

**Presentation by
Frank Cooper
Bedford Pumps Ltd**

FLOODDEX **PUMP INOVATION for WATER LEVEL
MANAGEMENT**

Drainage history

- Bedford Pumps Ltd are the UK's leading manufacturer of large submersible and conventional pumps to the Land Drainage industry.
- Total number of Gwynne/Bedford sites: >1000
- Land Drainage in the UK was originally regulated by the Statute of Sewers, passed by King Henry VIII in 1531.
- The Land Drainage Act of 1930 granted power to the Drainage Boards and Catchment Boards to carry out land drainage works and ensure that drainage could be managed effectively.
- Today the functions of Flood Protection and Land Drainage are the responsibility of Drainage Boards and the Environment Agency.

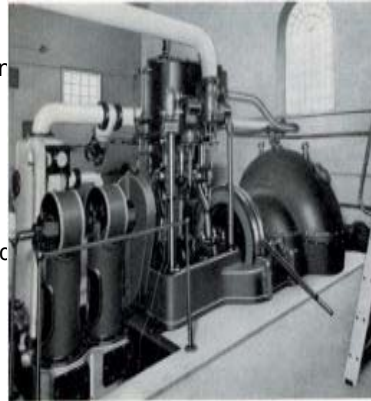
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Pumping Station Evolution

Double Entry Split Casing Pumps (1900 – 1950)

- Typically installed at ground level and operating on a suction lift
- Power provided by horizontal direct-coupled steam/diesel engines
- Pumps run at typically 150 to 350rpm which suited the speed of the steam engines of the c
- Housed within a building
- Labour intensive
- Priming required



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Pumping Station Evolution

Concrete Volute Pumps (1947 – 1966)

- Flowrates > 10 cumecs
- Pumps driven by oil engine
- Pumps run at typically 200 to 400rpm
- Housed within a building
- Labour intensive



Black Sluice P.S

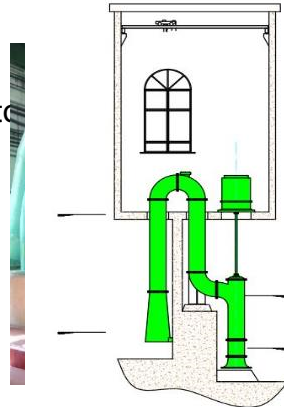
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Pumping Station Evolution

Conventional Axial & Mixed Flow Bowl Pumps (1945 – 2015)

- Pumps driven by TEFC electric motor
- Typical speeds increased from 490 to 1000rpm
- Housed within a building
- Submerged (no priming required)
- Siphonic Recovery utilised



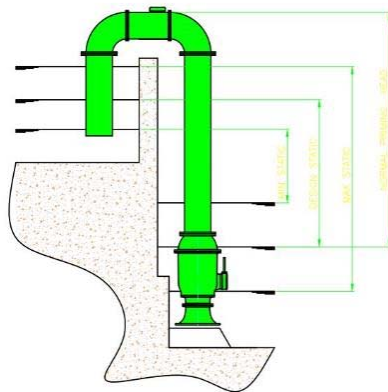
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Pumping Station Evolution

Submersible Axial & Mixed Flow Bowl Pumps (1985 – 2015)

- Pumps driven by submersible electric motor
- Typical speeds 490 to 1000rpm
- Housed outside (no superstructure required)
- Submerged (no priming required)
- Siphonic Recovery



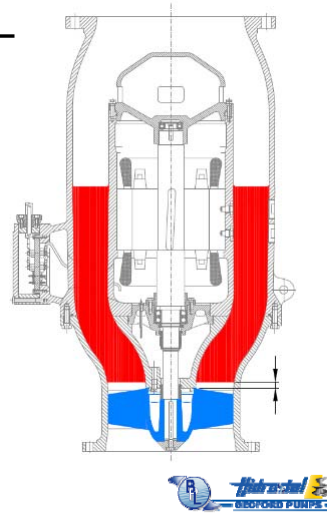
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Pump Design

Axial & Mixed Flow Bowl Pumps (1945 – 2015)

- High rotational speed (730 to 1000rpm)
- High impeller tip speed (>20m/sec)
- High inlet velocity (>4.5 m/sec)
- Minimum of 3 impeller blades
- Small compact design

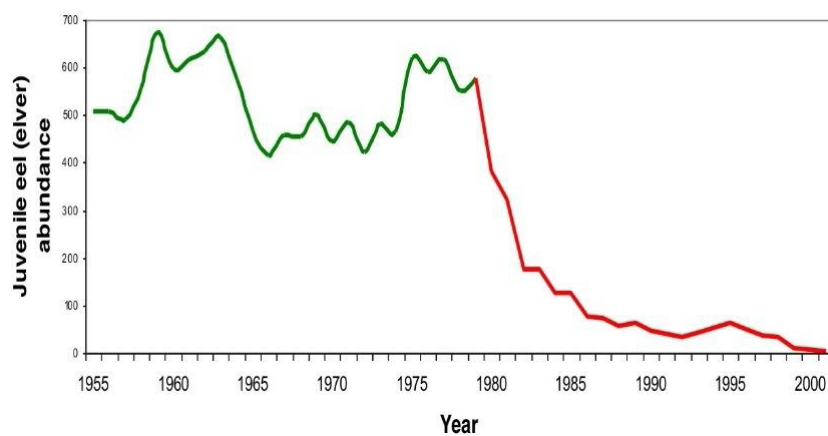


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Eel Decline

The collapse in European eel recruitment



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Eel Regulations

- Requirement to address obstructions (pumping stations etc) which restrict up & downstream Eel passage that prevent the migration of eels back to their spawning grounds in the Sargasso Sea
- European Eel Regulations 1100/2007 issued
- Resulting in The Eels (England and Wales) Regulations 2009
- All Pumping Stations of 20 m³ and above must be assessed with regard to their impact on Eel & Fish Migration and a plan put into place (**Eel Management Plan**)

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Consequence

The trend for smaller, higher speed pumps
has a consequence



Noticeable decline in eel population

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Fish Friendly - Pump Design

- First order received for Fish Friendly pumps - Kempsey P.S 2011
- New design from scratch
- Had to demonstrate hydraulic performance
- Had to be tested for Fish / Eel mortality rate by an independent body
- Not permitted to test on live fish and eels in the UK

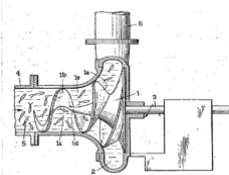
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Fish Friendly Pump Design



- In 1958 Martin Stähle invented the original fish handling pump as a means of unloading trawlers in Peru without damaging the fish
- In 1965 a patent was granted for the fish handling pump
- Since then Hidrostal has cultivated an impeccable reputation in the fish processing industry leading to the application of the F type pump used in food and fish farming



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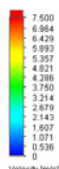


Fish Friendly - Pump Design

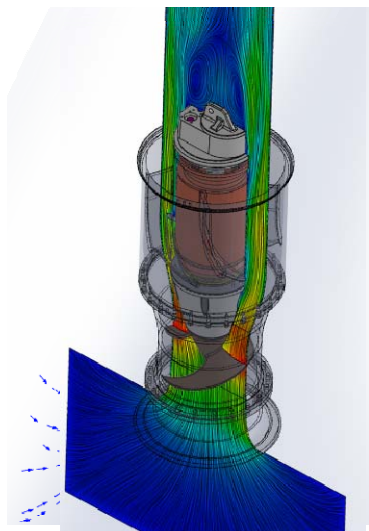
- Utilising existing Hidrostat technology Bedford Pumps have developed a new Axial /Mixed Flow Fish Friendly pump range
- 2 Bladed Design
- Smooth flow through impeller
- Low speeds / Low velocity
- Large axial and radial clearances
- High Efficiency

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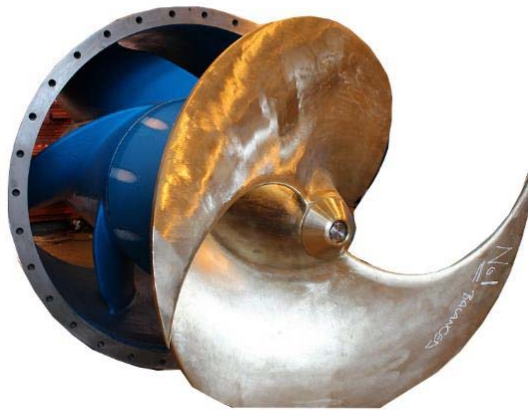
Fish Friendly – Pump Design



Cut Plot 1: contours
Surface Plot 1: contours
Flow Trajectories 1
Flow Trajectories 2
Flow Trajectories 3

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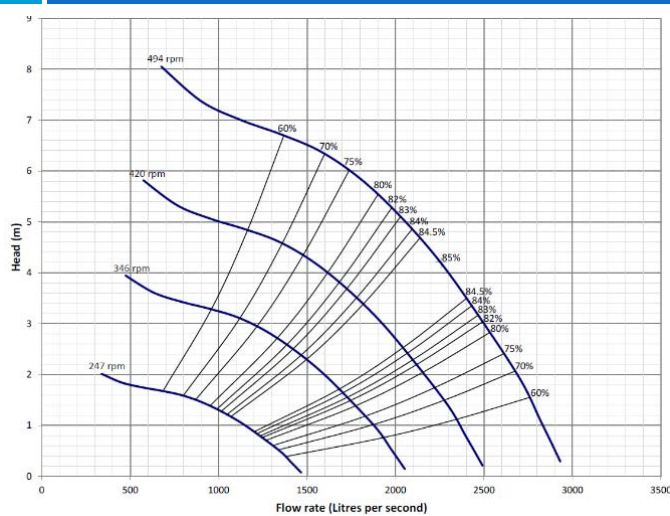
Fish Friendly - Pump Design



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Fish Friendly - Pump Design



○ Stable H/Q curve

○ BEP 85%

○ 3% Improvement over conventional Axial Flow Pump efficiency

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Fish & Eel Pump Testing



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Fish & Eel Pump Testing

Three representative groups of Fish & Eels were used for the test, separated in two size classes

Pump run at three different speeds

Roach and bream: Group 1: ≤ 15 cm
 Group 2: > 15 cm

Perch: Group 1: ≤ 15 cm
 Group 2: > 15 cm

Eel: Group 1: ≤ 45 cm
 Group 2: > 45 cm

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Results

Fish

- The most severe damage that occurred was some scale loss on the coarse fish. This was not caused by the pump impeller, but by the impact of the fish hitting the water after passing through the pump. In an actual Land Drainage application, the discharge point would be below the water level

Eels

- The pump achieved 100% survival of eels passing through the pump

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Conclusion from VisAdvies

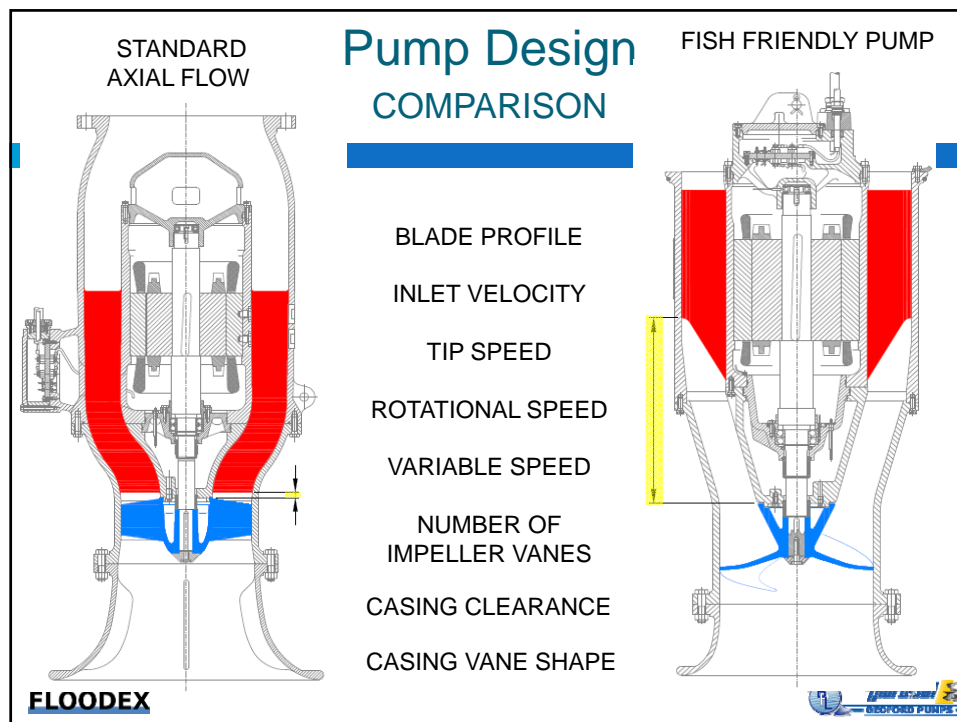
- The Bedford Axial Flow pump can be considered fish friendly in the sense that no direct mortality is observed after the exposure to the pump
- The delayed mortality can largely be attributed to the impact onto the water and the capture net
- Direct survival is 100% and the long term survival may be estimated than more than 95%
- Extract from VisAdvies Report:

In the last row of the graph the excellent score of the Bedford Pumps SAF.90.05.12 pump is shown. With its end score of 1 for fish survivability ...

“... it is the best pump on the market concerning this subject.”

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Land Drainage - Screening

- **Traditional Inlet Screens**
- Coarse bar with 60mm bar spacing
- Inlet velocity 0.34m/sec
- Optimised to protect the pumps but minimise blockages from weed
- Mechanically or hand raked
- Extends width of the drain



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- Allow fish / Fels to pass –



Land Drainage - Screening

- **Eel & Fish Friendly Screen**
- Fine screen prevents fish/eels entering a pumping station
- Barrier to Eel migration
- **Applications**
- Cooling water intakes
- Power Stations
- River abstraction to reservoirs or water



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Fine screens

- **Not ideally suited for L.D transfer stations**
- Fine 1.5mm spacing – Prone to blockage
- Velocity 0.1 - 0.15m/sec resulting in increased screen area – station width doubled
- High civil costs
- Head loss (0.3m = 10% extra power)



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Fine screens

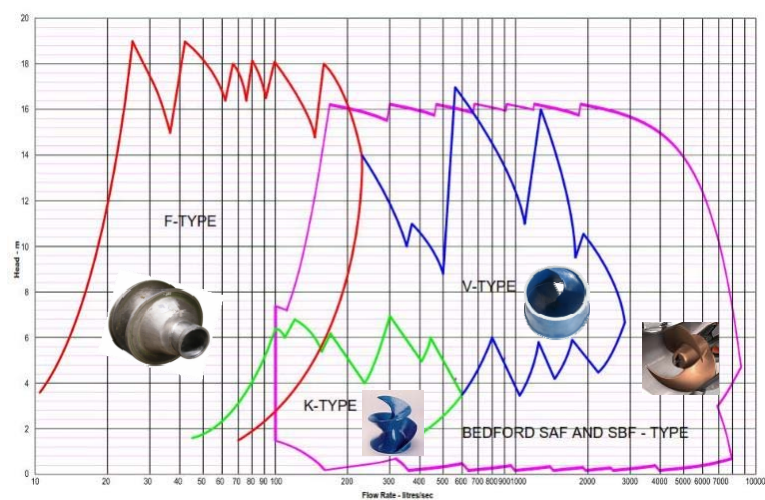
- Not suitable for L.D transfer stations which have to deal with



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Eel & Fish Friendly Pump Ranges



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Hidrostal's Range – Fish Friendly

- Full Range 2" to 36" Volute pump
- Flow 15 – 2,000 l/s
- Head up to 16m
- Portable Diesel Powered Range up to 30"



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Bedford Pumps Eel & Fish Friendly Submersible pumps

- **SAF/DAF – SBF/ DBF Range**
- Flows 200 l/s to 9,000 l/s
- Heads up to 15m
- Submersible / Conventional
- Variable speed operation
- Fault protected – IP68
- Versatile Arrangements
- 14 Standard sizes available
- Bespoke designs considered



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Fish Friendly Land Drainage P.S Design

- Pumps only one aspect of Fish Friendly design
- Consider:-
- Siphon/design/priming
- Pipework design
- Outfall design



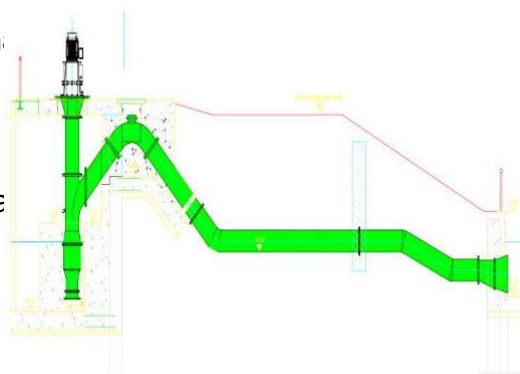
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Fish Friendly Land Drainage P.S Design

Fish Friendly Pumping Station Design

- Fish Friendly pump
- Submersible /Convention
- Low Velocity/Low Loss
- Open mesh station floor
- Fish Friendly Siphon break
- Long radius bends
- Submerged discharge
- Control philosophy



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Fish Friendly Land Drainage Sites

THANK YOU FOR LISTENING



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