GLM MORRIS ENGINEERING

Water Supply Intake Structures

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Overview

- Good intake design requires knowledge of sediment transport and geomorphic patterns.
- This presentation illustrates some basic river patterns associated with instream structures.
- Several examples of intake design based on these principles are presented.

Criteria	Important for Water Supply	Important for Aquatic Life
#1 Structural Stability	Structure should be structurally sound and not damaged by floods.	Structure should not promote bank erosion or other forms of channel instability.
#2 Sustain Sediment Transport	The structure should sustain a pool of adequate depth in front of the intake, not accumulate sediment and debris.	The structure should sustain the transport of coarse materials along the stream, and environmentally-damaging maintenance activities should be avoided.

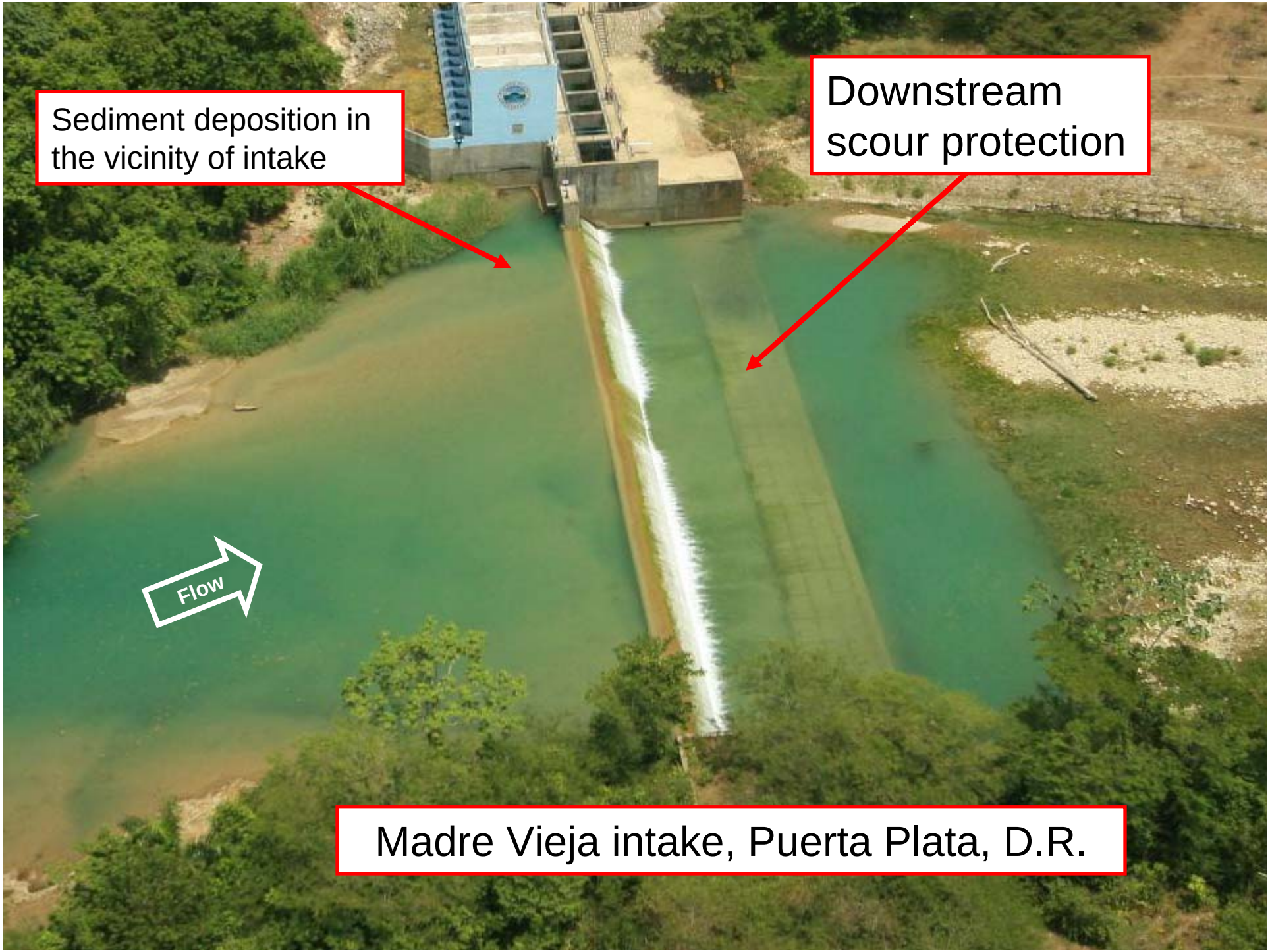
Criteria	Important for Water Supply	Important for Aquatic Life
#3 Migration Path	Not important	Provide a migration path so that both larval and adult stages are able to migrate, both in the upstream and the downstream direction.
#4 Minimum Flow	Structure should sustain withdrawals under all conditions	Guarantee continuous release of water downstream to sustain minimum instream flows.

Typical Water Supply Intakes

- Consist of low dam which accumulates sediment on upstream side.
- Prone to clogging by coarse sediment following floods
- Can act as migration barriers.

Río Guajataca pumped intake, Quebradillas

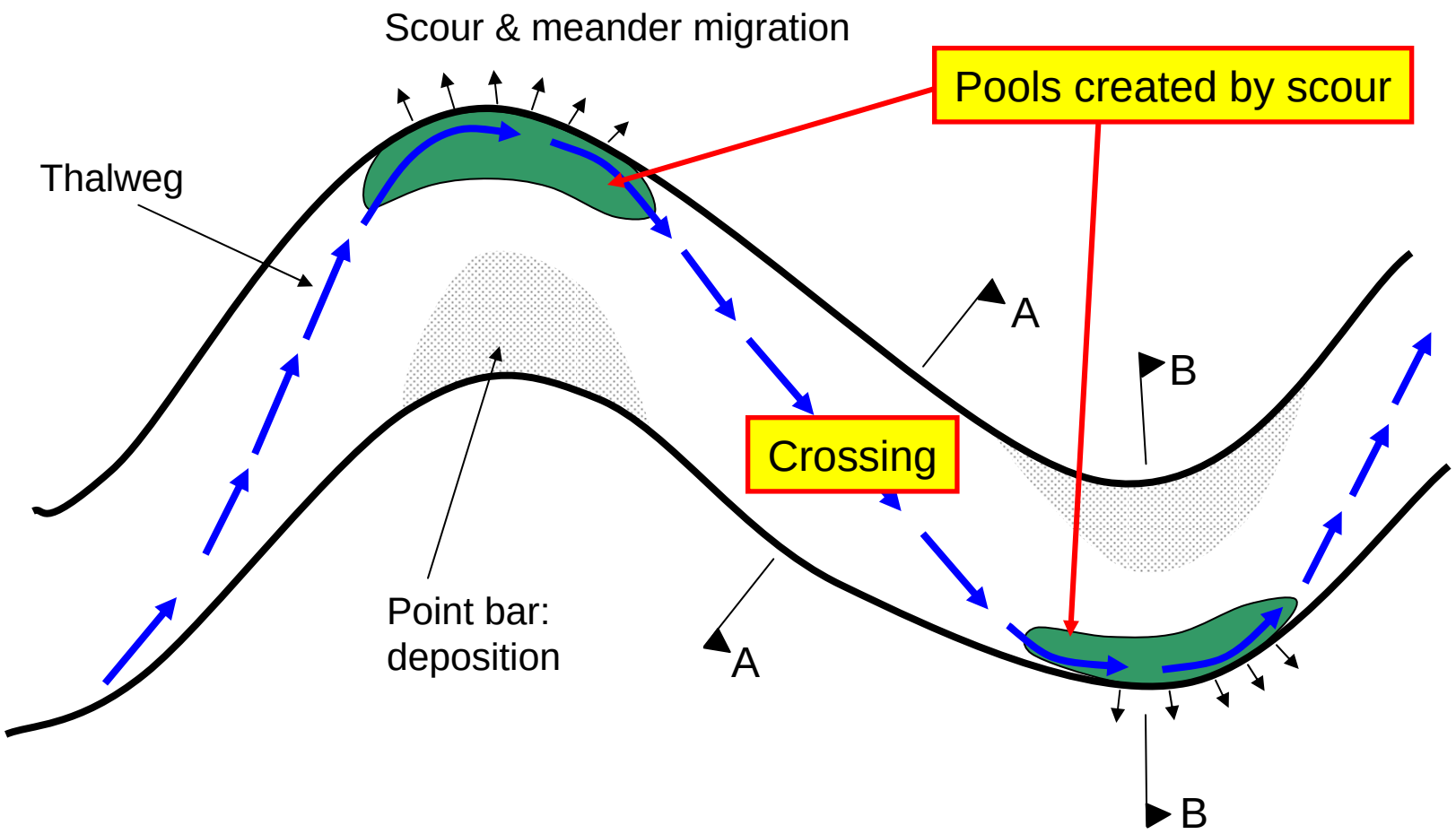
Río Cañas gravity intake, Miradero FP, Mayagüez.


Sediment deposition in the vicinity of intake
Downstream scour protection
Flow
Madre Vieja intake, Puerta Plata, D.R.

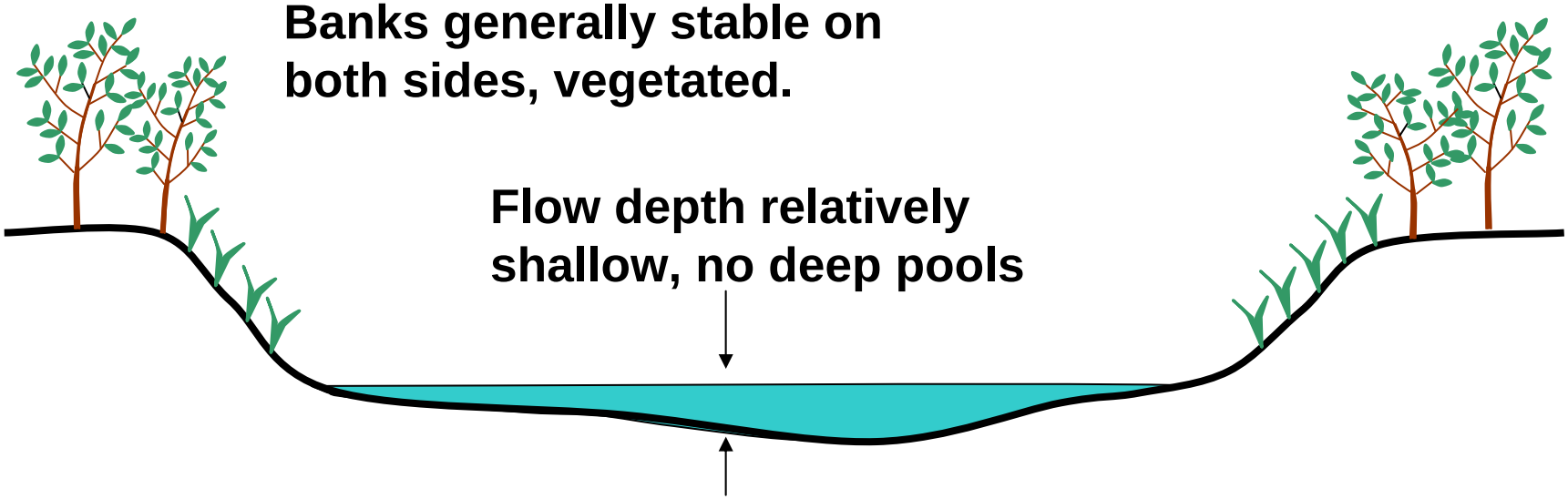
Intake design can be improved by utilizing basic geomorphic patterns in streams

- Meanders
- This presentation illustrates some basic river patterns associated with instream structures.
- Several examples of intake design based on these principles are presented.

Basic geomorphic patterns in streams

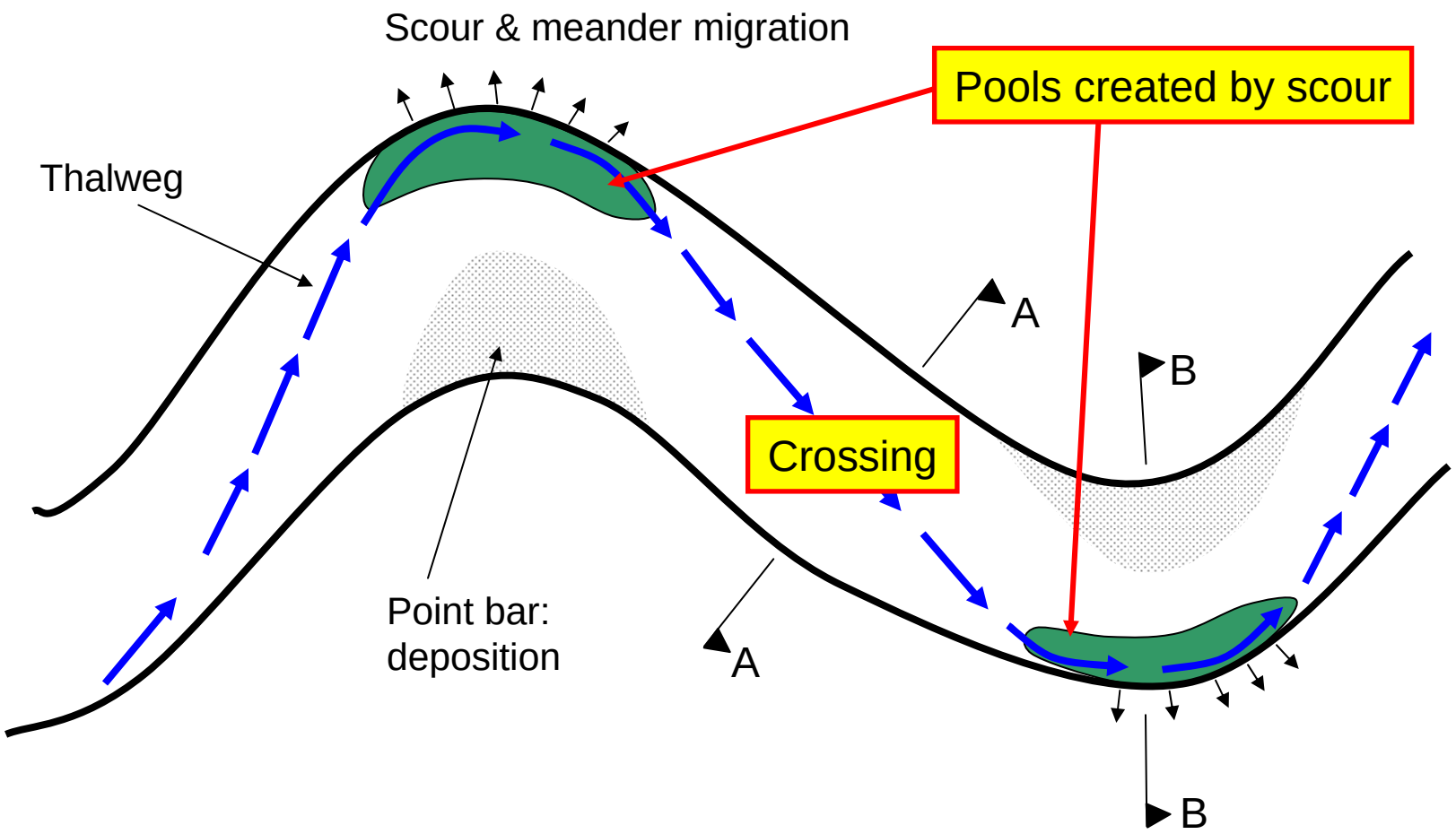


Crossing:
Shallow water, flow parallel to banks

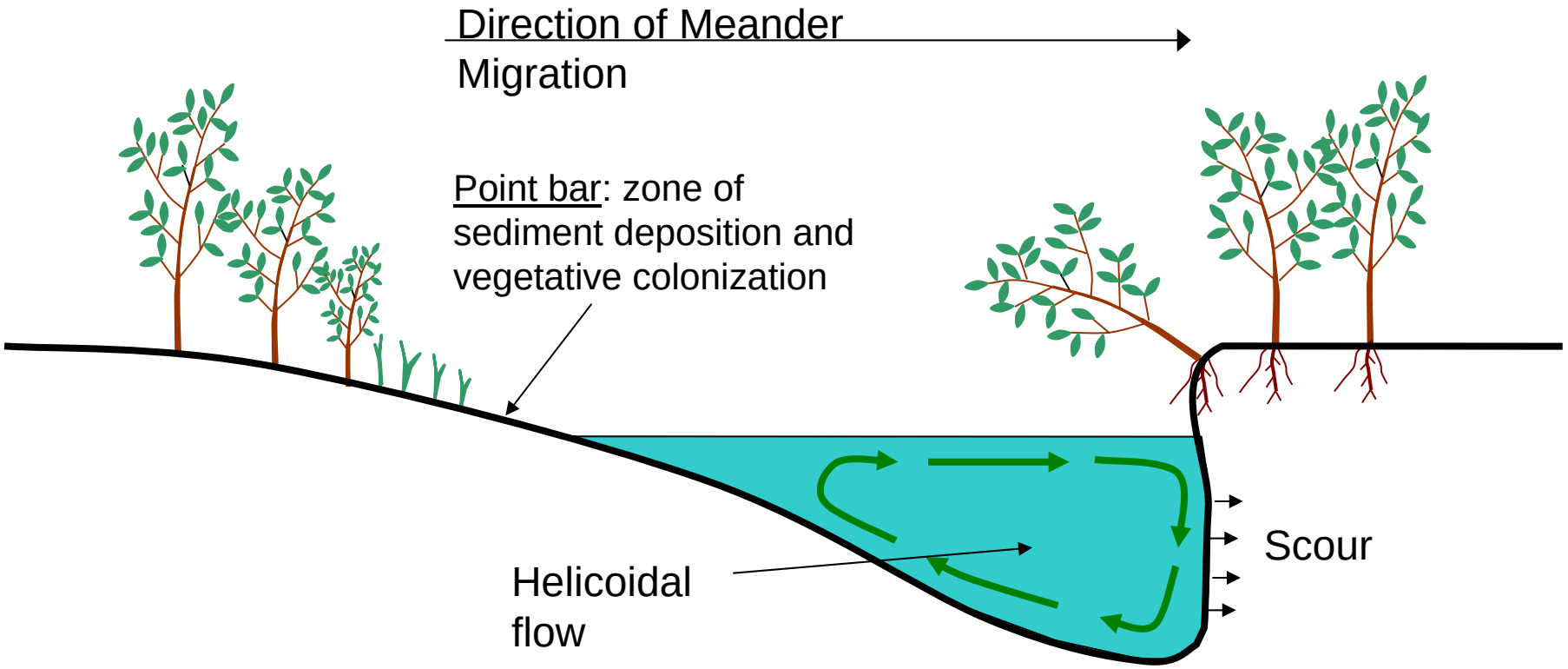


Section A-A
CROSSING

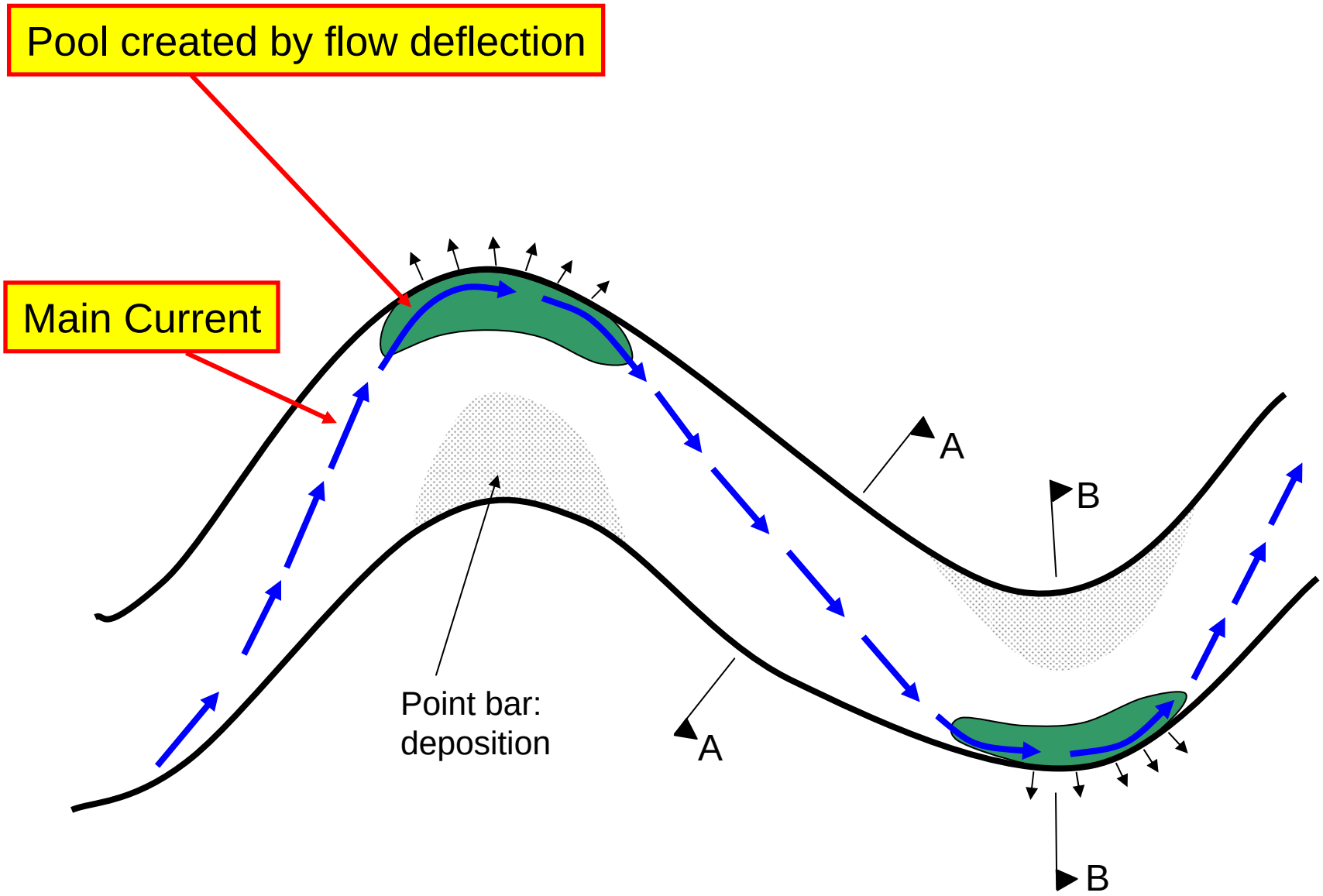
Basic geomorphic patterns in streams



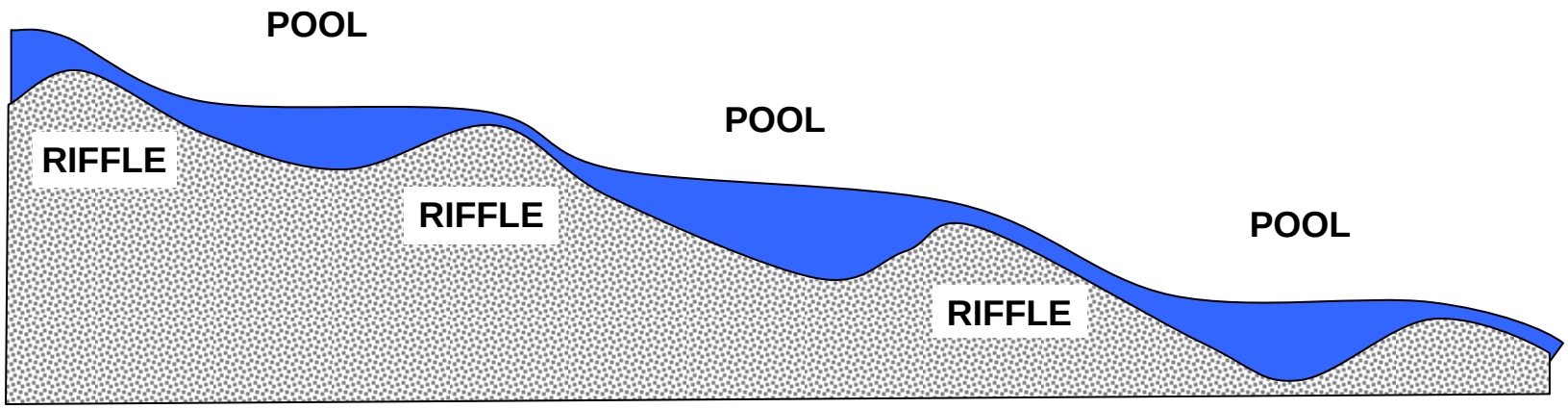
Pools:
scour hole created by deflection of flow by the bank at a meander bend



Section B-B
MEANDER BEND


Pool created by flow deflection
Main Current
A
B
Point bar:
deposition
A
B

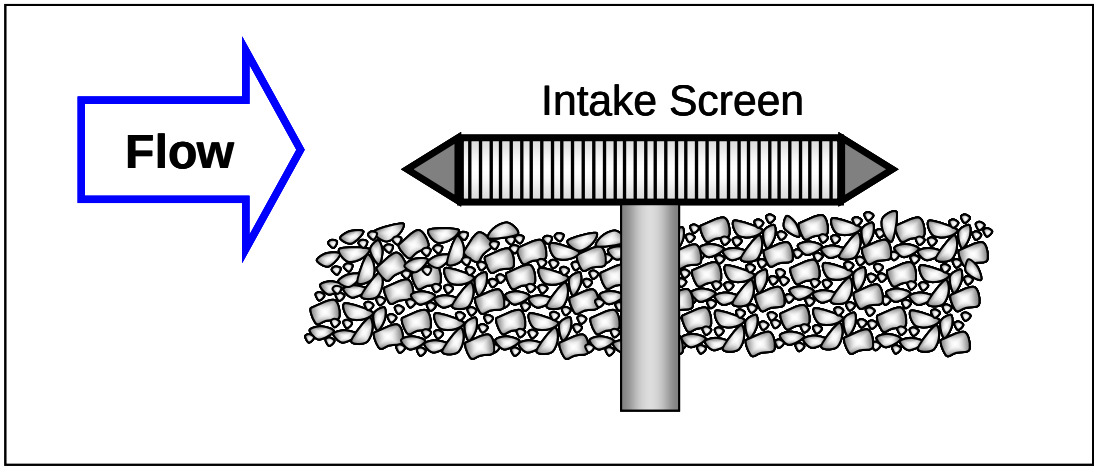
- **The natural riffle-pool sequence creates alternating areas of lesser and greater depth.**
- **It is logical to place intakes in areas that are naturally deep, or where depth can be created by scour.**



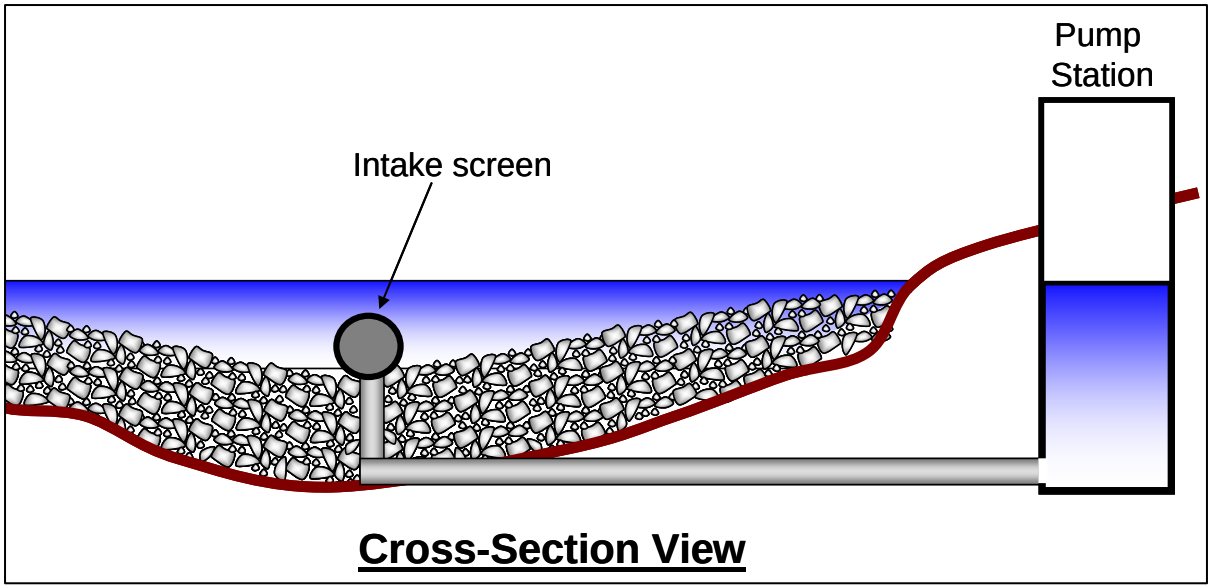
Strategy #1:
Locate intake in natural pool

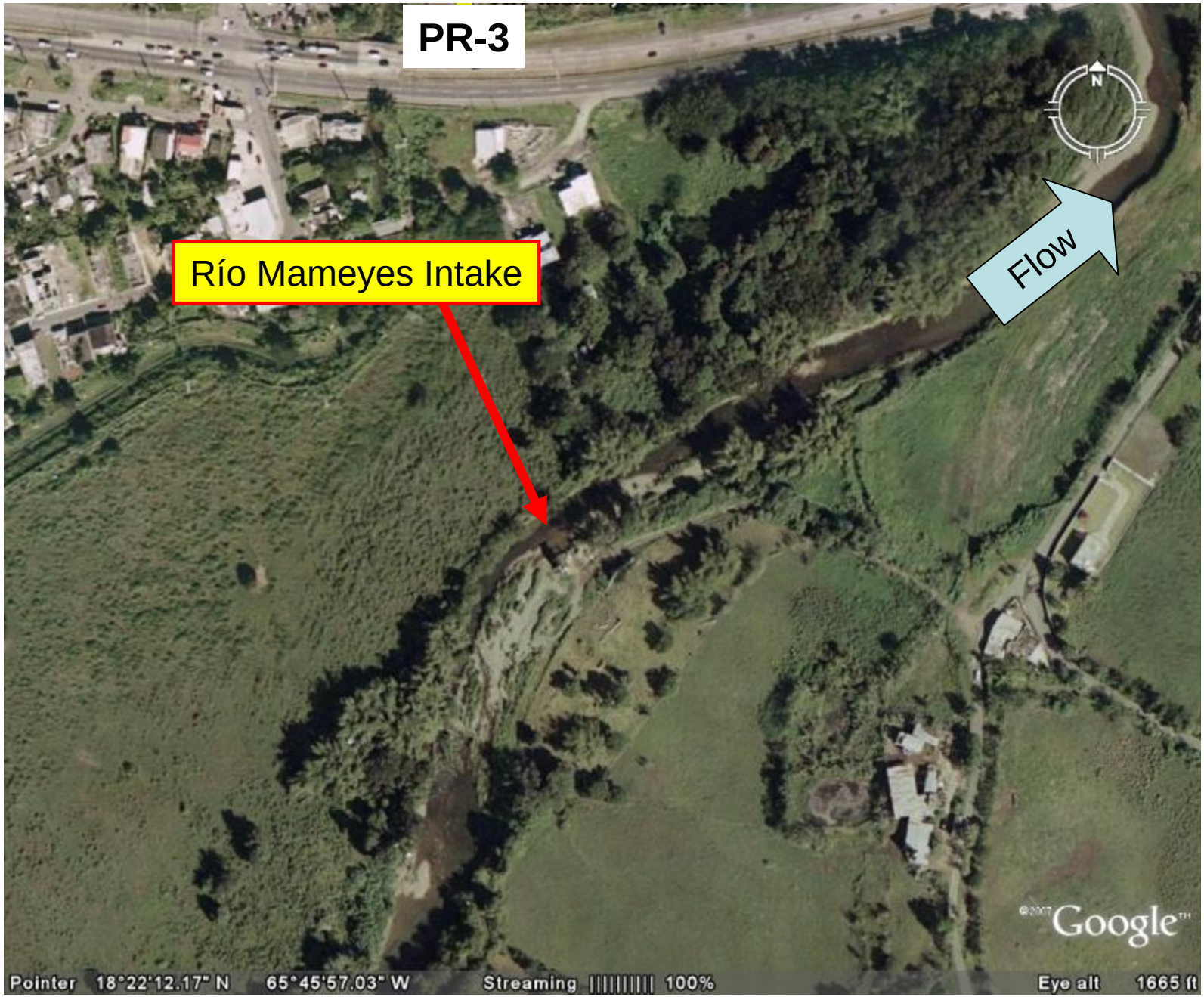
- Use existing stable scour pool in the river.
- Typically results in intake being located at the exterior of a meander bend.
- Should have rock or engineered structure to insure stability of bankside structures.

Río Mameyes intake:
An example of optimum intake design

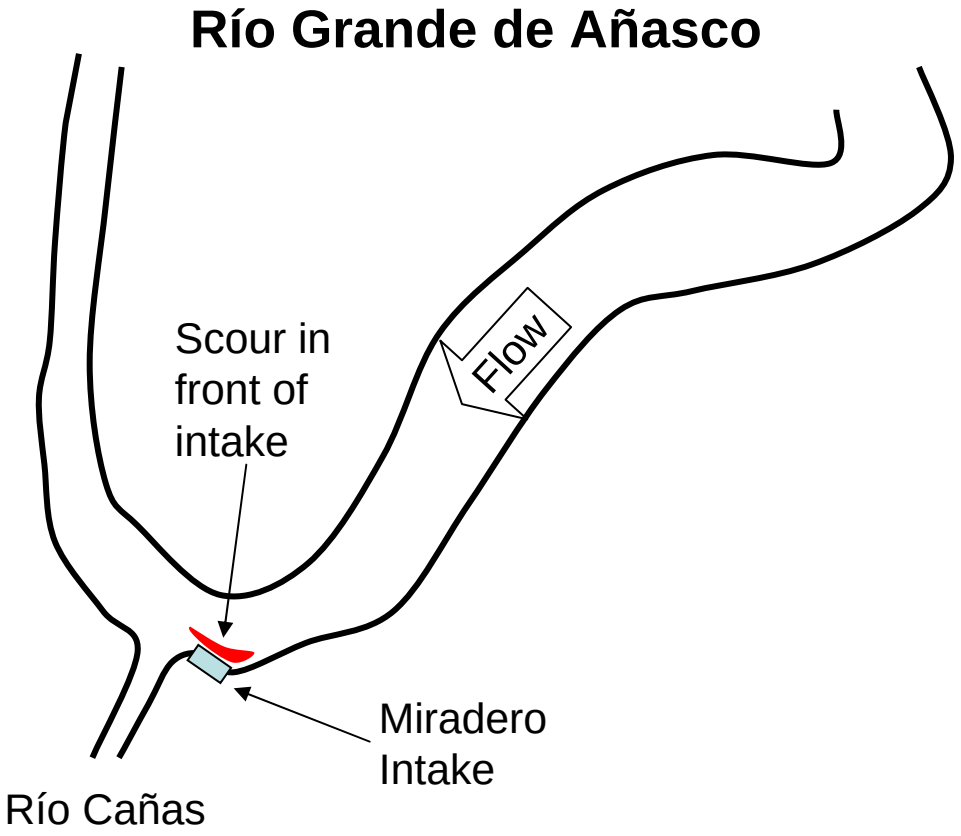


Extraction limited to 5 mgd

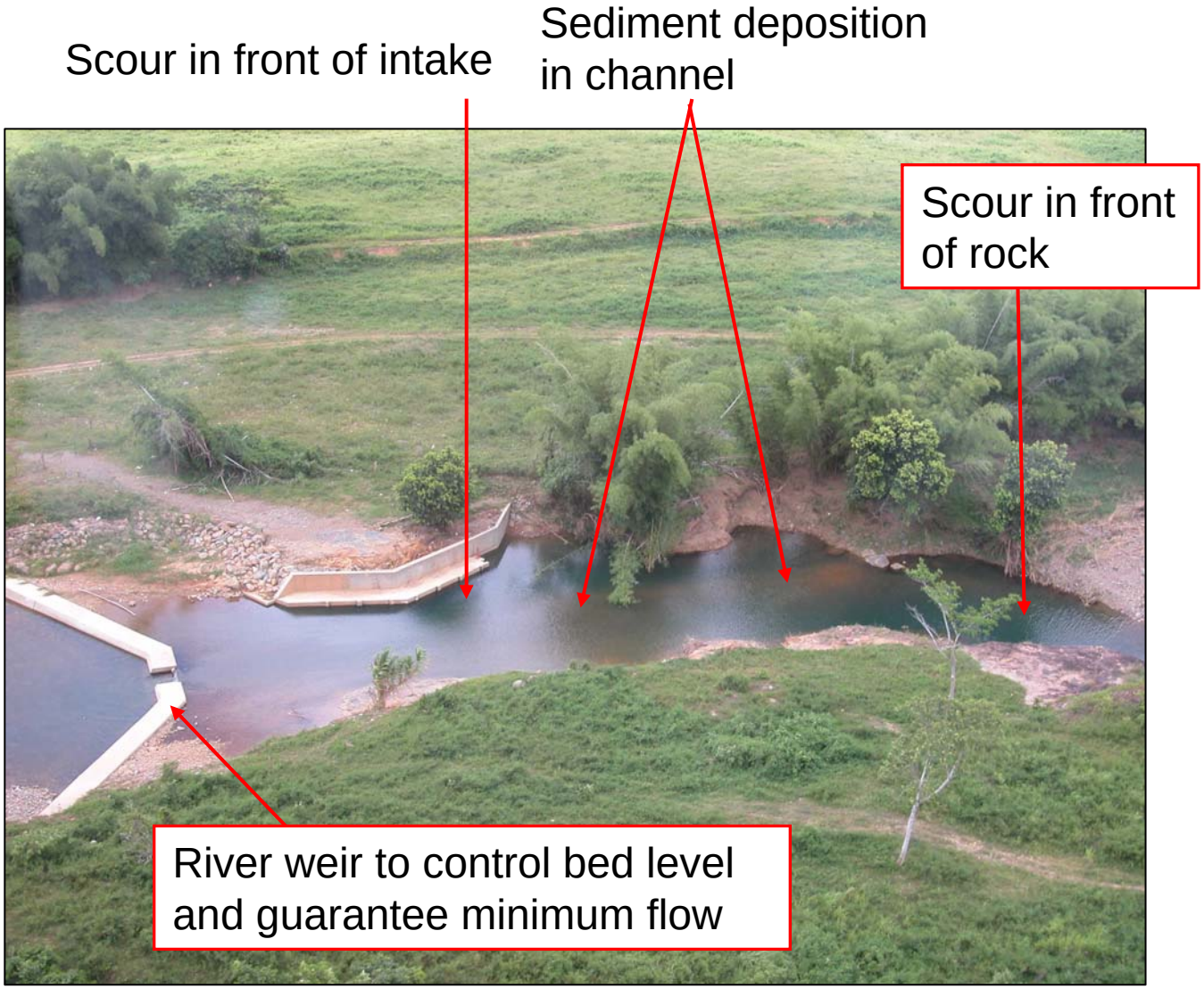



PR-3
Río Mameyes Intake
Flow
N
©2007 Google™
Pointer 18°22'12.17" N 65°45'57.03" W
Streaming 100%
Eye alt 1665 ft

Miradero intake, Río Añasco



Río Fajardo intake (offstream dam)



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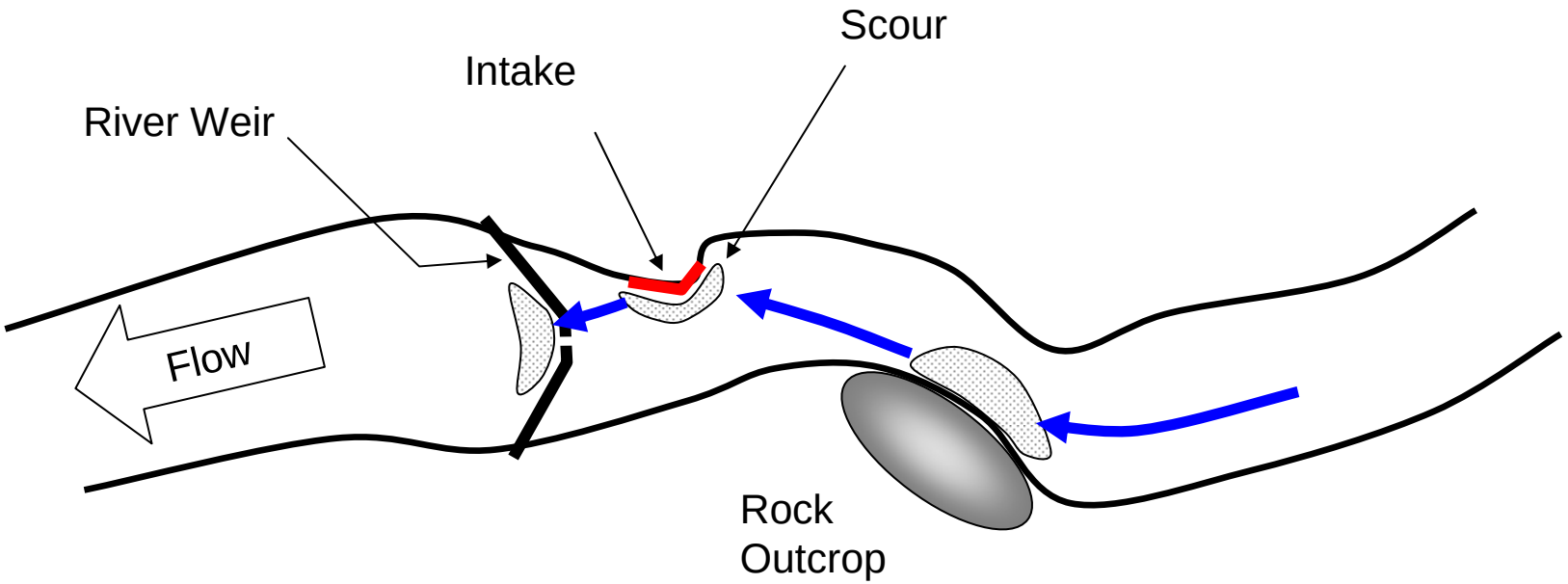
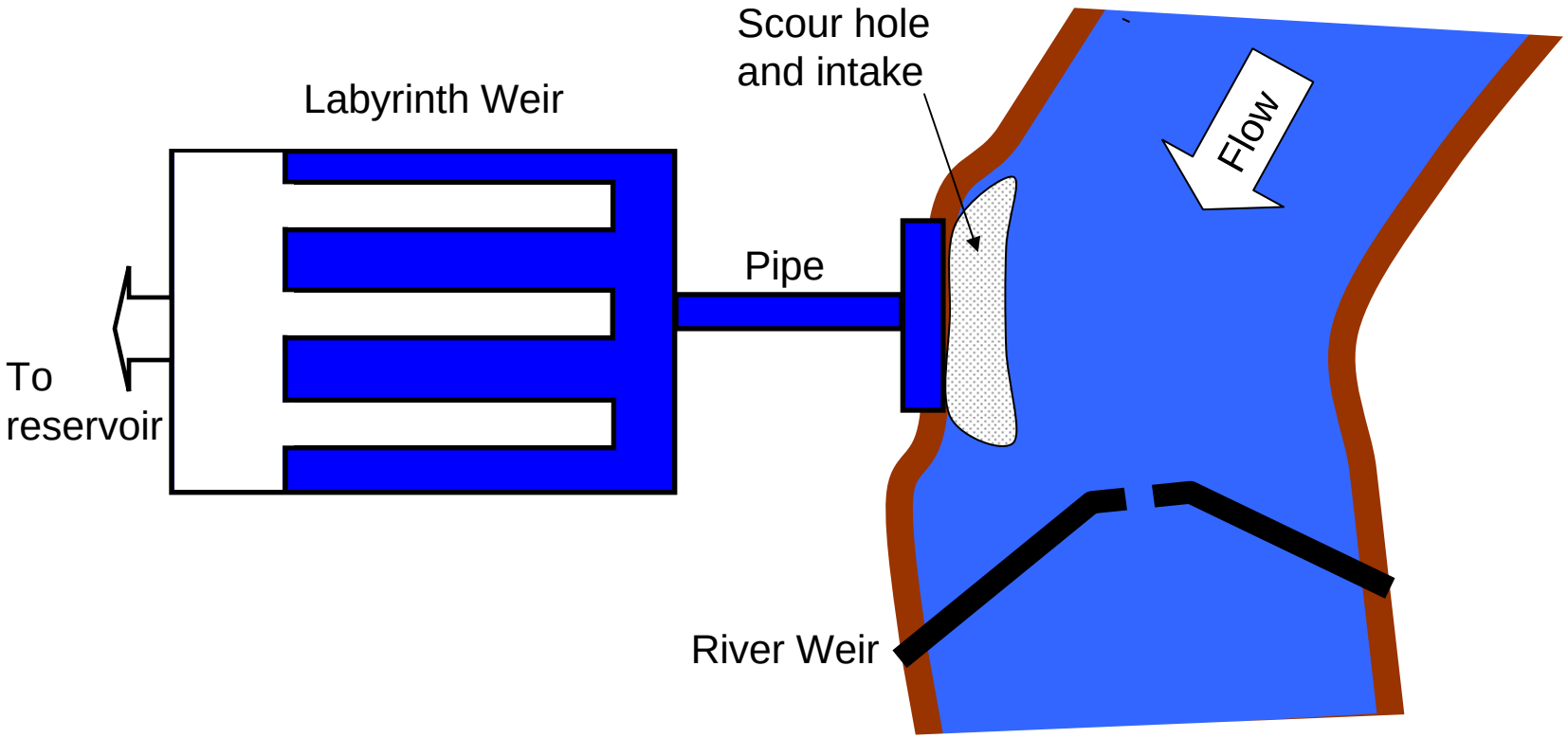


Río Fajardo intake: designed to maintain instream flow.



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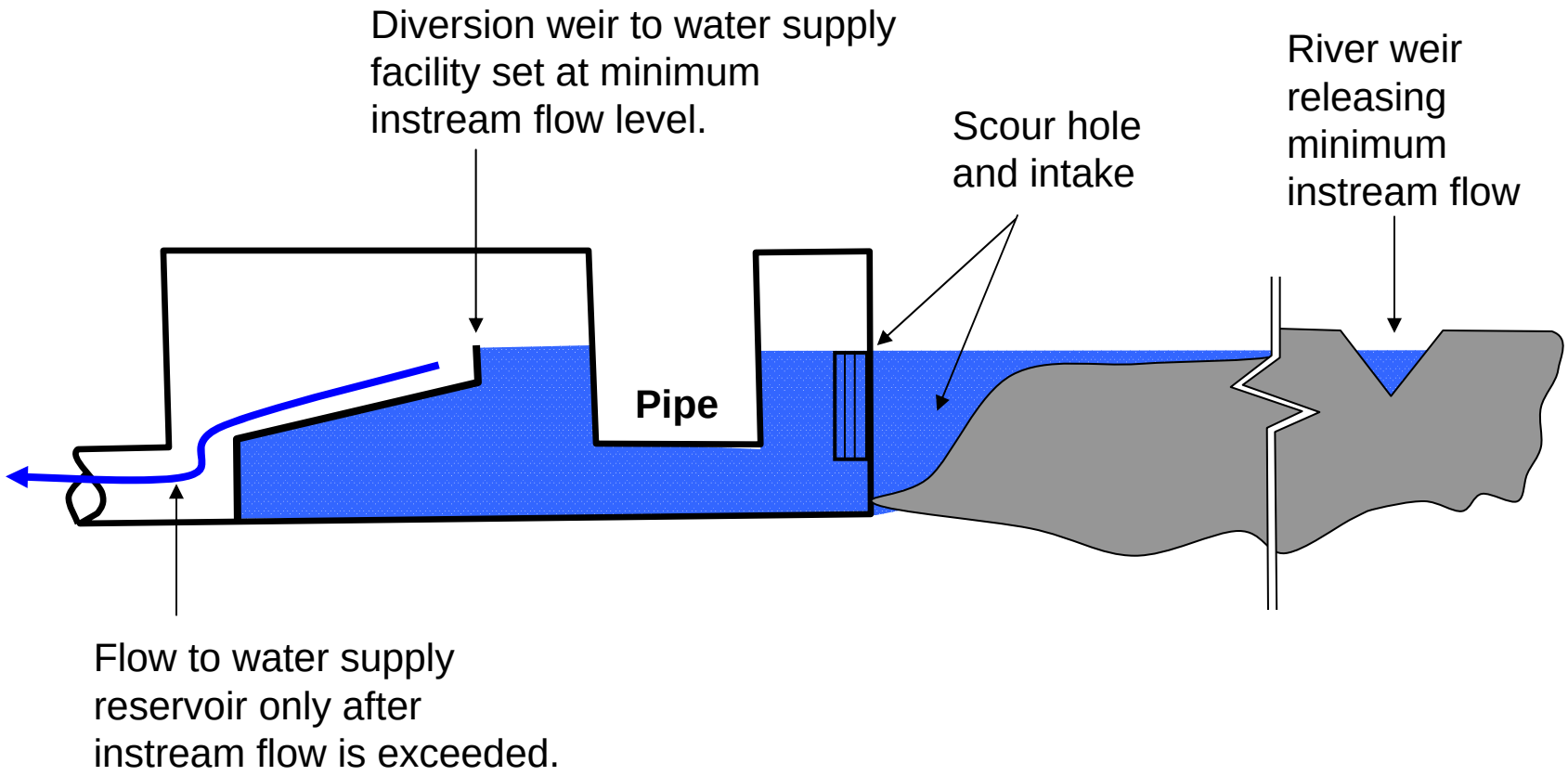
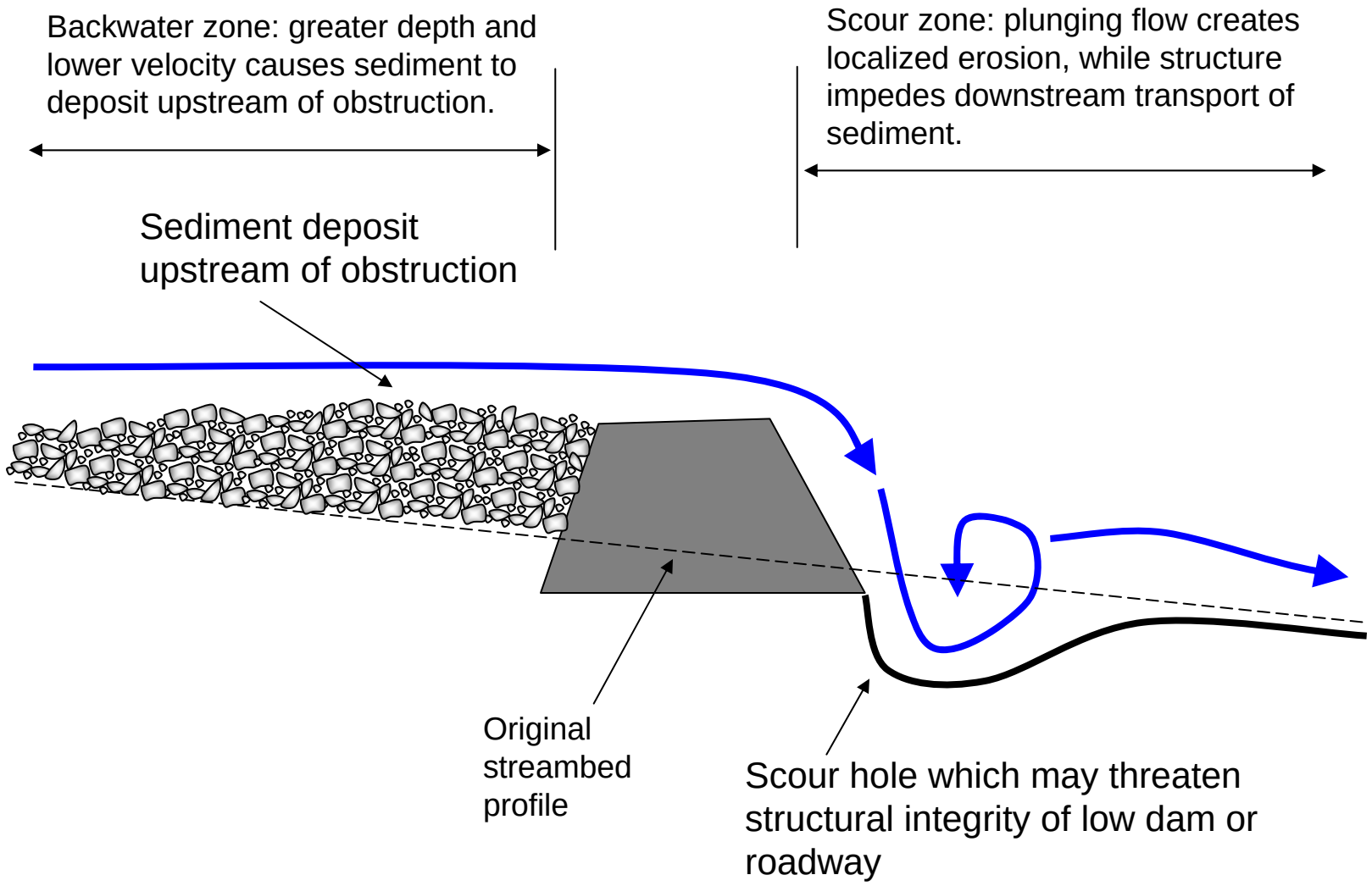
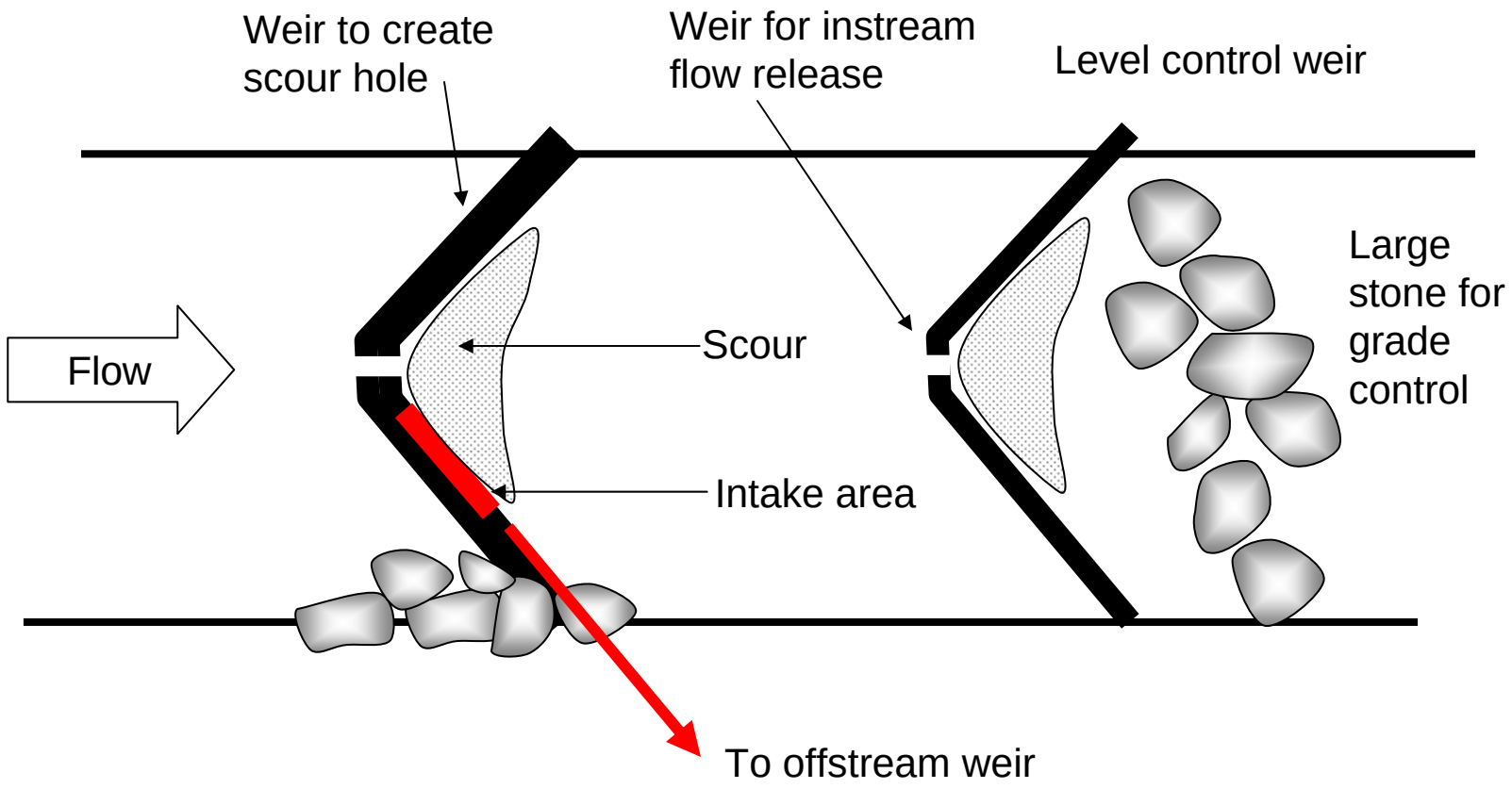


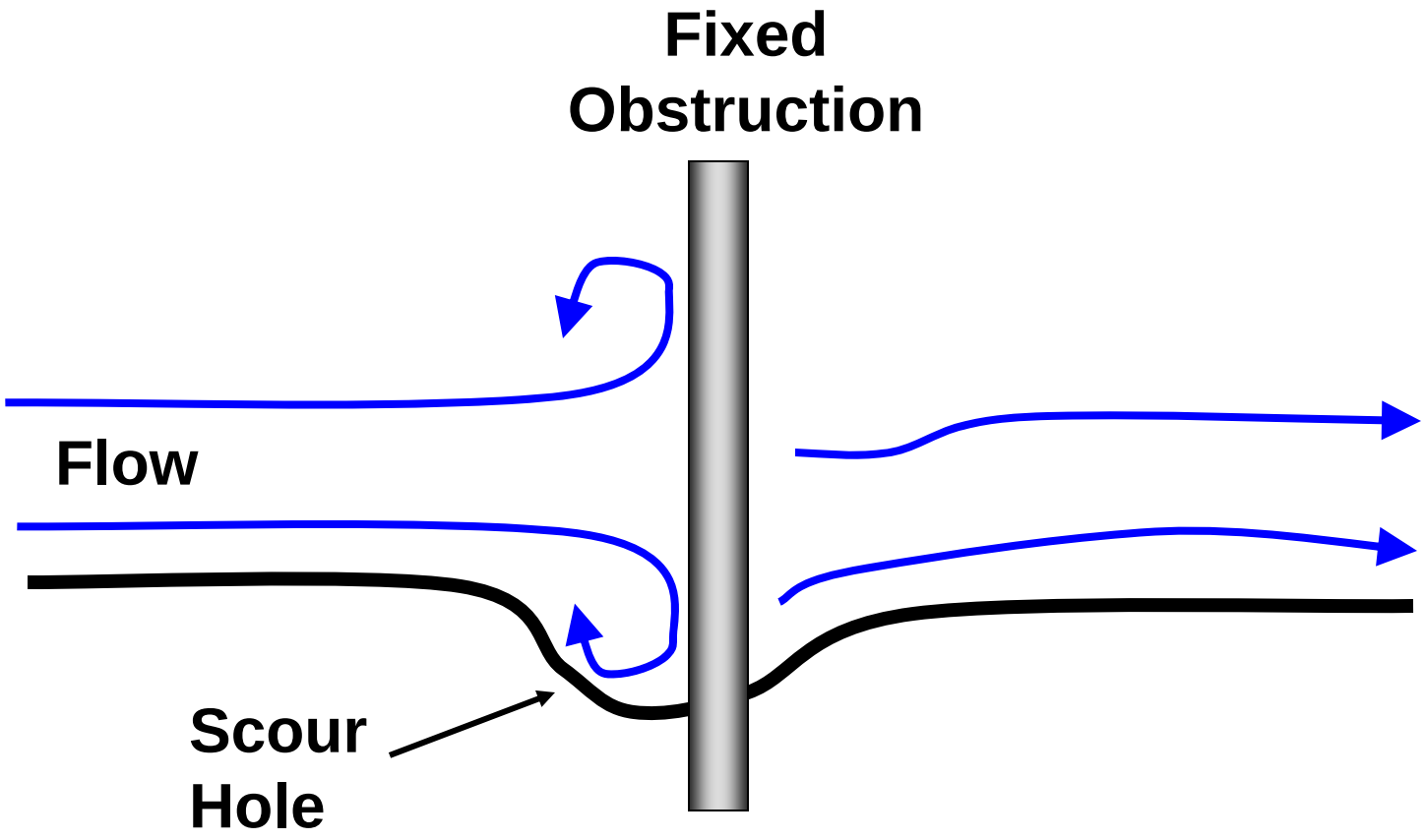
Strategy #2: Use flow plunging over an obstruction which causes scour



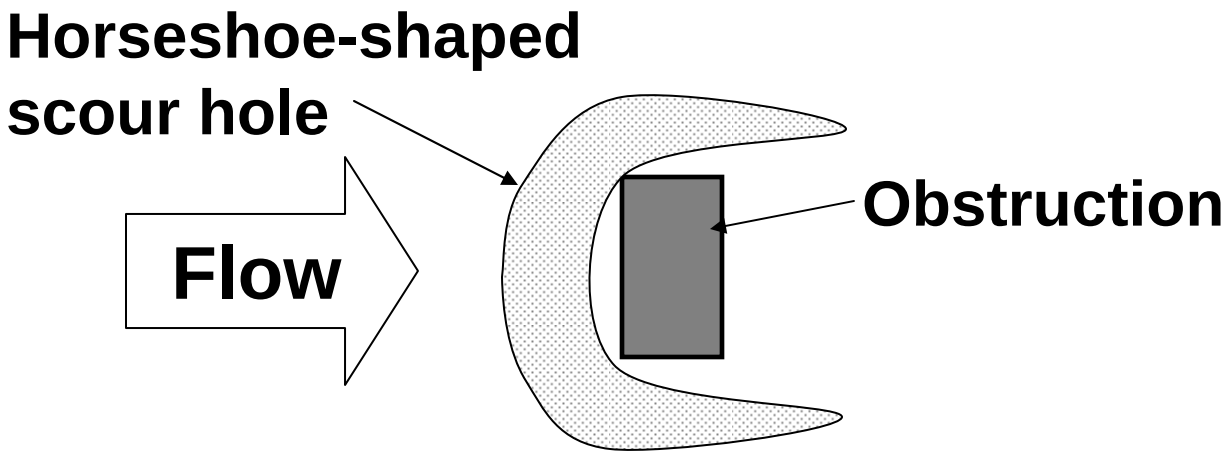
Río Blanco Intake
Create of a scour hole by overflow



Strategy #3:
Create of a scour hole by flow obstruction



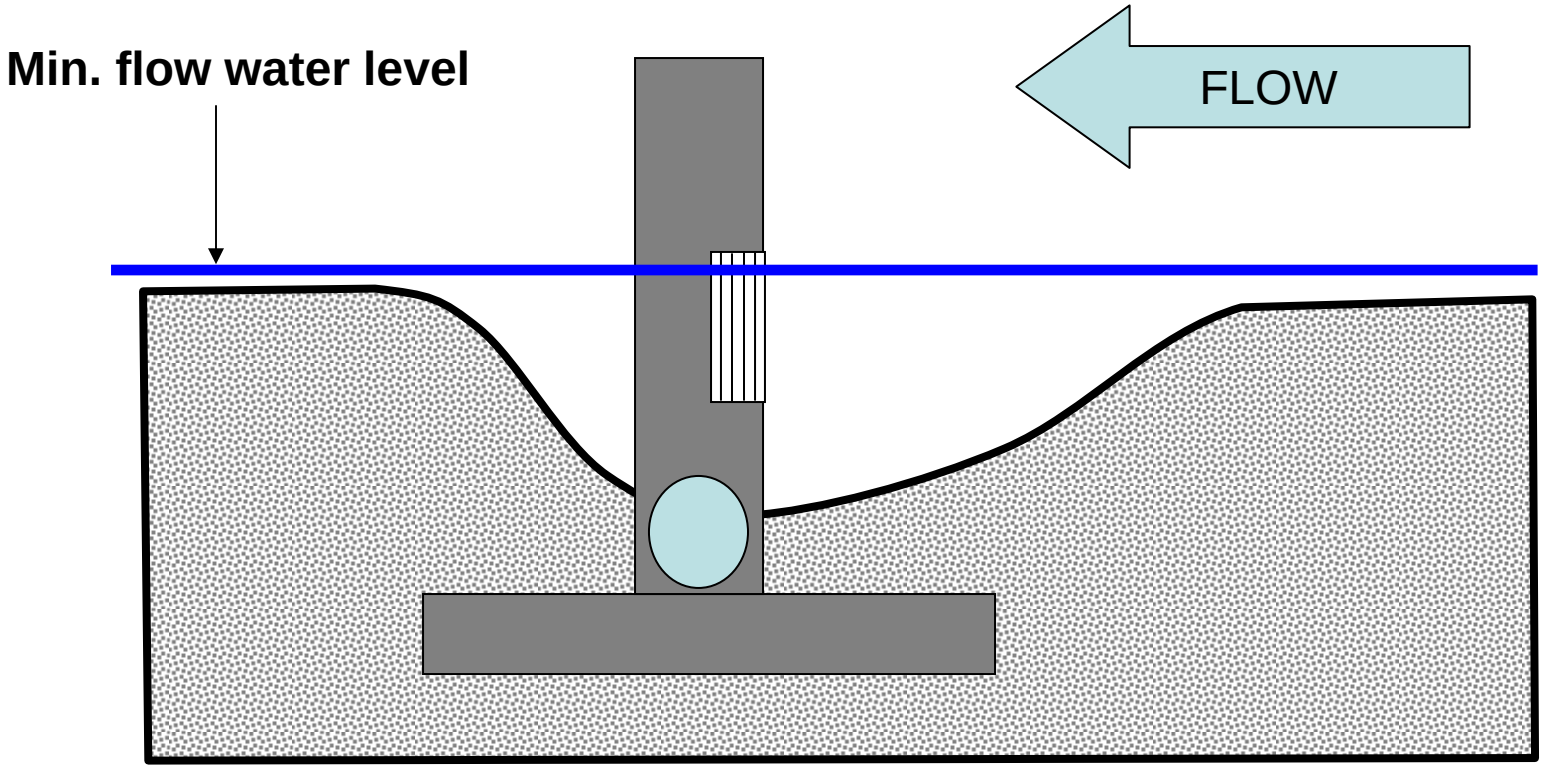
Plan View



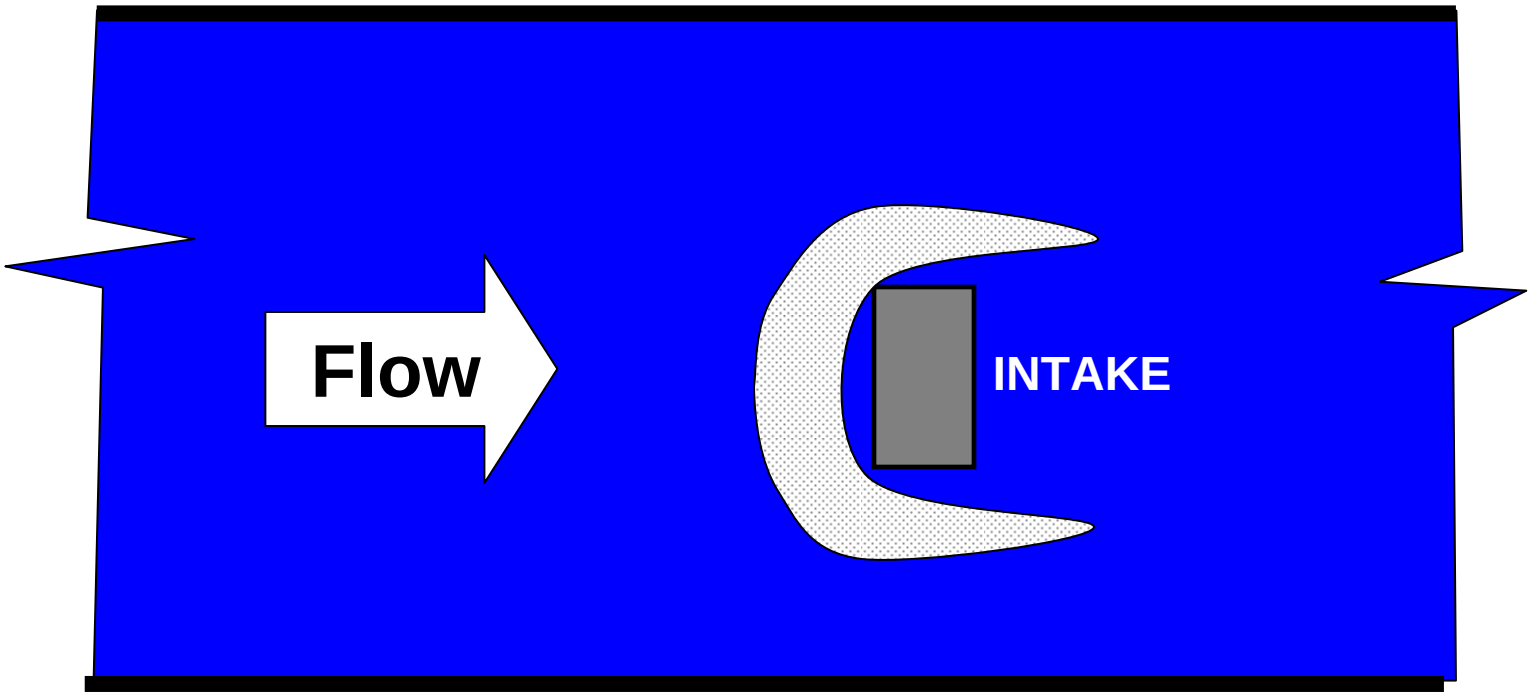
Flow deflection will create scour.
Example of scour pattern at a bridge pier

Deflection of wind by a rock creates a similar scour pattern in a windy desert environment (southern Bolivia)

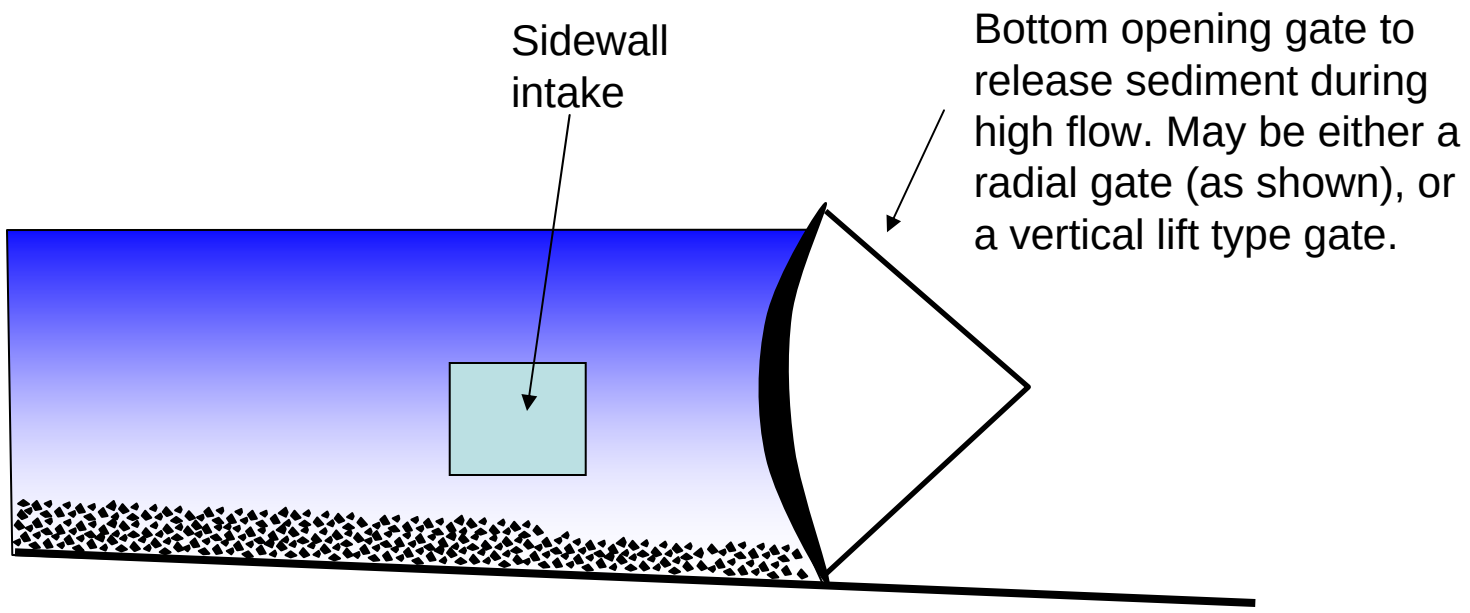
Water supply intake concept



Location of intake in center of the river has environmental advantages, but operational disadvantages



Strategy #4:
Flush sediment by operating a gate




Rio
Blanco
Tributary
New Fish Ladder
Pump Sta

Concluding Remarks

- Traditional intake designs are not optimal from either engineering or environmental standpoint.
- Intake design can be greatly improved by understanding river geomorphology,
- Unfortunately, most engineers have very little, if any, understanding of river geomorphic processes.
- There are no standards or guidelines to assist engineers in designing intakes which are best for conditions in Puerto Rico.

Thank You

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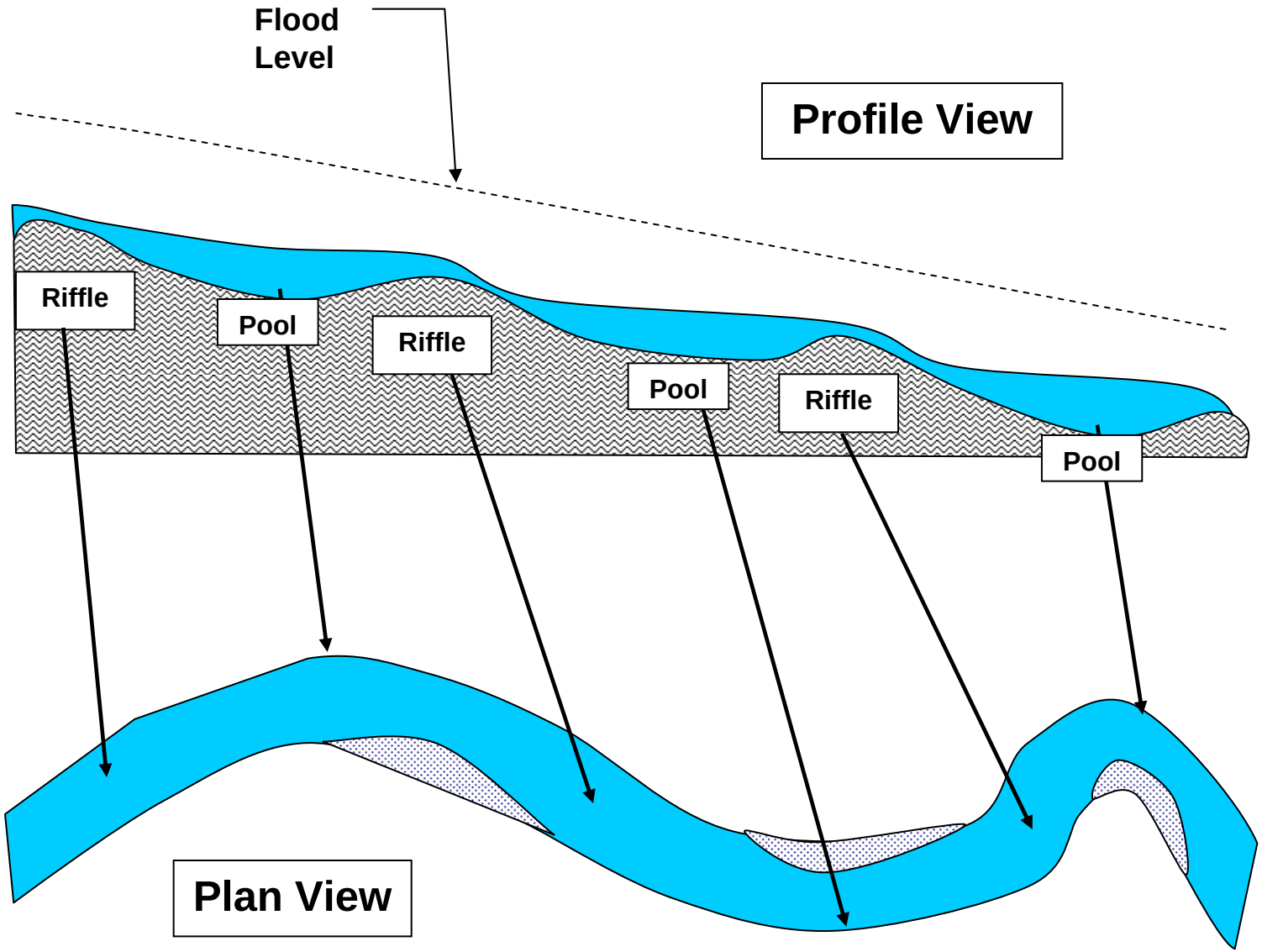
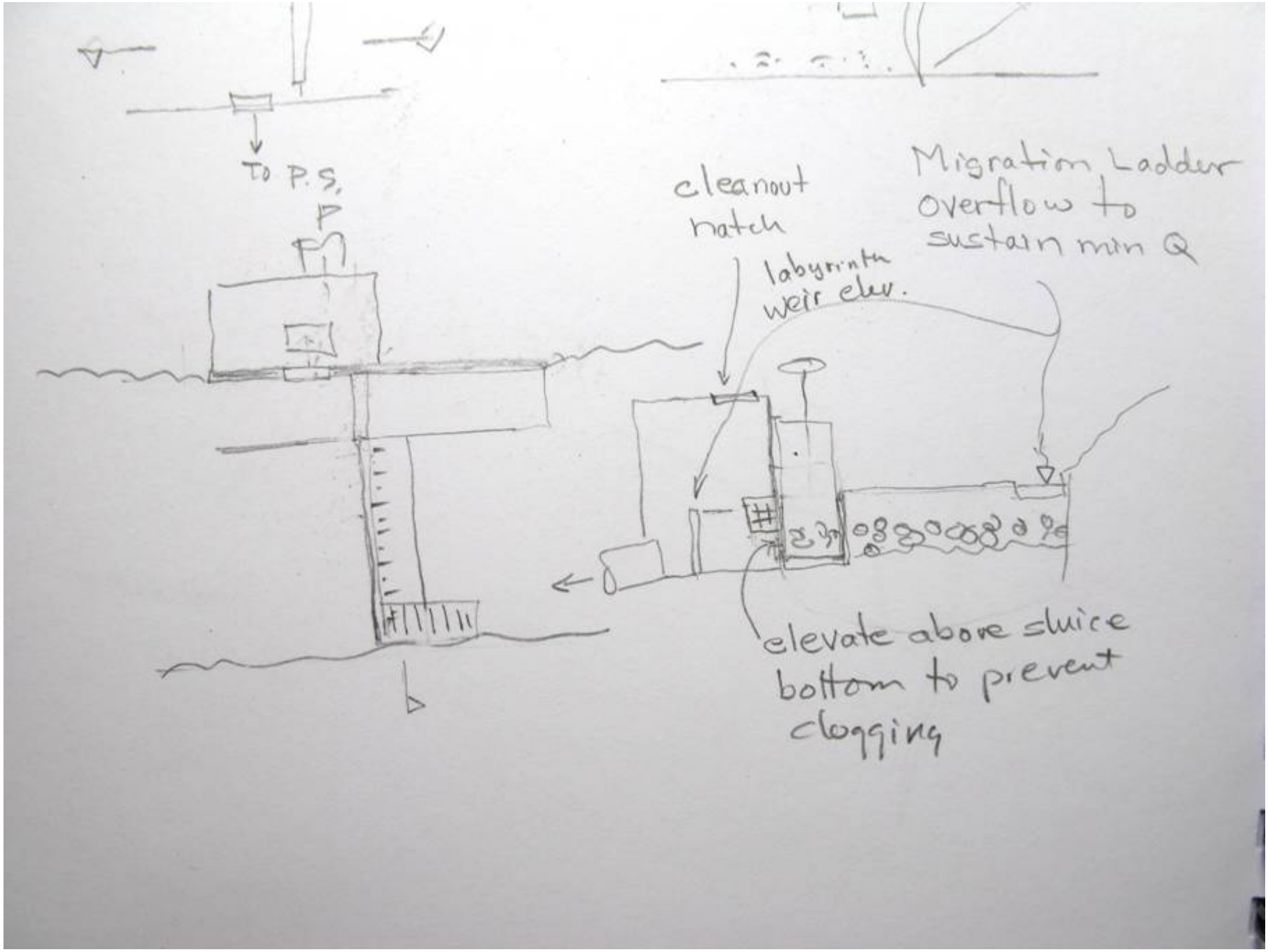

Flood
Level
Profile View
Riffle
Pool
Riffle
Pool
Riffle
Pool
Plan View


TO P.S.
P
cleanout hatch
labyrinth weir elev.
Migration Ladder overflow to sustain min Q
elevate above sluice bottom to prevent clogging