Review of Bridge BR-29- L Scour Failure and Applied Rehabilitation and Countermeasure Approaches.

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Place: Room B

Sub Category:

2.Engineering application

2.1 Bridge Score

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Covering Topics:

- Introduction
- BR-29-L Bridge geometry
- Site investigation
- Bridge failure mechanisem
- Proposed approches
- Modeling the Approches

Introduction

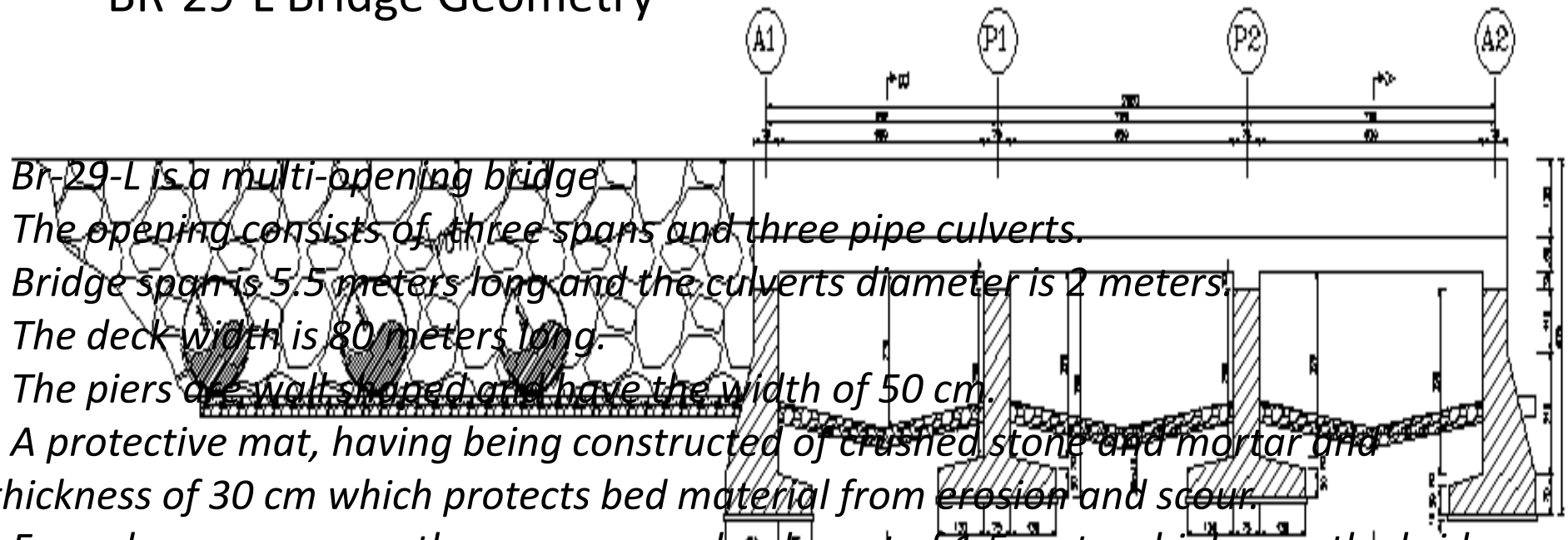
- A case study of Bridge structure failure in Iran.

- The occurrence of bridges failure in Iran is very common.

- River of ”Kan”, accommodates five main road bridges.

- BR-29 L, had been severely damaged during significant seasonal floods In the spring of 2002.

BR-29-L Bridge Geometry



- Br-29-L is a multi-opening bridge.
- The opening consists of three spans and three pipe culverts.
- Bridge span is 5.5 meters long and the culverts diameter is 2 meters.
- The deck width is 80 meters long.
- The piers are wall shaped and have the width of 50 cm.
- A protective mat, having being constructed of crushed stone and mortar and thickness of 30 cm which protects bed material from erosion and scour.
- For unknown reasons, there was an embankment of 1.5 meters high over the bridge deck which induces an extra surcharge over the piers.

Bridge Failure Mechanism

-Huge contraction at upstream side having changed the effective conveyance width from 42 meters to 27 meters.

-By sedimentation, the natural river bed tends to shift to right overbank forcing the flow to pass through first and second span.

-The scouring of invert revetment and pier foundation bed material causes the collapse of abutments and middle pier and consequently the failure of bridge deck.

Modeling The Existing Bridge Status

One dimensional river structure analysis HEC-RAS software was deployed

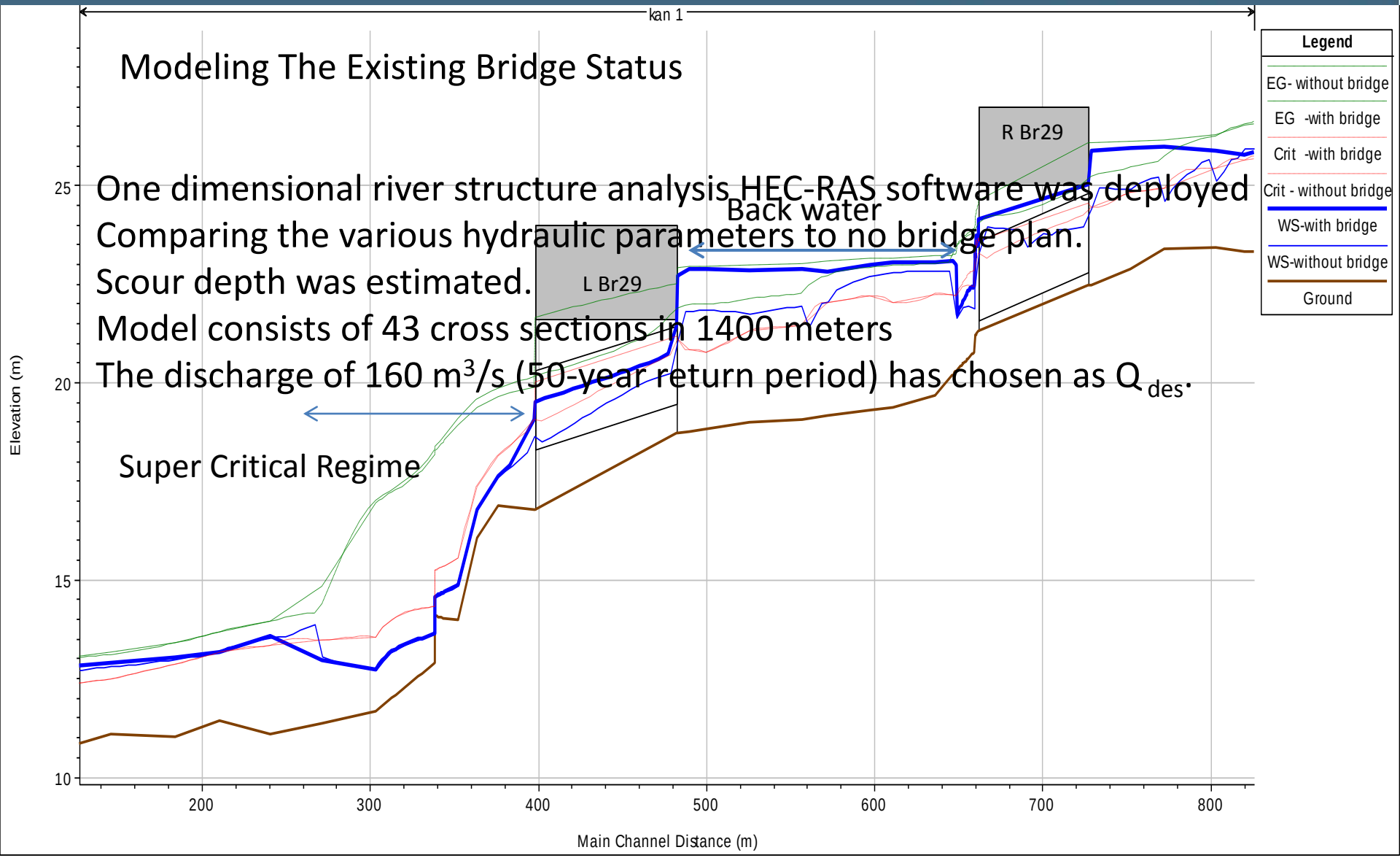
Comparing the various hydraulic parameters to no bridge plan.

Scour depth was estimated.

Model consists of 43 cross sections in 1400 meters

The discharge of 160 m^3/s (50-year return period) has chosen as Q_{des}.

Super Critical Regime

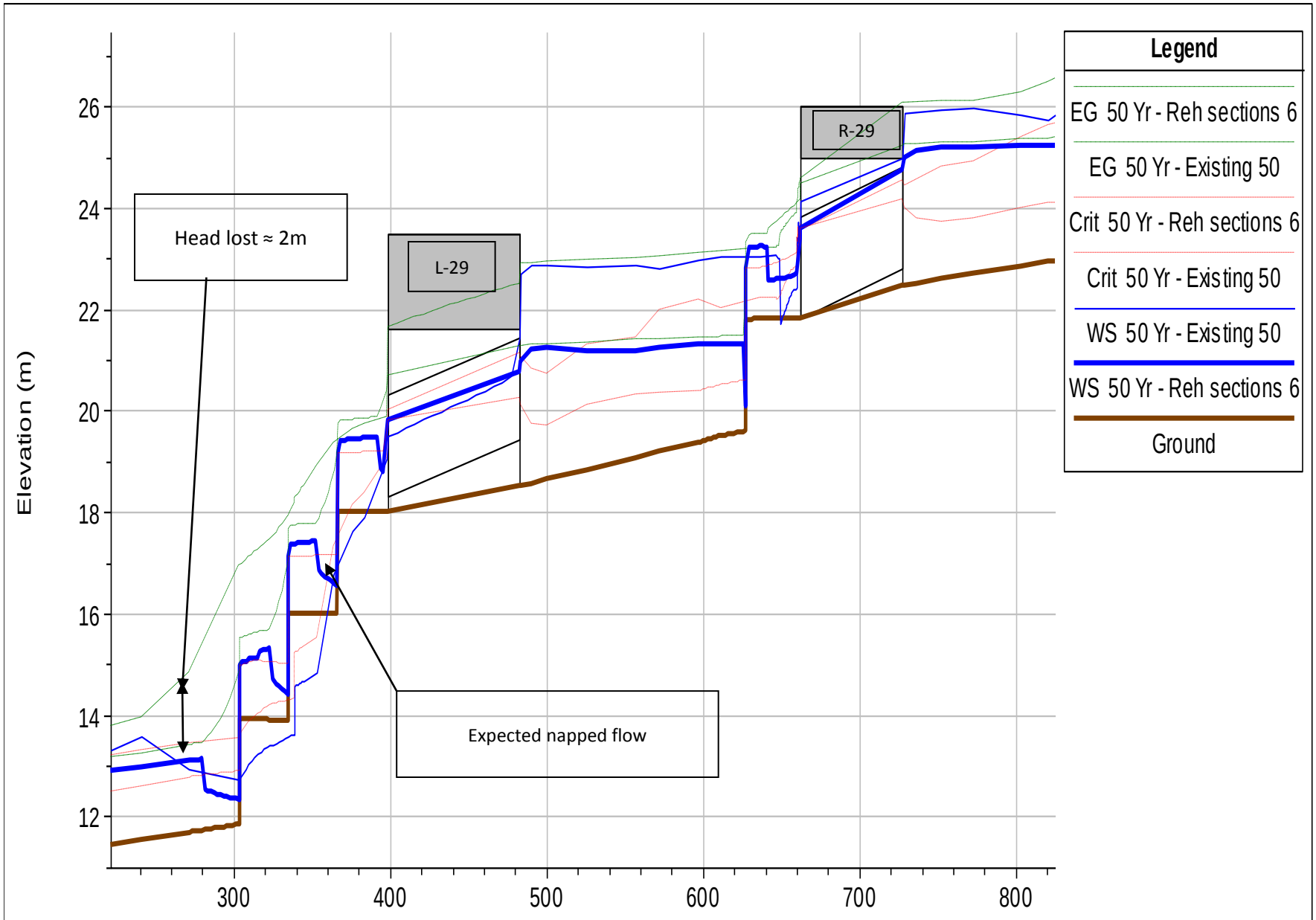


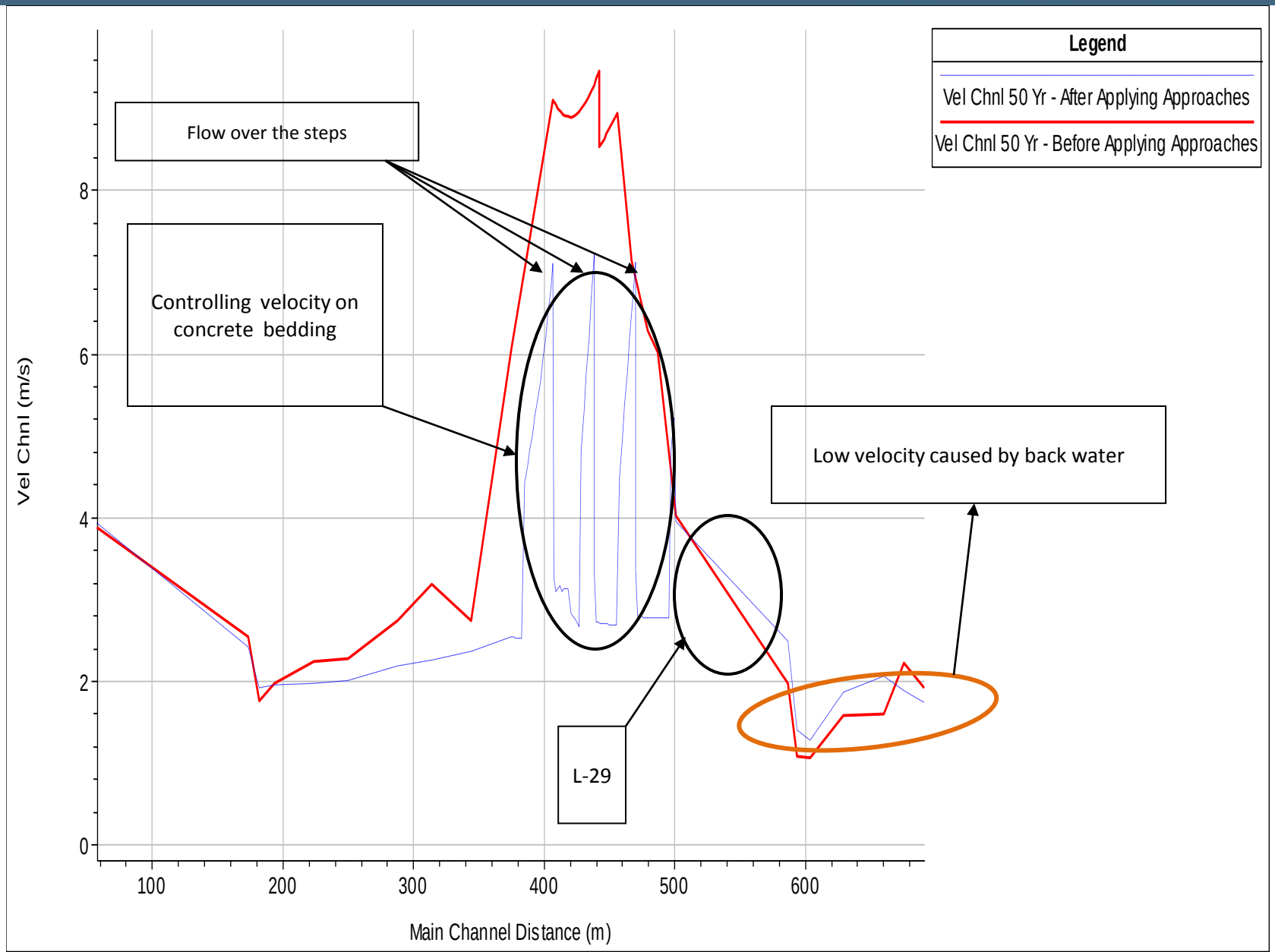
Proposed Approaches:

- Upstream cross section modifications(Debris removal, Slope modification,…)
effect: decreasing Contraction Scour

-Construction of hydraulic structures (*stepped drops, sill construction) .*
note: Two sets of stepped drops ,being designed for napped flow regime, were employed which dramatically lessen the kinetic energy of water at downstream of bridges.
effect: Improving existing status.

-B*ridge structure enhancement* (Increase of Bridge Height by removing the 1.5 meter embankment, *Also the piers were removed in new design phase as an obstacle to the flow*)
effect: decreasing Local Scour.


Legend
EG 50 Yr - Reh sections 6
EG 50 Yr - Existing 50
Crit 50 Yr - Reh sections 6
Crit 50 Yr - Existing 50
WS 50 Yr - Existing 50
WS 50 Yr - Reh sections 6
Ground
Elevation (m)
26
24
22
20
18
16
14
12
300
400
500
600
700
800
Head lost ≈ 2m
L-29
R-29
Expected napped flow


Legend
Vel Chnl 50 Yr - After Applying Approaches
Vel Chnl 50 Yr - Before Applying Approaches
Flow over the steps
Controlling velocity on concrete bedding
Low velocity caused by back water
L-29
Vel Chnl (m/s)
Main Channel Distance (m)
0
2
4
6
8
100
200
300
400
500
600

Thanks for listening