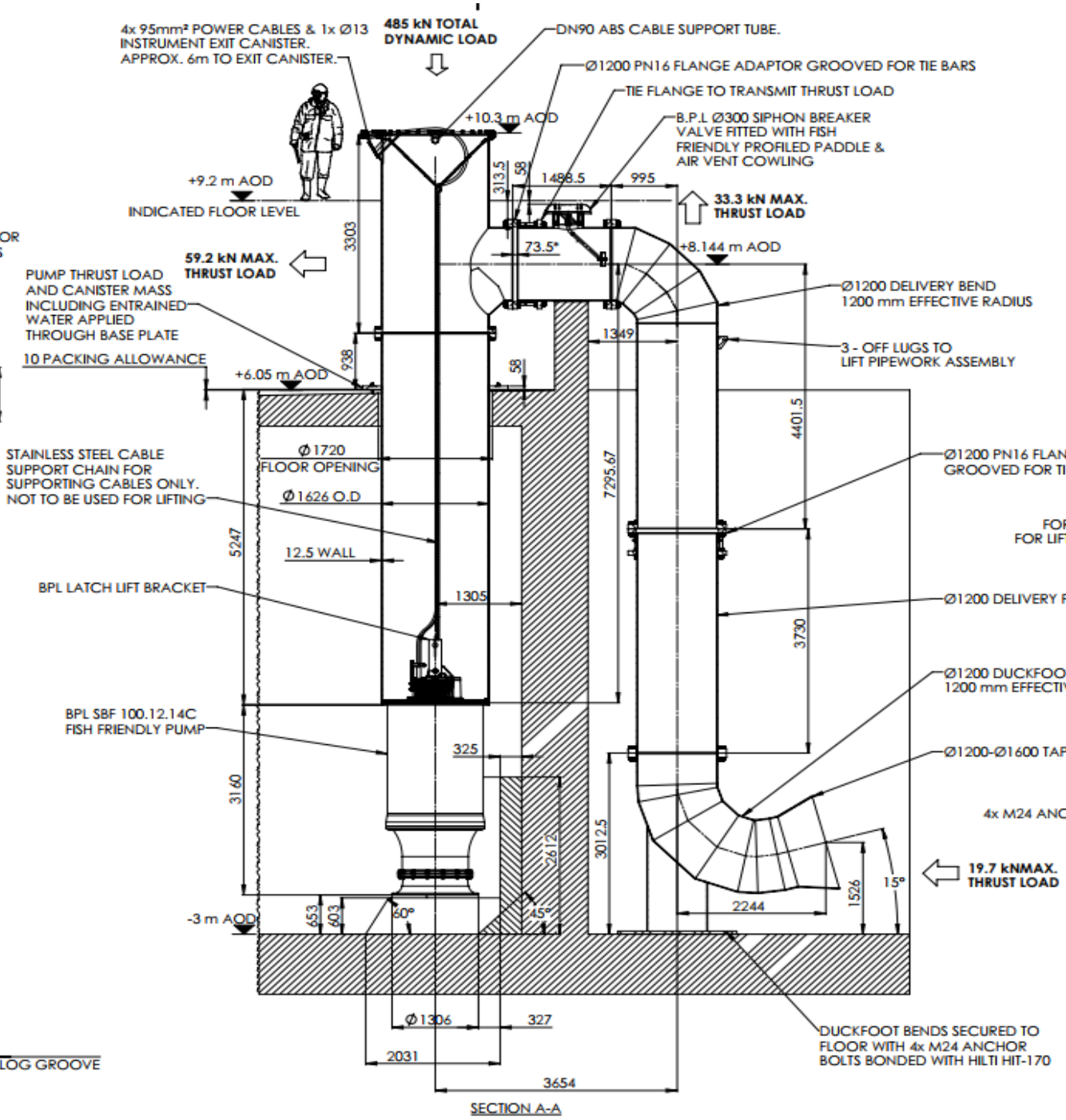
40 NOTES:

1. ALL DIMENSIONS TAKEN FROM JBA BENTLEY DRAWING NO'S IMNE000114-JBAB-VP-4_EH-DR-ME-4000 REV P01 IMNE000114-JBAB-VP-4_EH-DR-ME-4001 REV P01
2. 10 mm PACKING ALLOWANCE ADDED TO +6.05 m LEVEL.
3. WEEDSCREENS OMITTED.
4. 1x B.P.L LATCH LIFT TO BE SUPPLIED TO INSTALL & REMOVE PUMPS.
5. AREA AROUND BRACKET REF. DETAIL B TO REMAIN FREE FROM REBAR 300mm DEEP TO ALLOW ANCHOR BOLT DRILLING..
6. * DENOTES MID POINT SETTING. MAX ENGAGEMENT = 32. MIN. ENGAGEMENT = 115.
7. REFER TO DWG. 17485 FOR CONCRETE DETAIL

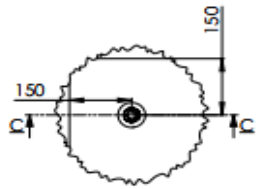



APPROX. WEIGHTS:

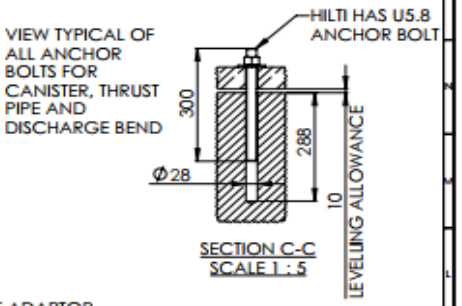
PUMP, CABLES & CHAIN - 14,000 kg.
ENTRAINED WATER IN PUMP & CANISTER ONLY - 24,000 kg.
CANISTER COVER PLATE - 860 kg.



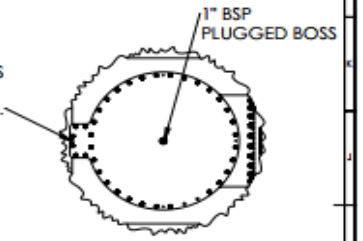

SECTION A-A



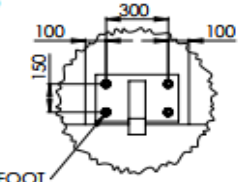

DETAIL B
SCALE 1 : 5



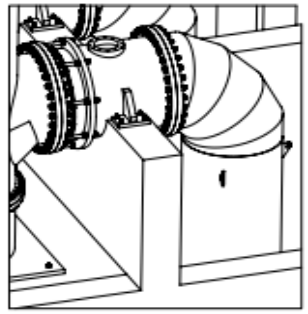

SECTION C-C
SCALE 1 : 5




DETAIL D




DETAIL E
SCALE 1 : 10



VIEW OF THRUST BEARING PIPE

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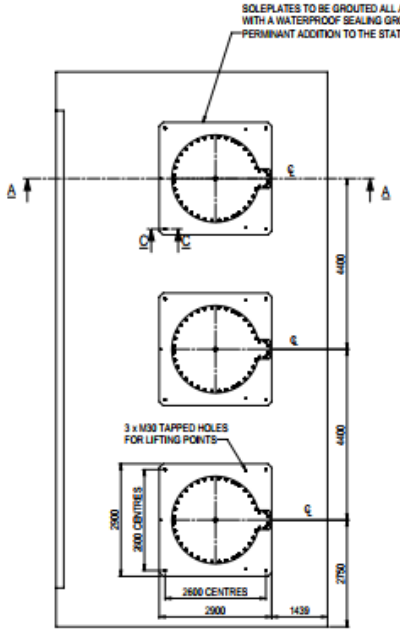
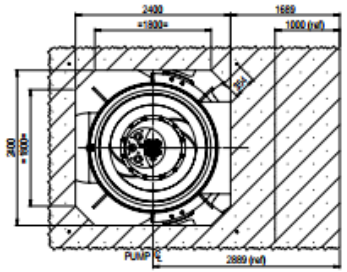
# SAF140.05.22

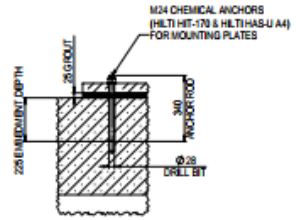
A0



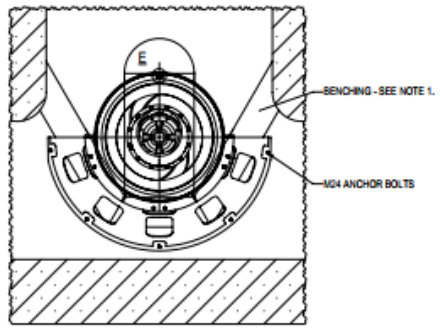

PLAN VIEW
SCALE 1:50



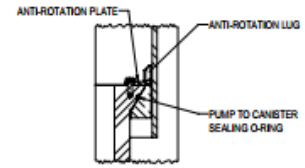

SECTION B-B
SHOWING PUMP IN CANISTER & TYPICAL FLOOR OPENING
SCALE 1 : 30



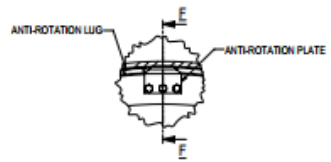

SECTION C-C
SHOWING BASE PLATE ANCHORS
SCALE 1 : 10



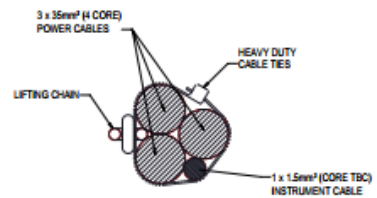

SECTION D-D
SHOWING CANISTER SUPPORT FRAME
SCALE 1 : 30



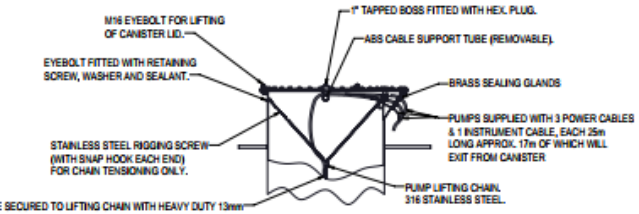

SECTION F-F
SCALE 1 : 5




DETAIL E
SCALE 1 : 5

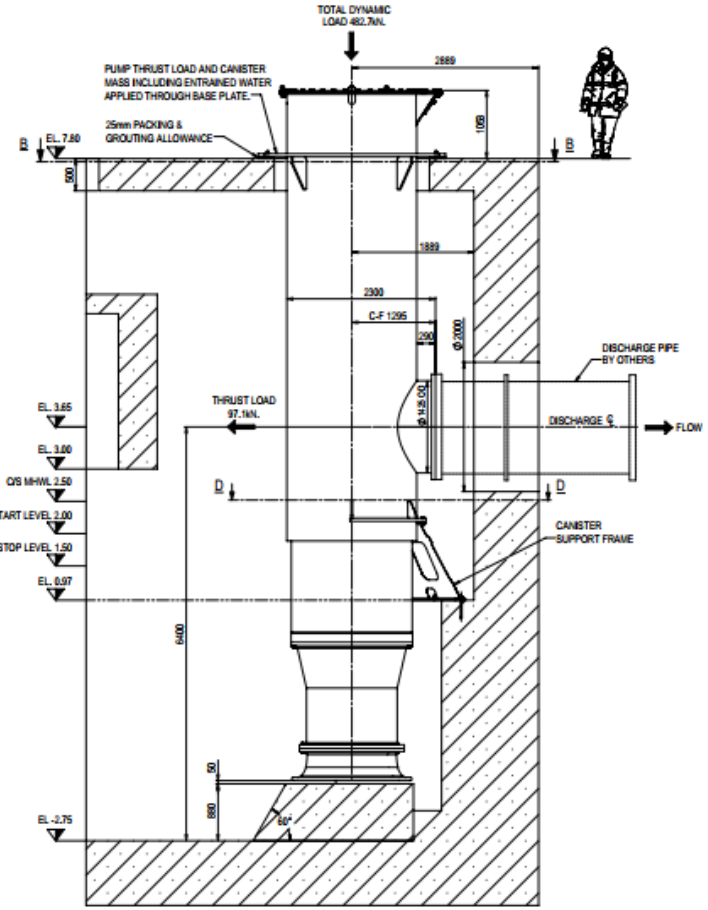



SECTION SHOWING ARRANGEMENT
OF CABLES TIED TO LIFTING CHAIN

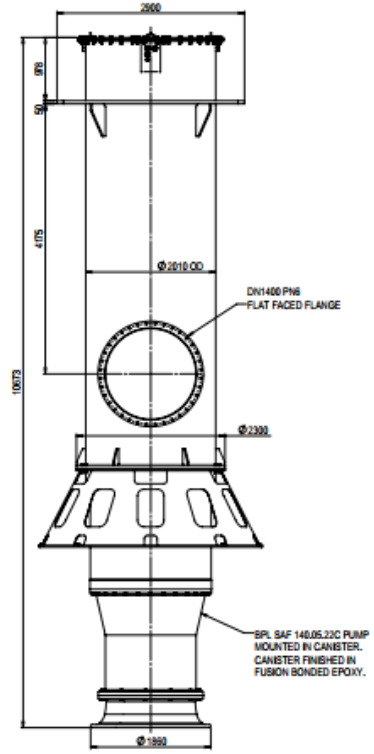



CABLES TO BE SECURED TO LIFTING CHAIN WITH HEAVY DUTY 13mm CABLE TIES, SPACED GENERALLY AT 120 CENTRES, USE ADDITIONAL TIES AT PUMP AND DISCHARGE ENDS GENERALLY AS SHOWN.
ROUTE CABLES OVER AND TIE THEM TO TH SUPPORT TUBE AT THE TOP OF THE CANISTER.

DETAIL OF CABLE EXITS & CHAIN RETENTION
(AS PART OF THE SIDE ELEVATION)




SECTION A-A
SCALE 1 : 30




ELEVATION
SHOWING PUMP AND CANISTER ONLY
SCALE 1:20

NOTES:
1. ALL LEVELS AND BENCHING DETAILS AS PER CUSTOMER DRG. No. CDA/DRYSTR-MOHESH KHAL REG/13-A/1 AND REG/18-1/1
2. STATION SHOWN FOR REFERENCE ONLY.
3. ALL DIMENSIONS IN mm ALL LEVELS IN m UNLESS OTHERWISE STATED.
4. ACCESS TO BE PROVIDED DIRECTLY ABOVE PUMPS FOR INSTALLATION AND MAINTENANCE OPERATIONS.

ESTIMATED WEIGHTS:
- PUMP INCLUDING CABLES & CHAIN - 20497kg
- CANISTER - 8160kg
- CANISTER LID - 973kg
- CANISTER SUPPORT FRAME - 587kg


CHRIS BOWER
SPECIALIST TRANSPORT

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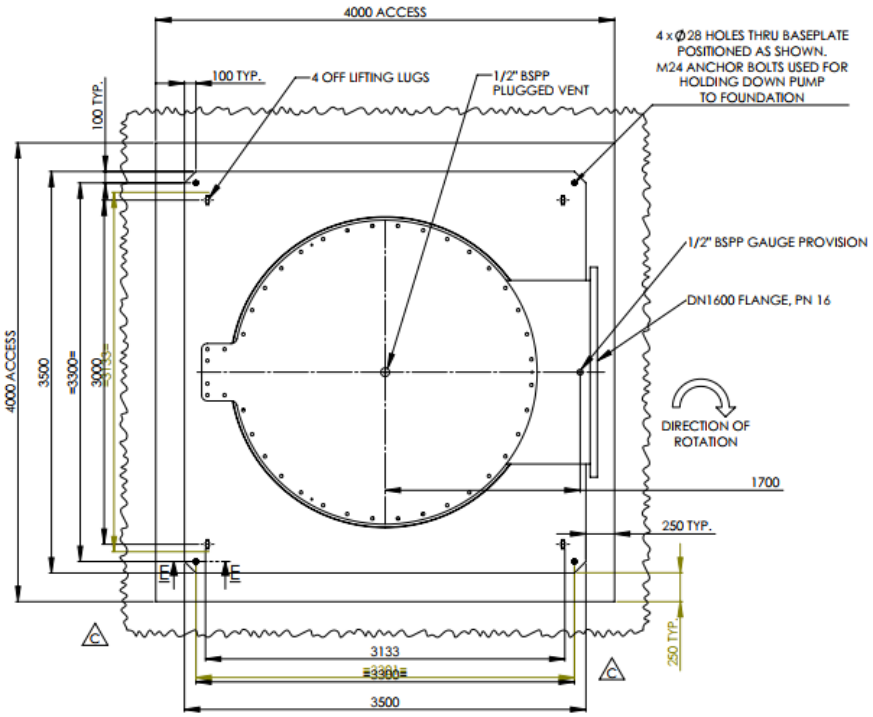
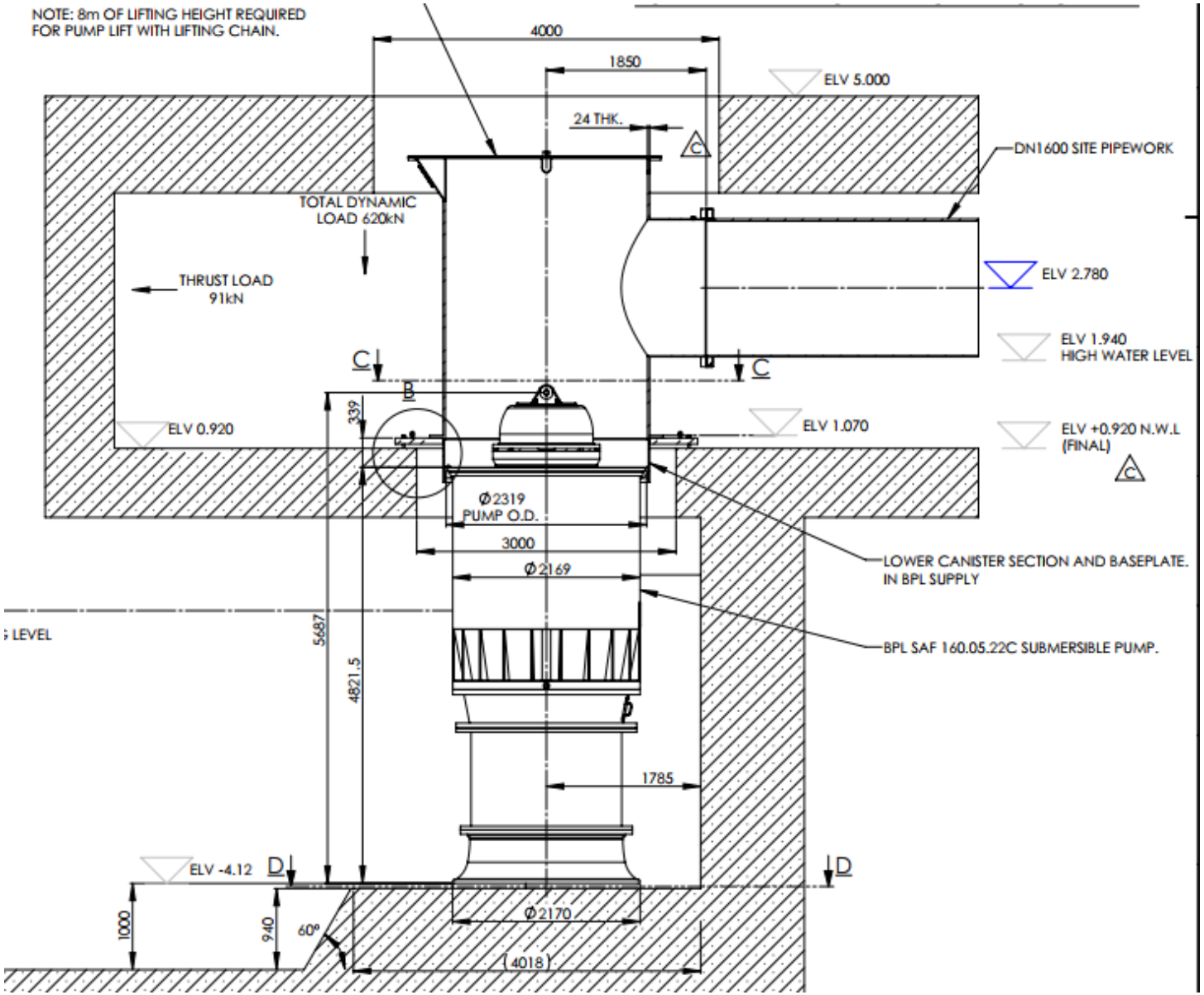

4000 ACCESS
100 TYP.
4 OFF LIFTING LUGS
1/2" BSPP PLUGGED VENT
4 x Ø28 HOLES THRU BASEPLATE POSITIONED AS SHOWN. M24 ANCHOR BOLTS USED FOR HOLDING DOWN PUMP TO FOUNDATION
1/2" BSPP GAUGE PROVISION
DN1600 FLANGE, PN 16
DIRECTION OF ROTATION
1700
250 TYP.
3133
3500
4000 ACCESS
3500
3000


NOTE: 8m OF LIFTING HEIGHT REQUIRED FOR PUMP LIFT WITH LIFTING CHAIN.
4000
1850
ELV 5.000
24 THK.
DN1600 SITE PIPEWORK
TOTAL DYNAMIC LOAD 620kN
THRUST LOAD 91kN
ELV 2.780
ELV 1.940 HIGH WATER LEVEL
ELV 0.920
ELV 1.070
ELV +0.920 N.W.L (FINAL)
339
Ø2319 PUMP O.D.
3000
Ø2169
LOWER CANISTER SECTION AND BASEPLATE. IN BPL SUPPLY
BPL SAF 160.05.22C SUBMERSIBLE PUMP.
5687
4821.5
1785
ELV -4.12
1000
940
60°
Ø2170
4018

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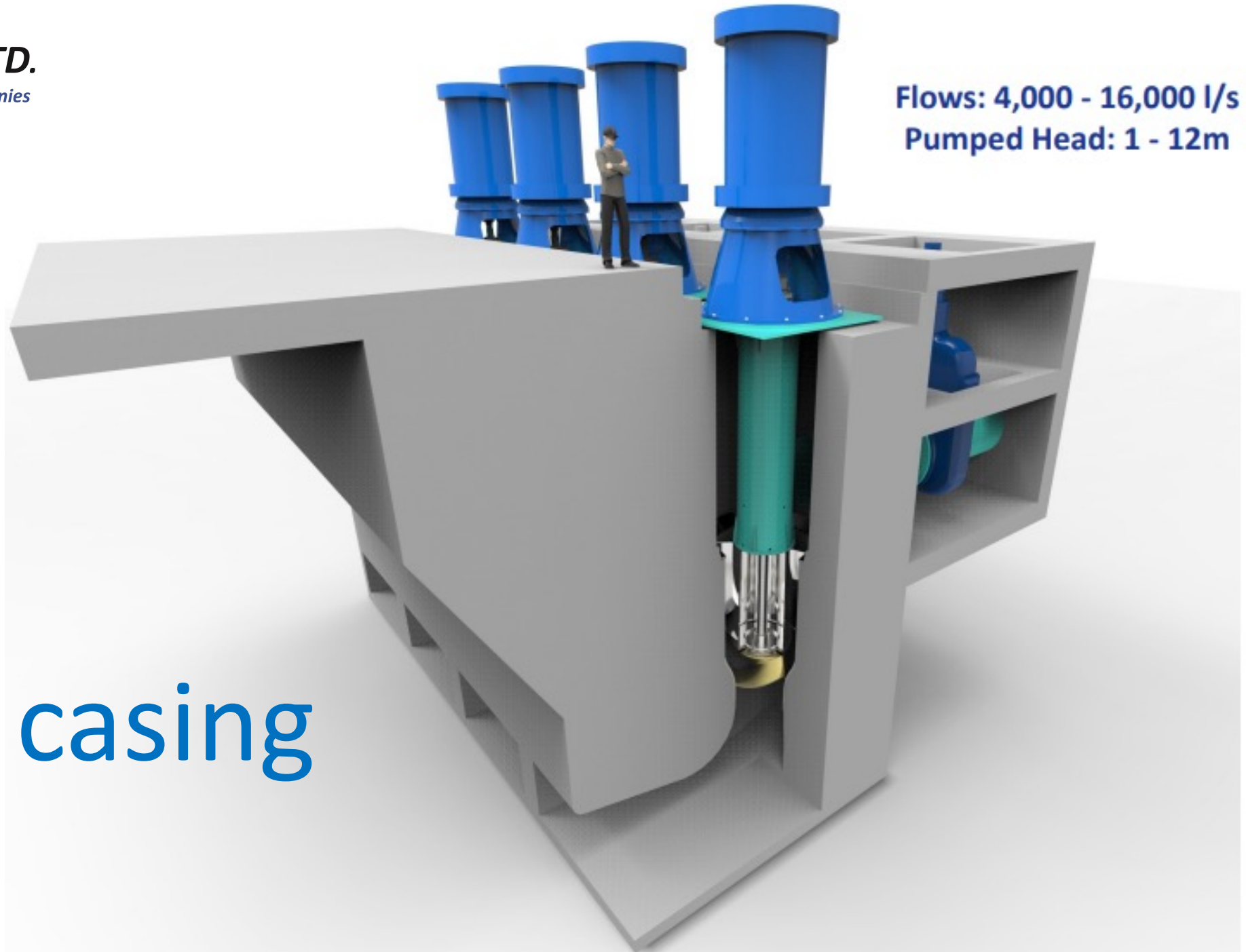
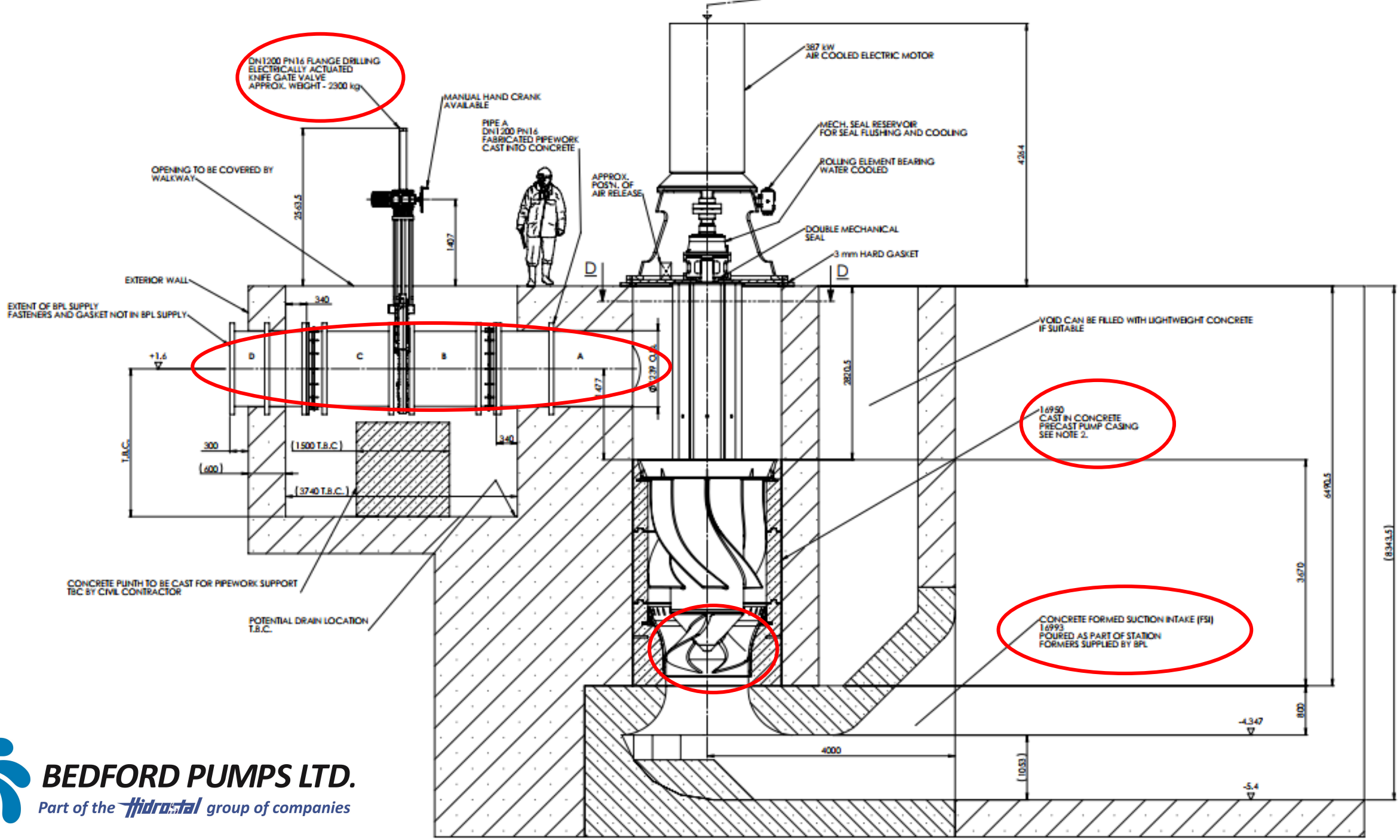



# Concrete casing




SECTION A-A

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AINSCOUGH
AINSCOUGH
CRANE HIRE LTD
Hodgson
D&G NOBLE
SCANIA

+44 (0)1234 852071
sales@bedfordpumps.co.uk
www.bedfordpumps.co.uk

## Bedford

Bedford Pumps L
turer producing
waste water pun
energy suspende
station near Usk i

The pumps for Pr
Station will extra
Reservoir, approx
Sluvad Water Trea
a large proportion

The contract betv
nership with Arca
Delivery Partners,
of four high flow
vertically suspenc
accommodate the
the river Usk thr
pumpsets have ar

The new pumping
river water, scree
screens, to Llande
ifold, and a combi
large variation i
operating range c
dated using mul
necessary.

Bedford Pumps s
most energy effici

Bedford Pumps w
Bearing Company
castings and fabri

## Bedford Pumps for F

Bedford Pumps Ltd have successfull
their Fish Friendly pumpsets at Pit
Columbia, Canada.

Pitt Polder P.S. is located within th
confluence of the Fraser and Pitt Ri
cated within a flood plain and the
comprising of a network of ditche
flood protection. This system was
River Flood of 1948, one of the large

The original Pitt Polder P.S was cons
tical pumps with no backup power.
its service life and was allocated fe
new station as it is an essential piec
al industry. The new pumping stati

Bedford Pumps, manufacturers of r
industry, supplied two of their Sub
the new Pitt Polder P.S. The pump
pump range, which have been rat
designed to assess their ability to
to tackle the rapid decline in global
pumpsets will each provide a duty
ble pumpset includes an integral 35
operation on a VSD.

Bedford Pumps supplied and com
The canisters, which are configured
tured in Canada to Bedford Pumps'

Bedford Pumps are a leading suppl
UK market but also to a thriving
27% of all installations. For Canada
to date with the very first order bei
ing station in the region, Hatzic La
flooding problems along the Fraser

## Bedford Pumps provi Fish Frien

Bedford Pumps Ltd, the UK's leading manufacturer of
capacity pumps for land drainage and flood control, ha
cessfully completed the commissioning of two of the
friendly pumpsets for Kings Lynn Internal Drainage Bo
North Lynn Pumping Station.

North Lynn P.S, located in the North West of Kings Lynn
the East Bank of the River Great Ouse, was built in 198
provides water level management to a catchment of a
mately 590 hectares. The pumping station had been ope
with just one pump which was coming to the end of its
life, but also required additional pumping capacity.

Bedford Pumps manufactured two canister mounted sub
ble type fish friendly pumps complete with 80 kW mot
North Lynn P.S. One pump and canister was installed a
rect replacement to the existing equipment, and the oth
the extra pump bay that was part of the original station
but had remained empty for over 30 years. Bedford Pum
signed the canisters and discharge pipework to fit the sc
The scope of supply also included the control panels, VF
pipework including modifications to the existing surge ta
cess, suction splitters, siphon breaker valves, condition m
ing devices, installation, commissioning, and site verif
testing.

Bedford Pumps were delighted to work once again with
Lynn Internal Drainage Board and consultants Stantec,
vide pumps to North Lynn which each provided a duty of
at 5m head, whilst satisfying the eel regulations requirem
site. The pumps, which have been rated as "Excellent"
independent trial designed to assess their ability to compl
the Eel Regulations, not only offer a safe passage to fis
eels but also provide enhanced life, lower maintenance
and improved efficiencies, resulting in the lowest total
ownership.

## Bedford Pumps sup suspended bowl storm p

Bedford Pumps Ltd, renowned manufacturers of high capa
neered stormwater pumps have delivered an import
providing two storm pumps for the Elland Lowfield pumpi
as part of Yorkshire Water's continued investment in infra

Storm pumps are frequently installed in wastewater pum
tions. Heavy rainfall can have a significant impact on the
network often resulting in intermittent discharges of dilute
during and after storm conditions. Bedford Pumps' st
pumps ensure that during times of heavy rainfall a greate
of stormwater can be safely taken away from homes ir
rounding area.

As well as the usual requirements of handling solids, grits
this application brought some additional challenges. Th
structure proved problematic as the opening for the pump
small for the increased duty requirements. Bedford Pu
their engineering know how to design a pump to suit the
without losing any performance or hydraulic efficiency. T
ed the need for additional civil work, saving substantial ca
In addition, prior to pump installation, sole plates were
eliminating the requirement for levelling on initial or su
maintenance installations, as well as conforming to gas tig
requirements.

Bedford Pumps always engineer longevity into their pum
tions. It goes without saying that Waste water storm pump
perform when required or there is a real possibility of ra
overflowing the station and flooding residential/busine
Due to the critical nature of these storm pumps, Bedfo
designed and supplied the pumps with shaft enclosing tub
ing the critical water lubricated bearings did not suffer p
flushing system was supplied by Bedford Pumps comprisi
valves; fittings and flow switches mounted on a common b

Another area of concern on waste water applications are
the pumped liquid to provide the lubrication, however, in
contaminated and therefore not a desirable liquid to lu
Pumps supplied the pumps with double seals using a siph
chanical seal faces thus ensuring the max MTBF for the m
sign and manufacturing off specialist robust and reliable
dockyard industries.

## Bedford Pumps multistage pumps scale the heights for Coppermills

Bedford Pumps, one of Europe's leading manufacturers of conventional and submersible pumps for the water and wastewater industries, has been awarded the contract to supply high lift pumps to Thames Water for its Coppermills Advanced Water Treatment Works (AWTW).

Coppermills AWTW is one of Thames Water's network of sites providing drinking water for London. The raw water is abstracted from the Lea flood relief channel and the New River and then stored in twelve reservoirs which feed the treatment works. Following treatment the potable water is pumped into supply by the high lift pumping station at Coppermills AWTW.

The existing pumps at Coppermills AWTW were installed when the station was constructed back in the 1960's. Bedford Pumps will initially supply two new high lift clean water pumps to supplement the existing old pumps. This will ensure a more reliable, high efficiency process. Bedford Pumps will work with SMBJV, (Skanska, MWH & Balfour Beatty Joint Venture) to supply a pair of Two-Stage Suspended Mixed Flow Bowl Pumpsets which will be installed in a vertical dry well suspended arrangement in order to fit into the existing tight space with access to the motors outdoors at ground level.

The pumps will each deliver a flow of 1,053 litres per second at 53m head via 3.3kV 800 kW variable speed motors.

This is not the first pumping solution that Bedford Pumps has delivered for the Coppermills site. In 2009 Bedford installed submersible bowl transfer pumps and a tunnel drainage pump at Coppermills WTW to facilitate a "dual pumping process" between Coppermills and the Thames Water Ring Main (TWRM). This was part of the £150M TWRM project, which involved tunnelling around London linking transfer pump shafts with water treatment works and pumping stations along the route.

Thames Water has a large existing installed base of Bedford Pumps products performing both clean water and waste water duties. Bedford Pumps is delighted to be able to assist the company in its latest venture.

*Fig 1. Existing pumps at Coppermills AWTW*

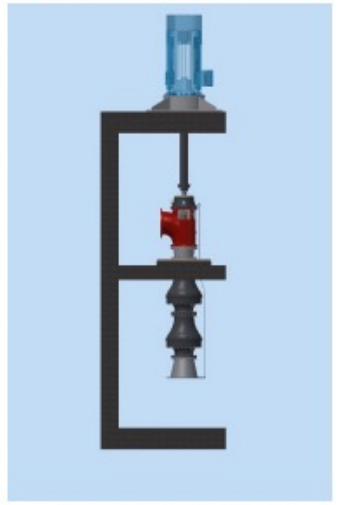

*Fig 2. Replacement pumps from Bedford Pumps Ltd*

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# Thank you for your attention

# Any questions?