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# LONG TERM ANALYSIS FOR THE EVALUATION OF HYDROPOWER PLANT IMPACTS ON SOLID TRANSPORT

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Case study: Use of BASEMENT software for the  
“Prescudin dam” hydropower plant authorization.

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**STUDIODESTRO**  
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**BASEMENT**  
User's Meeting

# THE FRAMEWORK: PRESCUDIN RIVER

## GEOGRAPHICAL FRAMEWORK:

- Located in north east Italy  
Alpinia region
- Tributary river of Cellina Creek

## THE PREEXISTING DAM:

- 10 m of hydraulic jump
- 30 m width
- Distance of 400 m from the  
other dam

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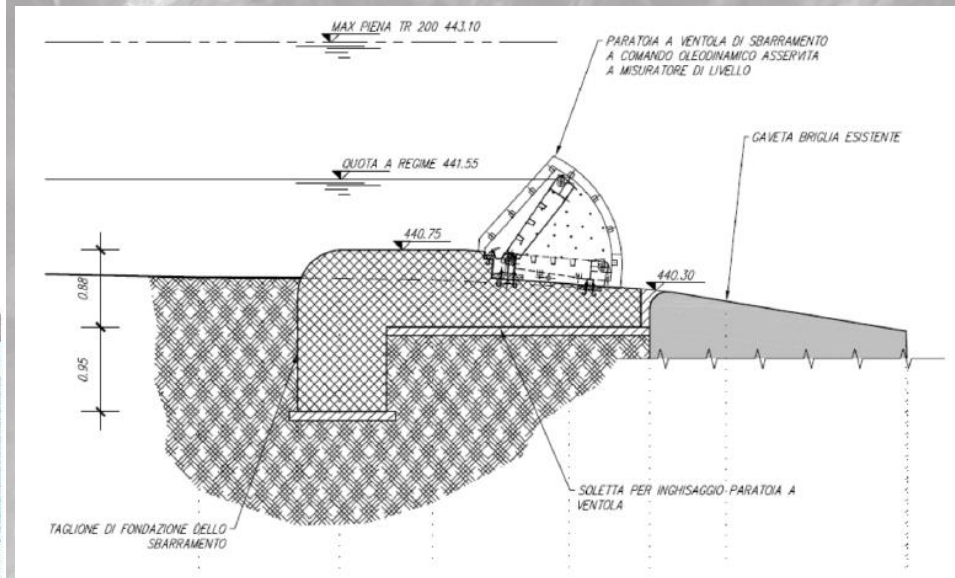
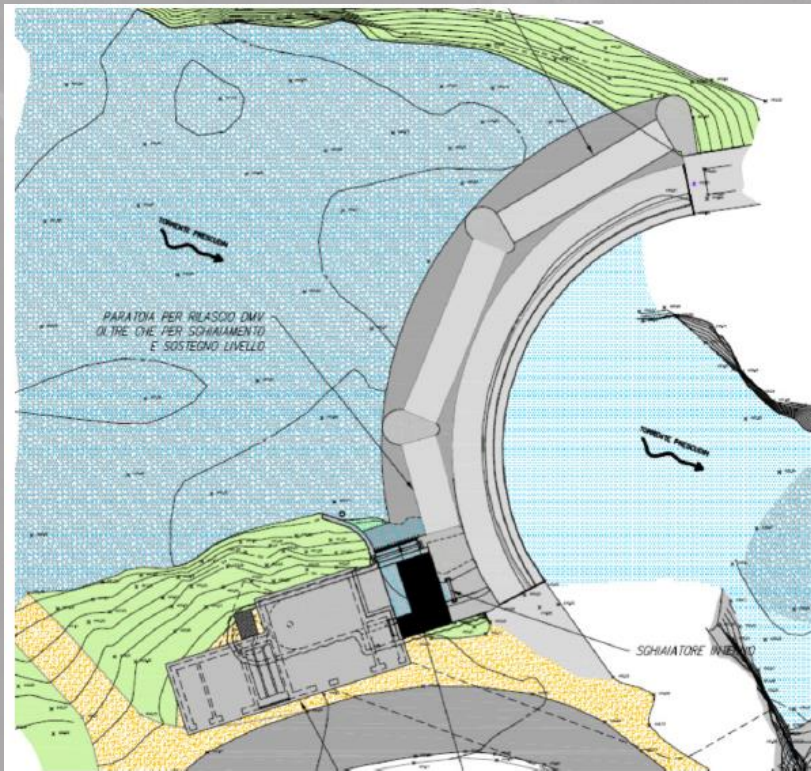


# THE DESIGN

- Build a hydropower plant structure long the preexisting dam
- Increase the hydraulic jump using 3 modular gates:
  - Move water long a preferential way
  - Modulate flow with extreme event

GENERATION OF:

**93,51 kW**



# THE ITALIAN LAW

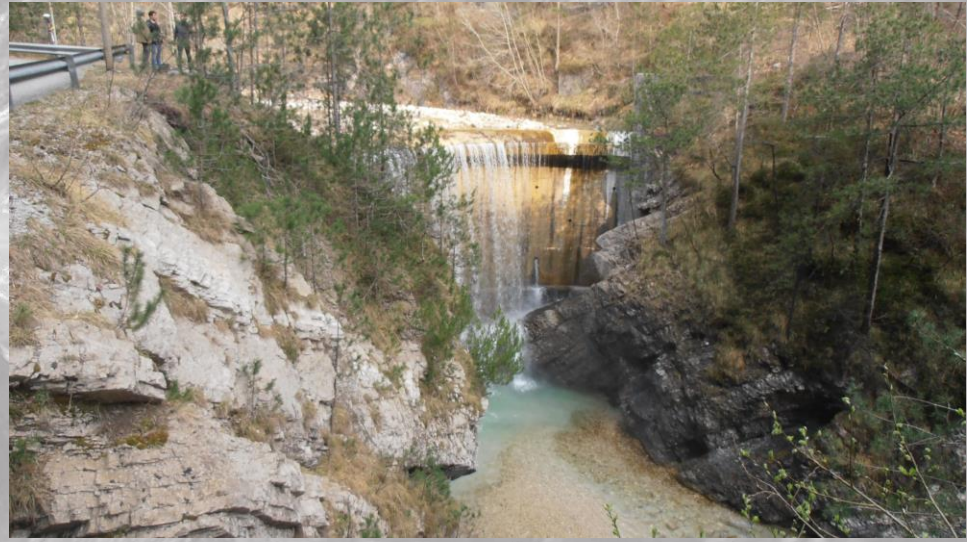
In this zone, Italian law doesn't allow new water withdrawals unless it is guaranteed that any alteration will affect the **longitudinal profile**, **hydraulic jump** and **section** of the river.



2D MORPHODYNAMICAL MOVABLE BED MODEL  
USING **BASEMENT ETH SOFTWARE**

# THE WORKFLOW

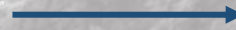
1. SITE INSPECTION
2. TOPOGRAPHIC SURVEY
3. HYDROLOGICAL ANALYSIS
4. MESH GENERATION
5. BASEMENT SIMULATION
6. DATA ANALYSIS
7. CONCLUSION



# SITE INSPECTION

EVALUATION OF:

- **AREA** POTENTIALLY INTERESTED BY NEW CONSTRUCTIONS



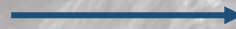
- LENGTH: **400 m**
- TOTAL AREA: **42'000 m<sup>2</sup>**

- **GRANULOMETRIC** COMPOSITION



- **5** GRAIN DIAMETERS
- **4** GRAIN CLASSES

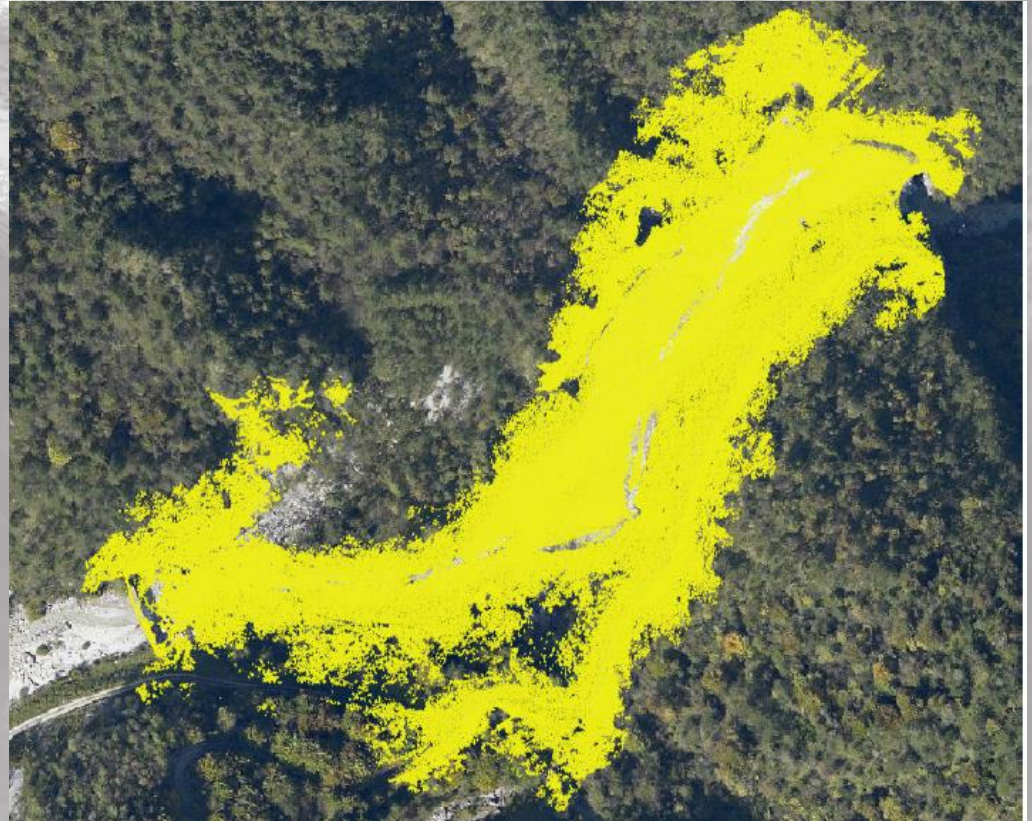
- **SOIL** CHARACTERISTIC



- **8** ZONE TYPE



# TOPOGRAPHICAL SURVEY



**300'000 POINTS** WITH AN INTERDISTANCE OF 0,5 m

# HYDROLOGICAL ANALYSIS

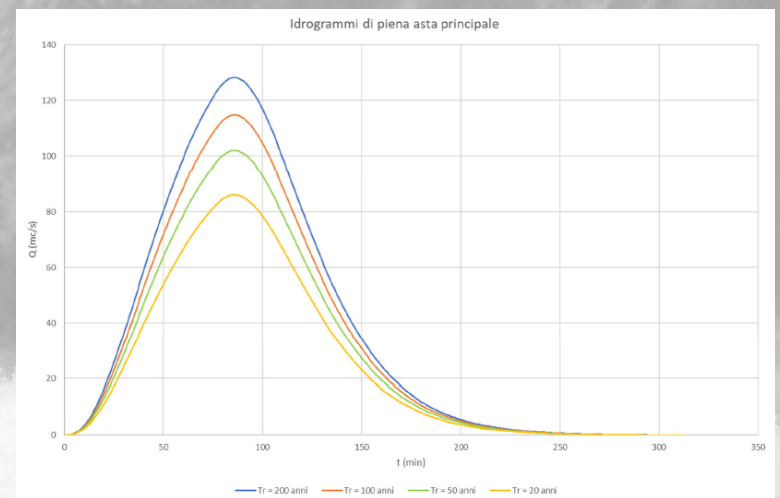
## CHARACTERISTICS:

- 1 MAIN PART + 2 SMALLEST TRIBUTARY
- 16,9 km<sup>2</sup> BASIN
- QUITE PERMEABLE SOIL



## INDIVIDUATION OF:

- **DAILY “TYPICAL” YEAR BEHAVIOUR**
- **SEASONAL FLOW RATE EXTREAMES**
- **FLOOD WAVE FOR 20, 50, 100, 200 RETURN PERIOD**





# MESH GENERATION

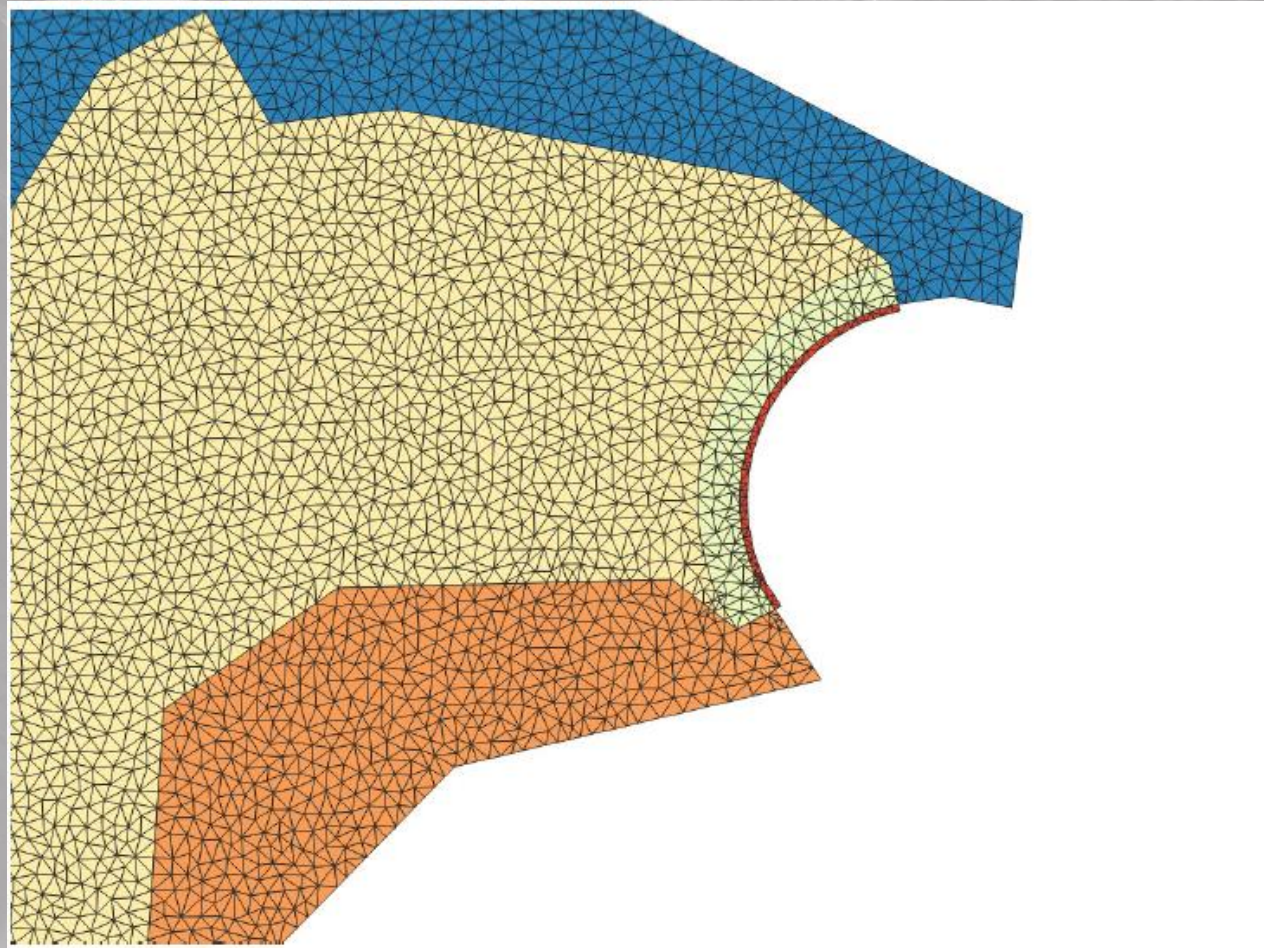
## **BASEmesh** TOOL INTO QGIS

1. Quality mesh
2. Elevation mesh
3. Interpolated mesh



### EXTRACTED MESH:

- **18'658** points
- **23246.3 m<sup>2</sup>** area



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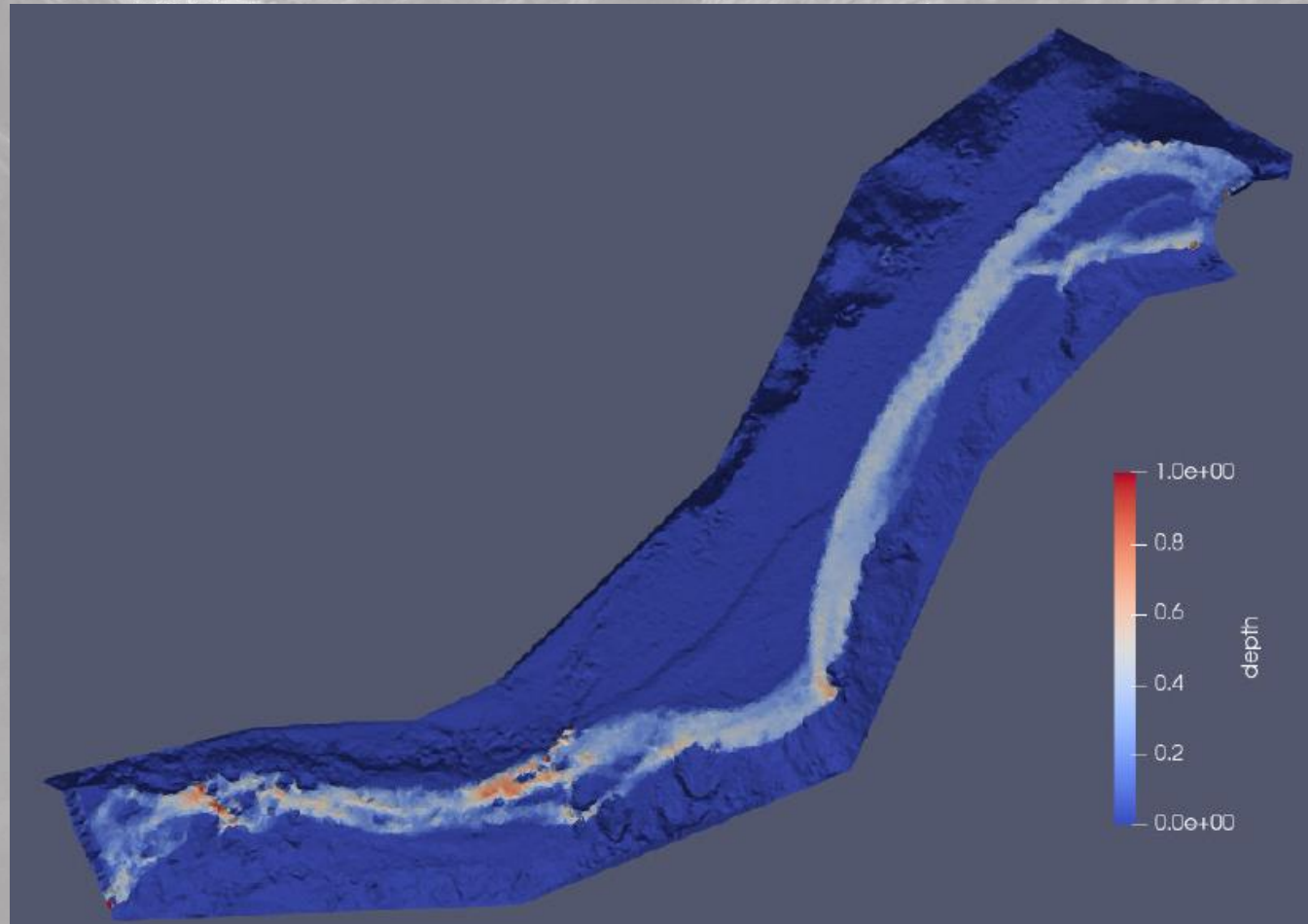
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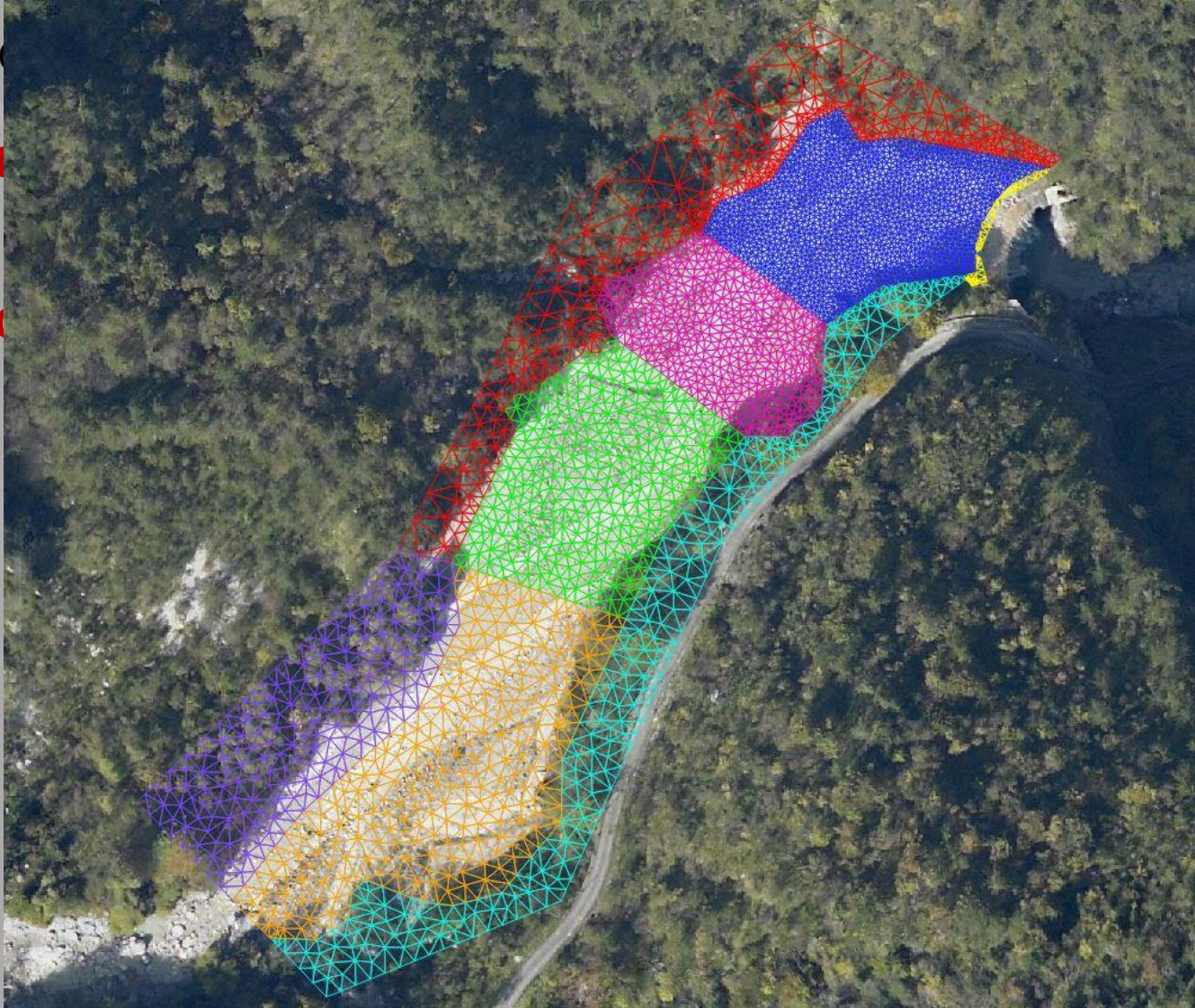


# MESH GENERATION

NEED FOR SC

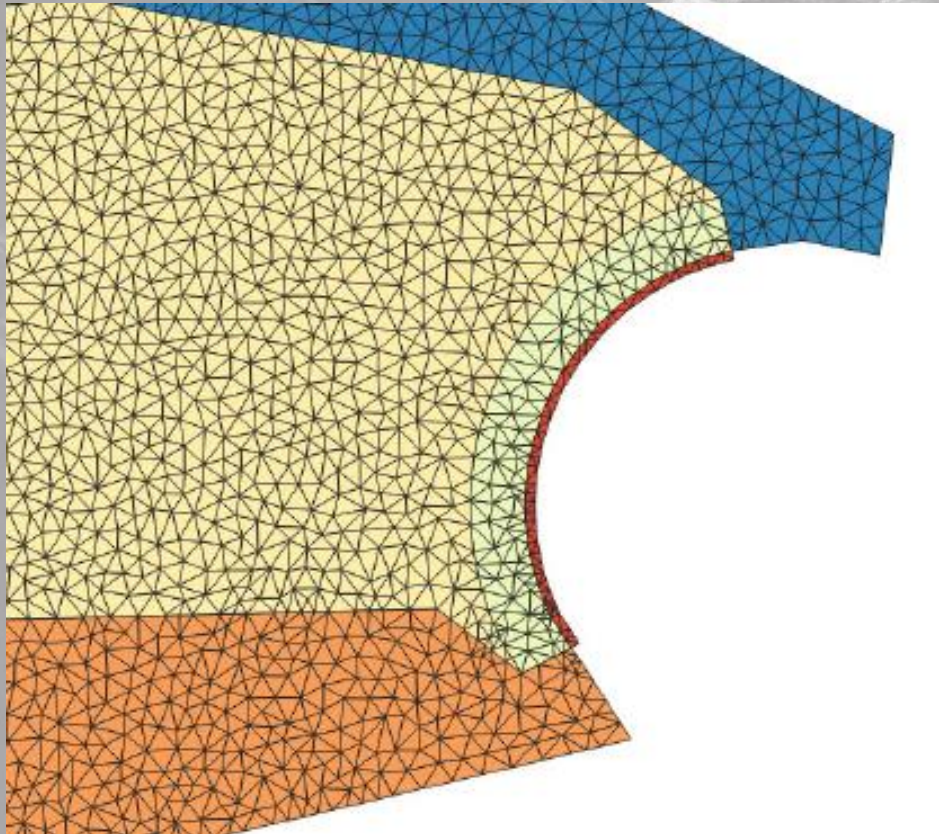
1. HYD

2. GEO

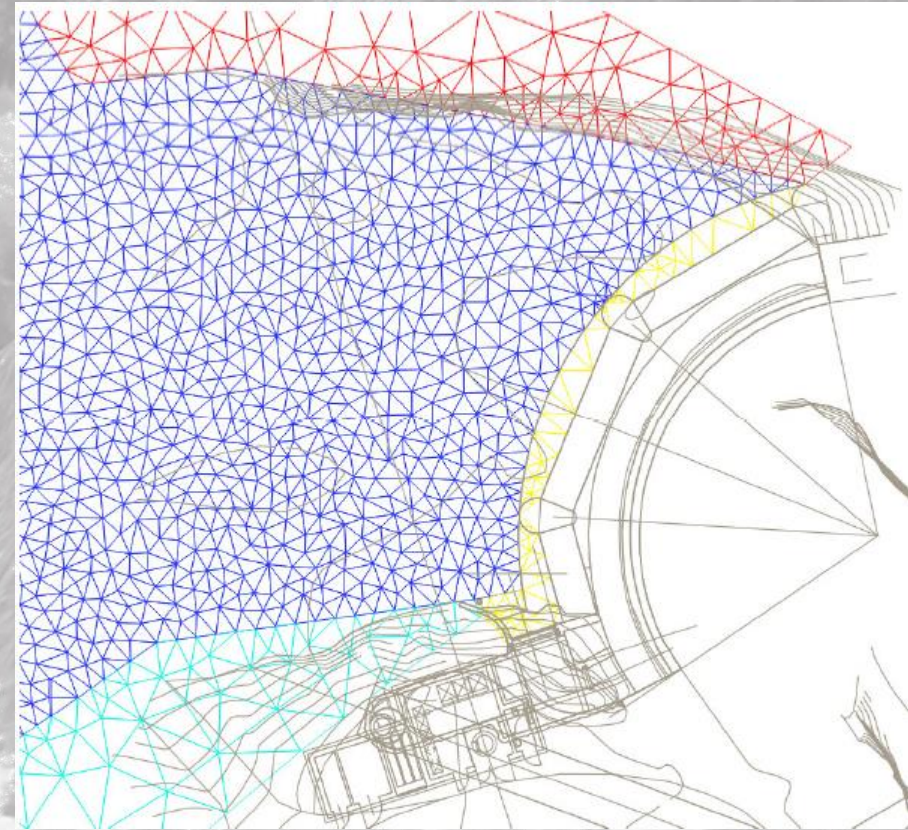


# MESH GENERATION

TWO RESULTING MESHES:

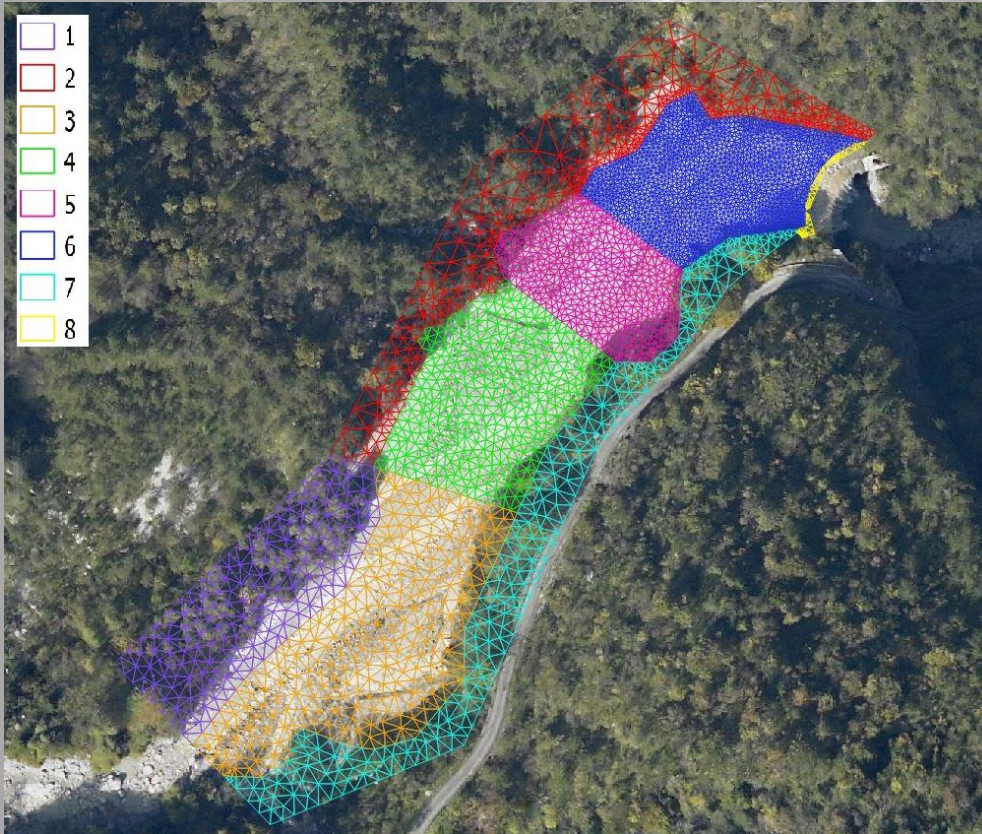


**PRESENT STATE MESH**



**DESIGN STATE MESH**

# BASEMENT SIMULATION: GENERAL



- **8 SOIL TYPES:**
  - ERODIBILITY
  - GRAIN CLASS
  - FRICTION
- **EXTERNAL SOURCES:** TRIBUTARY RIVER'S FLOOD WAVES
- **LONG SIMULATION:** SEVERAL RESTART SAVES
- **GRAVITATIONAL TRANSPORT**

# BASEMENT SIMULATION: BOUNDARY CONDITIONS

## HYDRAULIC CONDITIONS:

- INLET: HYDROGRAPH
- OUTLET:
  - PRESENT STATE
  - DESIGN STATE
- FIXED NODE LONG THE DAM BORDER
- H-Q: 90% SLOPE
- WATER WITHDRAW: H-Q and WALL
- DMV GATE: WEIR and H-Q (i=90%)
- GATES: WALL, WEIR and H-Q

## SOLID TRANSPORT CONDITIONS:

- INLET: IOUp
- OUTLET: IODown

## SUSPENDED LOAD CONDITIONS:

- INLET: No B.C. → clean water
  - OUTLET: out\_down
- Only for 2 and 20 mm diameter grains

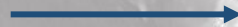
# RESULTS ANALYSIS: PERFORMED TEST

- **TYPICAL YEAR**



12 DAYS SIMULATION LENGTH

- **FLOOD WAVE**



RETURN TIME OF:

- 20 YEAR;
- 50 YEAR;
- 100 YEAR;
- 200 YEAR.

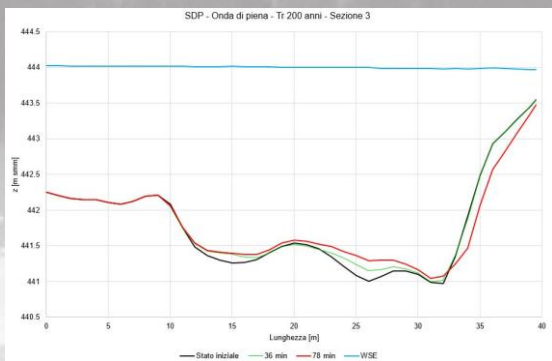
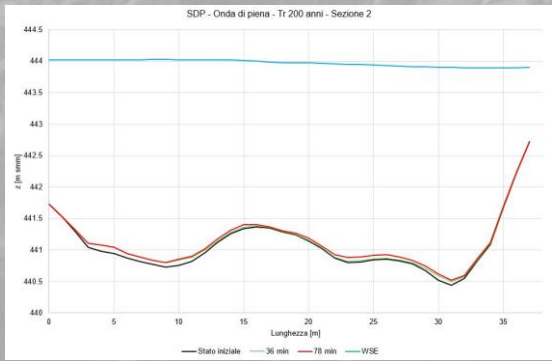
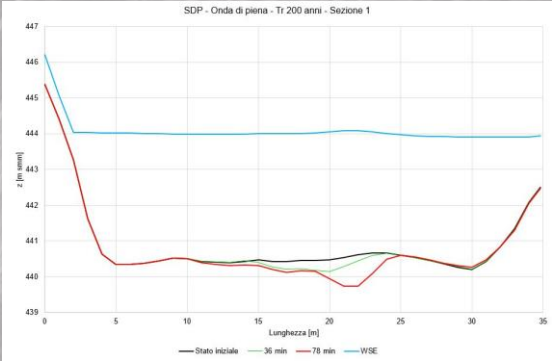
- **SEASONAL FLUCTUATIONS**



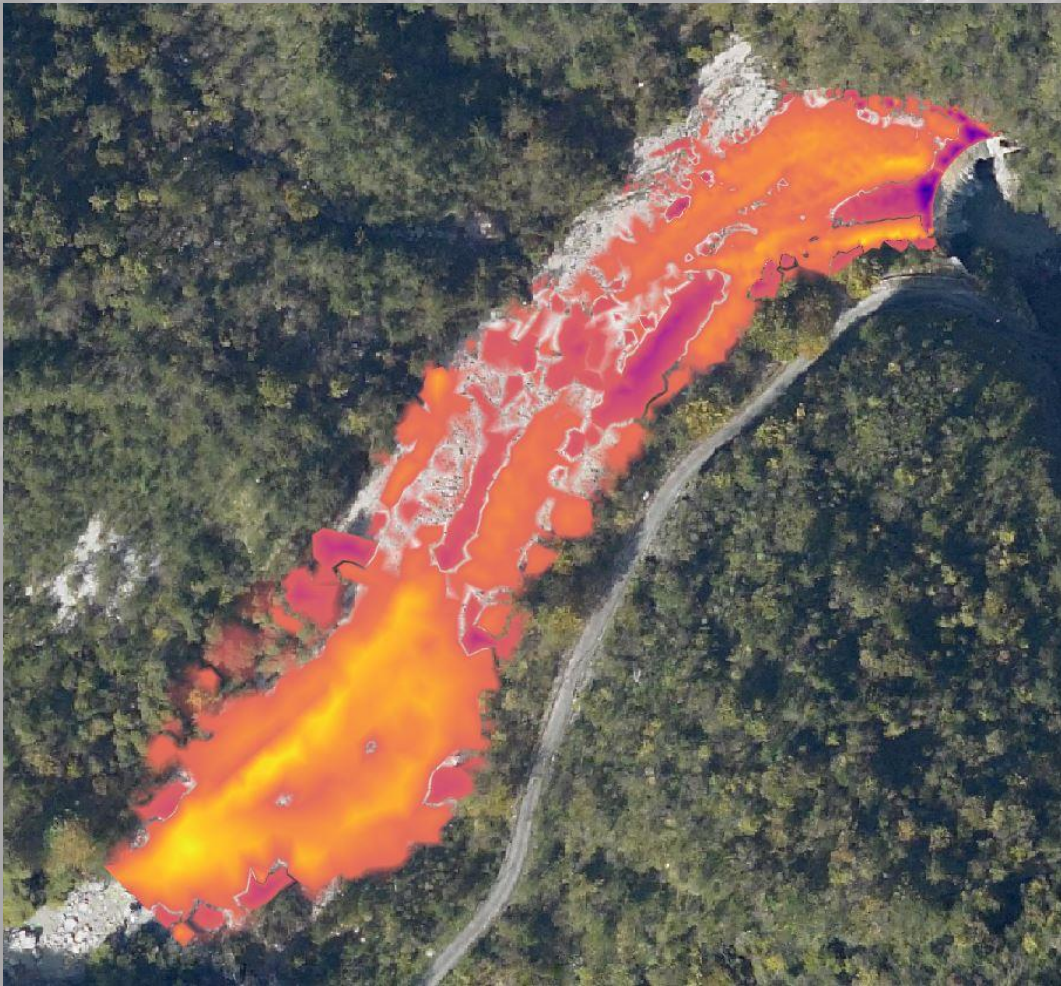
- AUGUST: POOR FLOWRATE
- MAY: LARGE FLOWRATE
- NOVEMBER: LARGE FLOWRATE



# RESULTS ANALYSIS: RIVER SECTION



# RESULTS ANALYSIS: PLAN VIEW



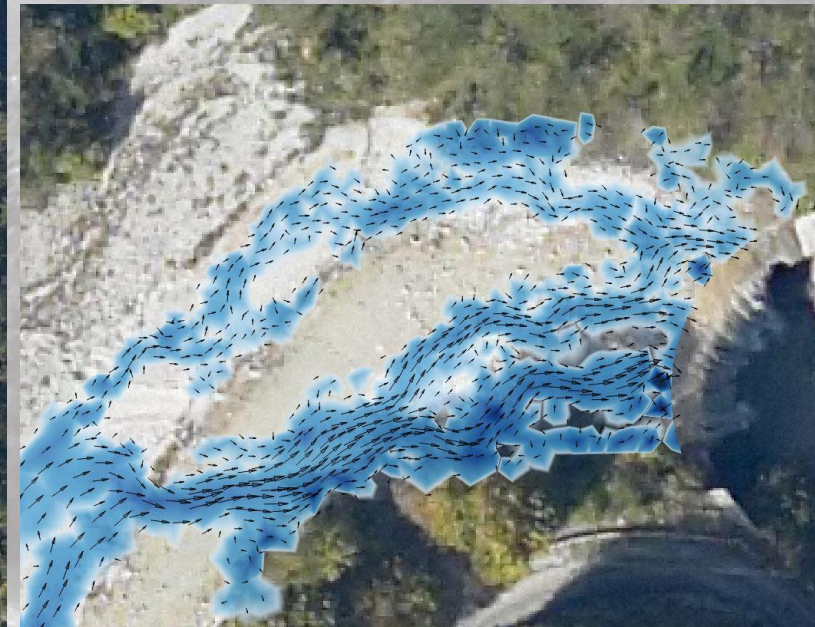
## EROSION AND ACCOMULATION



# RESULTS ANALYSIS: PLAN VIEW



**FLOW RATE**



# RESULTS ANALYSIS: CONCLUSIONS

- ✓ NO MODIFICATION OF THE LONGITUDINAL PROFILE
- ✓ ALTERATION OF HYDRAULIC JUMP ONLY WHEN WITHDRAW IS WORKING
- ✓ REVERSIBLE MODIFICATION OF RIVER SECTION



**REGIONAL ISTITUTION  
APPROVES THE PROJECT**



**THANK YOU FOR THE ATTENTION**