

# DETROIT WATER TEMPERATURE CONTROL AND DOWNSTREAM PASSAGE – FSS 95% DDR

Jeff Ament, Project Manager  
Kristy Fortuny, Technical Lead  
Jon Rerecich, Fish Biologist  
Steve Schlenker, Hydraulic Engineer

USACE Portland District  
Detroit PDT  
WFFDWG Meeting  
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# AGENDA

FSS 95% DDR - Plans and Sections

Screen Channel Hydraulics

CFD Results – FSS Entrance

CFD Results – Outflow

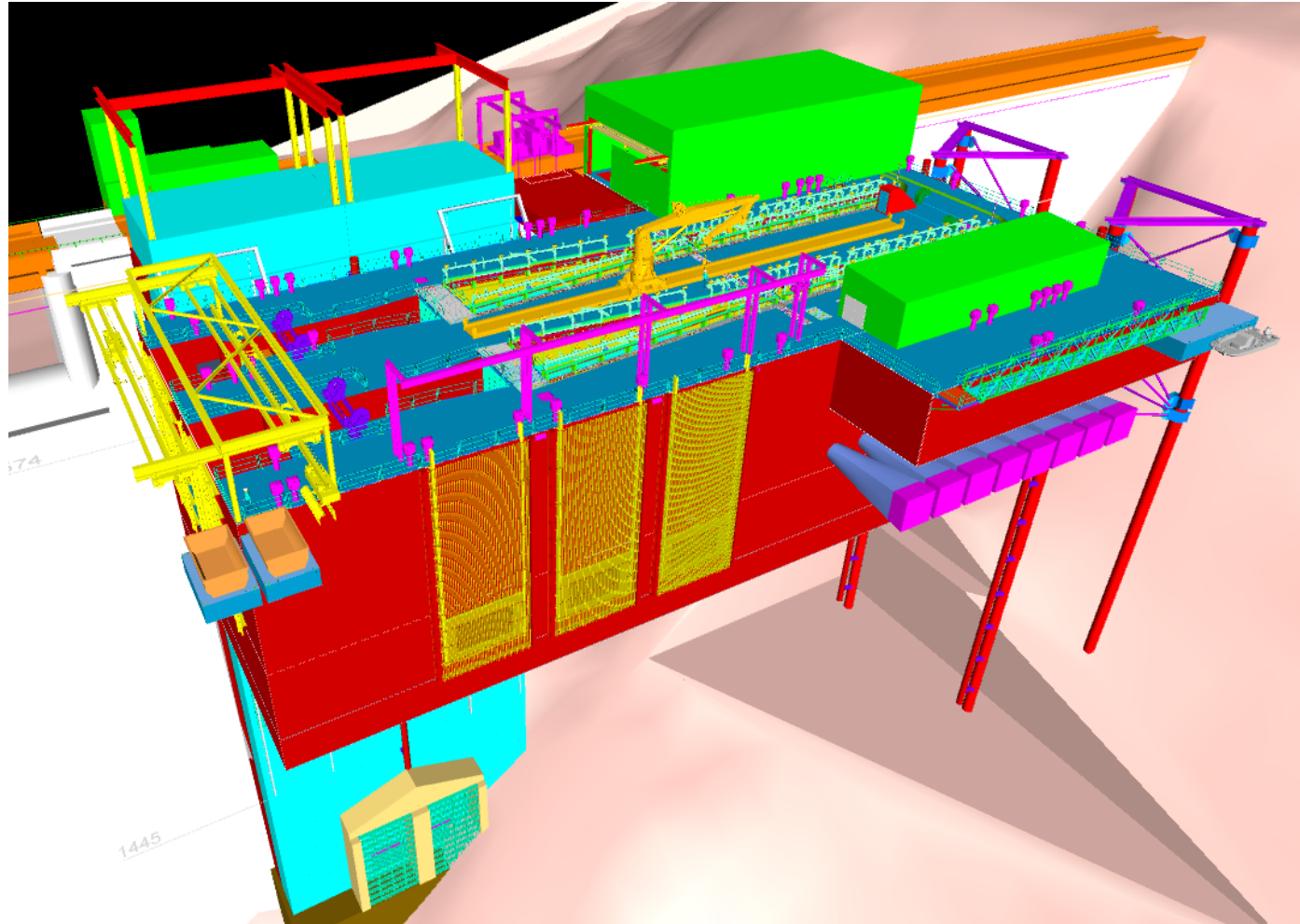
FHF Layout

Fish Offloading

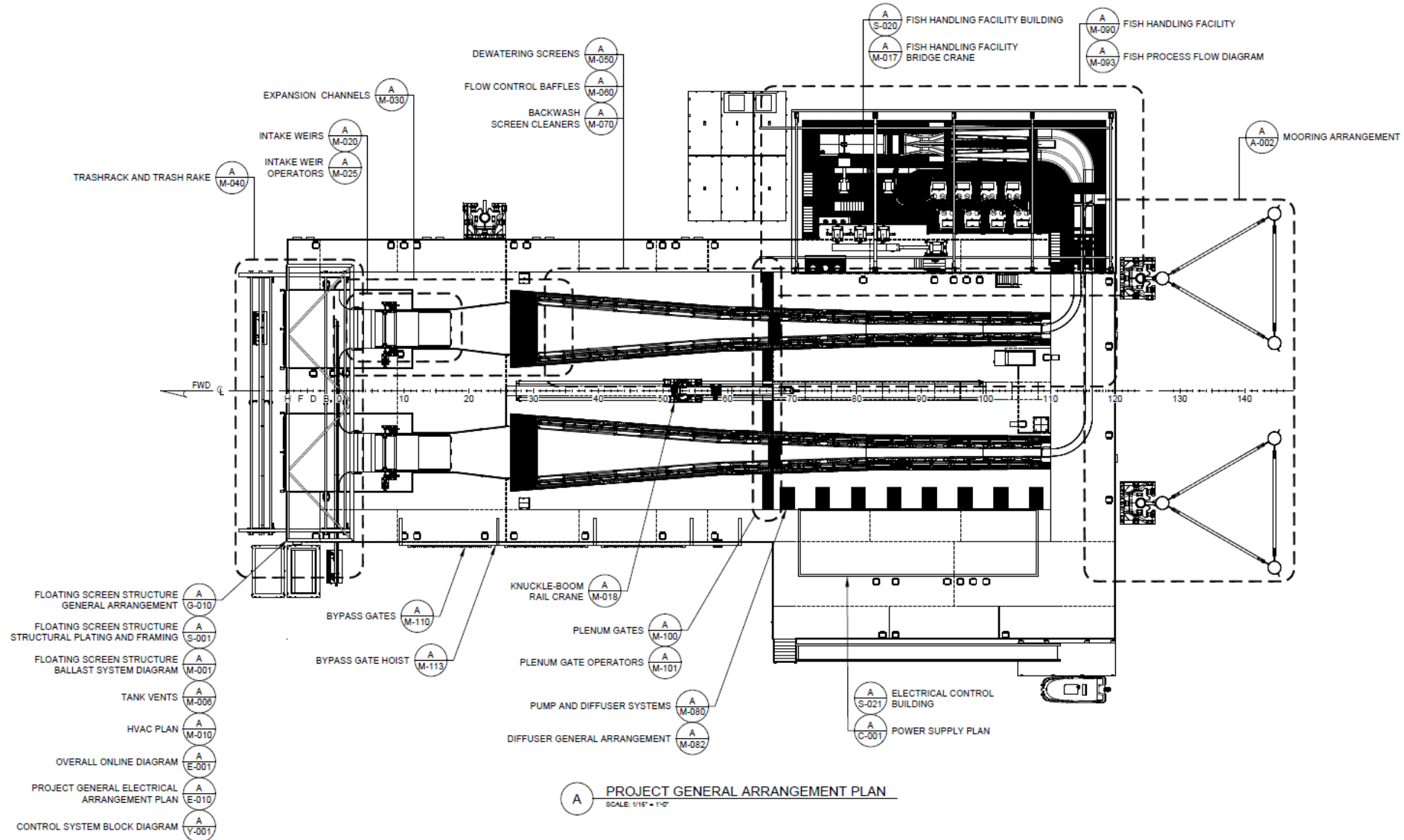
Bypass Gates



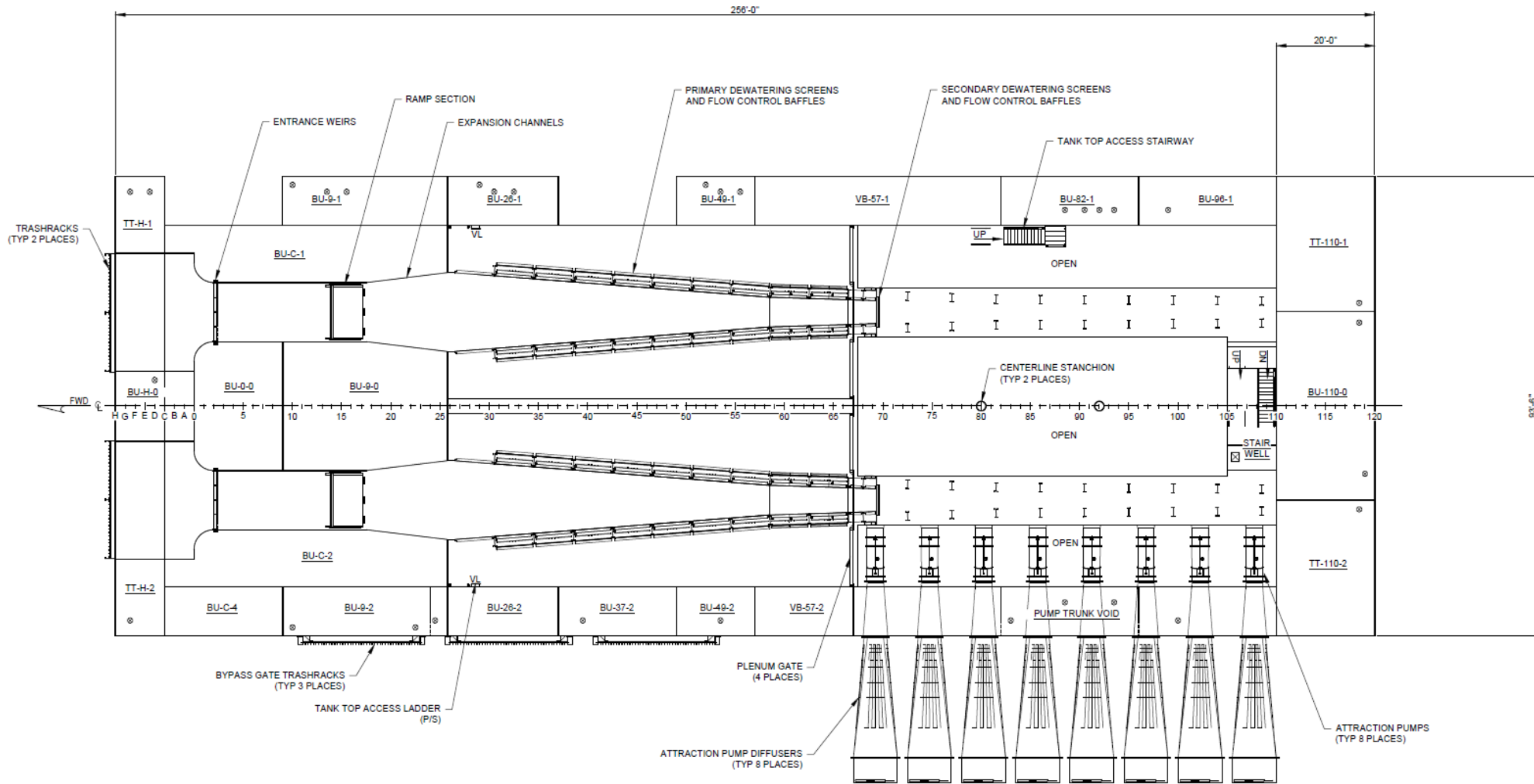
# FSS AND SWS ISOMETRIC



# FSS PLAN VIEW



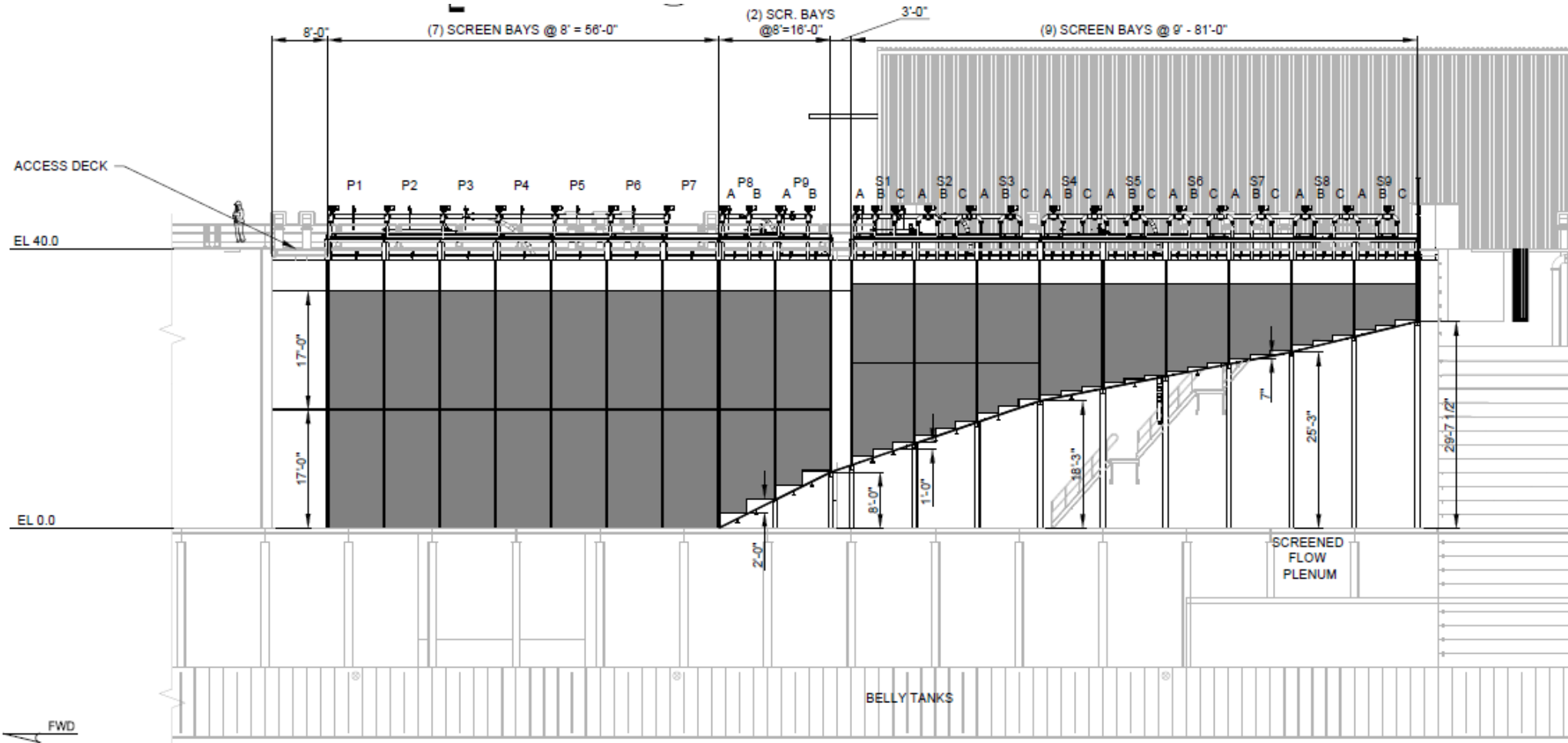
# FSS GENERAL ARRANGEMENT – LOWER FLAT



A GENERAL ARRANGEMENT - LOWER FLAT  
SCALE: 3/32" = 1'-0"



# FSS – DEWATERING SCREEN ELEVATION



FWD

0

A  
M-050

B

ELEVATION  
SCALE: 3/32" = 1'-0"



# FSS SCREEN SYSTEM OPERATIONAL SCENARIOS (OS)

- OS-1: Entrance weirs operate to maintain ~ 2 foot differential to provide entrance capture velocity
  - Channel velocities do not reach capture velocity in secondary screens at medium to lower FSS flow rates.
  - Plenum gates fully open (minimum differential between primary and secondary plenums)
- OS-2: Entrance weir fully lowered
  - Channel velocities reach capture velocity in secondary screens at all FSS flow rates.
  - Plenum gates throttled (maximum differential between primary and secondary plenums)
- OS-3: Entrance weirs operate to maintain ~ 2 foot differential to provide entrance capture velocity
  - Channel velocities reach capture velocity in secondary screens at all FSS flow rates.
  - Plenum gates throttled (maximum differential between primary and secondary plenums)



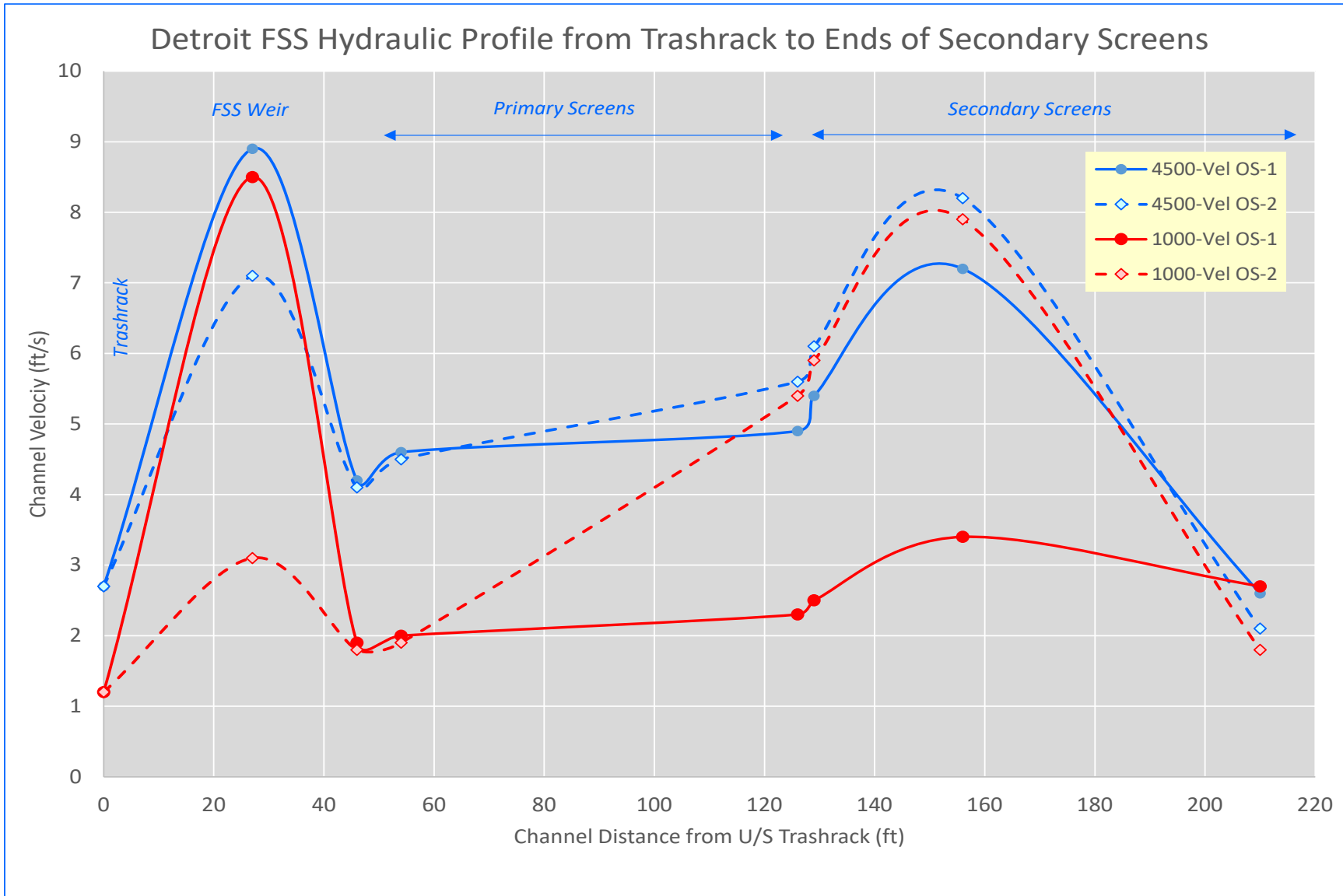
# SCREEN CHANNEL HYDRAULIC PROFILE

Detroit FSS 95% Design Hydraulic Profile through System													
<i>OS-1 (FSS Weir up, Capture Velocity at Entr. Weir, Plenum Gates Full Open)</i>													
	FSS Flow	Number of OP Barrels	Trashrack Velocity (ft/s)	FSS wier		Exp. Cha. Velocity (ft/s)	Primary screens		Secondary screens			Screen Approach	
				subm (ft)	Velocity (ft/s)		Velocities (ft/s)		Velocities (ft/s)			Velocities (ft/s)	
							U/s End	D/S End	U/s End	Acc Cha.	D/S End	Primary	Secondary
Max Criteria	4500	2	2.7	22.1	8.9	4.2	4.6	4.9	5.4	7.2	2.6	0.40	0.35
Max Q	5600	2	3.3	26.8	9.0	5.3	5.7	6.0	6.6	8.9	2.5	0.50	0.44
Min Q	1000	1	1.2	10.8	8.5	1.9	2.0	2.3	2.5	3.4	2.7	0.18	0.16
<i>OS-2 (FSS Weir Down, Capture Vel D/S in Secondary Screens, Plenum gates Throttled)</i>													
	FSS Flow	Number of OP Barrels	Trashrack Velocity (ft/s)	FSS wier		Exp. Cha. Velocity (ft/s)	Primary screens		Secondary screens			Screen Approach	
				subm (ft)	Velocity (ft/s)		Velocities (ft/s)		Velocities (ft/s)			Velocities (ft/s)	
							U/s End	D/S End	U/s End	Acc Cha.	D/S End	Primary	Secondary
Max Criteria	4500	2	2.7	22.1	7.1	4.1	4.5	5.6	6.1	8.2	2.1	0.37	0.39
Max Q	5600	2	3.3	26.8	9.0	5.3	5.7	6.0	6.6	8.8	2.5	0.50	0.44
Min Q	1000	1	1.2	10.8	3.1	1.8	1.9	5.4	5.9	7.9	1.8	0.15	0.37
<i>OS-3 (FSS weir up, Capture Vel at Entr weir &amp; in Sec. Screens, Plenum gates Throttled)</i>													
	FSS Flow	Number of OP Barrels	Trashrack Velocity (ft/s)	FSS wier		Exp. Cha. Velocity (ft/s)	Primary screens		Secondary screens			Screen Approach	
				subm (ft)	Velocity (ft/s)		Velocities (ft/s)		Velocities (ft/s)			Velocities (ft/s)	
							U/s End	D/S End	U/s End	Acc Cha.	D/S End	Primary	Secondary
Max Criteria	4500	2	2.7	22.1	8.9	4.2	4.2	5.5	6.0	8.0	2.6	0.39	0.40
Max Q	5600	2	3.3	26.8	9.0	5.3	5.7	6.0	6.6	8.8	2.5	0.50	0.44
Min Q	1000	1	1.2	10.8	8.5	1.8	1.8	5.4	5.2	7.6	2.9	0.15	0.38





# HYDRAULIC PROFILE CHART: 4500 & 1000 CFS, OS-1 & OS-1



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# POTENTIAL SCREEN DOWNSIZING

## R2 Technical Memorandum

- Increased approach velocity - Primary screens only.
- Overall 20-ft reduction in length of FSS.
- Operating flows (max, design, min) – Sweep velocity 7X greater than approach.
- 54-ft long primary channel length = Rapid passage and short exposure.
- Max approach - 0.4 fps or less at 3500 cfs operating flow.
- FSS operating flows vary and would rarely be at extreme high flow conditions of 0.8 fps.

Potential geotech issues with the north corner of the FHF – reduced excavation

Cost, constructability, and operational benefits.

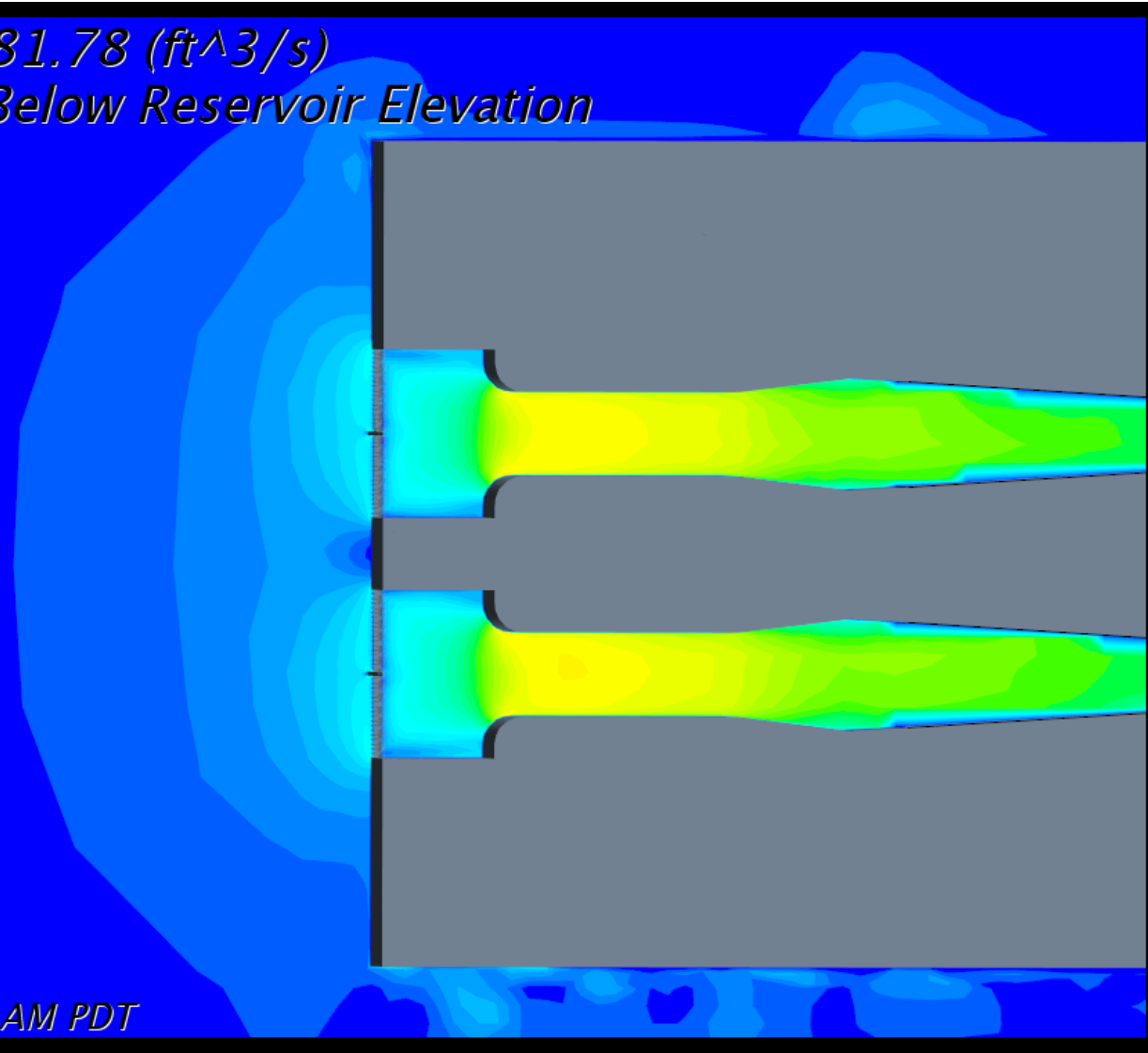
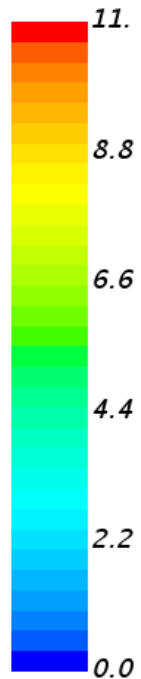
R2 Resource Consultants, Inc. (1997) - Review of Screening Criteria and High Flow Dewatering Literature Search.



# CFD MODELING AT ENTRANCE - PLAN

*Outlet Flowrate: 4381.78 (ft<sup>3</sup>/s)  
Velocity Plane 10ft Below Reservoir Elevation*

Velocity: Magnitude (ft/s)



STAR-CCM+  
Version: 12.06.010  
File: DET\_Rounded  
Wed 22 Aug 2018 10:32:18 AM PDT

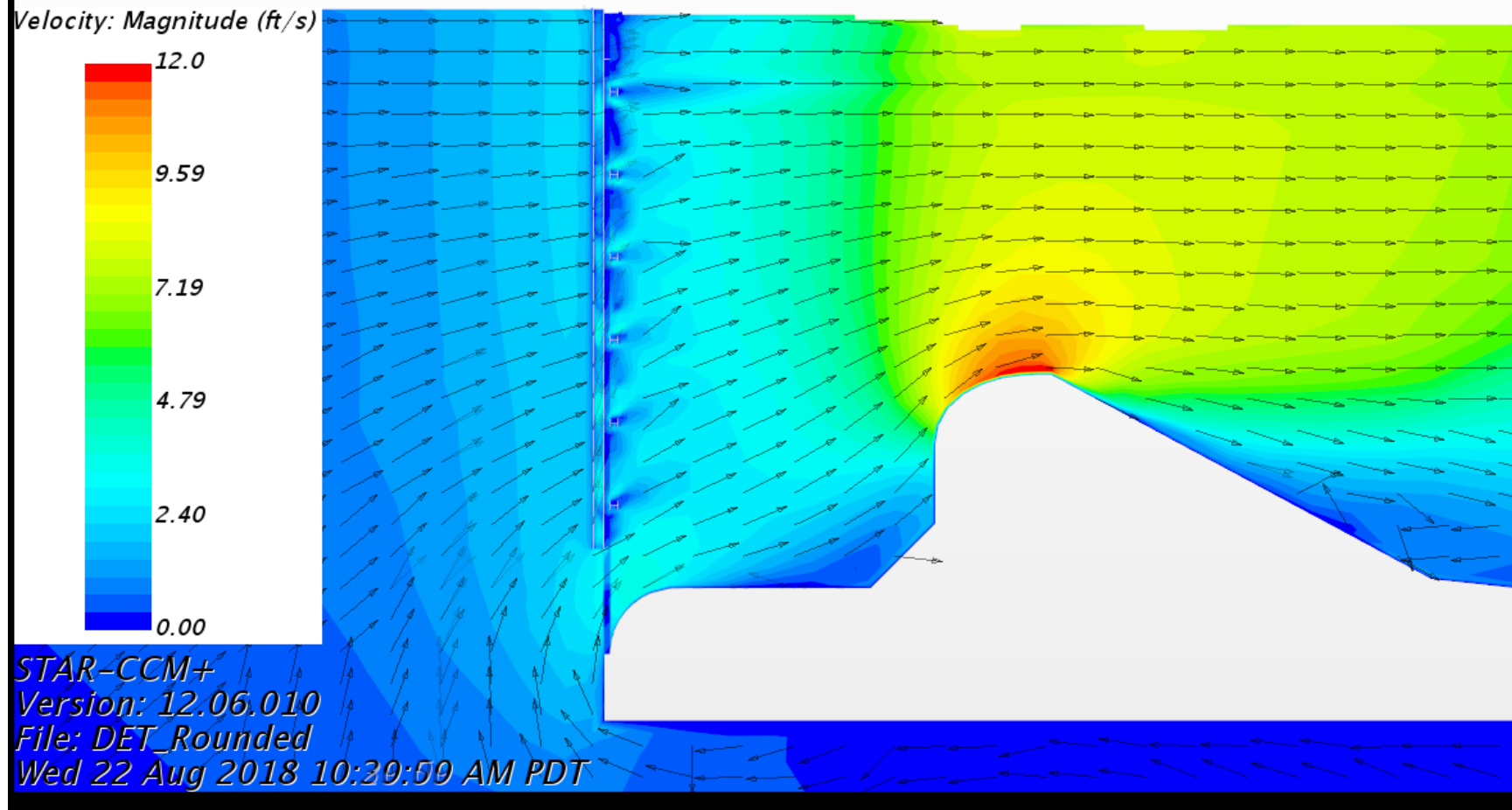


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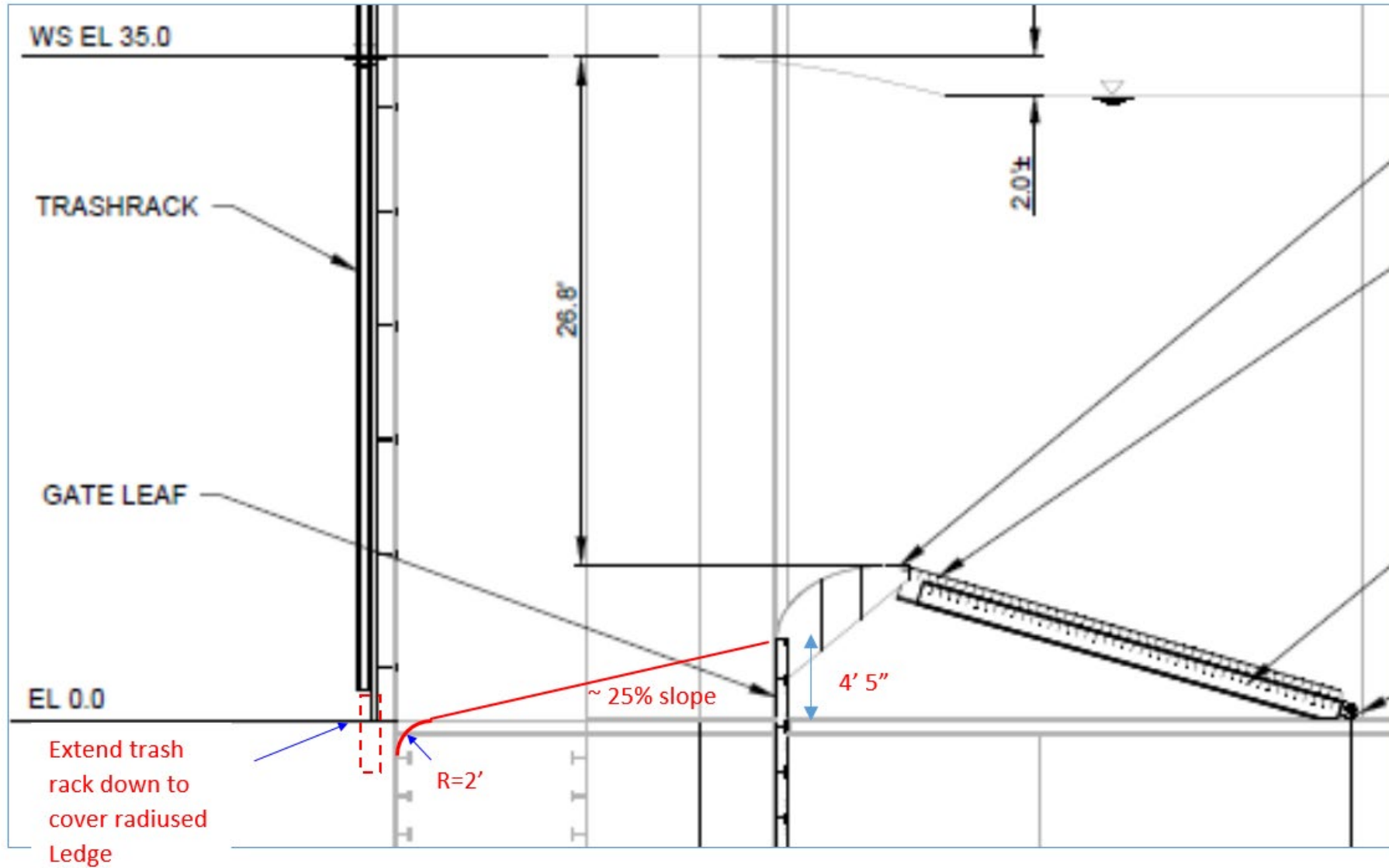


# CFD MODELING AT ENTRANCE - ELEVATION

*Outlet Flowrate: 4381.78 (ft<sup>3</sup>/s)*  
*Velocity Plane Near CL of Weir*



# FSS ENTRANCE CONFIGURATION - ELEVATION



# FSS ENTRANCE WEIR SETTINGS

**Table 4-2** - Entrance Weir Settings for a Range of FSS Flow Rates

FSS Flow	Number of Operating Channels	Weir Crest Submergence (ft below reservoir)
5600	2	26.8
5000	2	24.3
4500	2	22.1
4000	2	19.9
3500	2	17.7
3000	2	15.4
2500	2	13.1
2000	1	19.9
1500	1	15.4
1000	1	10.8



# CFD MODELING – OUTFLOW

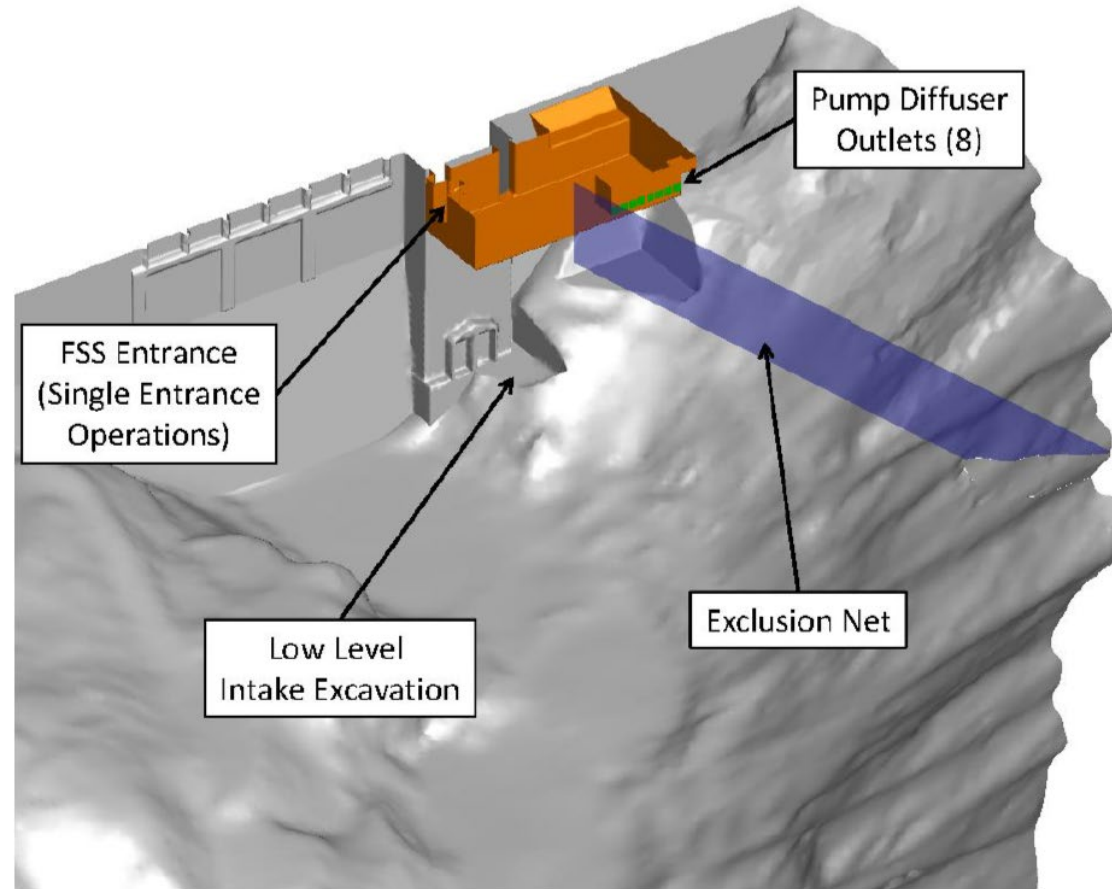
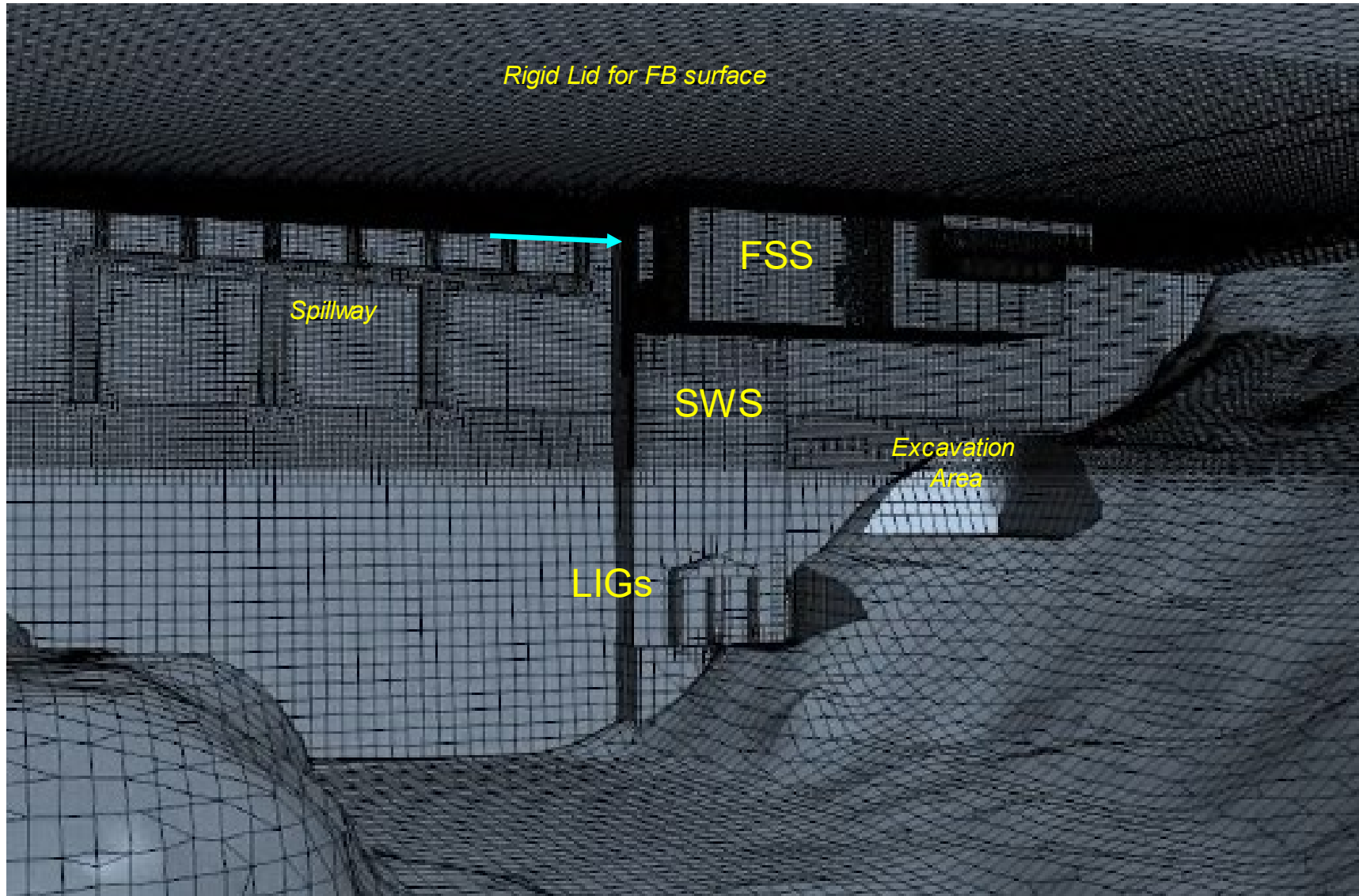


Figure 4-5 - Near-Field Model Geometric Features

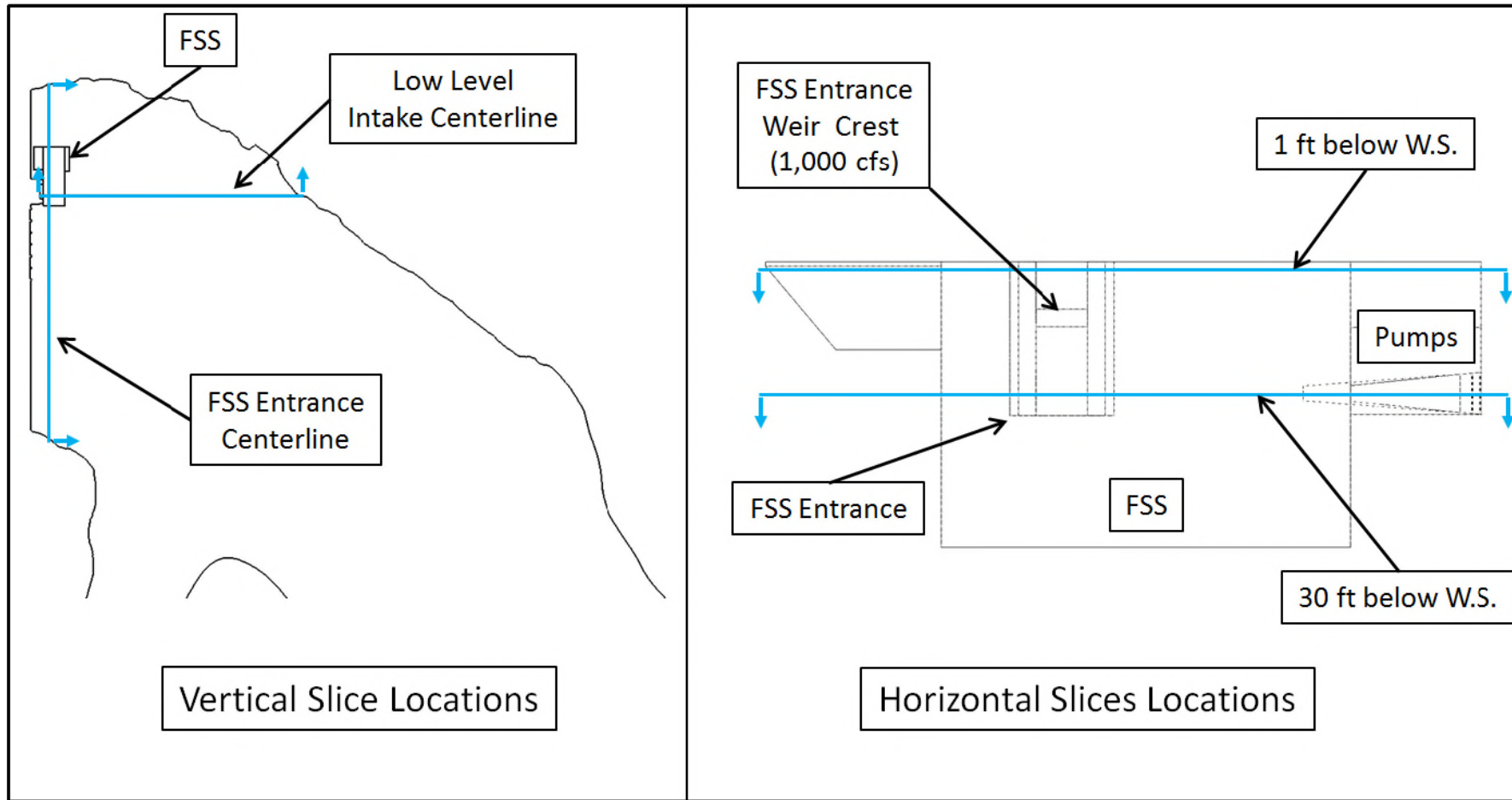


# NEAR FIELD CFD MODEL SURFACE MESH





# CFD VERTICAL AND HORIZONTAL PLANAR SLICES



# CFD MODELING – OUTFLOW WITHOUT PUMPS

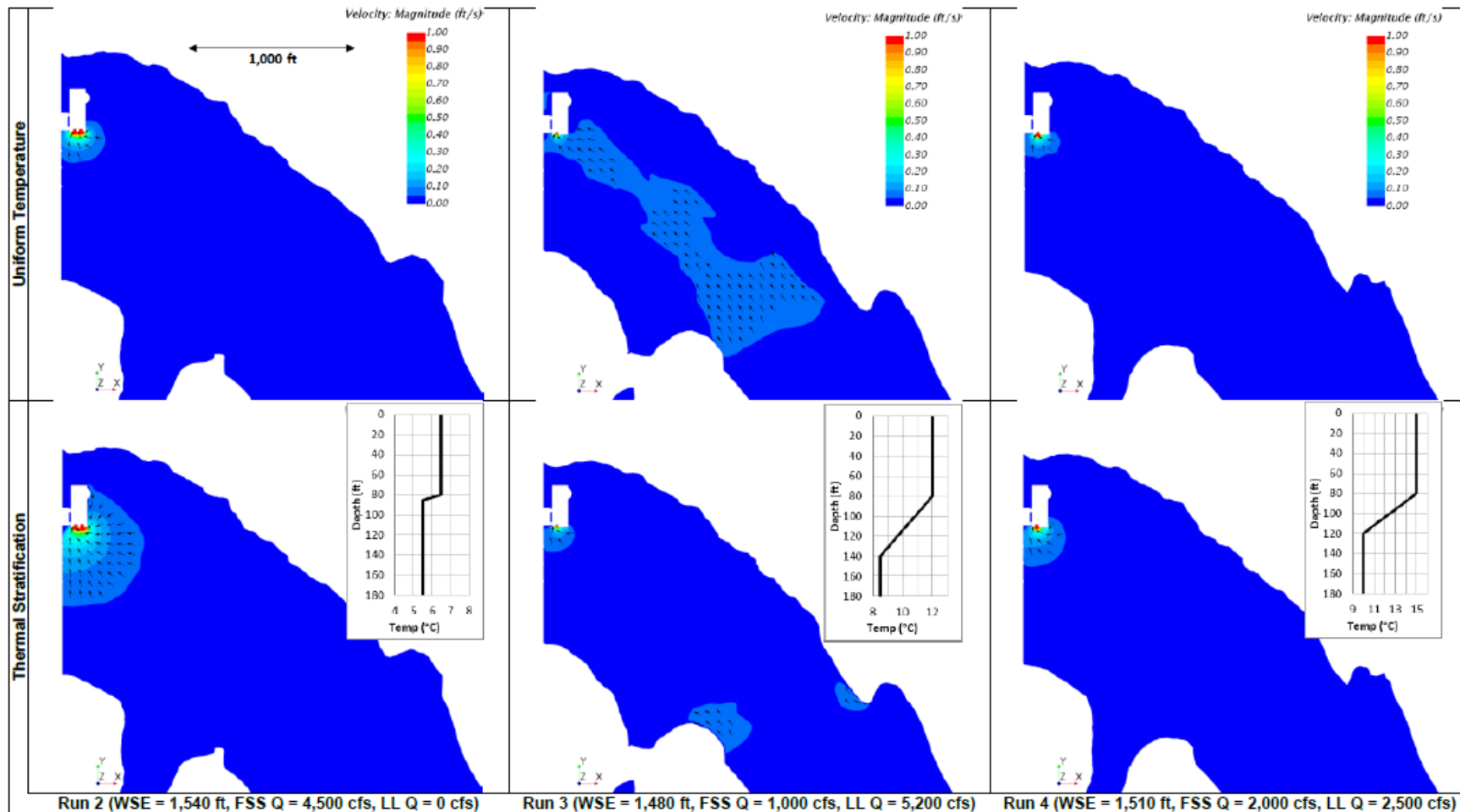


Figure 4-6 - Gravity Flow (Non-Pumped) Near-Field Model Results Overview (Plan)



# CFD MODELING – OUTFLOW WITHOUT PUMPS (CONT.)

CFD Modeling Report – April 2019

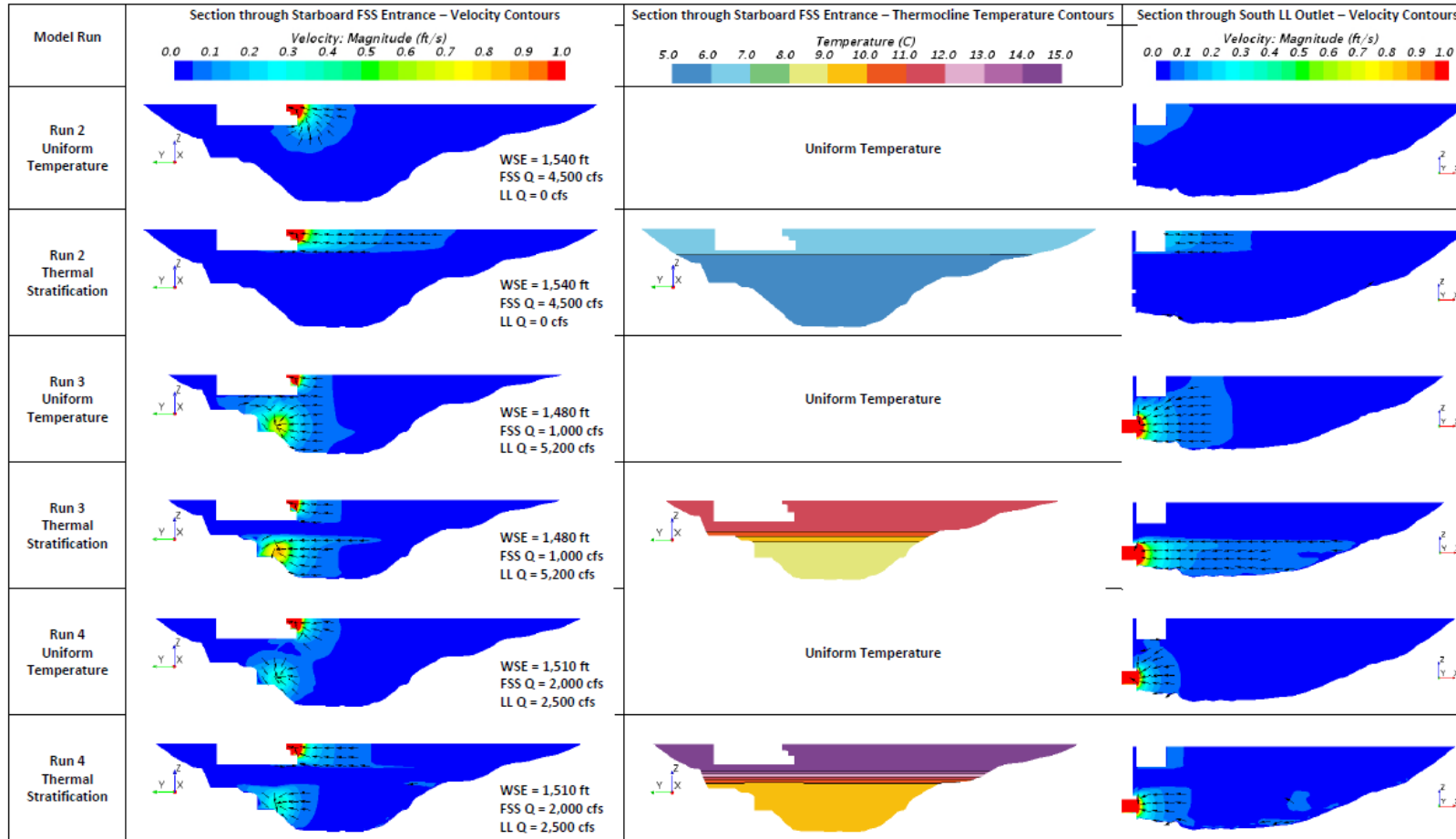
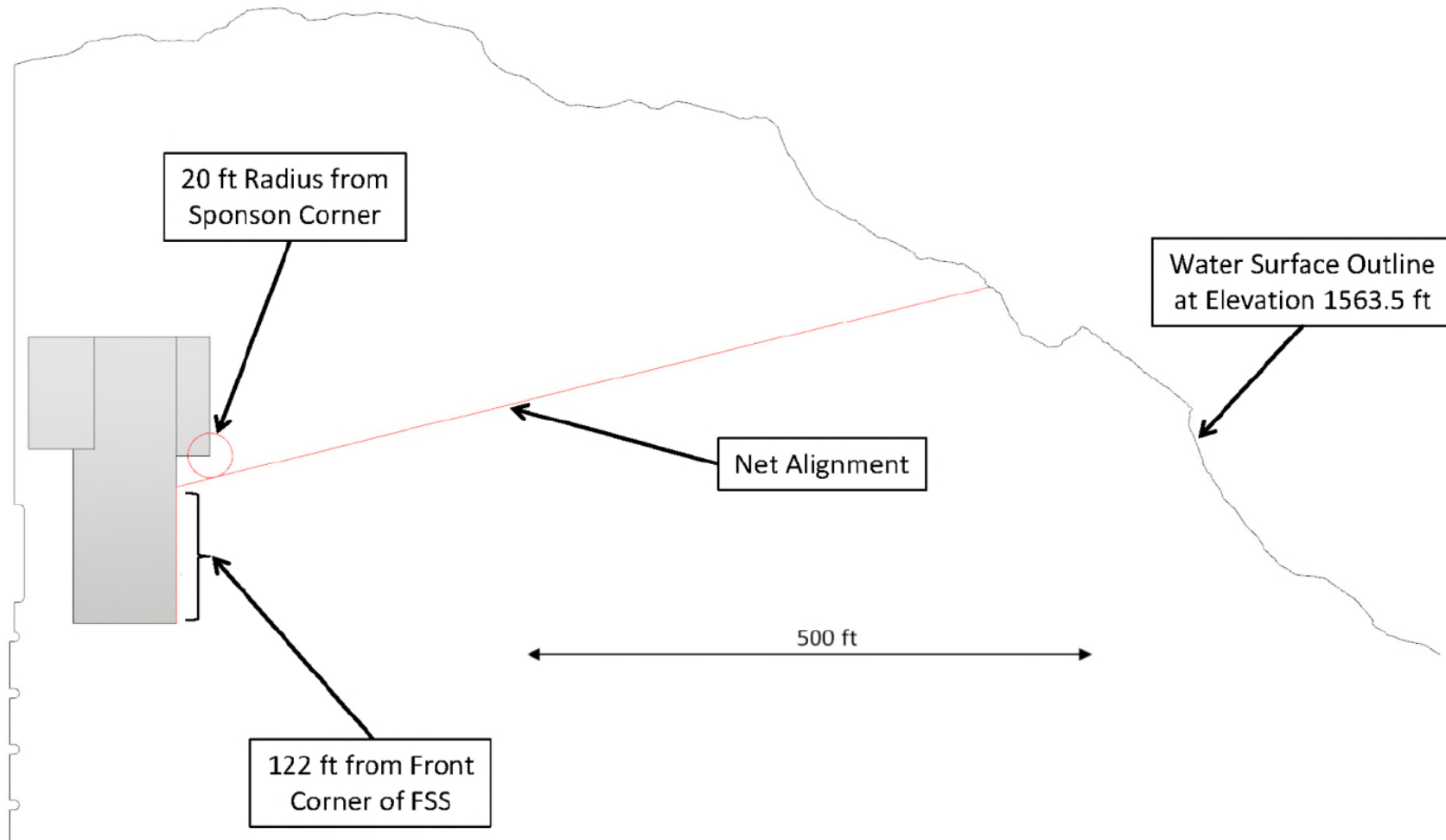


Figure 19 Section Views of Velocity and Temperature for Non-pumped Cases

# GENERAL PLAN VIEW OF PROPOSED NET ALIGNMENT



# PUMP ARRANGEMENT

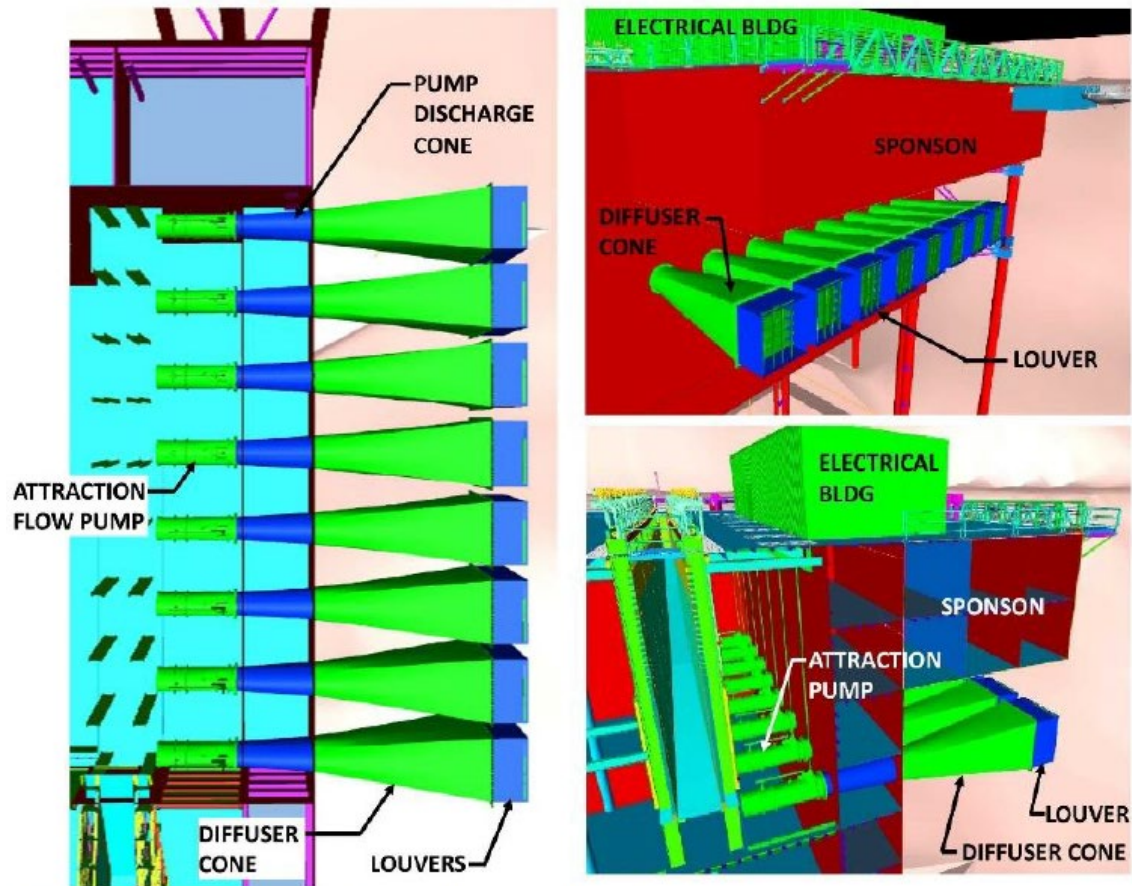


Figure 6-2 - Plan (left), isometric (top right), and oblique (bottom right) layout of Optional Attraction Flow Pumping Arrangement

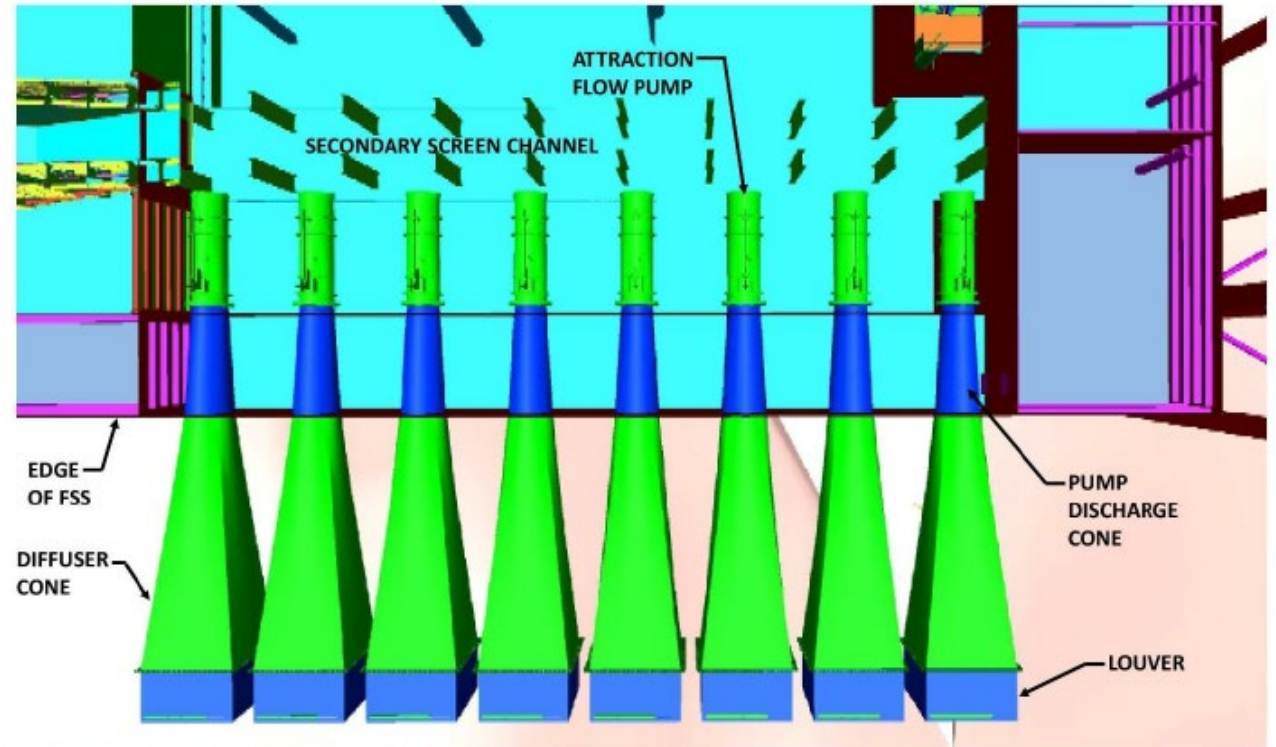
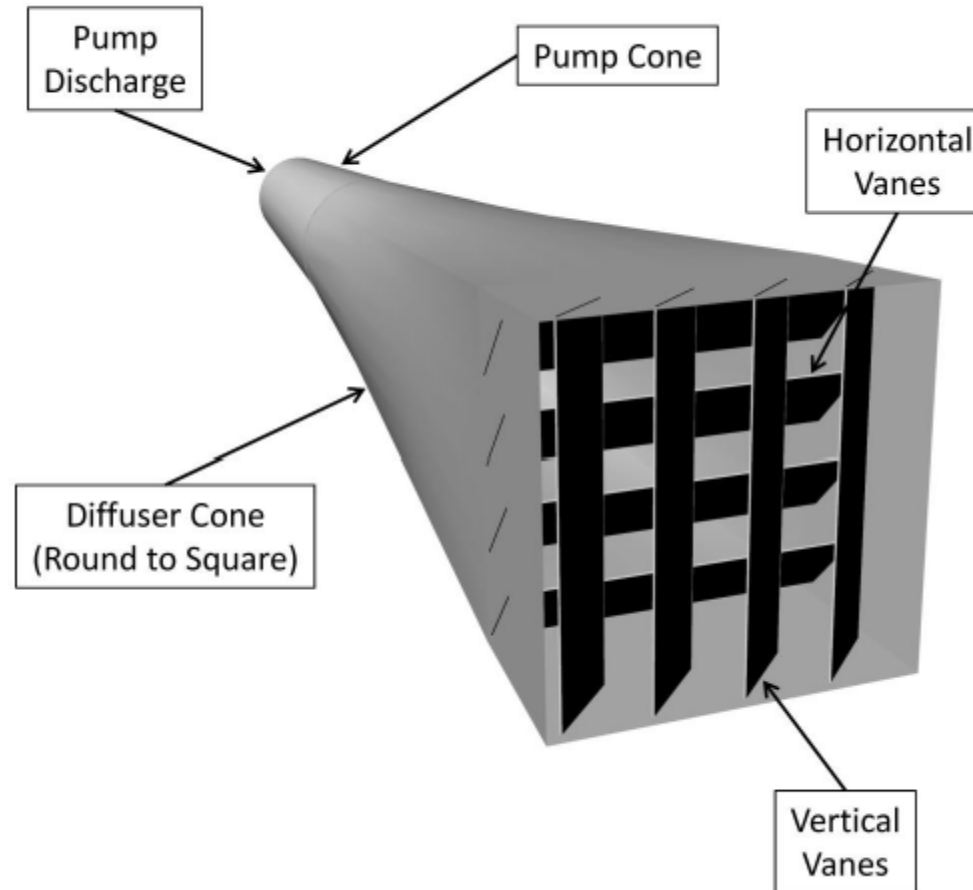


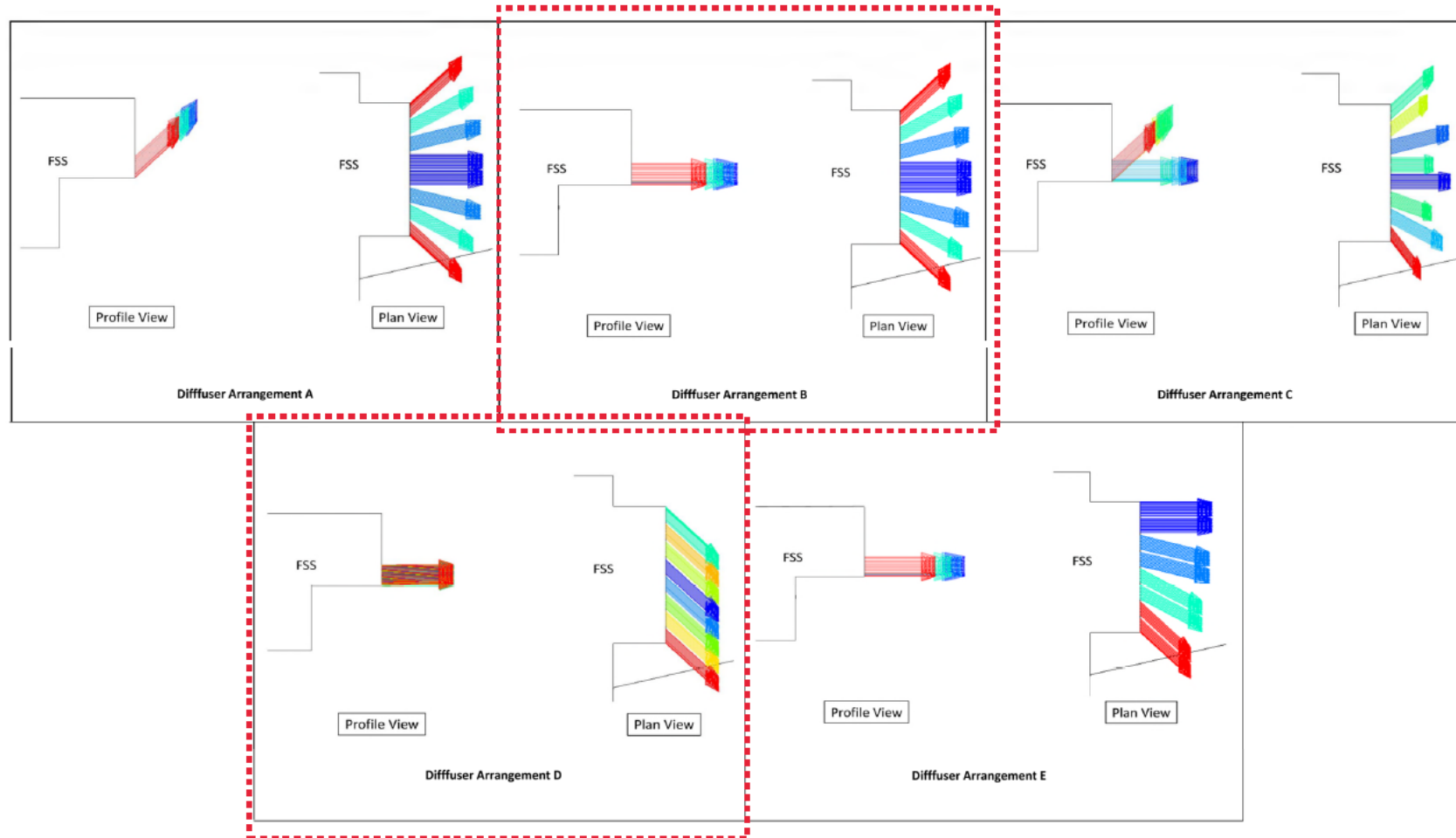
Figure 6-3 - Plan View of Diffuser System Arrangement.



# PUMP DIFFUSION



# VANE DIRECTIONS TESTED (ENCIRCLED INVESTIGATED FURTHER)



# CFD MODELING – OUTFLOW WITH PUMPS

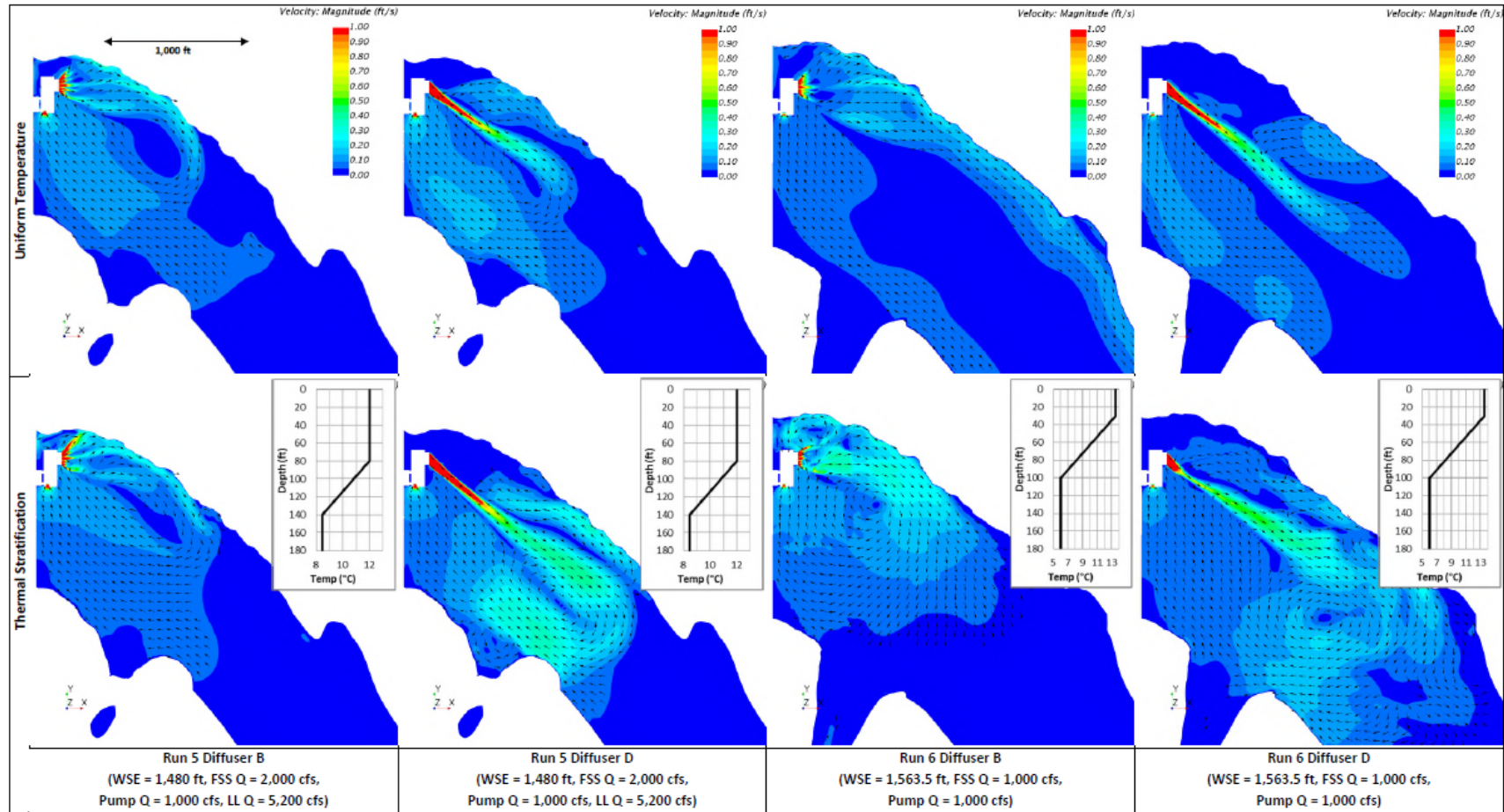


Figure 27 Plan View 30 ft Depth Velocity Contours for Pumped Runs



# CFD MODELING – OUTFLOW WITH PUMPS (CONT.)

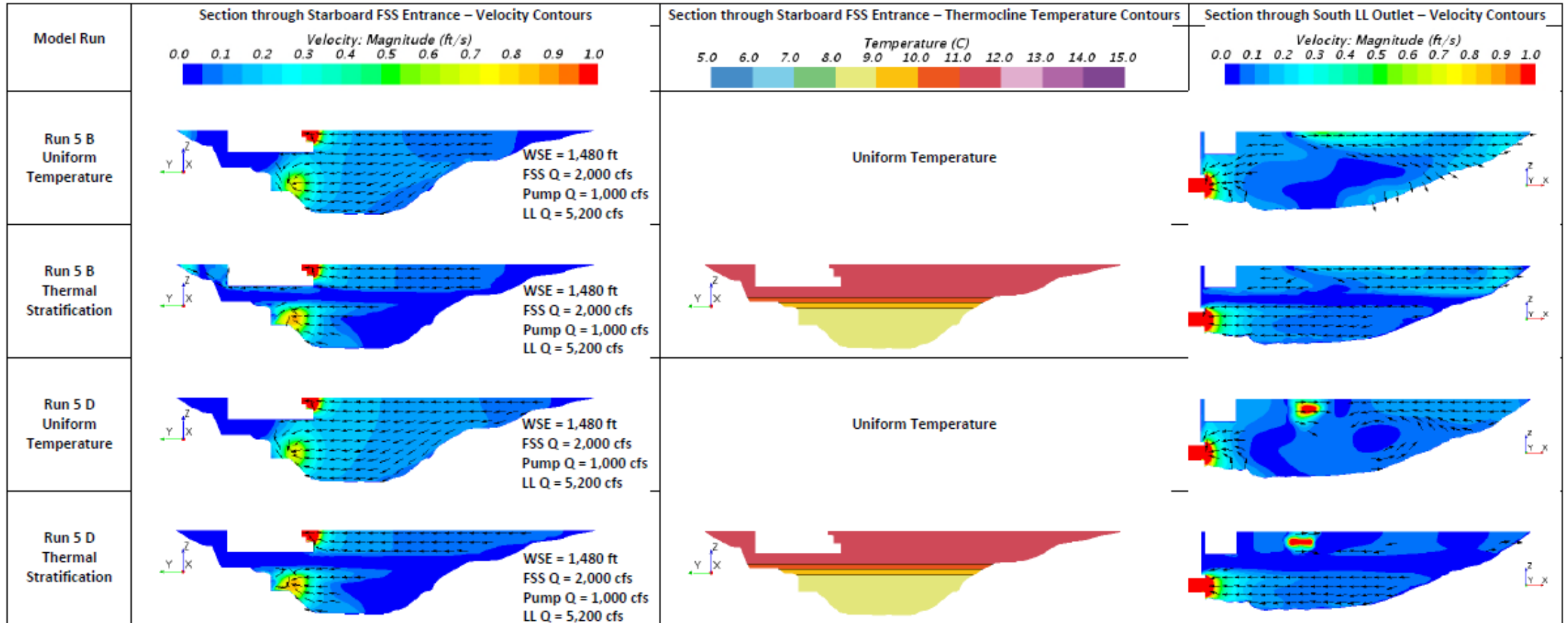
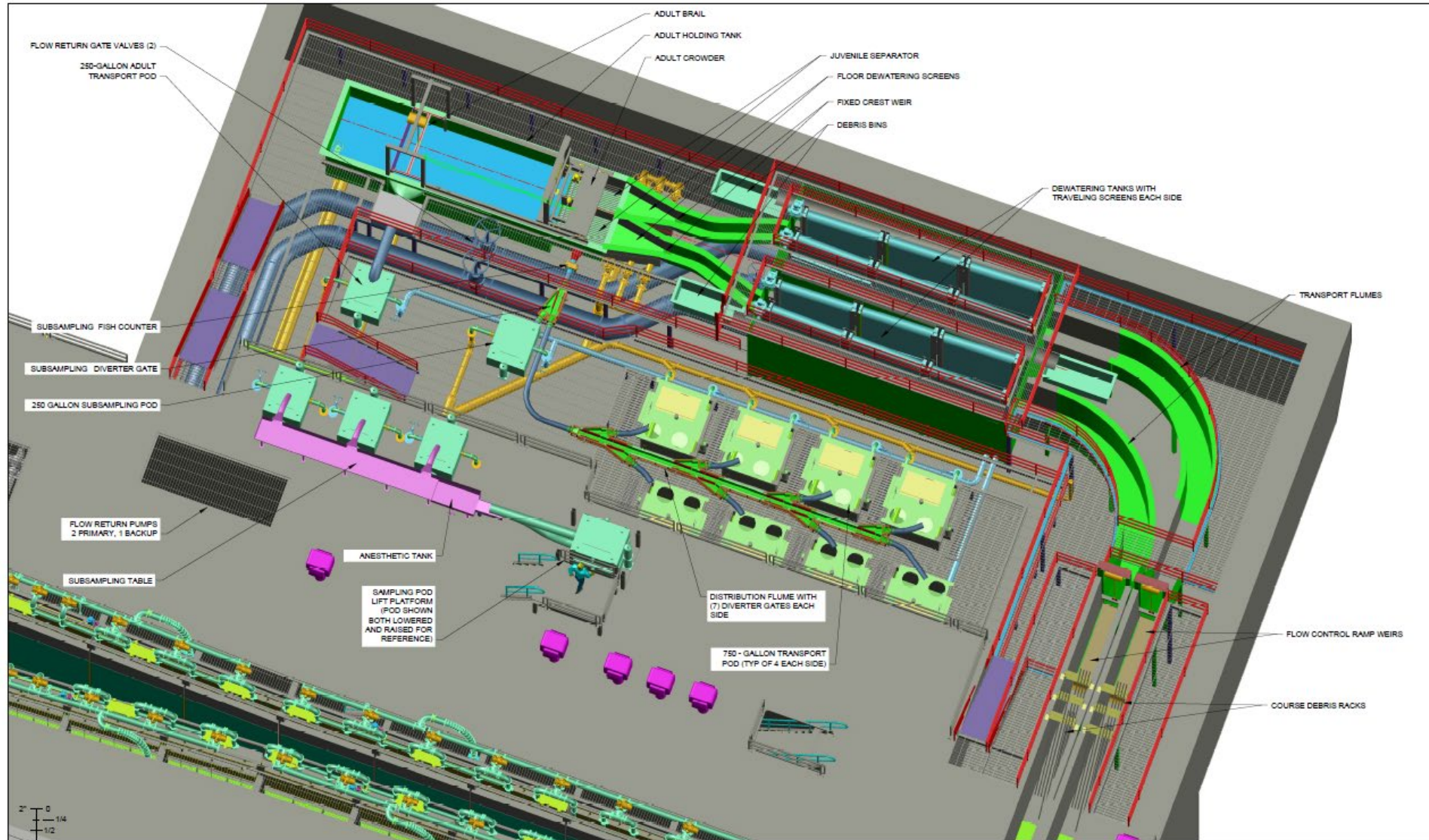
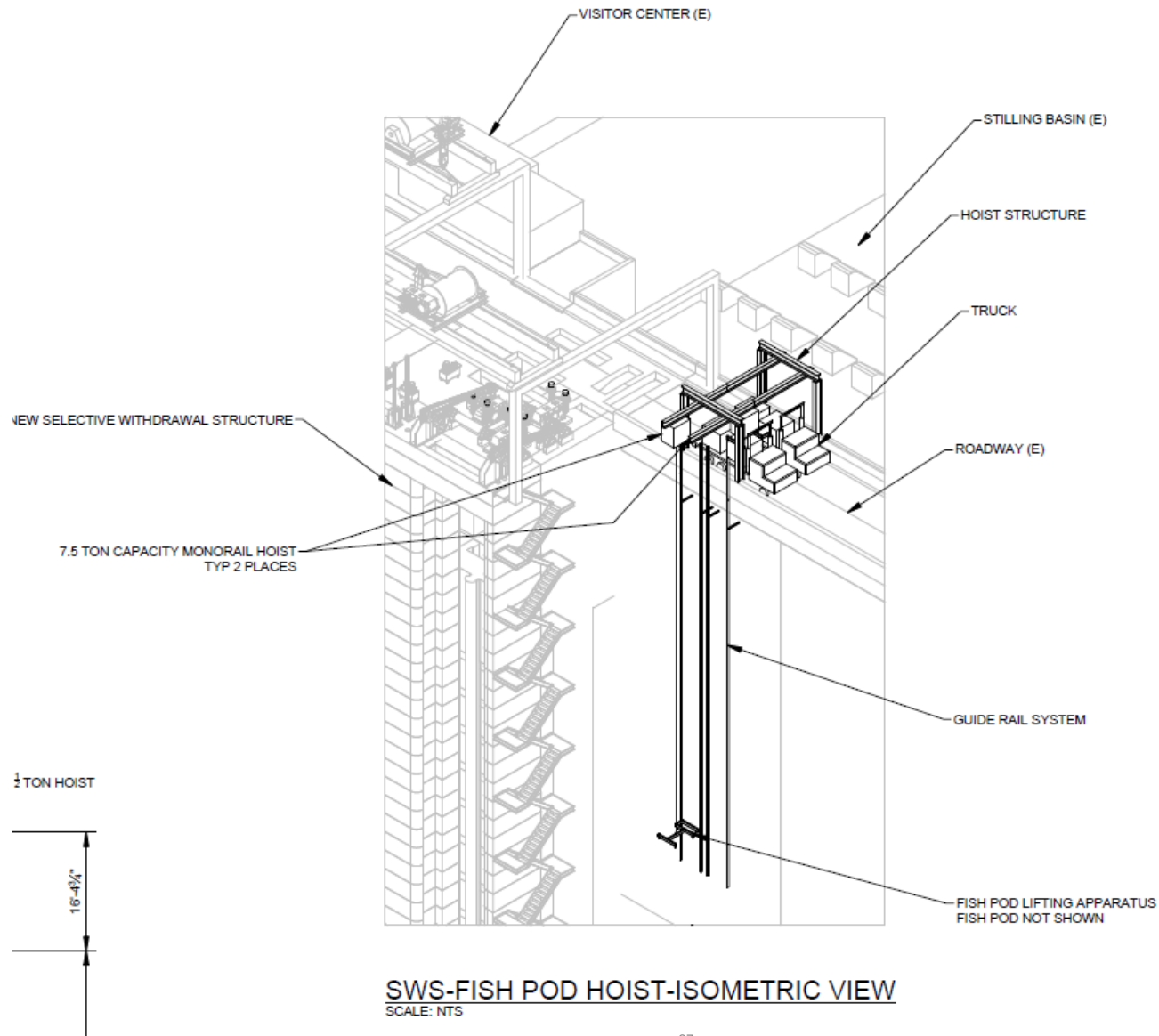


Figure 28 Section Views of Velocity and Temperature for Pump Run 5

# FISH HANDLING FACILITY LAYOUT



# FISH TRANSPORT



SWS-FISH POD HOIST-ISOMETRIC VIEW  
SCALE: NTS



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# BYPASS GATES

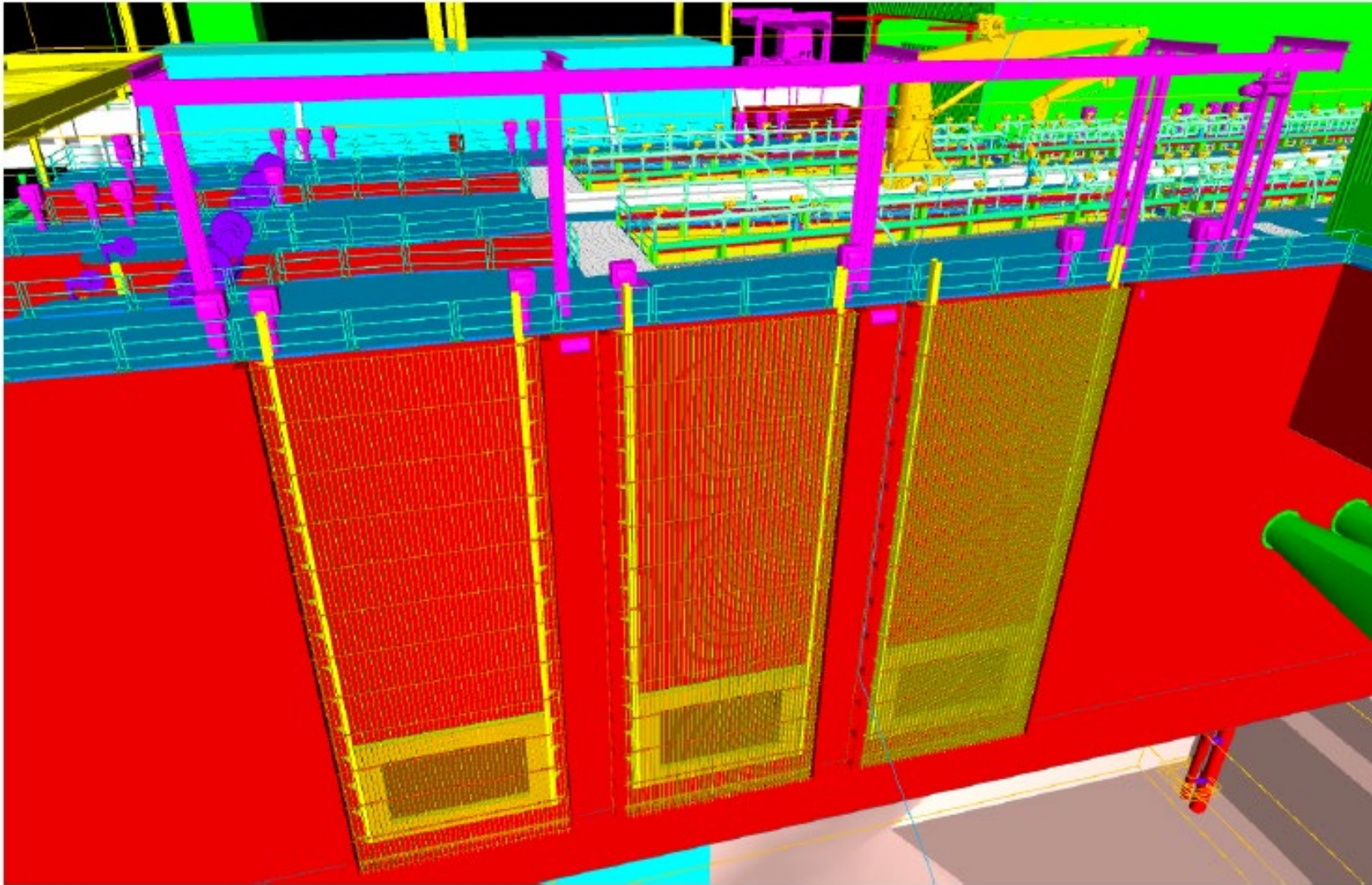


Figure 6-17 – Bypass Gate Hoist, Overhead Structure and Gates



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Questions?



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