MANNPOWER
CONSULTING LIMITED

The Archimedean Screw

Fish friendly hydropower generation

Joule Centre Conference
Penrith - April 2008

Archimedean Screw Operational Range

- Capacity from 100l/s to 10,000l/s
- Full capacity with reduced head
- Hydraulic head from 1m to 10m
- No head loss from screens or pressure pipes
- 87% hydraulic efficiency
- 77% ‘Water to Wire’ efficiency
- Operation down to 15% max flow
- 1 kW to 350 kW

Archimedean Screw Advantages

- High efficiency across large flow variation
- Fish friendly
- Floating objects and debris simply pass through with no need for expensive fine screening
- Robust, simple machinery. Low maintenance
- Design life 25 to 40 years.
- No complex control system – the speed is set by the grid connection or by the available flow.

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Case Study: River Dart Country Park

Ashburton, Devon

The Site

Weir and 600m long open leat

Kaplan system installed in 90's

- Leaf and debris blockage
- Mechanical failure

Site Advantages

- Plenty of water
- Abstraction licence in place
- Grid connection in place
- Power can be used locally

Options

Appraisal carried out Spring 2006

- Refurbish original scheme
- Replace with a new system

Decision to use Archimedean screw Summer 2007

- Fish friendly
- No need for fine screen which traps debris
- Efficient
- Suited to site layout

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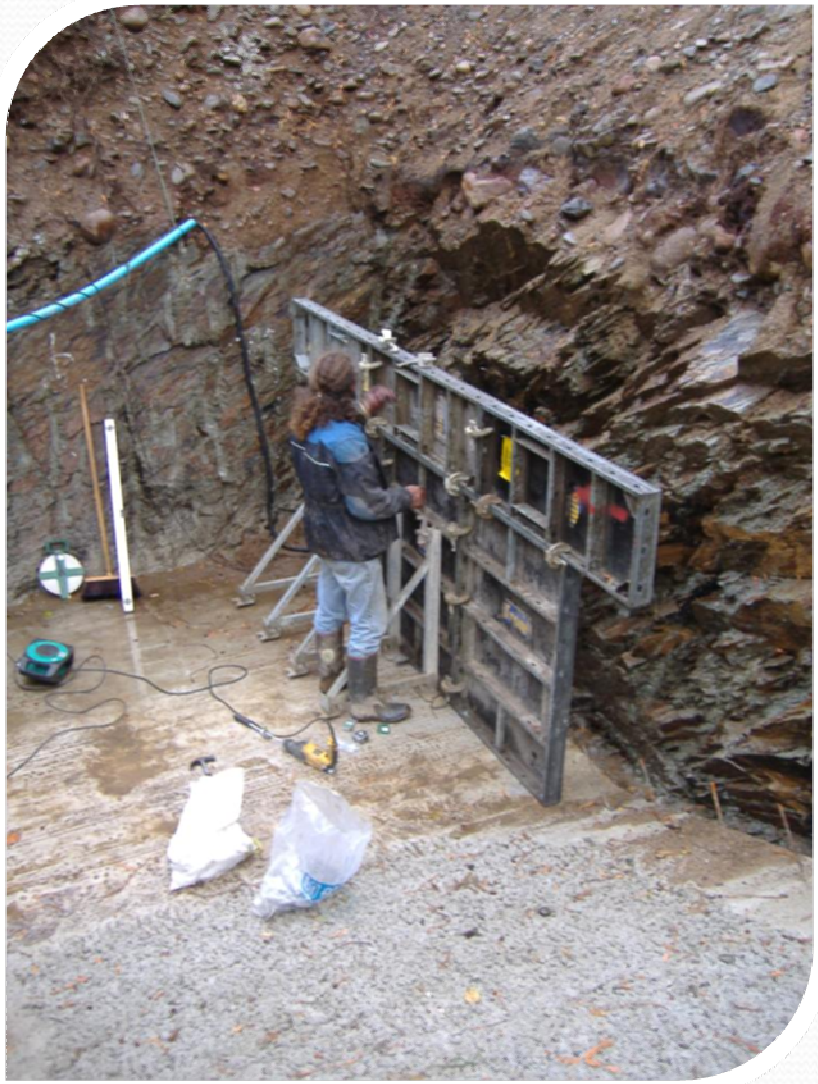
Construction

September 2006 – January 2007

Preparing the site

Foundations for concrete trough laid

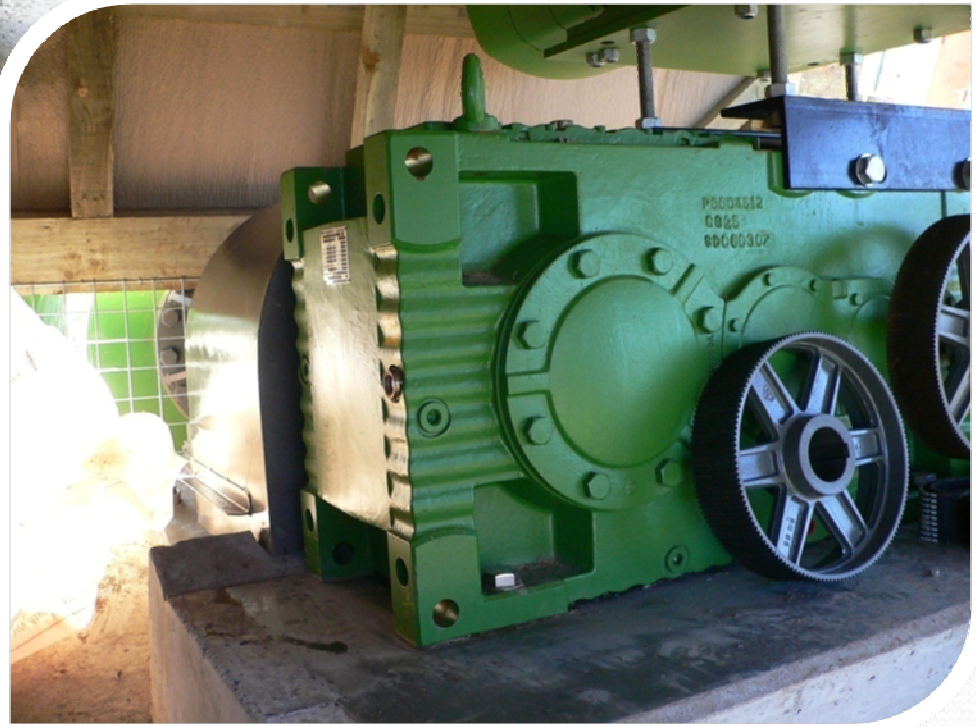


Concrete trough complete
Ready for the screw

Positioning

Preparing gearbox support

Installing gearbox



Completed January 2007

AdvertiserPost NEWS

SCREWS CONTROL: The Archimedes screw arrives at the country park.

Eureka! The screw that saves money

THE River Dart Country Park, Holne, took possession of a giant 11-tonne Archimedes screw – which its new owner reckons is going to save him £25,000-30,000 in electricity every year.

The hydro-dynamic screw arrived from Germany on Tuesday and is thought to be the first in the UK. It should be up and running within the next few weeks. It will be installed in a leat off the River Dart, which was constructed about 150 years ago to run the tin and

by LINDSEY SILL

copper mines.

Owner Mark Simpson said: "The joy of it is, is that it is a very simple design with very little to go wrong. The actual screw revolves at 30rpm and it is very fish friendly. Fish can quite happily swim through it without being injured, whereas some other hydro-schemes require lots of screening and are not so friendly."

The scheme will produce 50kw – enough to power four domestic houses. Mr Simpson reckons it will provide 75 per cent of his electricity needs, saving him a whopping £25,000-30,000 a year. The whole scheme is costing £120,000, giving a short four to five year payback period.

He received help from the Dartmoor Sustainability Fund and the Carbon Trust and said he thought the technology had huge potential.

"They are quite common in Germany and Austria, but as far as the UK is concerned it could be the first one."

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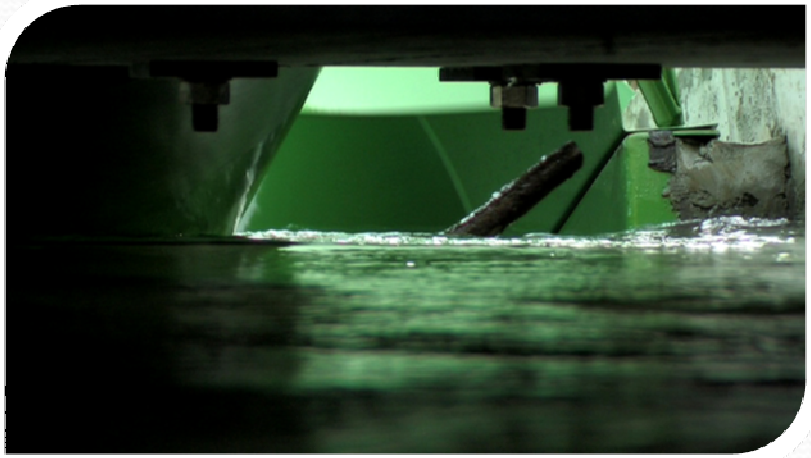
Live fish trials

Spring 2007

Fish and debris testing

- EA approved fish test proposal
- Independent fish biologist, EA supervision
- Over 1000 successful live fish passages
- Different species and sizes



Live fish photographed, and checked before introduction

Every fish caught and rechecked after passing through

Extensive underwater video footage to show behaviour of fish both entering and leaving the screw

A kelt 98cm long and 7.5Kg passed through unharmed

EA and SEPA experience

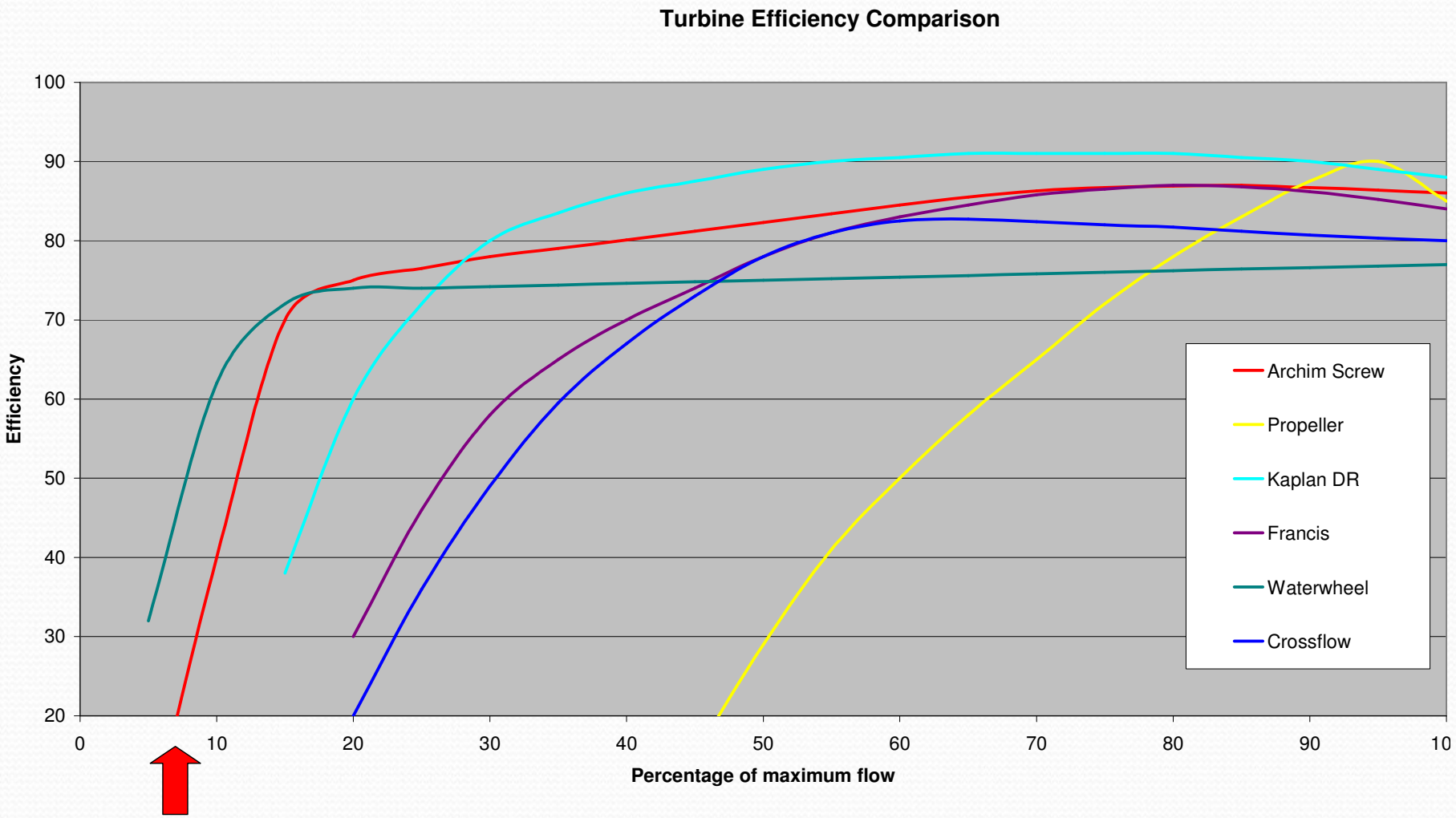
- Ashburton, River Dart – permitted to operate for one year with no screening while fish testing took place. No requirement to now fit any screening.
- Osbaston, River Monnow – 100mm screening agreed, but EA have recently requested that this be increased to allow even the biggest fish through.
- Strathdon, River Don – 90mm screening agreed, with monitoring programme now completed. No requirement to fit screening.
- Howsham, River Derwent – 125mm screening agreed, with monitoring programme to assess coarse fish and lamprey.
- New Mills, River Goyt – no fish screening required.
- Linton, River York Ouse – no fish screening required.

Performance tests

Summer 2007

Efficiency

- Independent verification of performance
- Very accurate ultrasonic flow meter used
- Results matched quoted specifications:-
  - Screw efficiency of 87%
  - ‘Water to wire’ efficiency of up to 77%
  - Highly efficient down to 20% of maximum flow
  - Variable speed system offers significant benefits


Turbine Efficiency Comparison
Efficiency
100
90
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
10
Percentage of maximum flow
Archim Screw
Propeller
Kaplan DR
Francis
Waterwheel
Crossflow

Customer satisfaction

- System has operated reliably for over 1 year
- Minimal maintenance required
- Output between 35kW and 52kW depending on river flow
- Previous Kaplan system never achieved over 45kW
- EA very pleased with fish test results
- Proving quite a visitor attraction

New projects

- **Strathdon** 70kW – **commissioned** December 2007
- **Glencullen** 5kW – **due for commissioning** April 2008
- **Bilstone** 6kW – **under construction** June 2008
- **Monmouth** 150kW – **under construction** June 2008
- **New Mills** 70kW – **under construction** July 2008
- **Linton** 130kW – **due to start construction** June 2008
- **Rocester** 50kW – **due to start construction** June 2008