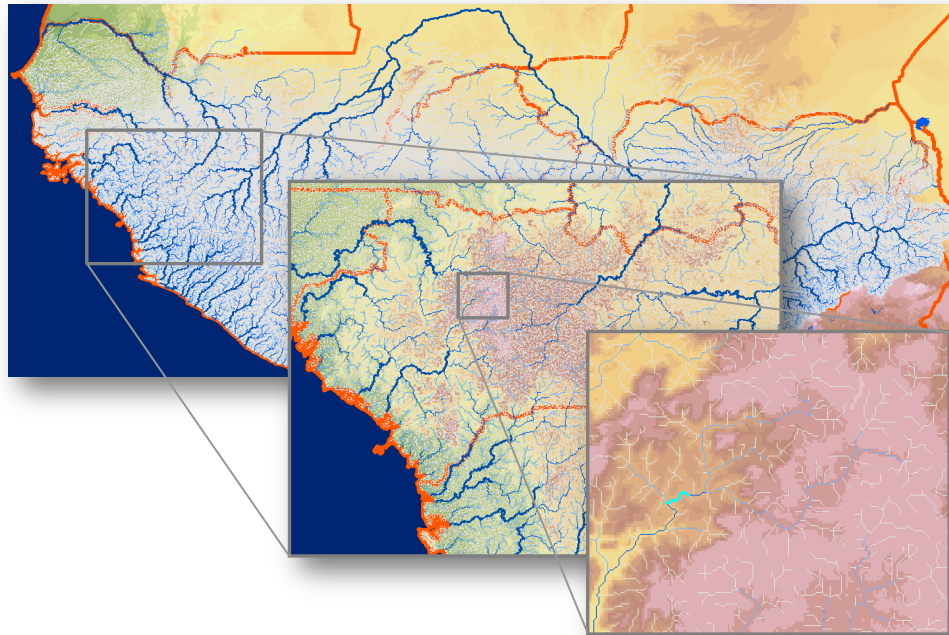# GIS Hydropower Resources Mapping for ECOWAS Region

Session 5:
Hydropower plants classification

Funded by

AUSTRIAN DEVELOPMENT COOPERATION

Spanish Cooperation

Training, Dakar, Senegal, July 2016

Trainer: Harald Kling
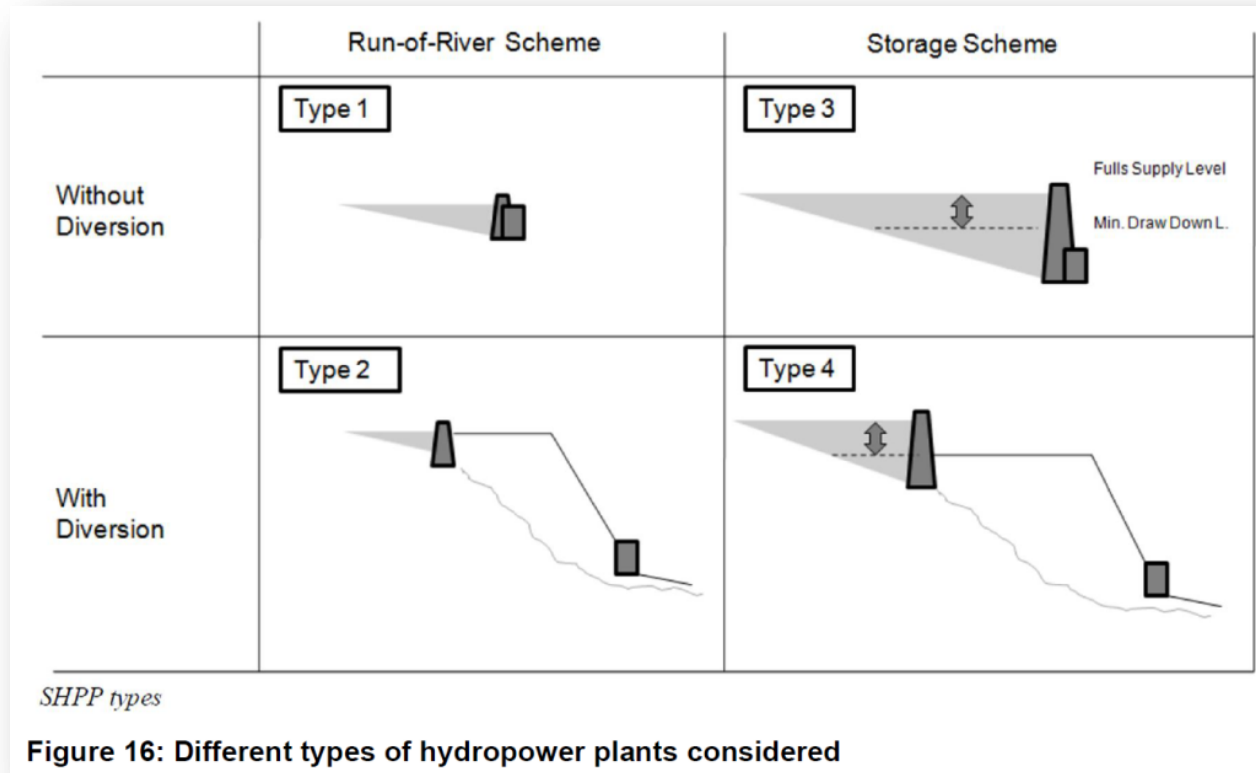
Pöyry, Hydro Consulting, Hydropower, Austria

Hydropower plants classification

Overview

- Plant layout

  With or without diversion

  With or without storage

- Plant size

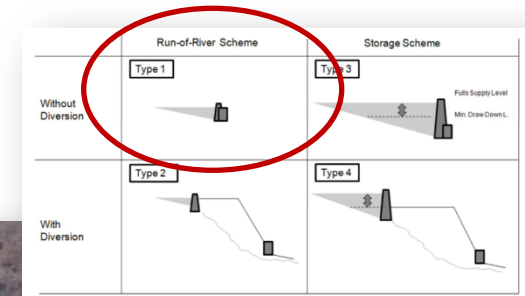 Installed capacity

- Group work:

  Longitudinal river profiles

Hydropower plants classification

Classification of plant type

Figure 16: Different types of hydropower plants considered

Hydropower plant types

Run-of-River scheme without diversion

Tourni HPP
Installed capacity 0.6 MW

Inflow

Dam

Penstock

Power house

River

Hydropower plant types

Run-of-River scheme with diversion

Inflow

Dam

Diversion

Penstock

River bed (dry)

Power house

River
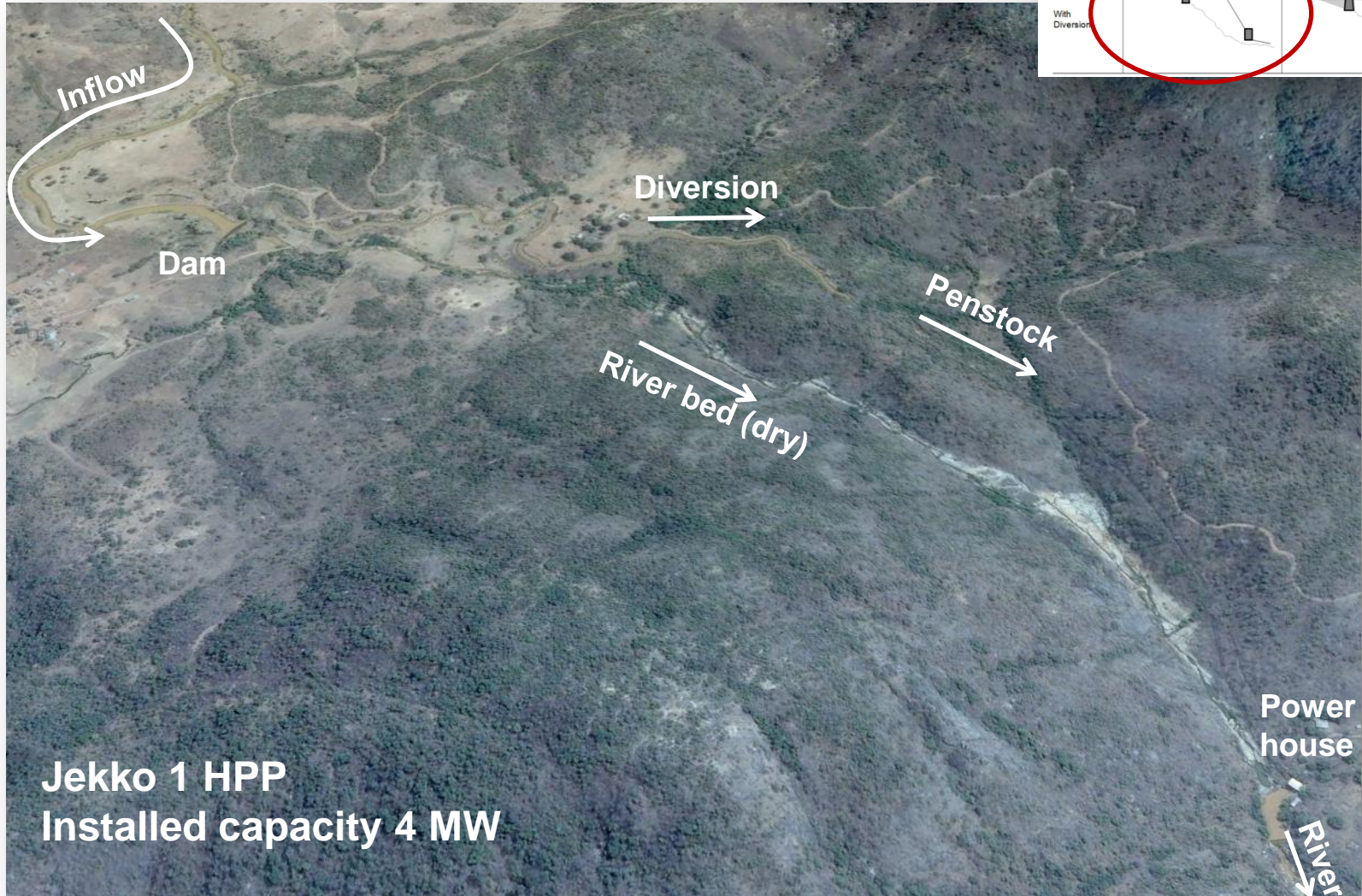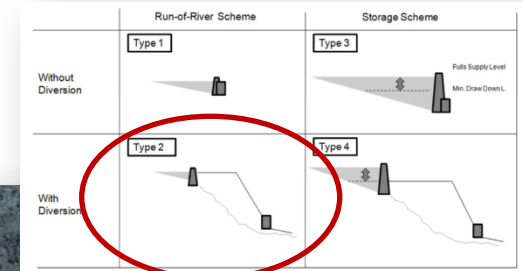
Jekko 1 HPP
Installed capacity 4 MW

Hydropower plant types

Storage scheme with diversion

Kurra HPP
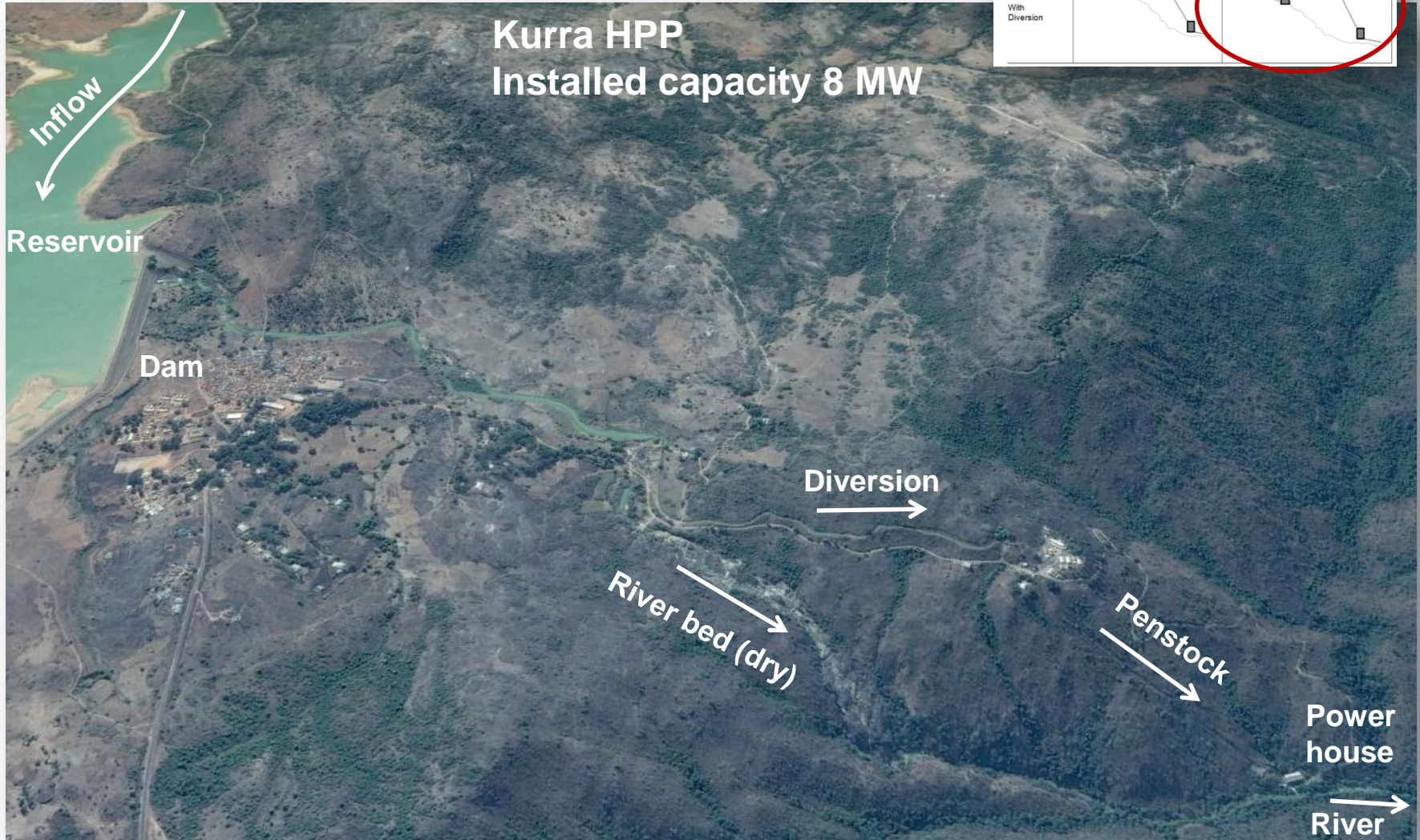Installed capacity 8 MW

Inflow

Reservoir

Dam

Diversion

River bed (dry)

Penstock

Power house

River

Hydropower plant types

Storage scheme without diversion

Kainji HPP
Installed capacity 760 MW

Inflow

Reservoir

Spillway

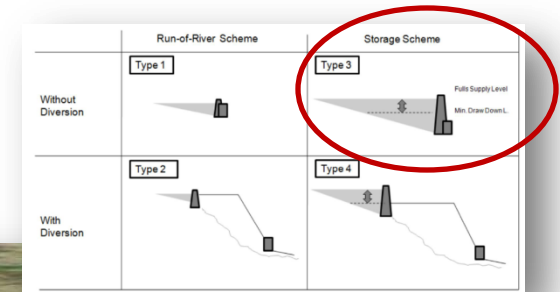Ship lock

Power house

Dam
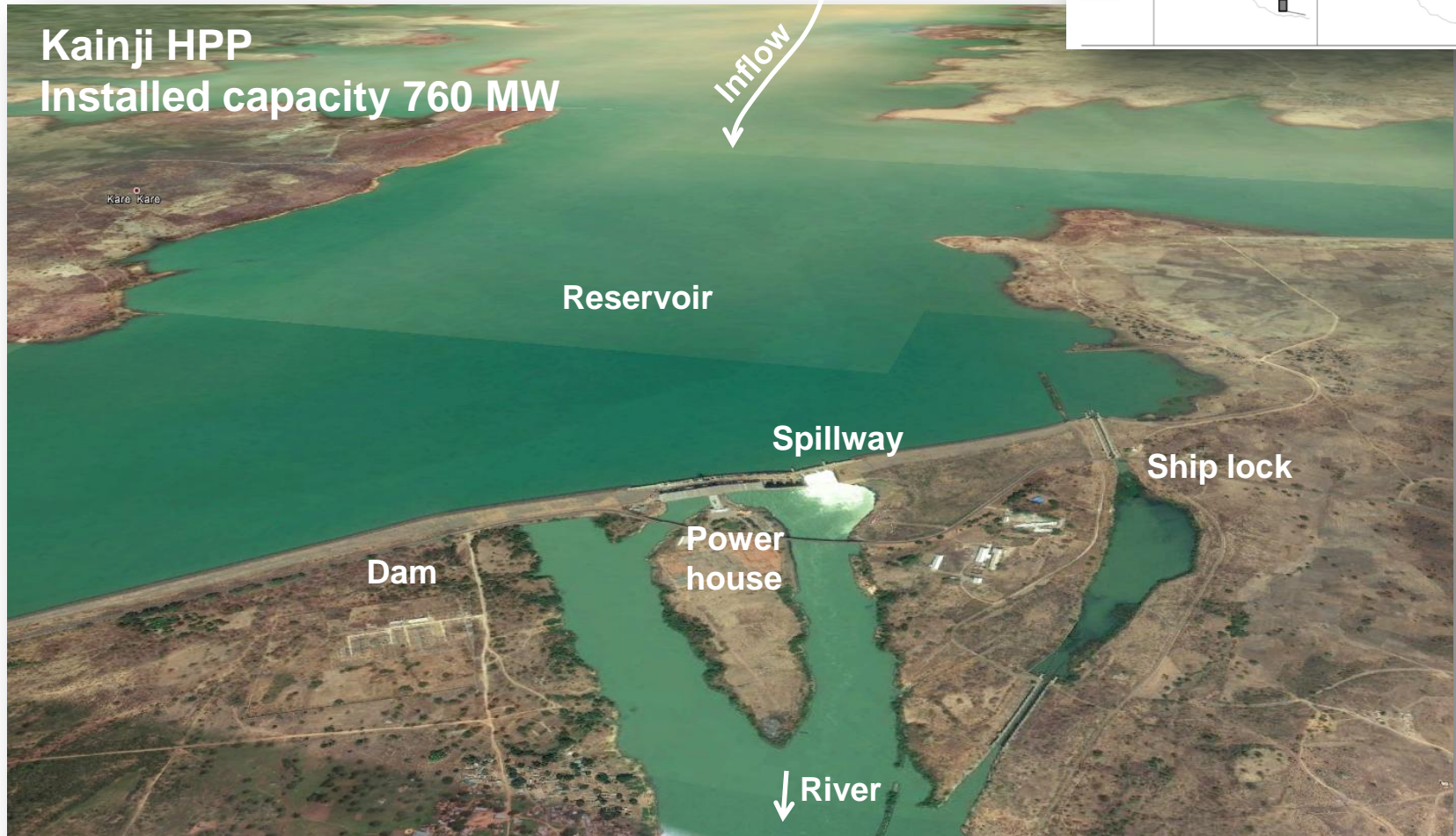
River

Hydropower plant types

Information in ECOWREX system

- Identification of areas suitable for specific plant types

- Attributes for GIS sub-area layer
  - PLANT_TYP1: Region suitable (yes/no) for hydropower plant type 1 (run-of-river without diversion)
  - PLANT_TYP2: Region suitable (yes/no) for hydropower plant type 2 (run-of-river with diversion)
  - PLANT_TYP3: Region suitable (yes/no) for hydropower plant type 3 (storage without diversion)
  - PLANT_TYP4: Region suitable (yes/no) for hydropower plant type 4 (storage with diversion)
  - A sub-area can be suitable for more than one plant type

- Classifcation system currently finalized, based on
  - General topographical characteristics of region
  - Flow characteristics
  - Hydropower potential

Hydropower plants classification

Classification of plant size

- Installed capacity
  - Key design parameter of hydropower plants
  - Used for classification of plant size

- Classification used in this study:
  - Pico/micro/mini HPP: < 1 MW installed capacity
  - Small HPP: 1-30 MW installed capacity
  - Medium/large HPP: > 30 MW installed capacity

- Classification of river reaches
  - Preferred plant size was determined for each river reach (500,000 reaches)
  - Classification scheme based on:
    - Mean annual flow [m³/s]
    - Specific hydropower potential [MW/km]

Hydropower potential

Classification of preferred plant size (installed capacity)
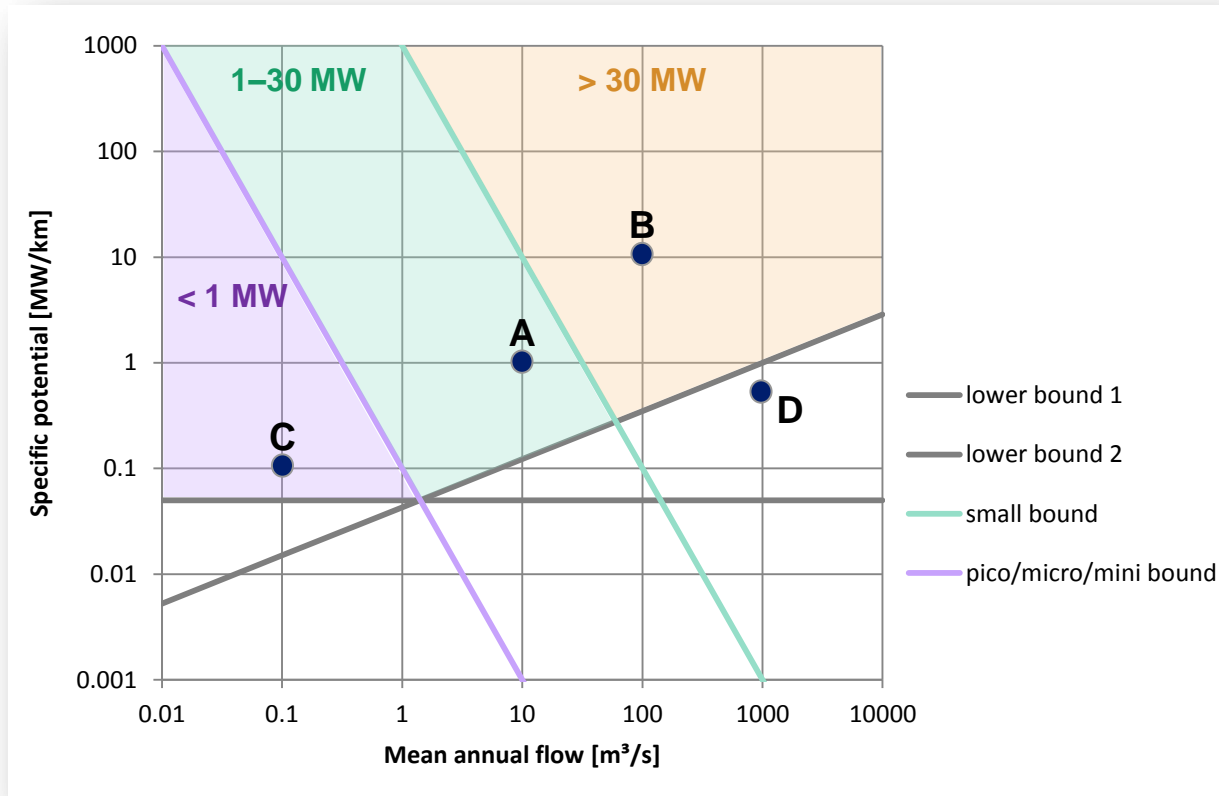
Examples:

- Reach A:
  - Mean annual flow = 10 m³/s
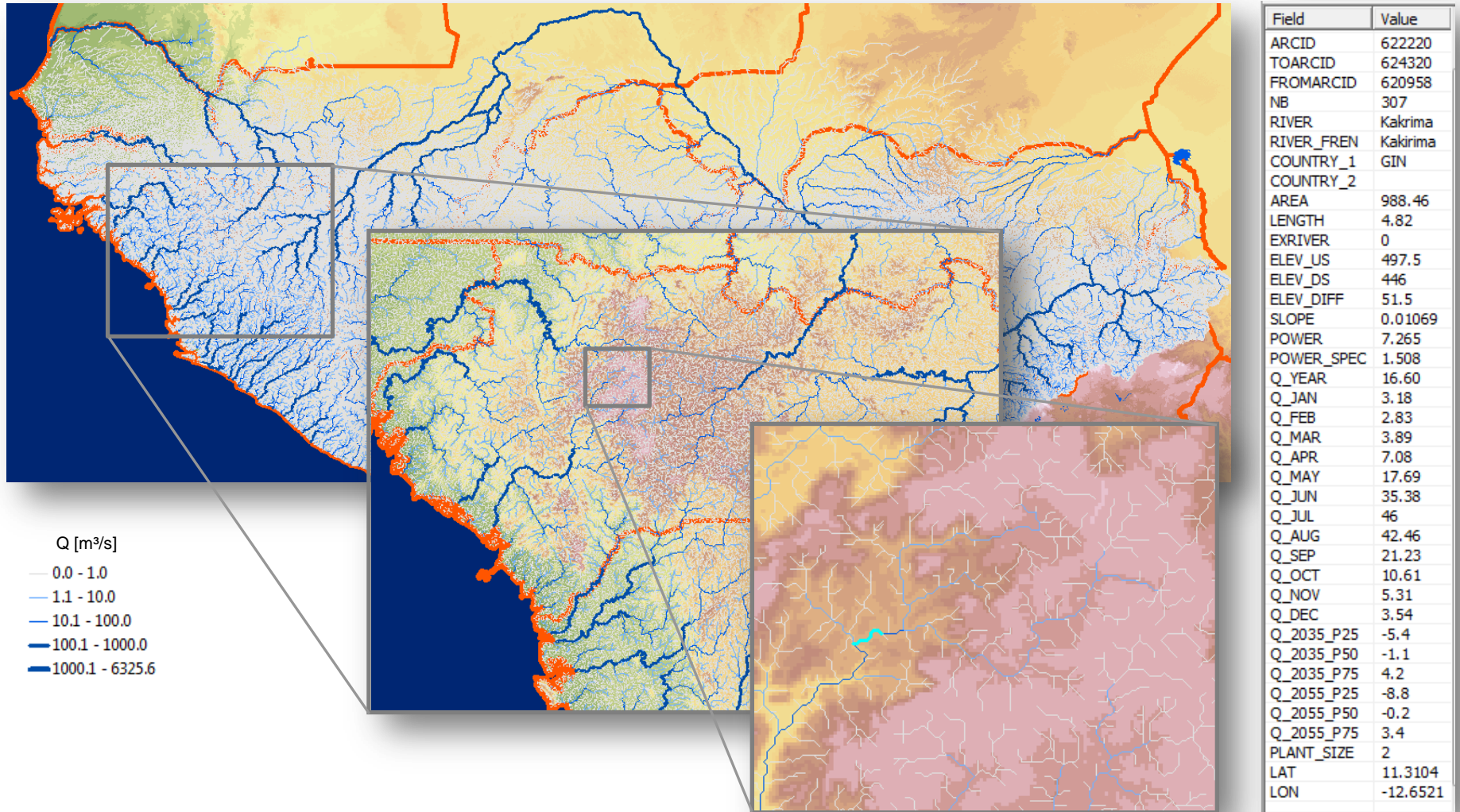 - Specific potential = 1 MW/km

- Reach B:
  - Mean annual flow = 100 m³/s
  - Specific potential = 10 MW/km

- Reach C:
  - Mean annual flow = 0.1 m³/s
  - Specific potential = 0.1 MW/km

- Reach D:
  - Mean annual flow = 1000 m³/s
  - Specific potential = 0.7 MW/km

River network layer

Zoom in and query attributes of river reaches

Field	Value
ARCID	622220
TOARCID	624320
FROMARCID	620958
NB	307
RIVER	Kakrima
RIVER_FREN	Kakirima
COUNTRY_1	GIN
COUNTRY_2	
AREA	988.46
LENGTH	4.82
EXRIVER	0
ELEV_US	497.5
ELEV_DS	446
ELEV_DIFF	51.5
SLOPE	0.01069
POWER	7.265
POWER_SPEC	1.508
Q_YEAR	16.60
Q_JAN	3.18
Q_FEB	2.83
Q_MAR	3.89
Q_APR	7.08
Q_MAY	17.69
Q_JUN	35.38
Q_JUL	46
Q_AUG	42.46
Q_SEP	21.23
Q_OCT	10.61
Q_NOV	5.31
Q_DEC	3.54
Q_2035_P25	-5.4
Q_2035_P50	-1.1
Q_2035_P75	4.2
Q_2055_P25	-8.8
Q_2055_P50	-0.2
Q_2055_P75	3.4
PLANT_SIZE	2
LAT	11.3104
LON	-12.6521

Q [m³/s]
- 0.0 - 1.0
- 1.1 - 10.0
- 10.1 - 100.0
- 100.1 - 1000.0
- 1000.1 - 6325.6

River network layer

Reaches classified for plant size

Legend:
- none
- pico/micro/mini hydropower < 1 MW installed capacity
- small hydropower 1-30 MW installed capacity
- medium/large hydropower > 30 MW installed capacity

Kinkon
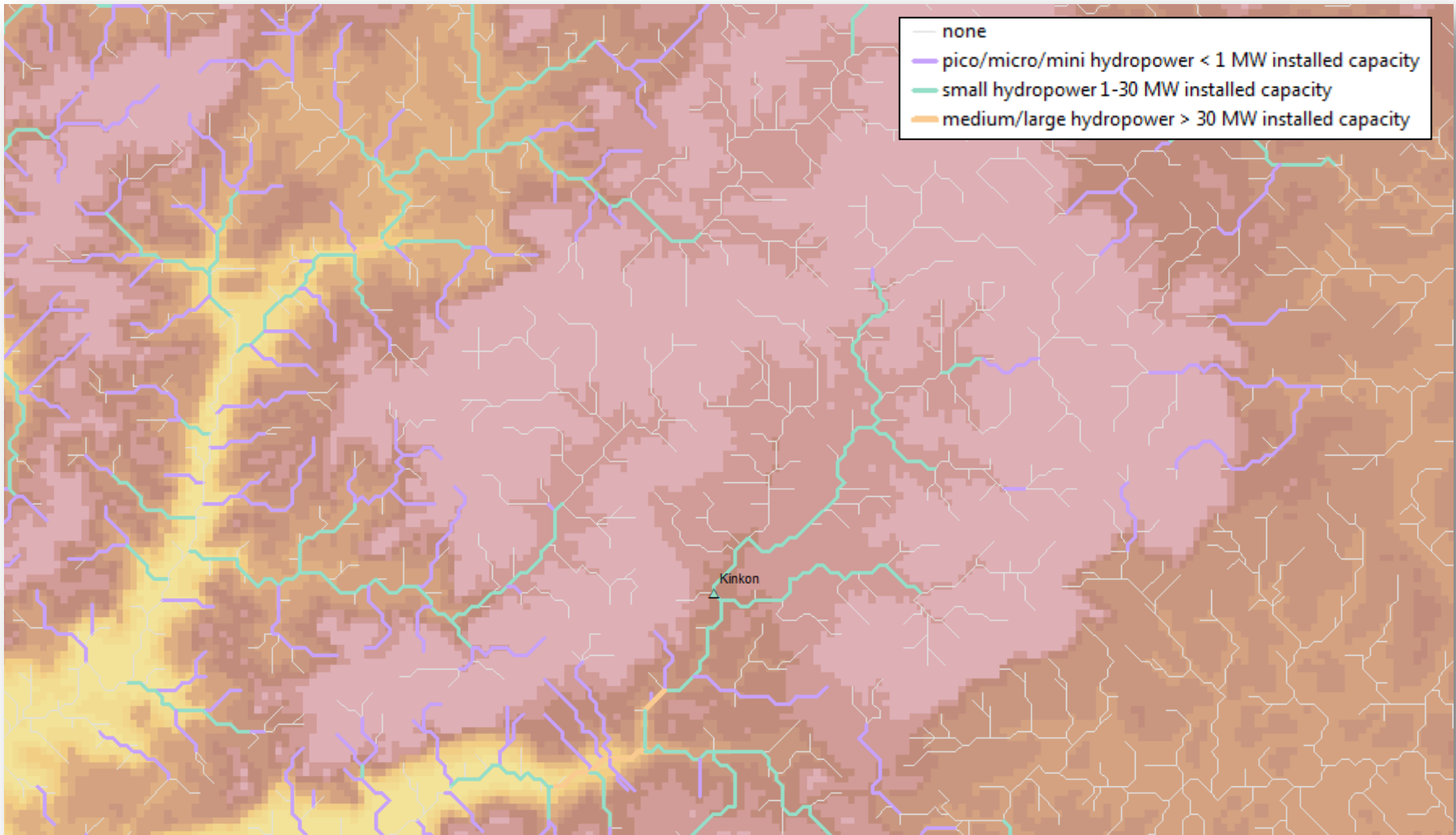
Hydropower potential

Longitudinal river profiles: Preferred plant size shown as background

Profile of Kakrima River

Kakrima basin
Coordinates of selected reach (Lat=10.844, Lon=-12.944), ArcID 670043
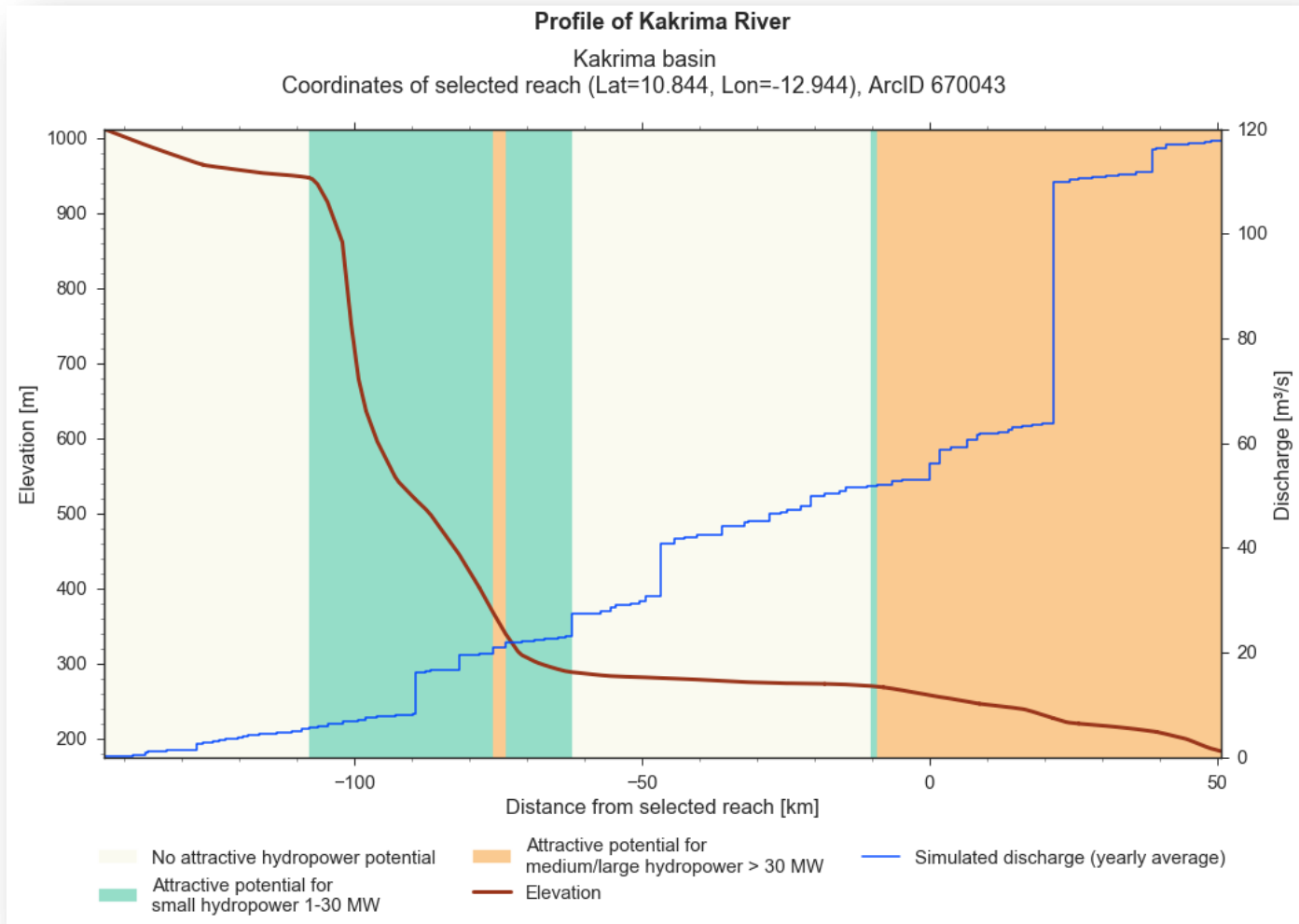
Hydropower potential

Longitudinal river profiles: Preferred plant size

Zoom in to reach
Switch between Q_YEAR and PLANT_SIZE view
Click on reach and show attributes
Note ARCID
Create longitudinal profile
In GIS pan along river and compare to long. plot
Explain tributaries

switch to GIS presentation...

Group work

Longitudinal river profiles

- Groups of 3-4 people

- Pick-up printed maps for your region of interest

- Study maps and discuss in group which river you would like to analyze in detail

- We will create the longitudinal plot together

PÖYRY   ECREEE TOWARDS SUSTAINABLE ENERGY