A CONTINUED EVALUATION OF UNITED STATES BUREAU OF RECLAMATION TYPE IX BAFFLED CHUTE SPILLWAY DESIGN PROCEDURES

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PRESENTATION OUTLINE:

INTRODUCTION;
DISCUSS ASSESSMENT APPROACH;
REVIEW RESULTS; AND,
SUMMARY/CONCLUSION.

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Dam with Baffled Spillway outside Bozeman, Montana

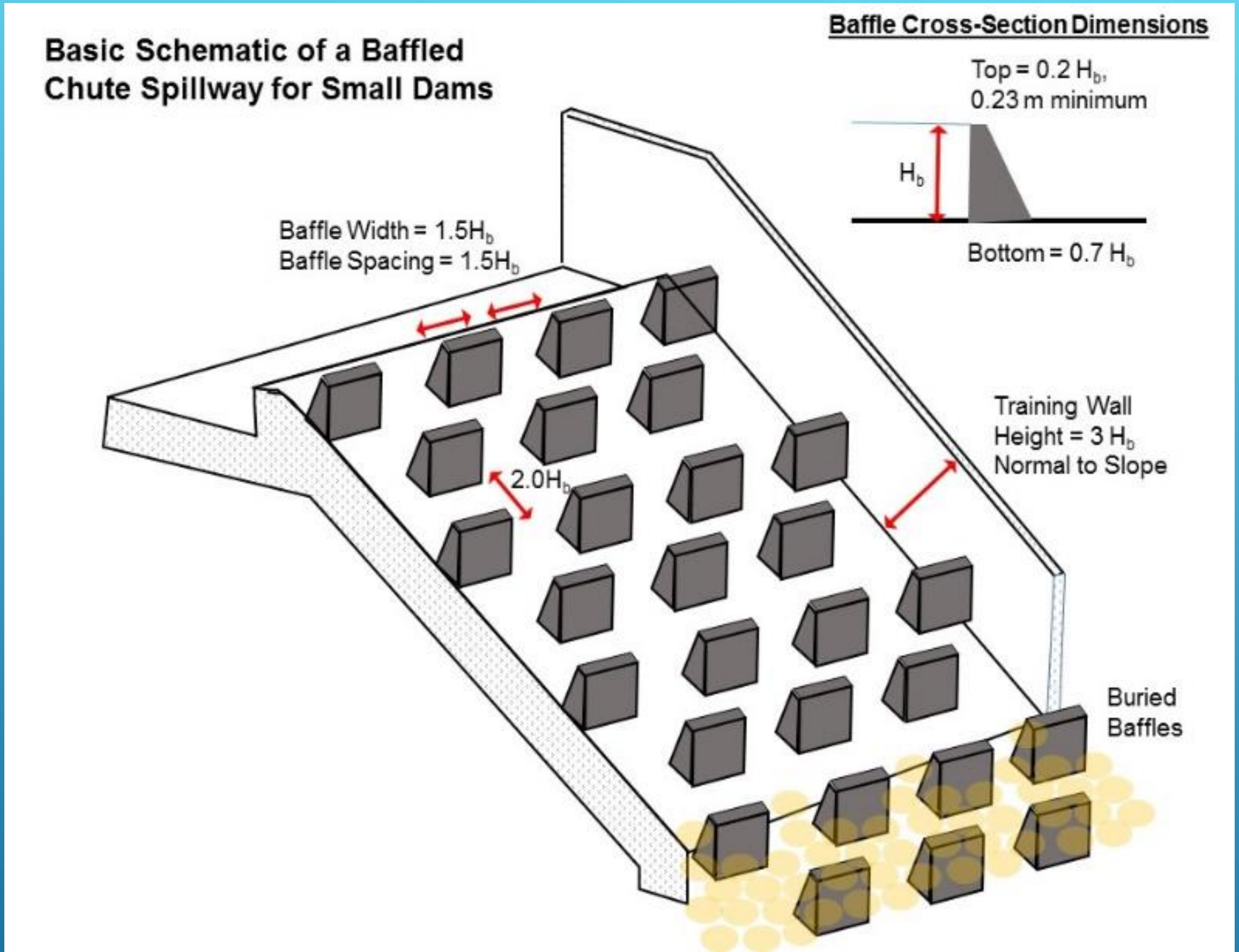
HOW MANY DAMS IN THE UNITED STATES ?

90,580 DAMS WITH 15,500 HIGH-HAZARD – 14% OF THESE ARE DEFICIENT

Dam with Baffled Spillway outside Bozeman, Montana

MANY OF THE SMALLER DAMS HAVE CHUTE SPILLWAYS

DESIGN OF THESE FROM 1950S ERA GUIDES



Source: Modified from US Bureau of Reclamation

General Schematic Half Width

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ASSESSMENT APPROACH:

SYNTHESIZE AVAILABLE DESIGN GUIDANCE

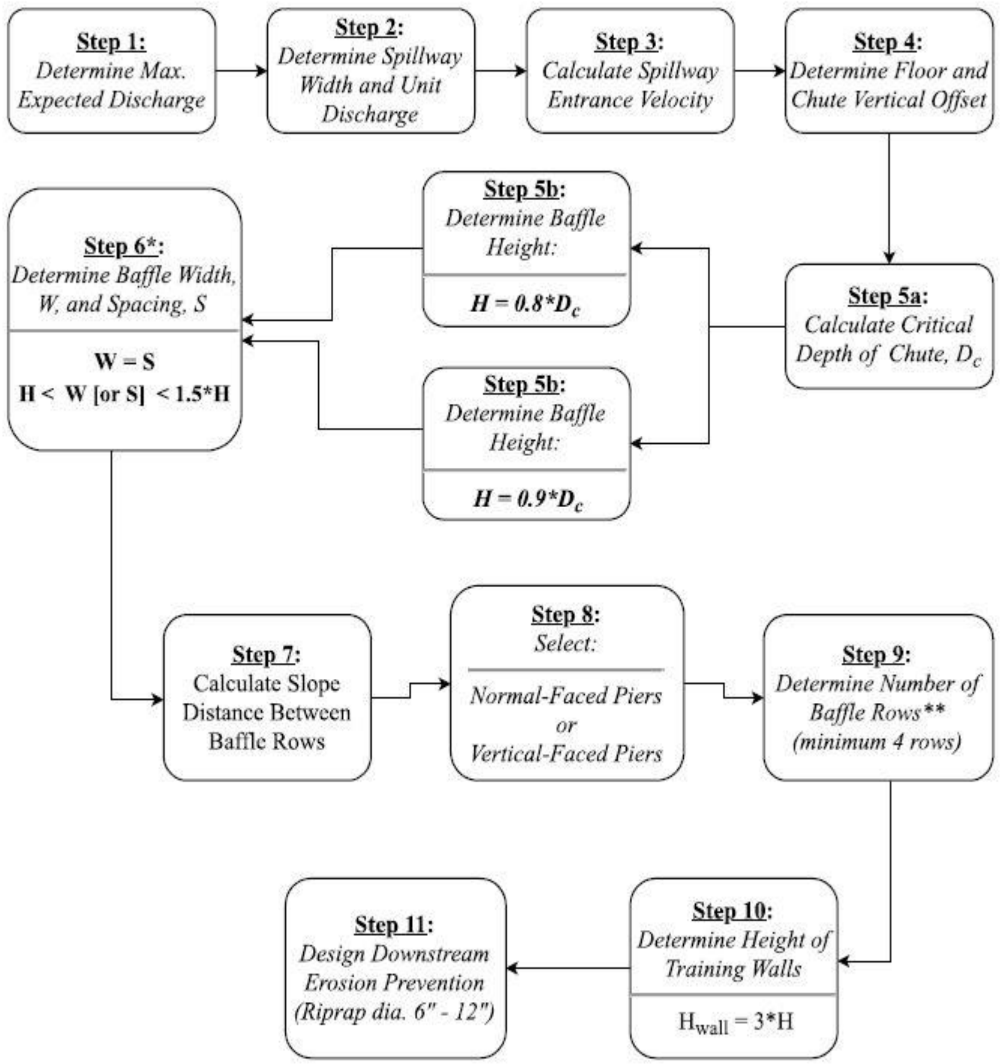
DEVELOP SOME HYPOTHETICAL DESIGNS FROM BUREAU OF RECLAMATION PHYSICAL MODELS – GILA, AZ TEST CASE FROM 1950S

SIMULATE SITE OPERATION WITH STAR CCM – CFD CODE;

APPLY DESIGN GUIDES AND LOOK FOR AREAS WHERE JUDGEMENT IS REQUIRED; AND,

MAKE RECOMMENDATIONS.

DESIGN FLOWCHART



Simplified Baffled Spillway Design Flowchart

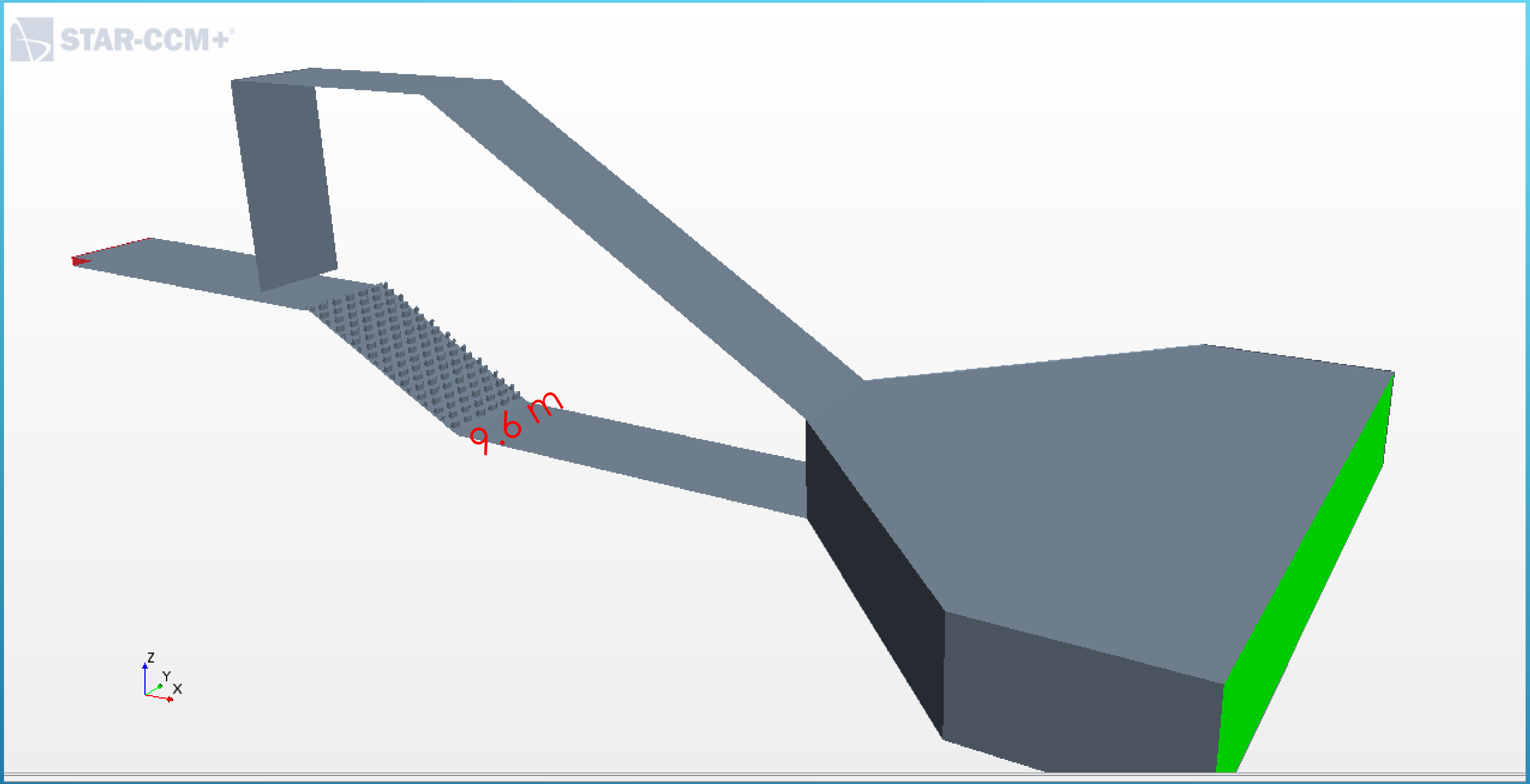
This flowchart illustrates the typical hydraulic design procedure for a baffled chute drop spillway as outlined by the Bureau of Reclamation's *Design of Small Dams*.

*Other dimensions are not critical hydraulically. Refer to Bureau of Reclamation's *EM-25* (Hydraulic Design of Stilling Basins and Energy Dissipators) or refer to Part B of Simplified Design Flowchart for design of Partial baffle blocks.

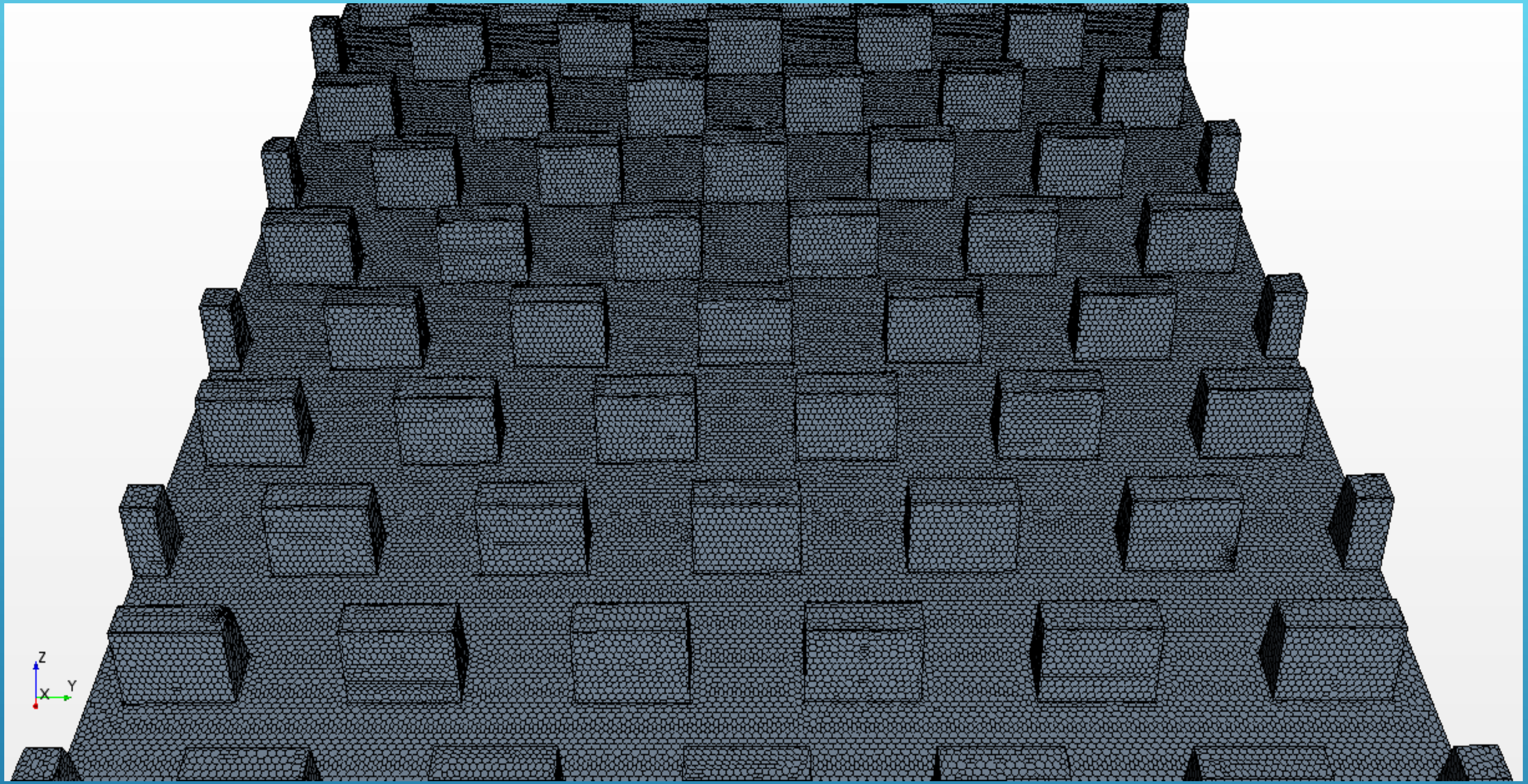
**At least one row of baffles should be buried below the outlet channel grade to protect against scour. Additional rows of baffles should be buried as needed to protect against scour.

Spillway Feature	Minimum Configuration	Conservative Configuration
Spillway Discharge (cms)	17 (600 cfs)	17 (600 cfs)
Spillway Width (m)	9.60 (31.5 ft)	9.60 (31.5 ft)
Unit Spillway Discharge (cms/m)	1.77 (19.05 cfs/ft)	1.77 (19.05 cfs/ft)
Baffle Height (m)	0.55 (1.8 ft)	0.61 (2.0 ft)
Baffle Width and Spacing (m)	0.82 (2.70 ft)	0.93 (3.05 ft)
Top Baffle Length (m)	0.23 (0.75 ft)	0.23 (0.75 ft)
Bottom Baffle Length (m)	0.38 (1.25 ft)	0.43 (1.40 ft)
Spacing between Baffle Rows (m)	0.72 (2.35 ft)	0.79 (2.60 ft)

MODEL SPILLWAY CONFIGURATIONS



MODEL COMPUTATIONAL DOMAIN



9.60 meter wide spillway

MODEL MESH ON CHUTE ~ 2 MILLION ELEMENTS IN THE MODEL

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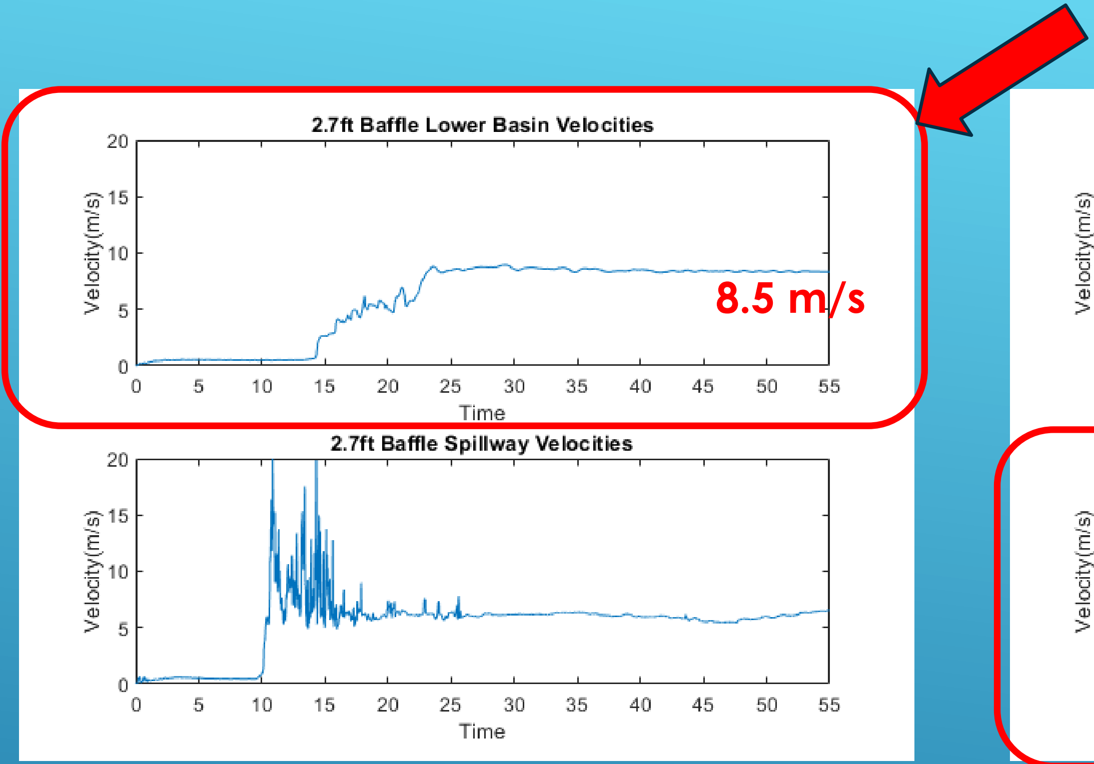
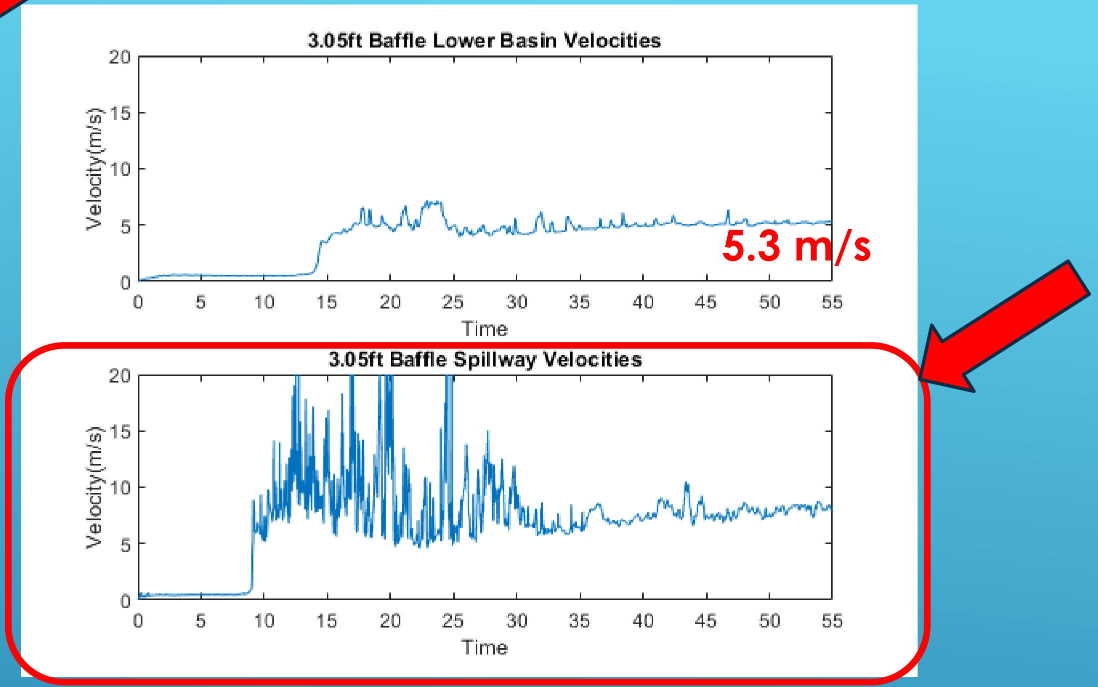
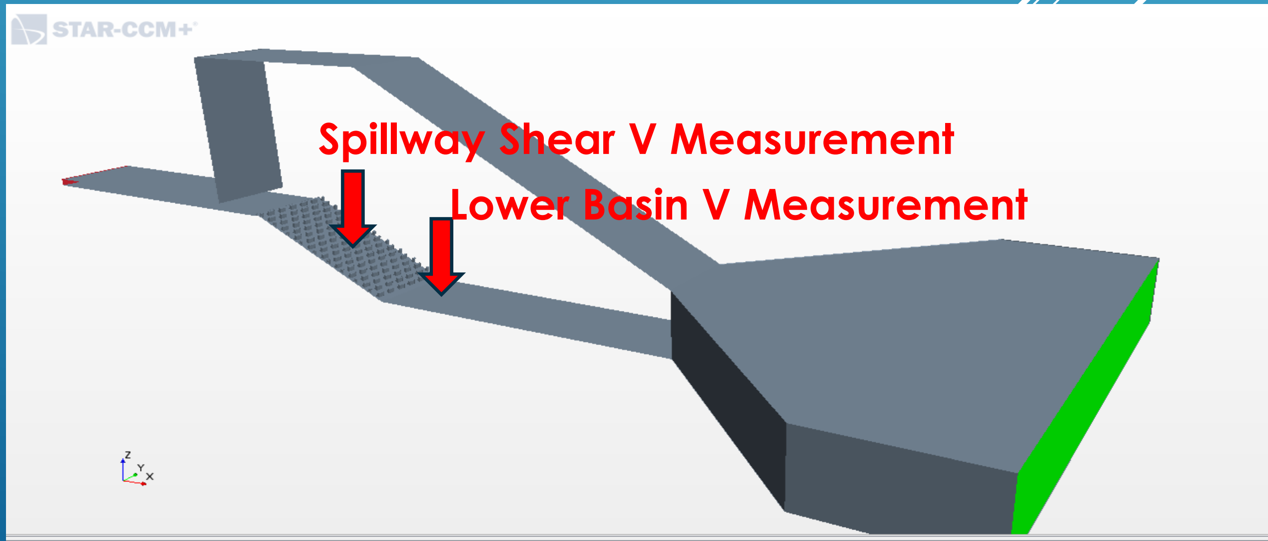


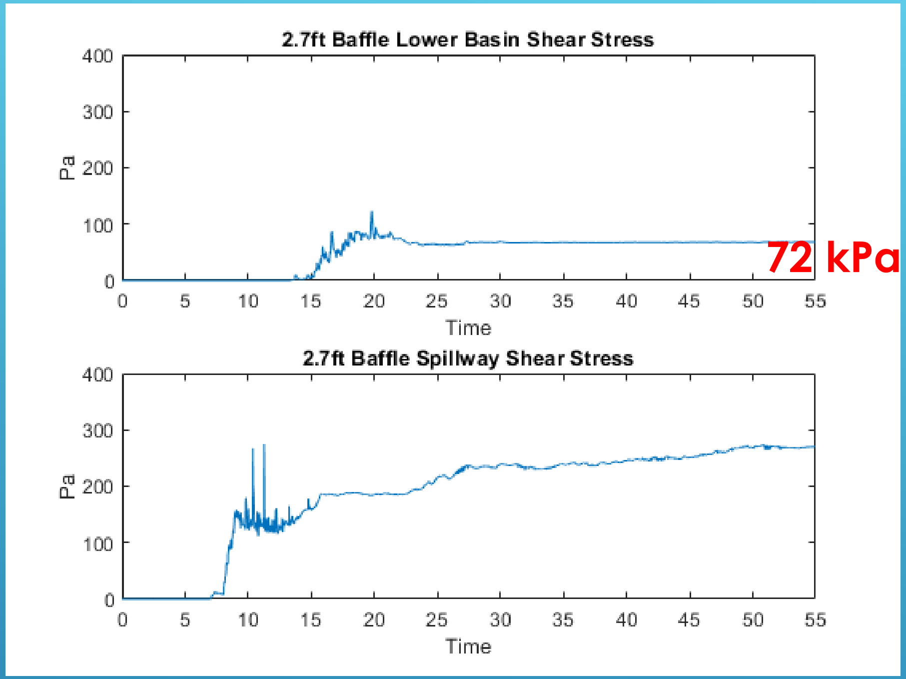
Minimum Model



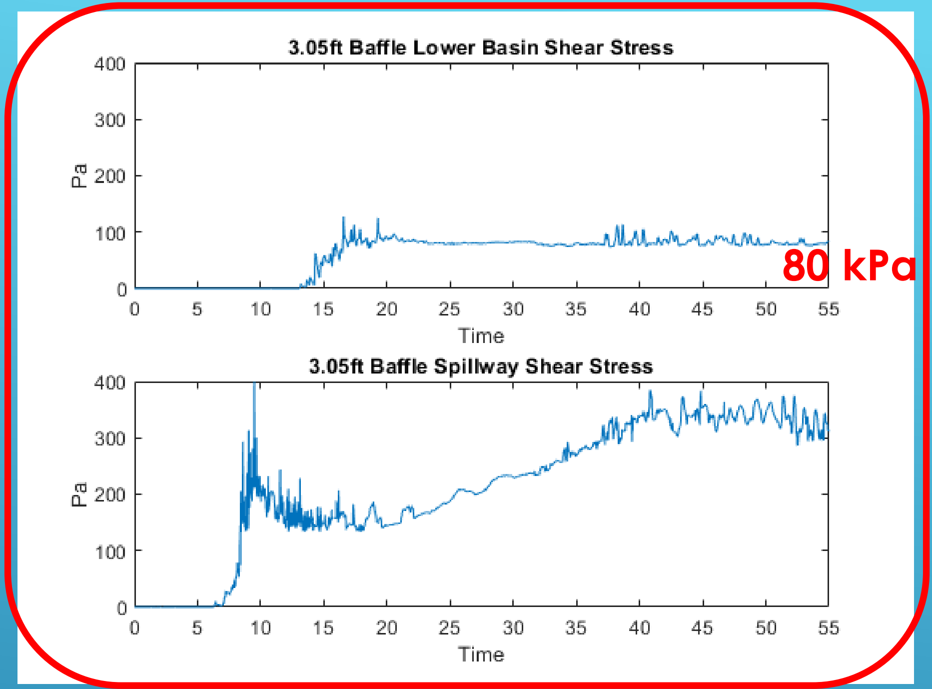
Conservative Model



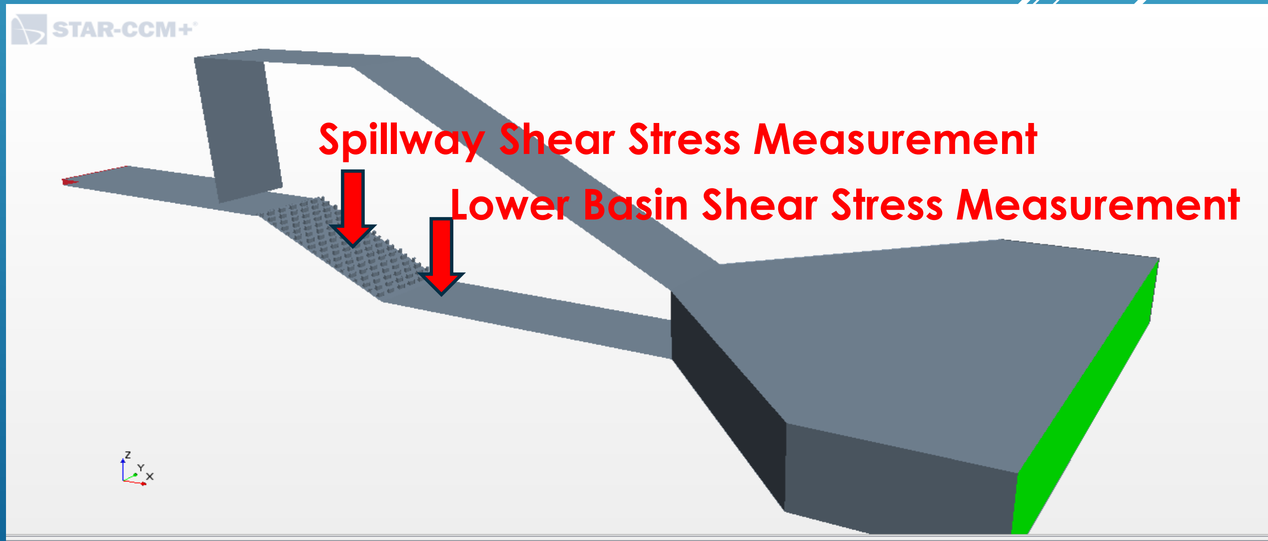
CFD MODEL RESULTS



Minimum Model



Conservative Model



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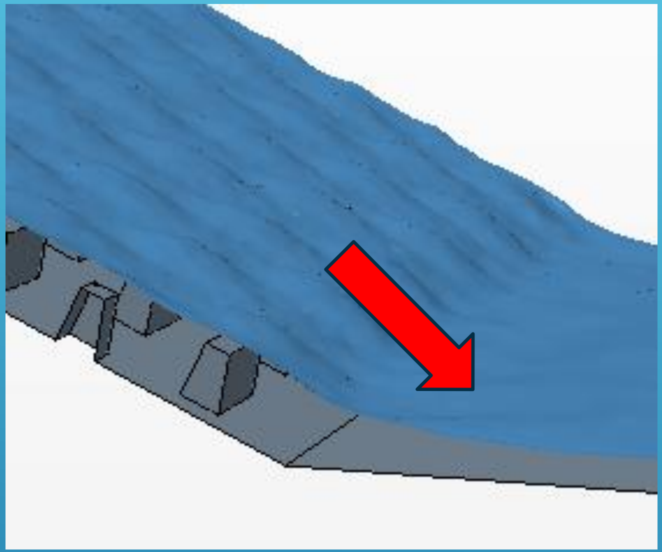
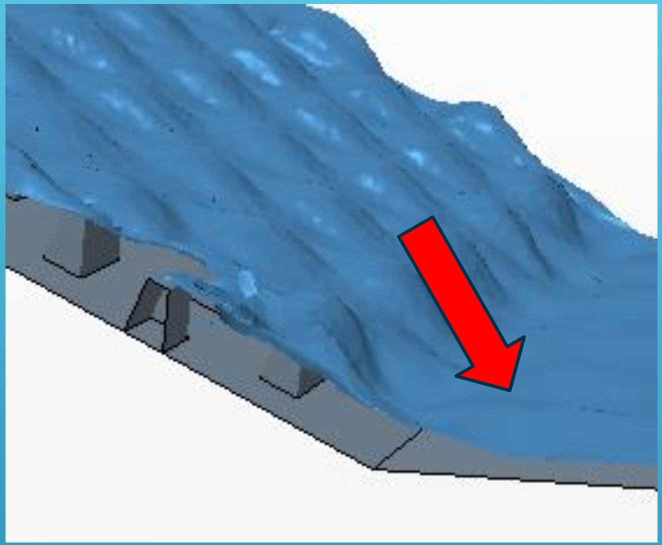


Minimum Model



Conservative Model

Larger vertical component of velocity which leads to higher bed shear stress

CFD MODEL RESULTS

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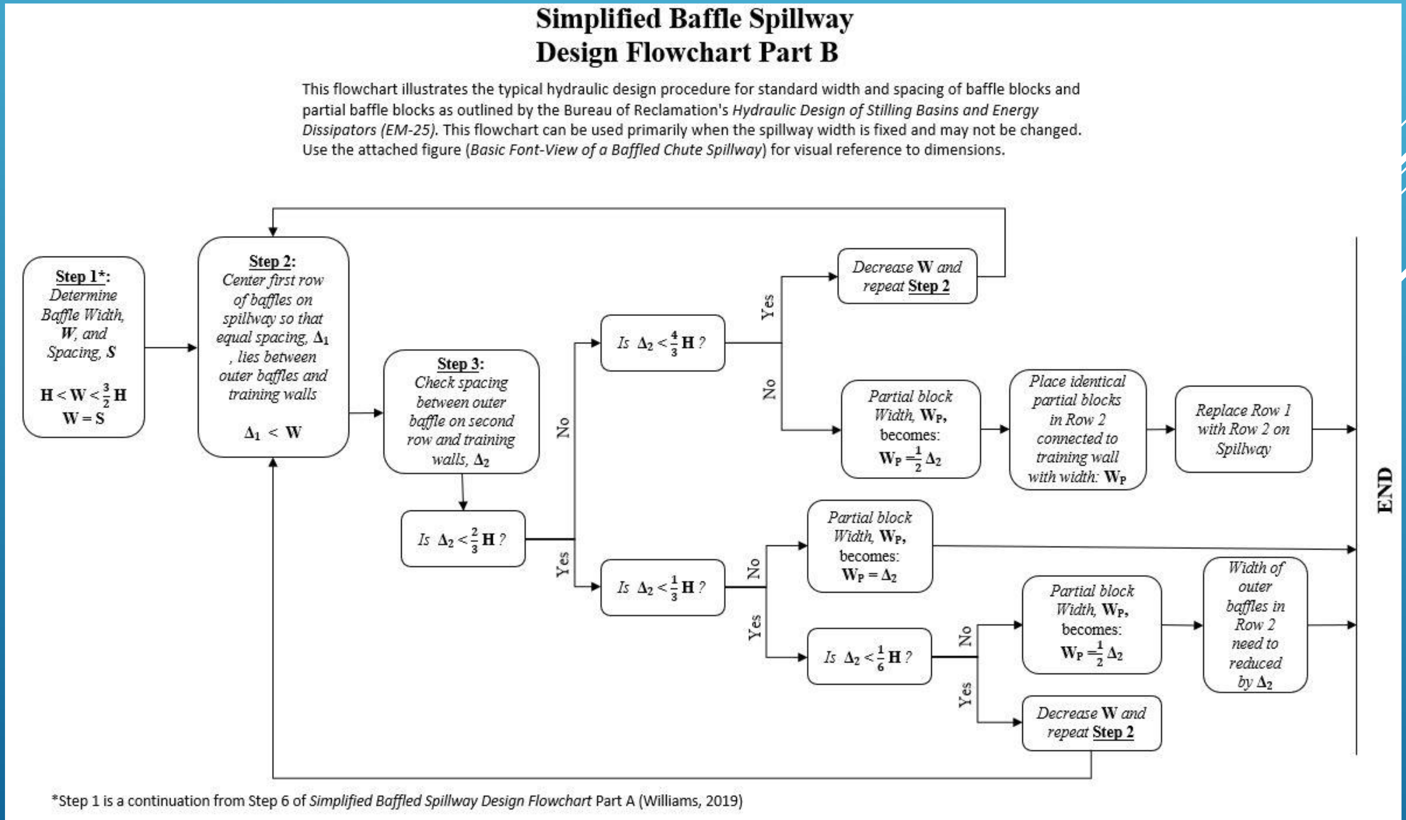
LARGER BAFFLES ARE NOT NECESSARILY MORE "CONSERVATIVE" FOR DESIGN

CFD MODELING IS RECOMMENDED WHEN DESIGNING BAFFLED SPILLWAYS

IN ADDITION, EVEN THOUGH THE UNIT DISCHARGE USED IN THIS STUDY WAS LESS THAN 1.9 M^2/SEC, OR THE THRESHOLD THAT SHOULD RESULT IN "…MINIMAL DOWNSTREAM SCOUR", THE RESULTING ESTIMATED BOTTOM SHEAR STRESSES FOR BOTH MODELS WOULD SUGGEST THAT MODERATE SCOUR WOULD OCCUR IF THE STILLING BASINS SOILS WERE SUSCEPTIBLE TO EROSION. SO THE THRESHOLD APPEARS ARBITRARY.

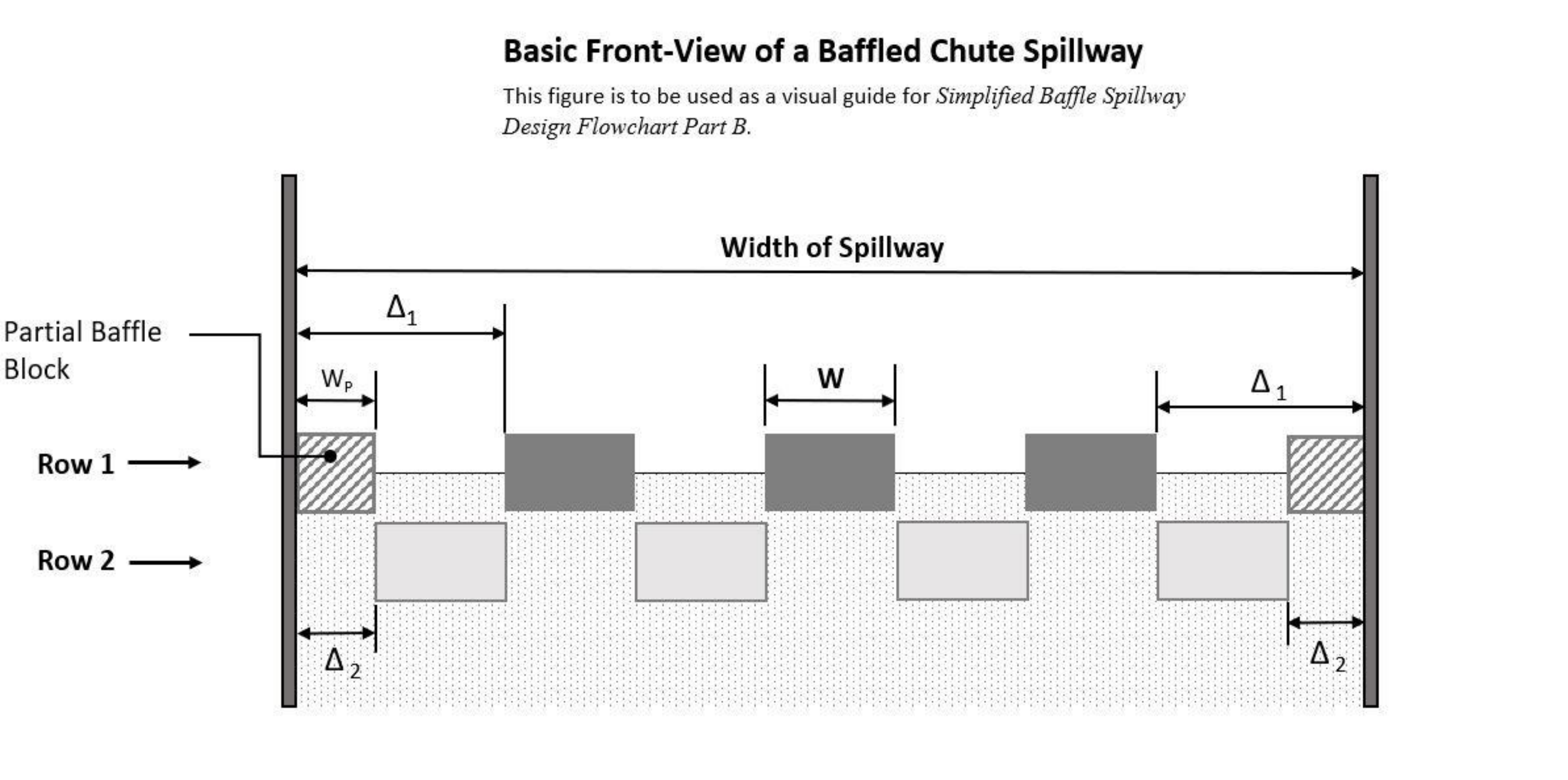
SUMMARY & CONCLUSION:

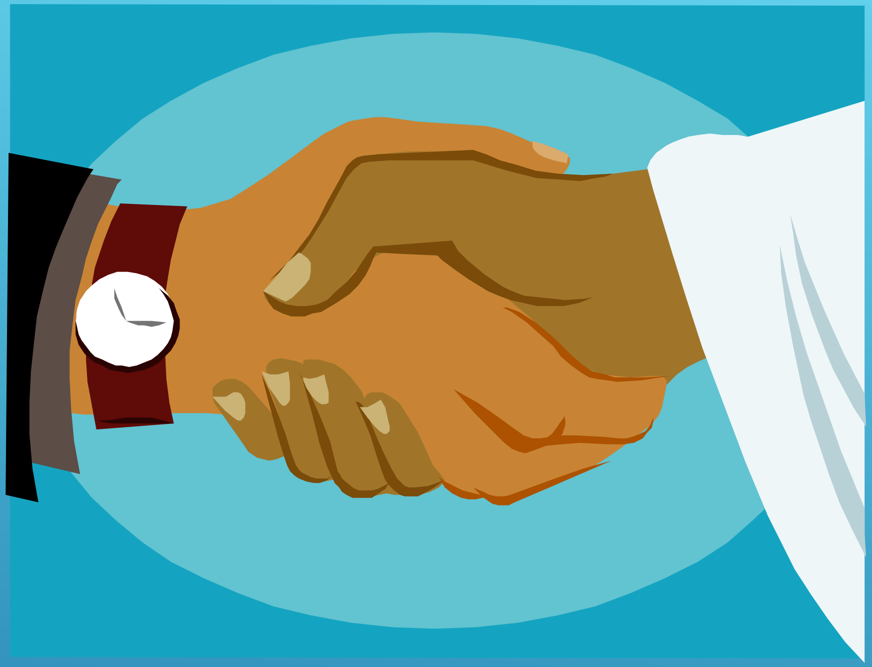
WE ALSO FOUND THAT THE DESIGN OF PARTIAL BAFFLES ON EACH SIDE OF THE SPILLWAY ADJACENT THE TRAINING WALLS WAS NOT VERY CLEAR IN THE BOR GUIDANCE



SUMMARY & CONCLUSION:

GRAPHIC TO BE USED WITH NEW FLOW CHART





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QUESTIONS AT THE END OF SESSION

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