Jun 21st, 4:45 PM - 5:00 PM

Innovations III: Fish Passage Philosophy on European Rivers Fueling Hydropower Installations in the 21st Century

Martin O'Farrell
Smith-Root, Inc.

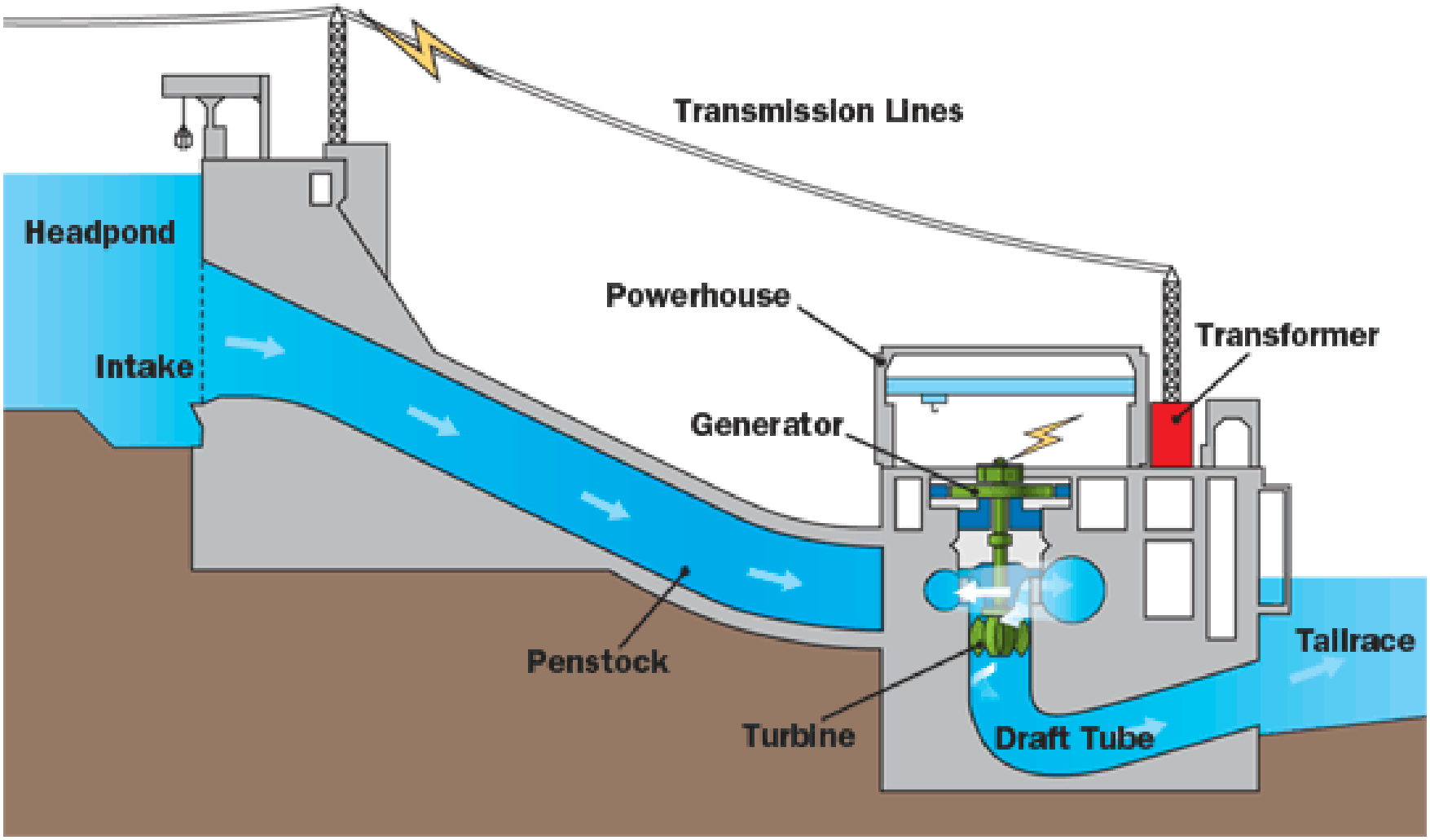
Jason Kent
Smith-Root, Inc.

Carl Burger
Smith-Root, Inc.

FISH PASSAGE PHILOSOPHY ON EUROPEAN RIVERS FUELLING HYDROPOWER INSTALLATIONS IN THE 21ST CENTURY

Martin O'Farrell, Jason Kent and Carl Burger
Smith-Root Inc., Vancouver, WA, USA

FISH PASSAGE 2016
University of Massachusetts,
Mass., USA,
22-24 JUNE 2016


Transmission Lines
Headpond
Intake
Powerhouse
Transformer
Generator
Penstock
Turbine
Draft Tube
Tailrace

DEPRESSION

RECESSION

AUSTERITY

ECONOMIC IMPERATIVES

PHILOSOPHY

PHILOSOPHICAL

BIOLOGICAL IMPERATIVES

FISHERIES MANAGEMENT

FISHERIES LEGISLATION

INLAND FISHERIES

RECREATIONAL FISHERIES

LEGACY

ACTIVITY

ENTHUSIASM

BLAME

FOR ANADROMOUS AND CATADROMOUS SPECIES, SUCCESSFUL UPSTREAM MIGRATION OF ADULTS AND JUVENILES, RESPECTIVELY, CREATES DEMANDS FOR SUCCESSFUL DOWNSTREAM MIGRATION OF JUVENILES AND ADULTS, RESPECTIVELY

GAME CHANGERS

On 23 October 2000, the "Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy" or, in short, the **EU Water Framework Directive** …..came into force

Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel

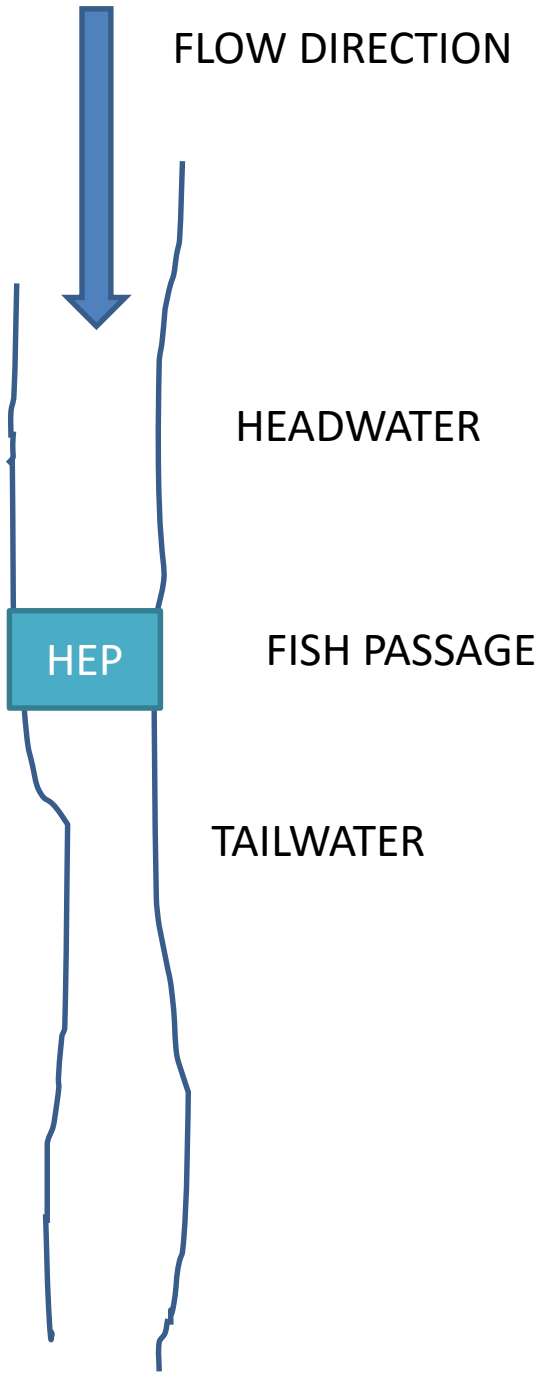
CONNECTIVITY

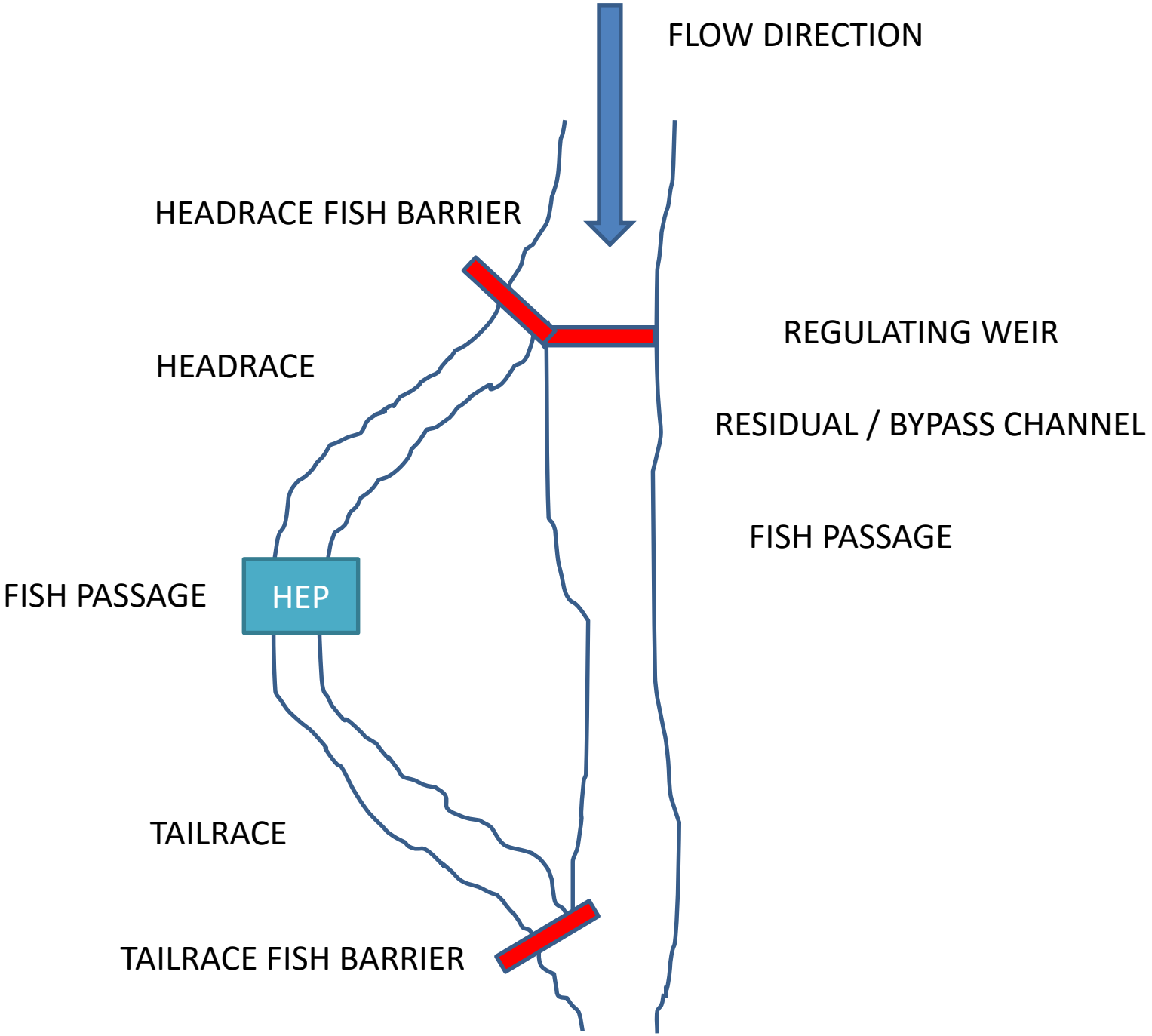
BIODIVERSITY

RESEARCH OBJECTIVES

PUBLICATIONS

SOLUTIONS


FLOW DIRECTION
HEADWATER
HEP
FISH PASSAGE
TAILWATER

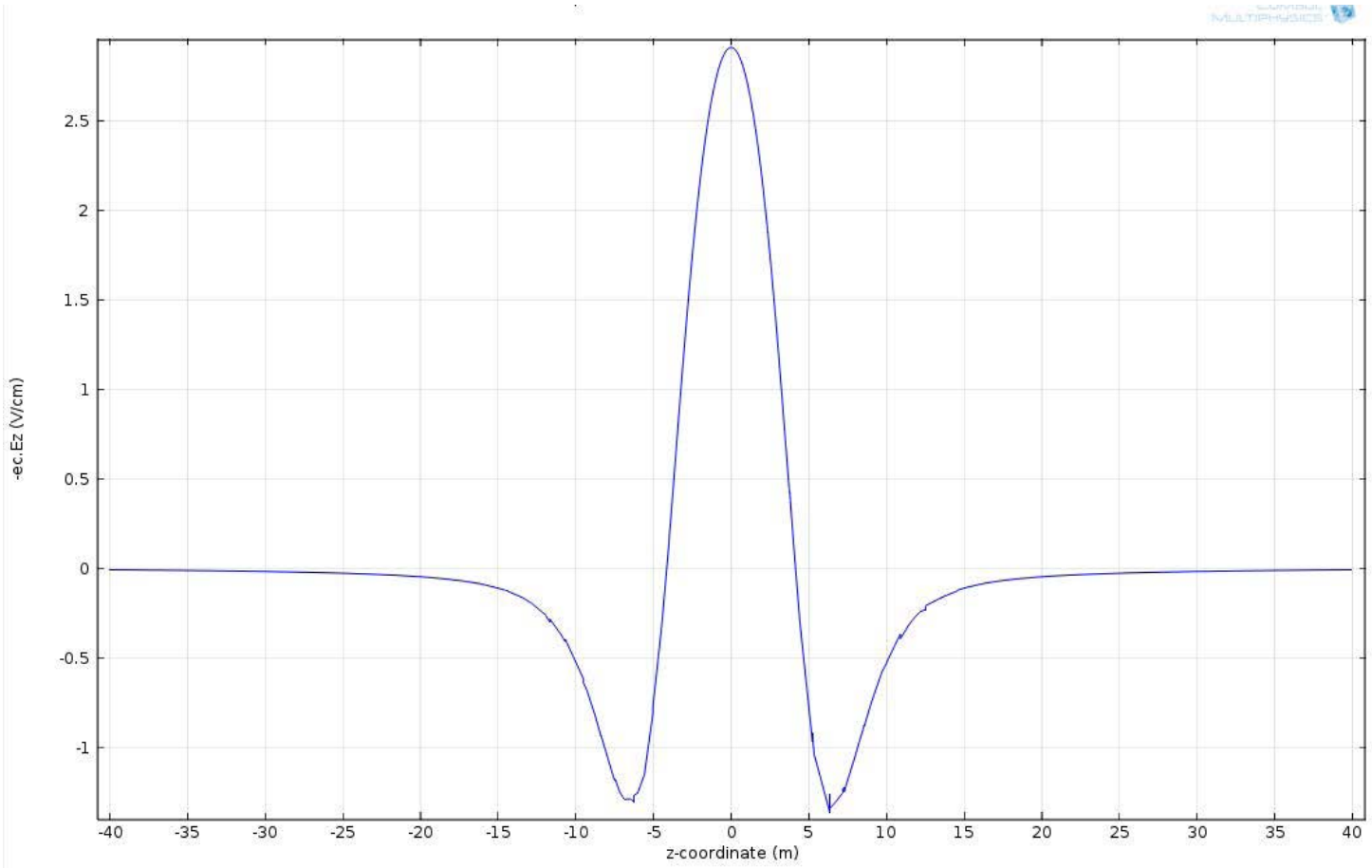

FLOW DIRECTION
HEADRACE FISH BARRIER
REGULATING WEIR
HEADRACE
RESIDUAL / BYPASS CHANNEL
FISH PASSAGE
FISH PASSAGE
HEP
TAILRACE
TAILRACE FISH BARRIER

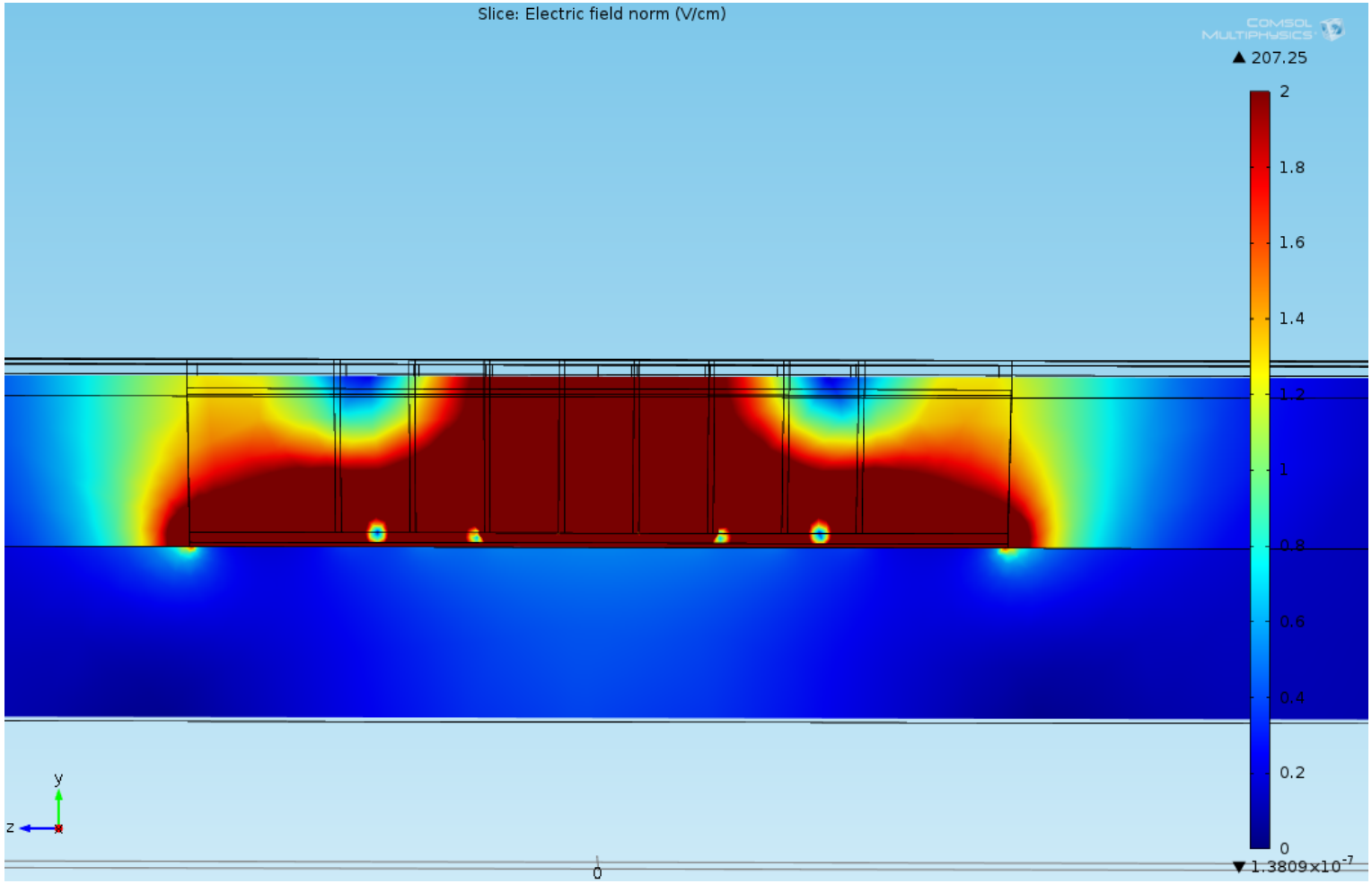
GRADUATED FIELD FISH BARRIER CONCERNS

- SAFETY
- RELIABILITY
- EFFICIENCY

CONSIDERATIONS FOR GRADUATED FIELD FISH BARRIER INSTALLATION

- VOLUME OF WATER TO BE ELECTRIFIED (m^3)
- WATER CONDUCTIVITY (µS/cm)
- VOLTAGE GRADIENT CHARACTERISTICS OF THE ELECTRIC FIELD (v/cm)
- LOCATION OF PEAK SURFACE VOLTAGE GRADIENT (v/cm)


-ec.Ez (V/cm)
2.5
2
1.5
1
0.5
0
-0.5
-1
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
z-coordinate (m)


Slice: Electric field norm (V/cm)
COMSOL MULTIPHYSICS
▲ 207.25
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
▼ 1.3809x10^-7
y
z
0

LIFE IS (NOT) A LONG QUIET RIVER……

AND EVERY INDUSTRIAL RIVER HAS A STORY WORTH TELLING

CUL-DE-SACS

RESIDUAL CHANNEL

TAILRACE CANAL

SPILLWAY CHANNEL

DRAFT TUBE

GRADUATED FIELD FISH BARRIER FEASIBILITY STUDIES / INSTALLATIONS IN EUROPE

Country	Location	Rationale	Species	Control direction	Installation
Norway	Litldalselva	*Gyrodactylus salaris* infestation	Atlantic salmon	Upstream	
	Drammen	*Gyrodactylus salaris* infestation	Atlantic salmon	Upstream	
	Laerdalselva	*Gyrodactylus salaris* infestation	Atlantic salmon	Upstream	
	Mesna	Exclusion of a nuisance species	Northern Pike	Downstream	
	Rygene (Nidelva)	Exclusion from tailrace	Atlantic salmon	Upstream	+
	Evenstad (Nidelva)	Exclusion from tailrace	Atlantic salmon	Upstream	
	Bjelland (Mandal)	Exclusion from tailrace	Atlantic salmon	Upstream	
	Kjeldal Lock (Telemark Canal)	Exclusion from upstream lakes	Northern Pike	Upstream	+
Sweden	Forshaga (Claralven)	Guiding upstream migrants	Atlantic salmon	Upstream	
UK	Pitlochry (Tummel)	Exclusion from tailrace	Atlantic salmon	Upstream	
	Mossford	Exclusion from tailrace	Atlantic salmon	Upstream	
	Shin	Exclusion from tailrace	Atlantic salmon	Upstream	
	Beeston Weir (Trent)	Exclusion from draft tubes	Freshwater fish species	Upstream	+
Switzerland	Vessey (Arve)	Exclusion from tailrace	Brown trout	Upstream	+
Ireland	Ardnacrusha (Shannon)	Exclusion from tailrace	Atlantic salmon	Upstream	
		Exclusion from tailrace	Sea Lamprey	Upstream	
		Exclusion from headrace canal	European eel	Downstream	

Carl Burger *et al* 2015

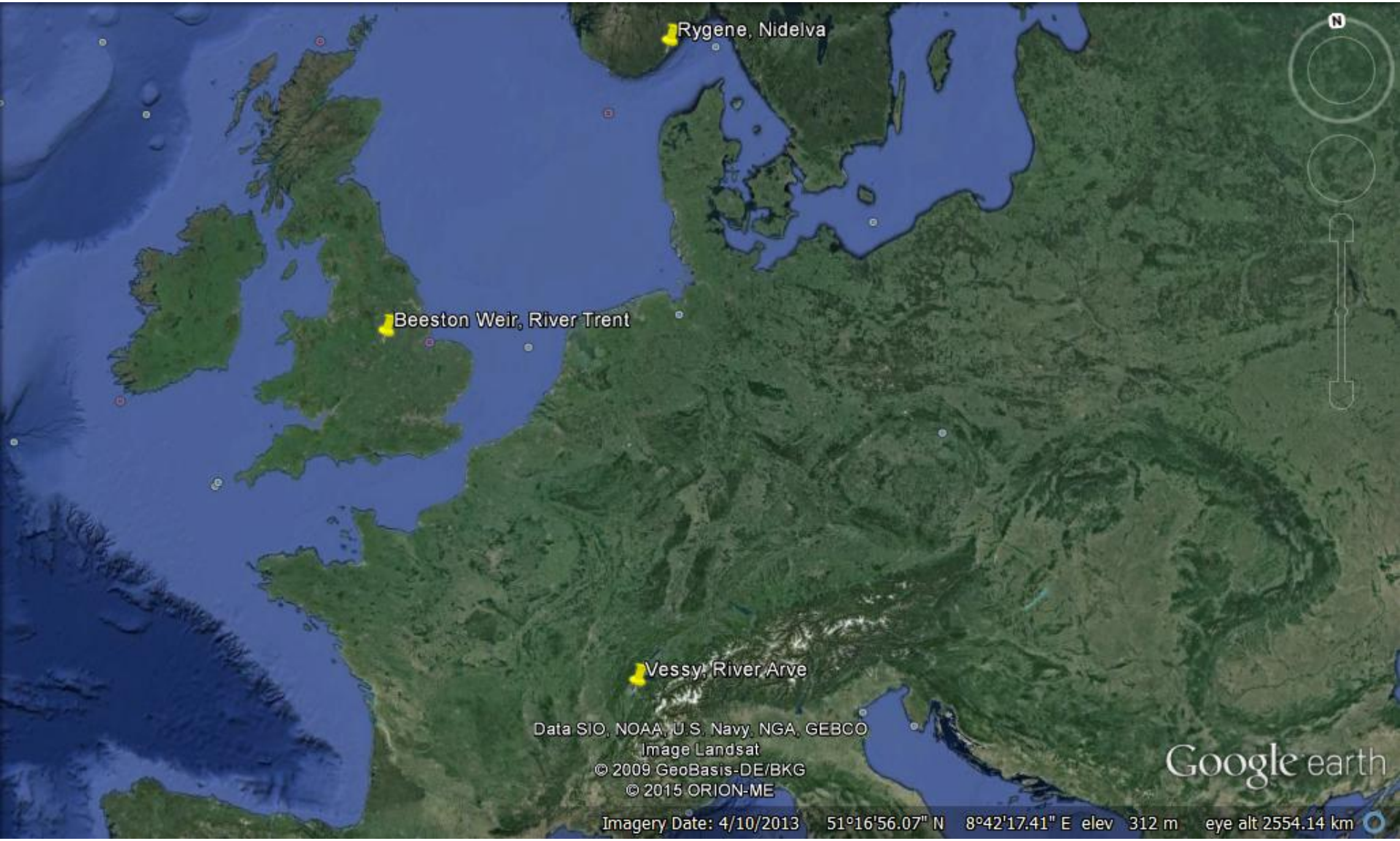
Barrier technology helps deter fish at hydro facilities

HYDRO REVIEW JUNE 2015 pp 50-57

O’Farrell *et al* 2014

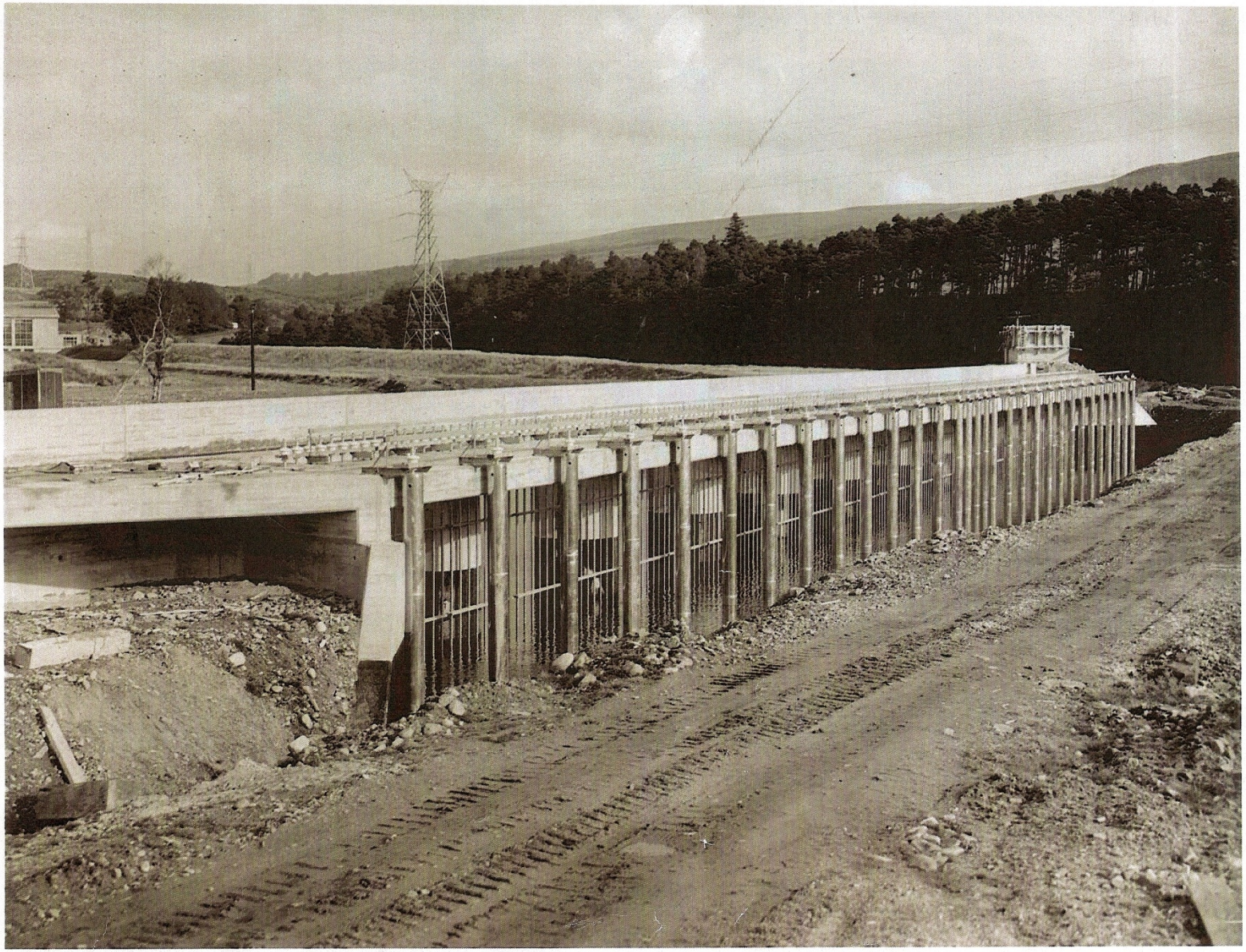
Blocking or guiding upstream-migrating fish: a commentary on the success of the graduated field electric fish barrier

International Fish Screening Techniques
Eds Turnpenny & Horsfield.
Witpress, Southampton, UK


Rygene, Nidelva
Beeston Weir, River Trent
Vessy, River Arve
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2009 GeoBasis-DE/BKG
© 2015 ORION-ME
Google earth
Imagery Date: 4/10/2013 51°16'56.07" N 8°42'17.41" E elev 312 m eye alt 2554.14 km


R464
Mill Rd
Sráid na Haibhainn
© 2010 Tele Atlas
Imagery Date: Sep 22, 2007
52°41'21.39" N
8°37'32.34" W
elev 3 m
Eye alt 527 m


Inveran
Inveran Houses
A837



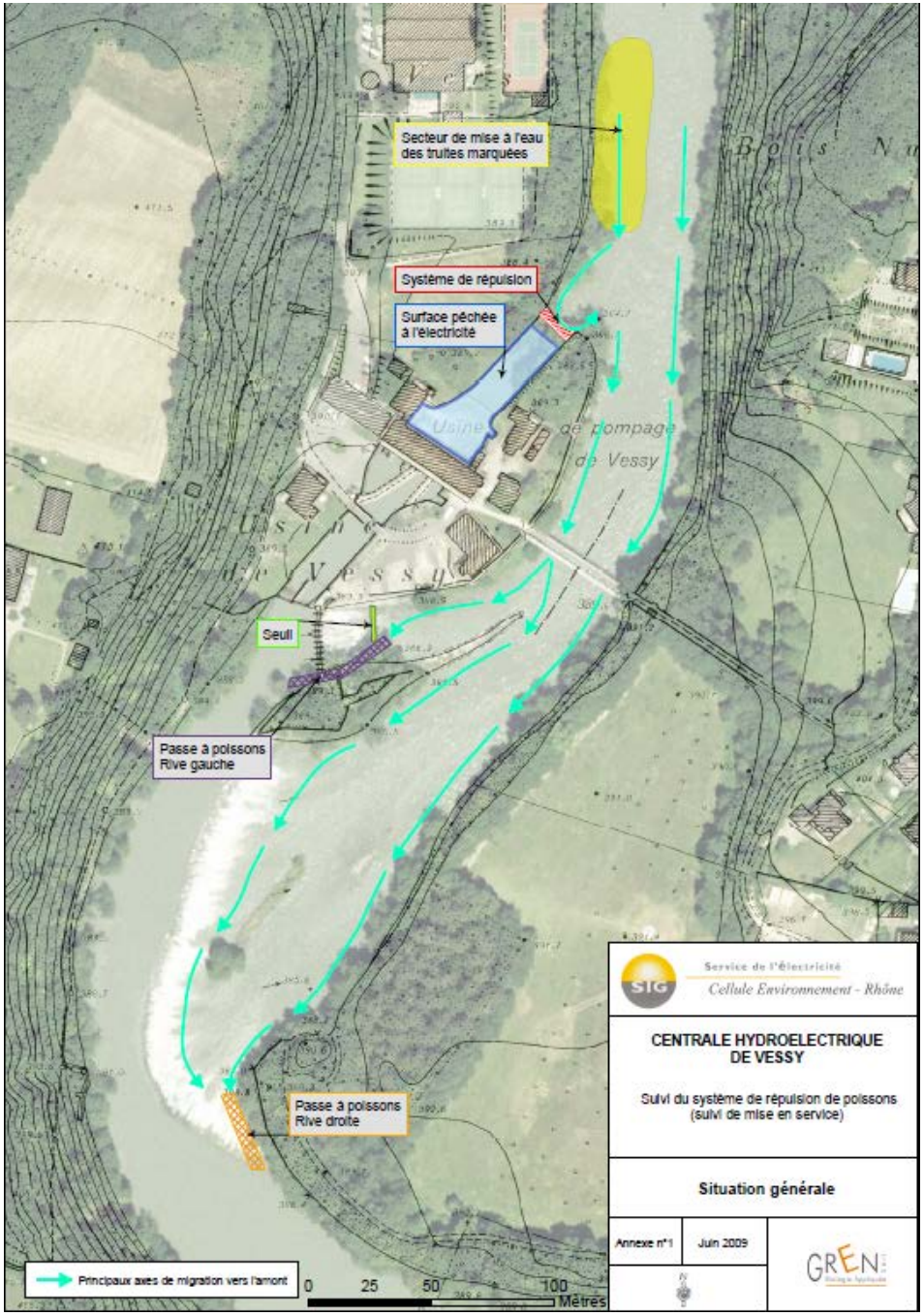
NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD. LOCH SHIN PROJECT.
No. 32/7/270. Shin Tunnel and Generating Station. Fish Heck and Pulse Generator House. 1/10/58.


© 2014 Google
© 2014 Infoterra Ltd & Bluesky
Google earth

Anon. 2009

Centrale Hydroelectrique de Vessy: Suivi du System de Repulsion des Poissons (Suivi de Mise en Service)

GREN Biologie



Service de l'Électricité
Cellule Environnement - Rhône

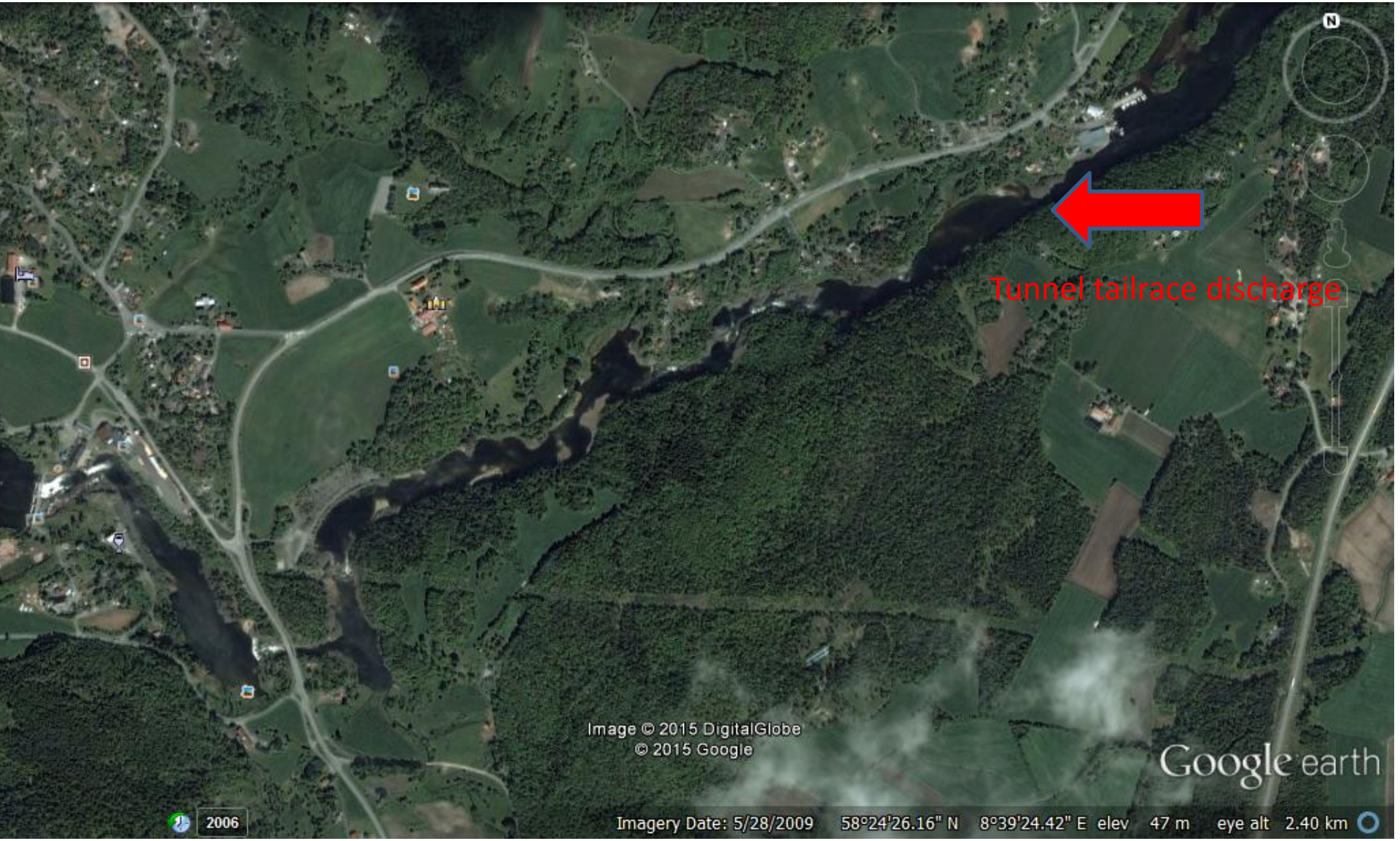
CENTRALE HYDROELECTRIQUE DE VESSY

Suivi du système de répulsion de poissons (suivi de mise en service)

Situation générale

Annexe n°1	Juin 2009	GREN

NIDELVA, NORWAY



Nidelva August 2012


Nidelva May 2013


Nidelva August 2013


Nidelva May 2014
ADVARSEL
Elektrisk Fiskesperre
Adgang forbudt

Video Monitoring of Salmon and Sea Trout by the Electric Fish Barrier at the Outlet from the Rygene Power Plant in Nidelva in Arendal in 2014

Authors – Anders Lamberg, Vemund Gjertsen, Sondre Bjørnbet and Magnus Bakken

Employer - Agder Energi Roduksjon AS
Assignment Reference – Svein Haugland


Flashs
Tailrace
Barrier
17 59
GUINNESS