US Army Corps
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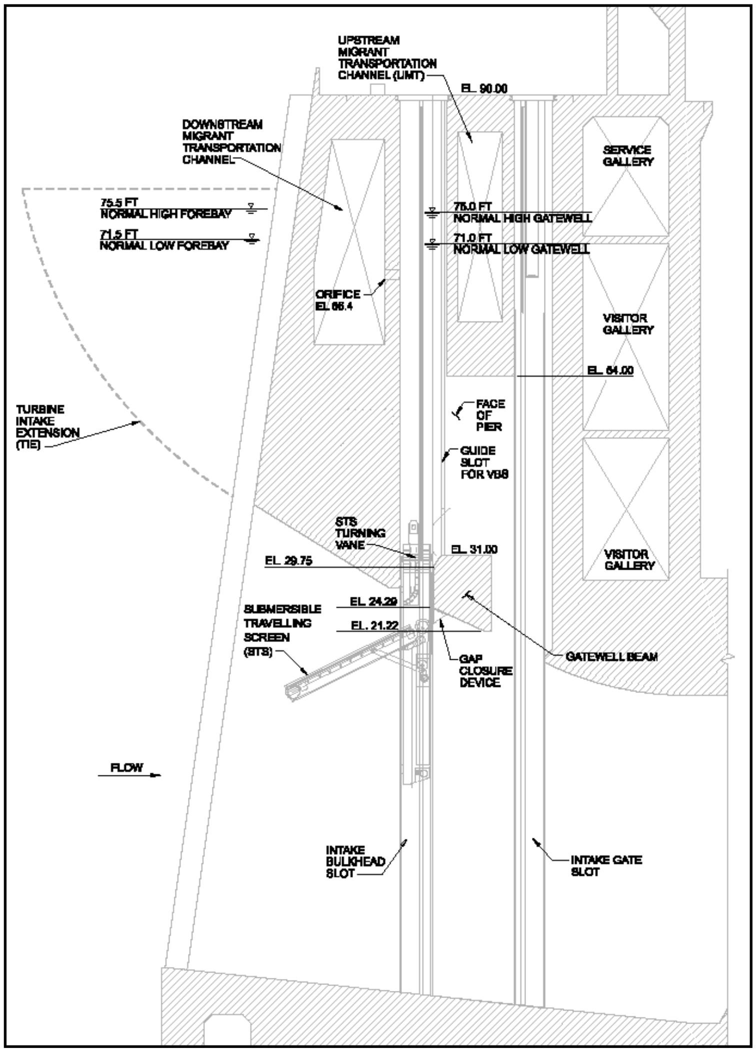
Portland District

Supplement to the Engineering Documentation Report

Bonneville Second Powerhouse
Fish Guidance Efficiency (FGE) Program
Post-construction



January 2015

Final Report

EXECUTIVE SUMMARY

An Engineering Documentation Report (EDR) was developed to investigate alternatives to improve juvenile salmon survival in the gatewells at the Bonneville Dam second powerhouse (PH2). The EDR examined flow control alternatives, operational alternatives, and a flow pattern change alternative for improving conditions within the gatewells, and ultimately recommended that a prototype of the flow pattern change alternative, called a "gate slot filler" or "turbulence reduction device" (TRD), be constructed and tested, both hydraulically and biologically.

A gate slot filler prototype was constructed and tested for biological and hydraulic performance during the spring of 2013. The results of the testing indicated that the prototype did not lead to adequate improvements in juvenile salmon survival within the gatewell. As a result, it was determined that other alternatives that were identified in the EDR should be reconsidered.

This study documents the effort that was undertaken to reconsider the alternatives for improving juvenile salmon survival in the gatewells at PH2 that were developed as part of the EDR. As part of the process, the list of alternatives was refined to the following five alternatives that were evaluated with a computational fluid dynamics (CFD) model.

Flow control alternatives:
- A3 – Static Flow Control Plate
- A6 – Remove Turning Vane
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane

Flow pattern change alternative:
- B1 – Gate Slot Fillers

The results from the modeling were used to evaluate the performance of the alternatives compared to the baseline conditions. Of the five alternatives modeled, only the following three met the design criterion that was developed for flow through the vertical barrier screen (VBS).

- A3 – Static Flow Control Plate
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane

Of the three alternatives that met the design criterion, alternative A3 – Static Flow Control Plate demonstrated a hydraulic environment within the gatewell that most closely resembled the target design condition (baseline with unit flow of 15 kcfs). The other two alternatives produced hydraulic conditions in the area of the STS and in the gatewells which could have negative impacts on FGE and fish survival.

In addition, velocity data that was collected in June 2014 supports the results of the CFD modeling. The data indicates that the flow control plate reduces the flow up the gatewell, reduces the approach velocity for the VBS, and potentially reduces intensity of turbulence in the gatewell, all of which are expected to improve juvenile fish survival in the gatewells.

The recommended alternative for further study as part of the DDR is a flow control plate. To meet the VBS flow design criteria, it is expected that a flow control plate that blocks approximately 50% of the opening between the gatewell beam and the intake gate will be required in bay A, and that a flow control plate the blocks approximately 25% of the opening will be required in bay B. It is also anticipated that a flow control plate will not be necessary in bay C as it appears to meet the VBS flow criteria without a plate at a unit flow of 18 kcfs. However, the exact dimensions and configurations of the plates will need to be determined as part of the DDR.

It is also recommended that alternative A5 – Modify Vertical Barrier Screen Plates (to Meet Velocity Criteria) be studied as part of the DDR. The velocity data that was collected in June 2014 (Harbor and Alden 2014) indicates that the although the flow control plate significantly reduces the areas of high approach velocity on the upper portion of the VBS panel, it does not completely eliminate them, as velocities in excess of 1 ft/s were observed in that region.

As part of the DDR, it is recommended that a prototype of the design that is developed for the flow control plate and VBS modifications be constructed. This prototype should be evaluated for biological and hydraulic performance prior to full implementation across the powerhouse.

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Appendix C	Flow Control Plate Design Calculations
Appendix D	Construction Cost Estimate
Appendix E	Agency Technical Review Comments

PERTINENT PROJECT DATA

PROJECT DESCRIPTION

Stream	Columbia River (River Mile 146.1)
Location	Bonneville, Oregon
Owner	U.S. Army Corps of Engineers
Project Authorization	Rivers and Harbors Act of 1935
Authorized Purposes	Power, Navigation
Other Uses	Fisheries, Recreation

LAKE/RIVER ELEVATIONS (elevation above sea level in feet)

Maximum Controlled Flood Pool	90.0
Maximum Spillway Design Operating Pool	82.5
Maximum Regulated Pool	77.0
Minimum Pool	69.5
Normal Operating Range	71.5 - 76.5
Maximum 24-Hour Fluctuation at Stevenson Gage	4.0
Maximum Flood Tailwater (spillway design flood)	51.5
Maximum Operating Tailwater	33.1
Standard Project Flood Tailwater	48.9
Minimum Tailwater	7.0
Base (100-year) Flood Elev. (at project site tailwater)	39.8

POWERHOUSES

First Powerhouse (Oregon)	
Length	1,027 feet
Number of Main Units	10
Nameplate Capacity (2 @ 43 MW, 8 @ 54 MW)	518 MW
Overload Capacity (2 @ 47 MW, 8 @ 60 MW)	574 MW
Station Service Units (1 @ 4 MW)	4 MW
Hydraulic Capacity	136,000 ft^3/s
Second Powerhouse (Washington)	
Length (including service bay & erection bay)	985.5 feet
Number of Main Units	8
Nameplate Capacity (8 @ 66.5 MW)	532 MW
Overload Capacity (8 @ 76.5 MW)	612 MW
Fish Water Units (2 @ 13.1 MW)	26.2 MW
Hydraulic Capacity	152,000 ft^3/s

SPILLWAY

Capacity at Pool Elevation (Elev. 87.5)	1,600,000 ft^3/s

FISH PASSAGE FACILITIES

Fish Ladders
Washington Shore
Cascades Island
Bradford Island
Juvenile Bypass System – First Powerhouse
Downstream Migrant System – Second Powerhouse
Upstream Migrant System

ACRONYMS AND ABBREVIATIONS

ADV	acoustic Doppler velocimeter
BiOp	Biological Opinion
BIT	Biological Index Testing
BPA	Bonneville Power Administration
CFD	computational fluid dynamics
CRFM	Columbia River Fish Mitigation Program
DDR	Design Documentation Report
DSM	downstream migrant transportation
EDR	Engineering Documentation Report
FCRPS	Federal Columbia River Power System
FFDRWG	Fish Facility Design Review Work Group
FGE	fish guidance efficiency
FPP	Fish Passage Plan
ft/s	feet (foot) per second
ft^3/s	cubic feet per second
ft^2/s^2	feet squared per second squared
GCD	gap closure device
HDC	Hydroelectric Design Center
JBS	juvenile bypass system
JMF	Juvenile Monitoring Facility
LCC	life cycle costs
LDV	laser Doppler velocimeter
mm	millimeter(s)
MW	megawatt(s)
MWh	megawatt hour(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O&M	operation and maintenance
PSMFC	Pacific States Marine Fisheries Commission
PDT	Product Development Team
PH1	first powerhouse
PH2	second powerhouse
PIT	passive integrated transponder
RM	river mile(s)
SCNFH	Spring Creek National Fish Hatchery
SP	super-peak (hours)
STS	submerged traveling screen
SWRG	USACE Northwestern Division Anadromous Fish Evaluation Program Studies Review Work Group
TEAM	Turbine Energy Analysis Model
TDG	total dissolved gas
TIE	turbine intake extension
TRD	turbulence reduction device
TSP	Turbine Survival Program
UMT	upstream migrant transportation
USACE	U.S. Army Corps of Engineers
VBS	vertical barrier screen

1. INTRODUCTION

1.1. PURPOSE AND SCOPE

The purpose of this report is to document activities that occurred as a result of the recommendations in *Engineering Documentation Report Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Program Post-Construction* (USACE October 2013). That document, referred to herein as the EDR, documented the investigation and development of alternatives to reduce the mortality and descaling of juvenile salmonids in the gatewells at the Bonneville Dam second powerhouse (PH2). The EDR concluded with a recommendation to construct and test a prototype that was anticipated to improve juvenile salmon survival by modifying flow patterns within the gatewells. The EDR also recommended that the other alternatives in the report be reconsidered if the prototype did not result in satisfactory improvements in juvenile salmon survival within the gatewell.

The prototype recommended in the EDR, called a “gate slot filler” or “turbulence reduction device” (TRD), was constructed and tested for hydraulic and biological performance (Harbor and Alden 2013; Gilbreath et al. 2014) during the spring of 2013. The results of the testing indicated that the prototype did not lead to adequate improvements in subyearling Chinook salmon survival within the gatewell (Gilbreath et al. 2014). In addition, the results of the hydraulic testing demonstrated hydraulic conditions within the gatewell that were previously unknown and not predicted with the computational fluid dynamics (CFD) model that was used to evaluate alternatives as part of the EDR. The unsatisfactory performance of the gate slot filler, along with the new hydraulic data, prompted the need for further study.

The scope of this project is to reevaluate the alternatives developed as part of the EDR to reduce juvenile salmon mortality and descaling in the gatewells at PH2. As part of this project, the CFD model was recalibrated using the hydraulic field data collected in 2013, and was then used to reevaluate flow control alternatives. Additional field hydraulic data was collected in 2014 to validate the data that was collected in 2013, as well as to validate the results of the recalibrated CFD model. This data collection effort was also used to preliminarily evaluate a prototype of a flow control alternative, which consisted of a plate attached to the top of the gatewell beam.

The specific tasks associated with this project include the following:

- Reconsider alternatives to develop a shortlist of preferred alternatives for reevaluation.
- Recalibrate the CFD model using field data collected in the spring of 2013.
- Reevaluate the shortlist of preferred flow control alternatives using the recalibrated CFD model.
- Collect field hydraulic data for validation of field data collected in the spring of 2013 and for validation of the CFD model output.
- Compare the shortlist of preferred alternatives using output from the recalibrated CFD model.
- Select a preferred alternative to be implemented or carried forward to a Design Documentation Report (DDR) phase.

1.2. PROJECT OBJECTIVE

The objective of this project is to recommend a concept to be implemented or carried forward to a Design Documentation Report (DDR) phase to increase survival of juvenile salmon in the gatewells at the Bonneville Dam PH2 while maintaining an acceptable level of fish guidance efficiency (FGE) into the gatewells.

1.3. BACKGROUND

In 1999, regional fisheries agencies agreed to pursue a phased approach to improve fish guidance and survival at PH2 by maximizing flow up the turbine intake gatewells, a guideline that has been used on similar programs to improve FGE. Typical juvenile fish bypass systems (JBS) at lower Columbia River dams consist of submerged traveling screens (STS), gatewell orifice passage, and turbine intake vertical barrier screens (VBS; Figure 1). The modifications at PH2 were completed in 2008 and included an increase in VBS flow area, installation of turning vanes to facilitate flow up the gatewells, addition of a gap closure devices (GCD) to reduce fish loss at the STSs, and allowances for the installation of an interchangeable VBS to allow for screen removal and cleaning without outages or intrusive gatewell dipping (Figure 2). Results of biological studies showed an increase in FGE by 21% for yearling Chinook and 31% for subyearling Chinook. Test fish conditions showed no problems with descaling and gatewell retention time (including fry) in a newly modified unit.

Elevated mortality and poor fish condition were recorded at the PH2 Smolt Monitoring Facility following Spring Creek National Fish Hatchery sub-yearling Chinook salmon releases in 2007. Physical inspections of bypass facilities at PH2 resulted in little evidence to indicate that a mechanical system was the causative mechanism. Testing in 2008 and 2009 suggested undesirable flow conditions in the gatewell created as a result of bypass system modifications (i.e. turning vanes, larger VBS, and gap closure devices) were the causative mechanism (Gilbreath et al., 2012). Starting in 2008, PH2 units were operated at the lower end of the 1% peak efficiency range during Spring Creek NFH releases. Since March 2011, PH2 units have been operated at the middle to lower end of the 1% peak efficiency range during regionally coordinated special operations to minimize PH2 screened bypass descaling and mortality. Confining operation to the lower end of the 1% range at PH2 reduces the operational flexibility and configuration that may maximize benefits to juvenile salmonid passage at this priority powerhouse and through the project. A detailed description of the lower, middle, and upper 1% turbine operating efficiency range can be found in the U.S. Army Corps of Engineers (USACE) Turbine Survival Program (TSP) Phase I and II Biological Index Testing (BIT) reports, as well as the current Fish Passage Plan (FPP). Preliminary results from the 1:25 physical model of the turbine suggest higher survival through the turbine when the flows are at the upper 1% range – final results should be available in late FY15 or early FY16.

In response to the results of the 2008 biological testing, the USACE developed preliminary alternatives for potentially reducing flow into the gatewells, and presented them to the regional fisheries agencies. The regional fisheries agencies agreed with the USACE analysis and approved the study to investigate and evaluate flow control and operational alternatives to increase juvenile salmon survival within the gatewells. The effort and results of that study are documented in the EDR (USACE, October 2013), to which this report is a supplement.

The EDR evaluated both operational and structural alternatives for increasing juvenile survival in the gatewells. The operational alternatives included:

- Operate main turbine units at lower to mid 1% peak operating range during juvenile fish release.
- Open the second downstream migrant system gatewell orifice to decrease fish retention time in the gatewell.
- Construct a horizontal slot in place of the existing orifices or additional orifices to decrease fish retention time in the gatewell.

The structural alternatives considered included the following to reduce flow into the gatewell:

- Construct a louver device downstream of the VBS to control the flow up the gatewell. Similar devices have been used at the John Day and McNary dams.

- Construct a sliding plate flow control device attached to the top of the gatewell beam.
- Modify the existing VBS perforated plates to result in a reduction of gatewell flow.
- Modify the turning vane and GCD.

One other structural alternative was considered that was not intended to reduce flow into the gatewell, but was intended to modify the flow pattern within the gatewell, resulting in a hydraulic environment that is less detrimental to juvenile salmon. This alternative, called a “gate slot filler” or “turbulence reduction device” (TRD), consists of solid members that are installed in the guide slots above the STS side frame to eliminate the sudden expansions that occur there. CFD modeling conducted as part of the EDR indicated that the sudden expansions above the STS side frame cause areas of flow circulation and high turbulence intensity. The CFD modeling conducted also showed a reduction in flow circulation and turbulence intensity with the gate slot filler in place. It was hypothesized that the gate slot filler could improve juvenile salmon survival by improving the hydraulic environment within the gatewell by modifying flow patterns and reducing turbulence intensity. Additional benefits of this alternative were that the operating range of the turbines would not be affected and that the existing fish guidance flow into the gatewells could be maintained.

The EDR recommended that a gate slot filler prototype be constructed and tested, both hydraulically and biologically. The EDR also recommended that the other alternatives in the report be reconsidered if the prototype did not result in satisfactory improvements in juvenile salmon survival within the gatewell.

A gate slot filler prototype was constructed and tested for hydraulic and biological performance (Harbor and Alden 2013; Gilbreath et al. 2014) during the spring of 2013. The results of the testing indicated that the prototype did not lead to adequate improvements in subyearling Chinook salmon survival within the gatewell (Gilbreath et al. 2014). In addition, the results of the hydraulic testing demonstrated hydraulic conditions within the gatewell that were previously unknown and not predicted with the CFD model that was used to evaluate alternatives as part of the EDR. The unsatisfactory performance of the gate slot filler, along with the new hydraulic data, prompted the need for further study, which resulted in the effort documented in this report.

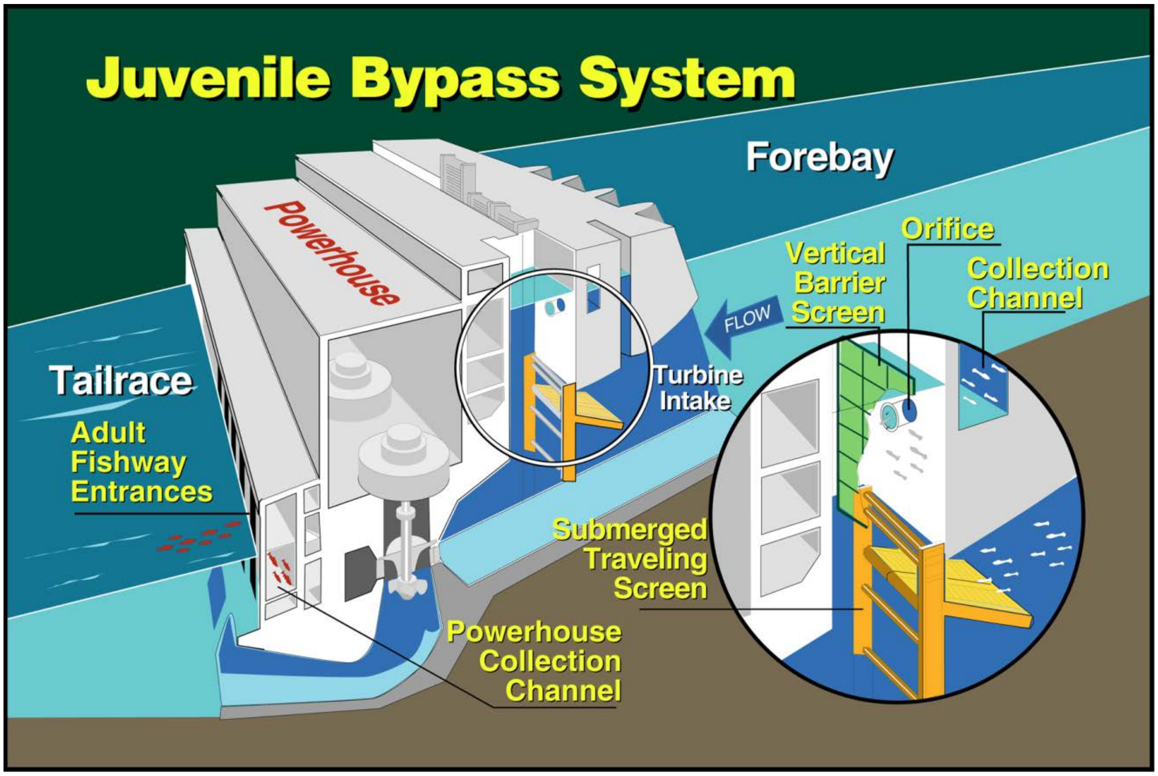

Figure 1. Typical Juvenile Bypass System with STS, VBS and Orifice

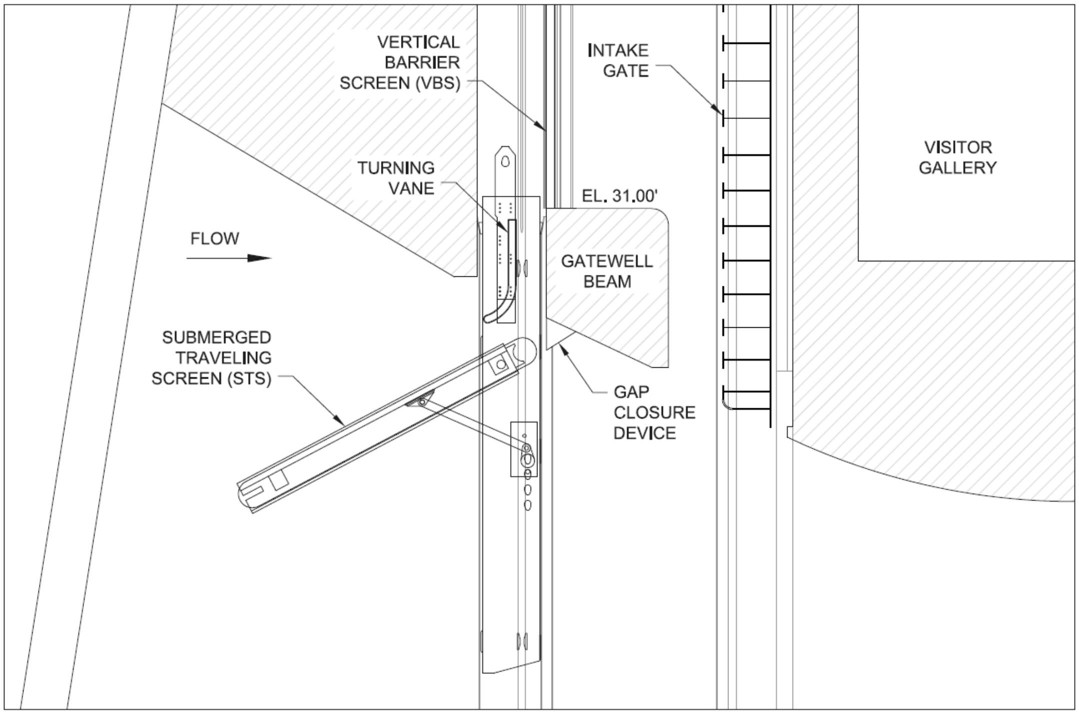

Figure 2. Gatewell Entrance

1.4. PROJECT AUTHORIZATION

The Bonneville Project began with the National Recovery Act, 30 September 1933, and was formally authorized by Congress in the River and Harbor Act of 30 August 1935. Authority for completion, maintenance, and operations of Bonneville Dam was provided by Public Law 329, 75th Congress, 20 August 1937. This act provided authority for the construction of additional hydroelectric generation facilities (Bonneville PH2) when requested by the Administrator of Bonneville Power Administration (BPA). Letters dated 21 January 1965 and 2 February 1965 from the Administrator developed the need for construction of Bonneville PH2. Construction started in 1974 and was completed in 1982.

Actions to improve juvenile salmonid survival were identified by NOAA Fisheries at Bonneville PH2 in the Federal Columbia River Power System (FCRPS) 2008 Biological Opinion (BiOp) and 2010 Supplemental BiOp. This project is Columbia River Fish Mitigation Program (CRFM) funded and in response to Reasonable and Prudent Alternative (RPA) 18.

1.5. PROJECT COORDINATION

The study and report were coordinated with the regional fisheries agencies and Native American tribes through the Fish Facility Design Review Work Group (FFDRWG), Northwestern Division Anadromous Fish Evaluation Program Studies Review Work Group (SRWG), and Fish Passage Operations and Maintenance (FPOM) regional work group.

2. EVALUATION OF GATE SLOT FILLER PROTOTYPE

The EDR recommended that a gate slot filler (also referred to as a turbulence reduction device, or TRD) prototype be constructed and be hydraulically and biologically tested. A prototype gate slot filler was constructed and installed in unit 14A in the spring of 2013. The prototype consisted of two rectangular steel structures that were installed on each side of the gatewell above the side frames that support the turning vane and STS. The gate slot fillers were intended to function as extensions of those frame members to eliminate the sudden expansion in the width of the gatewell that exists above them. The gate slot fillers were approximately 25 feet long and extended from approximate elevations 31-feet to 56-feet. The prototype was tested for hydraulic and biological performance (Harbor and Alden 2013; Gilbreath et al. 2014) during the spring of 2013.

2.1. HYDRAULIC TESTING OF PROTOTYPE

USACE contracted with Harbor Consulting Engineers to collect velocity data for hydraulic evaluation of the gate slot filler prototype. Harbor, along with their sub-consultant Alden Research Laboratories, collected velocity data in the gatewell using four acoustic Doppler velocimeters (ADVs) that were mounted to a beam that was lowered into the gatewell. The apparatus was constructed such that the ADVs could traverse horizontally across the beam by a manually controlled motor. The vertical position of the beam was controlled by two winches, one on either side of the beam. Three-dimensional velocity data was collected by lowering the beam to a target elevation, then gathering data at set horizontal increments along the beam. The result was several data collection points arranged in a grid pattern approximately 0.65 feet upstream of the VBS.

Data was collected in unit 14A, which had the gate slot filler in place, unit 15A, which had no gate slot filler and served as the baseline condition, and 14C, which had no gate slot filler. Data was collected over a range of operating conditions. A summary of the data collection conditions is shown in Table 2-1 below.

Table 2-1. Summary of Data Collection Conditions

Location	**Approximate Unit Flow**			
	12 kcfs	**15 kcfs**	**16.5 kcfs**	**17 kcfs**
Unit 14A (with gate slot filler)	X	X		X
Unit 15A (no gate slot filler)	X	X		X
Unit 14C (no gate slot filler)			X	

The hydraulic testing indicated very similar flow patterns between the gatewell with the gate slot filler (14A) and the gatewell without (15A) for all flow conditions tested. Figure 3 and Figure 4 show the results for both configurations for the high unit flow scenario. Both figures show similar flow patterns with sweeping velocities along the VBSs and an area of flow circulation above the VBSs. The areas of high velocity through the VBSs in the upper portions of the screens are nearly identical. In addition, the data did not show that the gate slot filler was effective in reducing turbulence intensity over the range of unit flows evaluated (Harbor and Alden 2013).

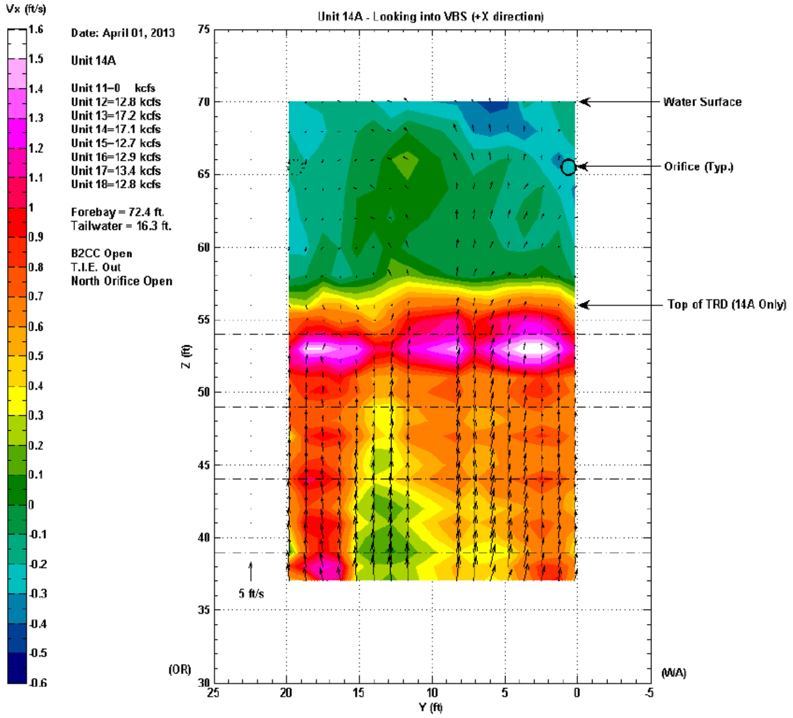

Figure 3. 2013 Field Data, Unit 14A with TRD, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns (from Harbor and Alden 2013)

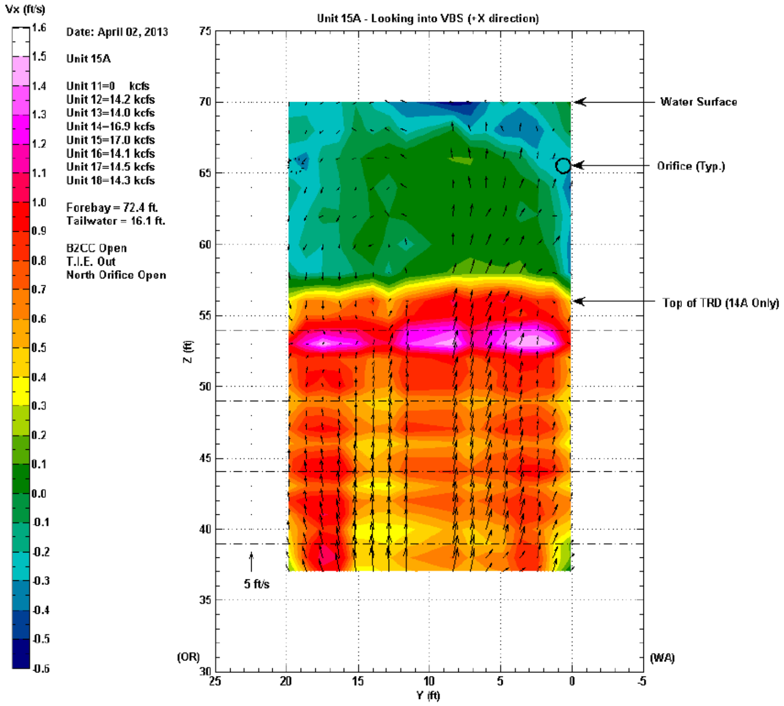

Figure 4. 2013 Field Data, Unit 15A no TRD, Unit Q=17.0 kcfs, VBS Normal Velocities and Flow Patterns (from Harbor and Alden 2013)

2.2. BIOLOGICAL TESTING OF PROTOTYPE

Biological testing of the gate slot filler prototype was coordinated through the USACE Northwestern Division Anadromous Fish Evaluation Program Studies Review Work Group (SRWG) during FY 2012/2013. USACE contracted the National Marine Fisheries Service (NMFS) to conduct the biological evaluation, which took place in the spring of 2013.

The SRWG research summary specified that implementation of gate slot fillers beyond proof of concept testing would be considered if mortality and descaling at the upper turbine operation range with the gate slot filler in place was reduced to impacts measured at the lower turbine operation range with no gate slot filler in place. This result could occur with gate slot fillers as a standalone modification, or in conjunction with future physical or operational modifications to the screened bypass system.

The primary purpose of the evaluation was to test the hypothesis that filling the guide slots above the STS frame on both sides of a PH2 gatewell will improve gatewell flow conditions thereby reducing mortality and descaling at the upper turbine operation range. Flows ranging from 12.0-12.5 kcfs within the 1% peak efficiency curve represented the lower turbine operation range. Flows ranging from 17.5-18.0 kcfs represented the upper turbine operation range. Evaluation of gatewell residence times, fish condition (mortality, injury, and descaling) would be compared between treatments at the upper and lower operating ranges. Specific objectives included:

1. Estimate fish condition (mortality, injury, and descaling) and gatewell residence time at the upper and lower operation range under the following gatewell configurations in 14A:
    A. Gatewell without gate slot filler and upper turbine operation range.
    B. Gatewell with gate slot filler and upper turbine operation range.
    C. Gatewell without gate slot filler and lower turbine operation range.

2. Compare both treatments against treatment C. (sample sizes shall be calculated to detect a difference in fish condition of 3% at $\alpha = 0.05$).

Four replicate series of biological tests were conducted in April 2013 with passive integrated transponder (PIT) tagged Spring Creek National Fish Hatchery (SCNFH) subyearling Chinook salmon released from the +90 deck via a trash rack release pipe at the Unit 14A intake with one open gatewell orifice. 3,712 study fish were recaptured at the Juvenile Monitoring Facility (JMF) using the Sort by Code system. Releases occurred during the mornings using the same methods used during the 2008-09 studies described in Gilbreath et al., 2012. The testing continued over a consecutive four week period beginning with the first release on April 8 and the final release on May 1. The average fish size during the first week of testing was 70 mm fork length (111 fish/lb). Fish grew to an average size of 77 mm fork length (78 fish/lb) during the final releases in week four. Test fish were released into the DSM2 collection channel near the unit 14A orifice jet once per week to help quantify baseline tag loss, mortality, and travel time. The VBS in the test unit was inspected and cleaned once per week. The VBS seals were intact, gatewell and VBS debris levels were low, and VBS drawdown criteria was never exceeded during testing.

The SCNFH subyearlings were released as parr prior to smoltification. Gatewell evaluations by NMFS at Bonneville Dam during 2008 and 2009 did not show descaling levels sufficiently high for meaningful analysis. The descaling rate of SCNFH subyearling Chinook was not evaluated in the 2013 testing. Percent descaling was a metric planned for a run-of-river test fish evaluation, which did not occur. SCNFH fork length data were used in a logistic regression model that suggested mortality at each operating level decreased as fish size increased (Gilbreath et al. 2012). The larger run-of-river yearling and subyearling Chinook released for testing in 2009 during middle and upper turbine operation range resulted in trends of increasing mortality with increasing turbine flow, however, mortality rates were much lower than SCNFH subyearling Chinook during similar operation. A notable result from the 2009 testing of run-of-river yearling Chinook was a large increase in descaling from 1.0% at mid turbine operation range to 11.5% at upper turbine operation range.

Results from the 2013 biological testing are presented in Table 2-2 below. The primary measure of results reported in Gilbreath et al. (2014) includes observed mortality as a percentage of test fish recaptured. Gilbreath et al. (2014) reported that the mortality differences between the upper 1% treatments with TRD's in and out compared to the lower 1% treatment were large and highly significant (P<0.01; ANOVA).

Table 2-2. Numbers of fish released, recaptured, and mortality from release in 14A with turbine unit operation in the 1% best efficiency range as well as the baseline collection channel releases

	TRDs	**Released #**	**Recaptured %**	**Mortality of Recaptured %**
Collection channel	NA	218	98.6	0
Low Operation Range	Out	1148	95.1	2.1
Upper Operation Range	Installed	1202	68.2	19.1
Upper Operation Range	Out	1145	51.3	23.6

The preliminary mortality data from the 2013 testing were sufficient to determine that the TRD did not perform with the magnitude of mortality change needed to continue testing with run-of-river juvenile salmonids. This led to a USACE recommendation to the regional fish managers on April 11, 2013 during a Special FFDRWG call to discontinue plans for testing run-of-river fish. The regional managers agreed based on these data and testing ceased.

Recapture rates followed similar trends observed during the 2008-2009 testing. Operations at the upper 1% peak efficiency range had lower recapture rates and higher mortality than operations during the low 1%. The fate of recaptured fish is unknown. Please see the Results and Discussion sections in Gilbreath et al. 2014 for more information regarding recapture outcomes and how they relate to the study results. Recapture outcomes should be reported in future biological evaluations of the preferred alternative.

2.3. RESULTS OF TESTING

The hydraulic testing conducted in 2013 by Harbor and Alden indicated that the gate slot filler did not have a significant impact on the general flow patterns or turbulence intensity within the gatewell compared to the baseline condition. In addition, the biological testing conducted by Gilbreath et al. (2014) showed that the gate slot filler did not improve survival rates of juvenile salmon to an acceptable level. The results of both tests suggest that the gate slot filler will not perform adequately as a standalone alternative in the Bay A gatewells to allow unrestricted turbine operation in the upper range through the fish passage season.

Another result of the hydraulic testing was that it demonstrated flow patterns in the baseline condition gatewell that were not previously observed in any field data, physical modeling, or CFD modeling. In particular, the areas of high velocity through the upper portions of the VBSs were not previously known to exist. Based on this field data, it was determined that the CFD model should be recalibrated to more closely reflect the flow patterns observed in the data.

3. DESIGN CRITERIA

The EDR was developed with no specific design criteria, but with the understanding that the alternatives considered should improve survival for juvenile salmon in the gatewells and not impact fish guidance flow into the gatewells. Accordingly, the flow control alternatives considered as part of the EDR did not score high for FGE compared to the other alternatives due to their potential of reducing fish guidance flow into the gatewells. The FGE scores were weighted heavily in the evaluation matrix, and as a result, the overall scores for the flow control alternatives were lower than for the operational and flow pattern change alternatives.

Regional coordination led to a 05 Sept 2013 Special FFDRWG discussion where agency representatives acknowledged the potential for reduced FGE with the flow control alternatives, but also recognized the potential benefits of these alternatives, including increased survival in the gatewell and the ability to maintain the full operation range of the PH2 main turbine units. It was determined that the risk of reduced FGE with a flow control alternative was acceptable for the anticipated benefits.

As a result, design a criterion was developed for this study to help evaluate the design alternatives. The criterion that was established based on coordination with FFDRWG and NOAA states that the flow through any VBS at any unit flow cannot exceed the flow though the Bay A VBS at a unit flow of 15,000 cfs. This criterion is based on the determination that juvenile salmon gatewell survival is acceptable in the Bay A VBS at a unit flow of 15,000 cfs, and the assumption that juvenile salmon gatewell survival directly correlates with flow through the VBS.

In addition to the VBS flow criterion that was established, the other considerations to be taken into account as part of the reassessment of alternatives include the hydraulic conditions within the gatewell and expected biological impacts.

4. RECONSIDERATION OF DESIGN ALTERNATIVES

As discussed in the Section 2, the gate slot filler prototype that was recommended in the EDR did not perform adequately as a standalone alternative to increase juvenile salmon survival in the gatewell at the upper turbine operating range. The EDR recommended that the other alternatives in the report be reconsidered if the prototype did not perform satisfactorily. The EDR considered flow control alternatives, operational alternatives, and a flow pattern change alternative. A reconsideration of those alternatives is provided below.

4.1. FLOW CONTROL ALTERNATIVES

Several flow control alternatives were considered as part of the EDR. These alternatives included the following:

- Adjustable louver device on the downstream side of the VBS
- Adjustable sliding plate on the gatewell beam downstream of the VBS
- Modifying the VBS porosity plates
- Modifying the turning vane and/or gap closure device

Based on the results of the gate slot filler prototype testing, input from the PDT, and coordination with NOAA, the list of flow control alternatives to be considered as part of the this study was modified to the following:

- A1 – Adjustable louver device on the downstream side of the VBS
- A2 – Adjustable sliding plate on the gatewell beam downstream of the VBS
- A3 – Static plate on the gatewell beam downstream of the VBS
- A4 – Modify the VBS porosity plates (for flow control)
- A5 – Modify the VBS porosity plates (to meet velocity criteria)
- A6 – Remove the turning vane
- A7 – Remove the gap closure device
- A8 – Remove the STS and turning vane

4.1.1. A1 – Adjustable Louver Device

This alternative involves installation of a series of adjustable louvers in the opening downstream of the VBS that would reduce flow into the gatewell by providing additional resistance to flow that passes through the VBS. The intent of the adjustability component is to allow for greater operational flexibility through the turbine operation range to maximize flow into the gatewell to preserve as much guidance as possible. This type of feature will likely have higher operation & maintenance (O&M) requirements and will be more prone to failure compared to stationary devices. This alternative was dismissed during the EDR due to its complexity, O&M requirements, and implementation time. For these reasons this alternative was not selected for further evaluation as part of this study.

4.1.2. A2 – Adjustable Sliding Flow Control Plate

This alternative involves installation of a system of two sliding plates attached to the top of the gatewell beam (elev. +31) downstream of the VBS that would reduce flow into the gatewell by constricting the area between the gatewell beam and the intake gate. Similar to the adjustable louver alternative, this alternative is intended to allow for greater operational flexibility through the turbine operation range to maximize flow into the gatewell to preserve as much guidance as possible. This type of feature will likely have higher operation & maintenance (O&M) requirements and will be more prone to failure compared to stationary devices. This alternative was dismissed during the EDR due to its complexity, O&M requirements, and implementation time. For these reasons this alternative was not selected for further evaluation as part of this study.

4.1.3. A3 – Static Flow Control Plate

One of the additional flow control alternatives considered as part of this study is a static flow control plate. This alternative is similar to the sliding plate alternative, but is much less complex. It simply consists of a steel plate that is bolted to the gatewell beam (elev. +31) and reduces flow into the gatewell and through the VBS by constricting the area between the gatewell beam and the intake gate, as shown in Figure 5. It is anticipated to have lower O&M costs and provide more reliable performance, but will not provide for operational flexibility because it will not be adjustable. However, this alternative will reduce flow into the gatewell over the full operating range of the turbine units, which could potentially reduce

FGE. FFDRWG representatives, including NOAA, have shown particular interest in this alternative, and it was determined that this alternative warranted further evaluation as part of this study.

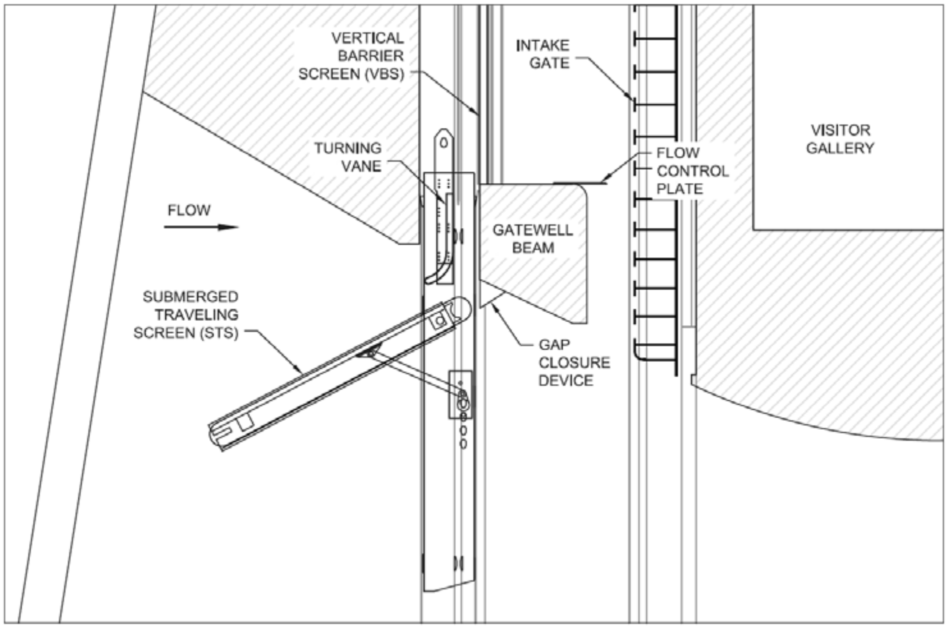

Figure 5. Static Flow Control Plate Concept

4.1.4. A4 – Modify Vertical Barrier Screen Plates (for Flow Control)

This alternative involves redesigning the porosity plates on the VBS to reduce the flow into the gatewell. The PDT determined that the design for this alternative would require a physical model. The distribution of flow through the VBS is very complex it is expected that a detailed physical model would be required for an appropriate design that achieves the target flow and uniformly distributes flow through the screen. A design of this detail is beyond the intended use of the current CFD model, which is only appropriate for providing relative comparisons of scenarios. There is not currently an existing physical model of a PH2 unit, and the project schedule cannot accommodate the development of one, so this alternative was not selected for further evaluation as part of this study.

4.1.5. A5 – Modify Vertical Barrier Screen Plates (to Meet Velocity Criteria)

The alternative involves modifying the porosity plates on the upper portion of the VBS so that the screen meets the approach velocity criteria for the full range of turbine operation. Based on the velocity data collected in 2013 (Harbor and Alden 2013), there are areas on the VBSs where approach velocity criteria is violated when the turbine unit flows exceed a certain amount. The alternative considered is not anticipated as a standalone method of controlling flow into the gatewells, but is intended only to address the screen approach velocity criteria violation and should be used in conjunction with one of the other alternatives to adequately control the flow into the gatewells. It is expected that the design for this alternative would be much simpler than the design for Alternative A5 since the problem area is localized on the VBS. It is not expected that a physical model would be required for this design and that more simple engineering techniques could be used. It was determined that this alternative would not be evaluated as part of this study, but is recommended for further consideration in conjunction with one of the other alternatives as part of the DDR.

4.1.6. A6 – Remove Turning Vane & A7 – Remove Gap Closure Device

One flow control alternative considered in the EDR involved modifying the turning vanes and/ or the gap closure devices. This alternative was separated into two distinct alternatives as part of this study. The two new alternatives did not consider modifying the devices, but considered complete removal of the devices. It was unknown if modifying these devices would have an impact that was sufficient enough to improve hydraulic conditions to the degree required, so it was decided that evaluating the complete removal of these devices would provide an indication of whether modifying these devices would be a worthwhile pursuit.

4.1.7. A8 – Remove Submerged Traveling Screen and Turning Vane

The final flow control alternative considered was the removal of the STSs. Removal of the STSs is anticipated to reduce flow into the gatewell because they currently intercept and redirect flow into the gatewells. However, the main function of the STSs are to intercept fish and direct them into the gatewell, so removing them will most likely result in fewer fish entering the gatewell and more fish passing through the turbine units. Regardless, it was determined that evaluating this alternative as part of this study would be insightful.

4.2. OPERATIONAL ALTERNATIVES

The EDR considered three operational alternatives, including limiting operation of the turbine units to the lower end of the 1% peak efficiency range, opening second orifices in each gatewell to the downstream migrant transportation (DSM) channel, and constructing slot orifices in each gatewell to the DSM channel.

A Special FFDRWG on 30 April 2012 included discussion of the FGE alternatives evaluation. Two of the operational alternatives, operate units off 1% peak and open second gatewell orifice, were not supported by NOAA. The USACE concurred in a 08 May 2012 letter to NOAA that these two operational alternatives would no longer be pursued. The third operational alternative, vertical slot with adjustable weir, ranked high initially, but slipped below the lower ranked flow control alternatives due to construction complexity, costs, and uncertainty of impacts to the existing system downstream of the gatewell orifices. As a result, none of the operational alternatives were selected for further evaluation as part of this study.

4.3. FLOW PATTERN CHANGE ALTERNATIVE

A flow pattern change alternative called a “gate slot filler”, or “turbulence reduction device” (TRD), was considered as part of the EDR. The EDR recommended that a gate slot filler prototype be constructed and tested, both hydraulically and biologically. A prototype was constructed and tested for hydraulic and biological performance (Harbor and Alden 2013; Gilbreath et al. 2014) in 2013. The prototype is discussed in detail in Section 2, but, in general, the testing indicated that the prototype did not lead to adequate improvements in subyearling Chinook salmon survival within the gatewell (Gilbreath et al. 2014). Based on the prototype testing, the gate slot filler is no longer considered a standalone alternative for improving survival in the gatewells. However, it was determined that this alternative should be further evaluated as part of this study because it might have potential to be used in conjunction with a flow control alternative to potentially improve hydraulic conditions within the gatewells.

4.4. BIOLOGICAL CONSIDERATIONS

It is impossible to determine with certainty how guidance into the gatewell would change for each alternative without an intensive fish guidance efficiency field study at PH2. The best available information from previous years' fish guidance evaluations, hydraulic field and laboratory work, main unit operations, and survival studies were considered when evaluating each alternative for potential loss to FGE. Appendix B of the 2013 EDR provides the biological background including: an overview of past PH2 guidance studies results, radio telemetry results for PH2 route specific survival, hydroacoustic results for distribution and FGE, gap loss, decision criteria for the PH2 FGE improvements and anticipated benefits, project operations and flexibility, SIMPAS model project survival, and literature citations. Biological benefits in the gatewell should be balanced with changes in FGE. Reducing flow into the gatewell may reduce guidance. Reducing the ability of the guidance structures, i.e., the STS, gap closure device, and turning vane to guide flow into the gatewell will reduce fish guidance as well. The goal of preserving as much guidance into the gatewell is premised on the insight gained from these studies as well as the additional JBS and turbine route specific survival data obtained during more recent studies at PH2.

Table 4-1 displays the PH2 JBS and turbine survival data of past study results since 2004 following installation of the new Juvenile Monitoring Facility outfall in 1999.

Table 4-1. PH2 JBS and turbine survival data for Radio Telemetry (RT) and Juvenile Salmon Acoustic Telemetry System (JSATS) studies.

Year and tag type	Yearling Chinook		Steelhead		Subyearling Chinook	
	JBS	Turbine	JBS	Turbine	JBS	Turbine
[a]2004 RT	0.970	0.951	0.889	0.951	0.927[1]/0.958[2]	0.824[1]/0.833[2]
[b]2005 RT	1.008	0.965	0.956	0.868	0.984	0.895
[c]2008 JSATS	1.017	0.979	0.984*	0.982*	0.991	0.954
[d]2009 JSATS	0.974*	0.971*	0.956*	0.939*	0.881*	0.939*
[e]2010 JSATS	0.981*	0.957*	0.978*	0.911*	0.976*	0.936*
[f]2011 JSATS	0.982	0.947	0.940	0.919	NA	NA
[g]2012 JSATS	0.940*	0.954*	0.989*	0.921*	0.977	0.959

*Single-release survival estimate

[1] 56 kcfs day/TDG night spill operation

[2] 23 kcfs spill operation

[a] Counihan et al. 2006a

[b] Counihan et al. 2006b

[c] Faber et al. 2010

[d] Faber et al. 2011

[e] Ploskey et al. 2011
[f] Ploskey et al. 2013
[g] Mark Weiland, personal communication, Nov. 2014

The biological goal for this report has not changed since the 2013 Final EDR. The biological goal is to improve conditions for juvenile fish while maintaining (or improving) the FGE and survival improvements of the original Bonneville PH2 FGE design.

These data and the total weighted scores from the 2013 EDR Alternatives Evaluation Matrix were used as a basis for discussion of the flow control alternatives and those to be carried forward for further evaluation.

4.5. SELECTION OF DESIGN ALTERNATIVES FOR FURTHER EVALUATION

As a result of reconsidering the design alternatives from the EDR, the following design alternatives were selected for further evaluation as part of this study.

Flow control alternatives:

- A3 – Static Flow Control Plate
- A6 – Remove Turning Vane
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane

Flow pattern change alternative:

- B1 – Gate Slot Fillers

These alternatives were evaluated with a computational fluid dynamics (CFD) model to evaluate their impacts on the hydraulics within the gatewells. The results of the CFD modeling are discussed in Section 5 and in Appendix B.

5. COMPUTATIONAL FLUID DYNAMICS MODELING

As part of this study, a computational fluid dynamics (CFD) model was selected to be the primary tool to evaluate the expected hydraulic performance of design alternatives that were selected for further evaluation. As a general rule when evaluating results from a CFD simulation, the reviewer should consider the following. The hydraulic conditions within the gatewells are very dynamic in reality as well as in the CFD model. Depending on which model iteration data is obtained from, the velocities and flow patterns can change significantly. The CFD model was constructed with the intent of providing relative comparisons of gatewell hydraulic conditions between modeled improvement alternatives and modeled baseline conditions, and not with the intent to provide highly accurate representations of actual existing or future gatewell hydraulic conditions.

A detailed documentation of the modeling effort is in provided in Appendix B, *Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Computational Fluid Dynamics Modeling Report for the Supplement to the EDR, November 2014*.

5.1. MODEL DEVELOPMENT

The CFD model used to evaluate alternatives as part of the EDR is a sectional model of a single powerhouse unit. This same model was used as a starting point for this study; however some modifications were made to it prior to using it to evaluate alternatives. The modifications include adjustments to the model geometry to more closely resemble record drawings and field measurements. In addition, the model was recalibrated to provide better correlation with the field data that was collected in 2013 (Harbor and Alden 2013).

5.2. EVALUATION OF BASELINE CONDITIONS

The existing gatewell configuration was modeled in order to establish a hydraulic baseline to compare the results of the design alternatives model runs to. The model was run for unit flow conditions representing the lower, middle, and upper turbine operation ranges as shown in Table 5-1.

Table 5-1. Baseline Run Outflow Conditions

Turbine Operation	Unit Flow (cfs)	Bay A Flow (cfs)	Bay B Flow (cfs)	Bay C Flow (cfs)
Lower Range	12,000	4,536	4,104	3,360
Middle Range	15,000	5,670	5,130	4,200
Upper Range	18,000	6,804	6,156	5,040

The 18,000 cfs unit flow provided a baseline for hydraulic conditions assumed to represent unfavorable flow conditions for fish passage at upper operation range, while the 15,000 cfs unit flow provided a baseline for assumed minimally favorable hydraulic conditions for fish passage at the middle operation range. The 12,000 cfs provided a baseline for assumed favorable hydraulic conditions for fish passage at the lower operation range.

The CFD model results were post-processed using FieldView, a CFD model post-processing software program, and the results are discussed below. The CFD model-predicted VBS flows for each baseline flow condition considered are summarized in Table 5-2. Bay A has the highest flow of the three bays in each unit and therefore, the highest VBS and gatewell flow.

The design criterion that was established for this study is that the flow through any VBS at any unit flow cannot exceed the flow though the bay A VBS at a unit flow of 15,000 cfs. Applying that criterion to the CFD modeling effort, the bay A VBS flow predicted by the CFD model for a unit flow of 15,000 cfs is 245 cfs, so that is the target that design alternatives evaluated with the CFD model are to be measured against.

Table 5-2. Baseline Runs VBS Flow Summary

Turbine Operation	Unit Flow (cfs)	Bay A VBS Flow (cfs)	Bay B VBS Flow (cfs)	Bay C VBS Flow (cfs)
Lower Range	12,000	186	177	146
Middle Range	15,000	245	222	183
Upper Range	18,000	294	267	220

The general flow patterns within the gatewells are similar for all three of the unit operations modeled. The CFD model results for the medium unit flow condition (15,000 cfs) are summarized in Figure 6 through Figure 8. Figure 6 shows velocity magnitude and direction for a cross-section though the center of bay A, Figure 7 shows velocity magnitude and direction for a cross-section though all bays just upstream of the VBSs, and Figure 8 shows an isosurface of turbulent kinetic energy in all three bays. Although these figures were developed with CFD model results with a unit flow of 15,000 cfs, they are indicative of the flow patterns that the model predicted for all three unit operations. As the unit flow increases, the velocity magnitudes and intensity of turbulence in the gatewells increase.

For all baseline conditions, the majority of the gatewell flow enters on the upstream side of the turning vane, and the remainder enters downstream of the turning vane along the gatewell beam. The flow that passes along the upstream side of the turning vane demonstrates flow separation downstream of the intake roof, as shown by the area of low velocity in Figure 6. Similarly, the flow that enters the gatewell along the gatewell beam demonstrates flow separation downstream of the lower end of the turning vane, as shown by the area of low velocity on the downstream side of the turning vane. The result is an uneven distribution of flow into the gatewell, which induces turbulence (Figure 8) and irregular flow patterns (Figure 6 and Figure 7).

As the flow passes above the turning vane, the gate slot width increases abruptly above the turning vane and STS side frame and the flow can not immediately expand to fill the volume. This sudden expansion induces turbulence and irregular flow patterns within the gatewell. An opposing circulation of flow upward and then downward on either side of each bay results as the flow expands downstream of the abrupt gate slot transition, as shown in Figure 7.

One final hydraulic characteristic that is observed in the baseline conditions is the presence of areas of high velocity through the upper portions of the VBSs, as seen in Figure 7. These “hot spots” on the VBSs are also observed in the field data collected in 2013 and 2014. The field data and modeling indicate that the velocities normal to the screen in these areas exceed the allowable criteria of 1 ft/s.

The CFD model results for the upper turbine operation range (18,000 cfs) are summarized in Figure 9 through Figure 11. The gatewell flow patterns for the 18,000 cfs unit flow condition are generally similar to those for the 15,000 cfs unit flow condition, but the velocity magnitudes and intensity of the turbulence in the gatewell are greater.

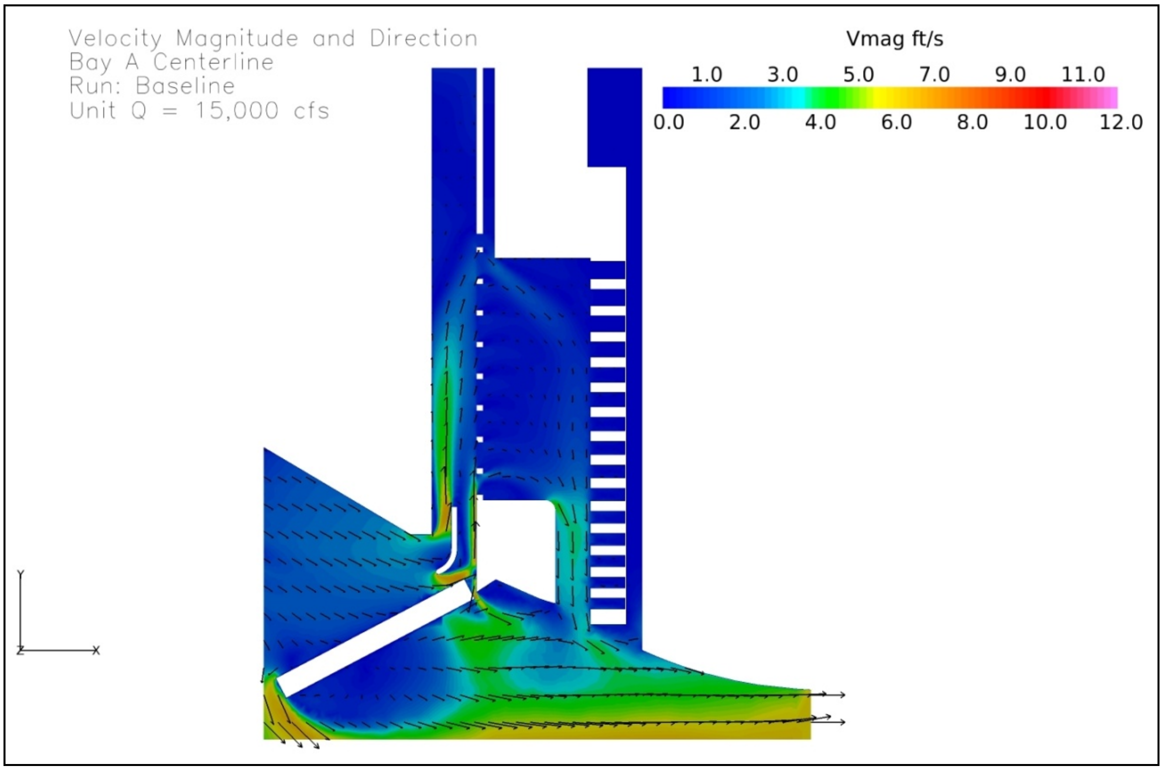

Figure 6. Baseline Conditions, Unit Q=15 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

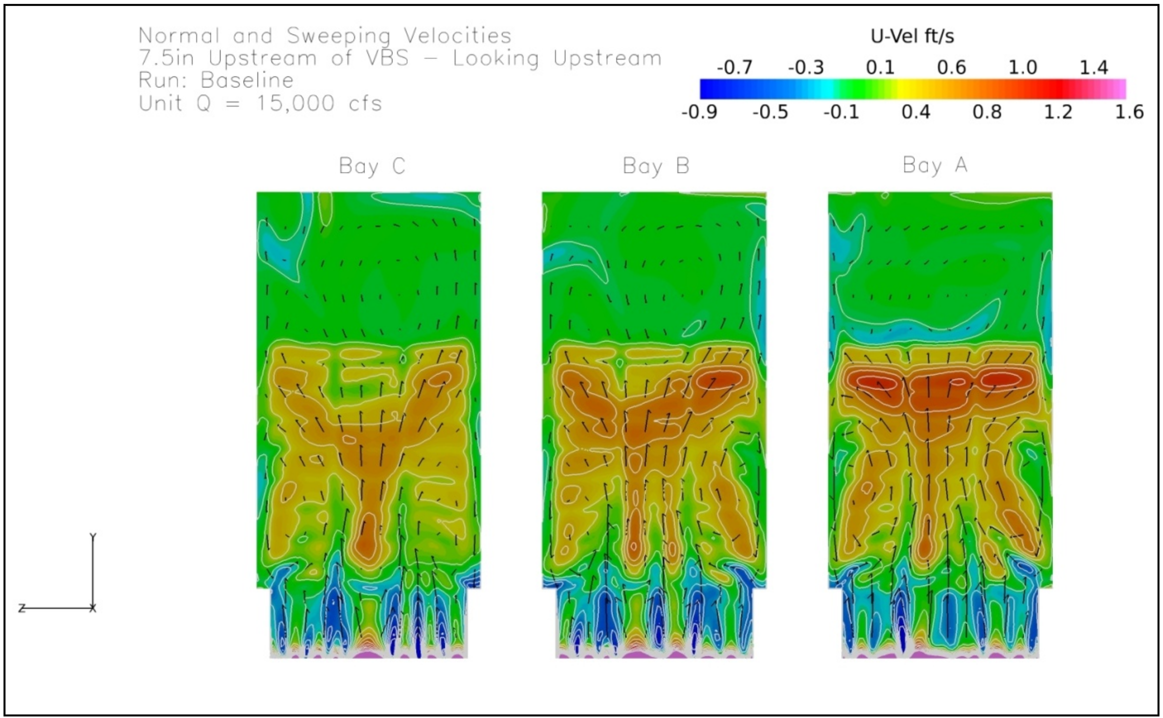

Figure 7. Baseline Conditions, Unit Q=15 kcfs, VBS Normal Velocities and Flow Patterns

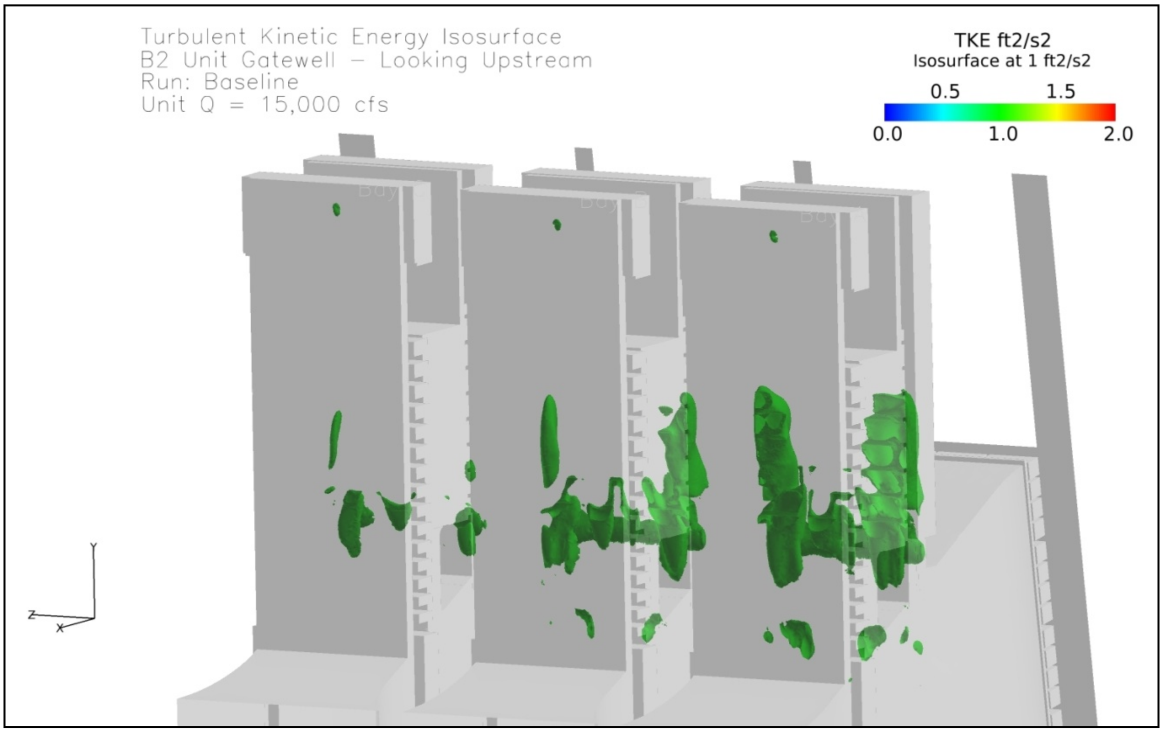

Figure 8. Baseline Conditions, Unit Q=15 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

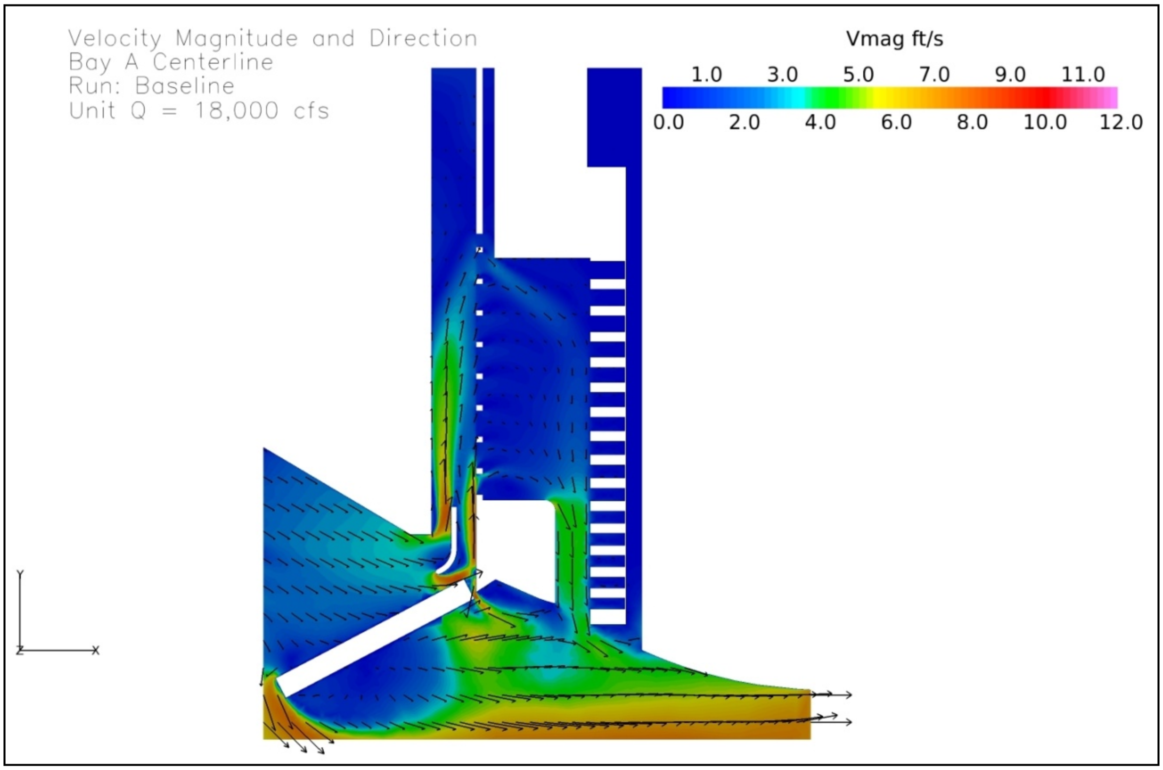

Figure 9. Baseline Conditions, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

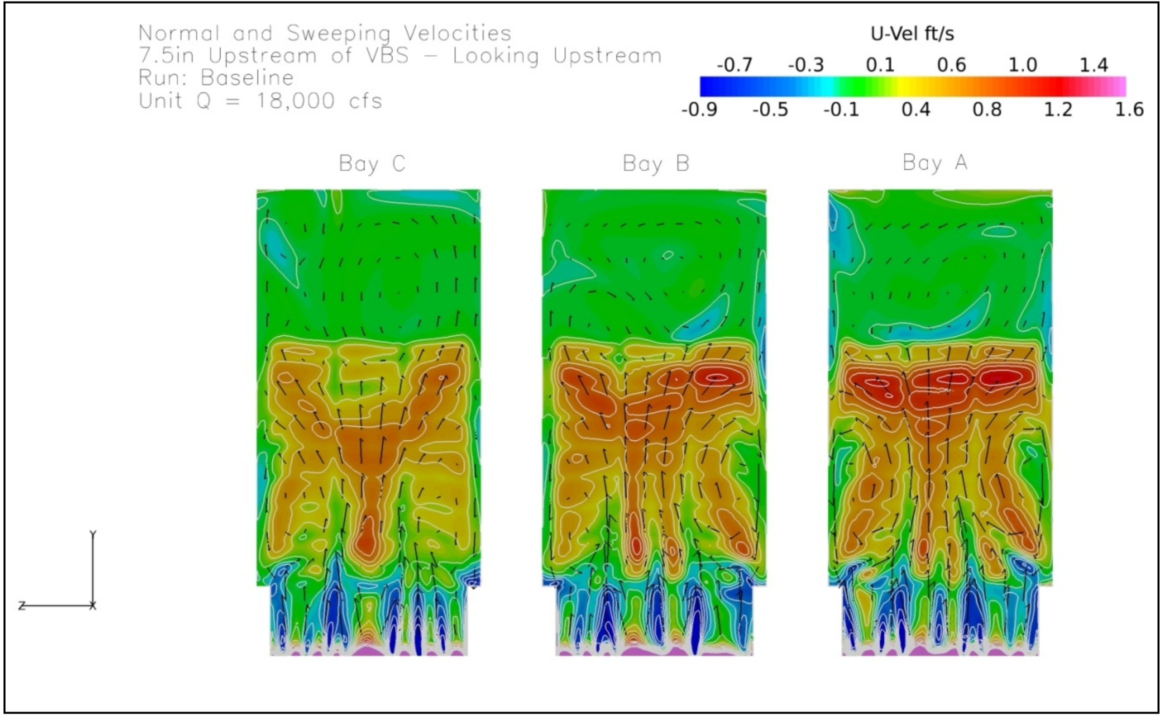

Figure 10. Baseline Conditions, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

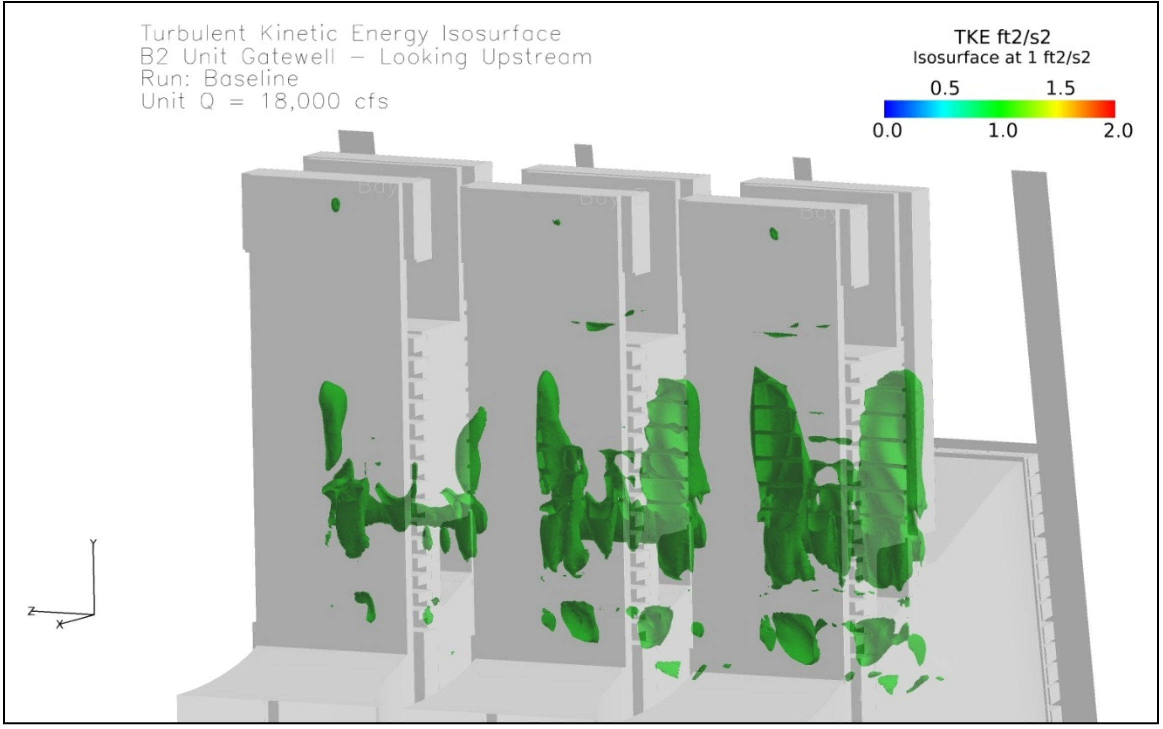

Figure 11. Baseline Conditions, Unit Q=18 cfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

5.3. EVALUATION OF DESIGN ALTERNATIVES

The design alternatives that were selected to be modeled as part of this study include the following:

- A3 – Static Flow Control Plate
- A6 – Remove Turning Vane
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane
- B1 – Gate Slot Fillers

The CFD model-predicted VBS flows for each baseline flow condition considered are summarized in Table 5-3. The design criterion that has been set for this study is that the flow through any VBS at any unit flow cannot exceed the flow though the bay A VBS at a unit flow of 15,000 cfs. The bay A VBS flow predicted by the CFD model for a unit flow of 15,000 cfs is 245 cfs, so that is the target that design alternatives evaluated with the CFD model are to be measured against.

Table 5-3. Design Alternative Runs VBS Flow Summary

Alternative	**Unit Flow (cfs)**	**Bay A VBS Flow (cfs)**	**Bay B VBS Flow (cfs)**	**Bay C VBS Flow (cfs)**
Design Target	18,000	Max. 245	Max. 245	Max. 245
A3 – Flow Control Plate (25%)	18,000	263	239	183
A3 – Flow Control Plate (50%)	18,000	214	193	154
A6 – Remove Turning Vane	18,000	301	273	221
A7 – Remove GCD	18,000	168	146	125
A8 – Remove STS & TV	18,000	219	195	161
B1 – Gate Slot Filler	18,000	303	266	221

5.3.1. Alternative A3 – Static Flow Control Plate

This alternative consists of installing solid plates that connect to the gatewell beams and cantilever toward the intake gates, restricting the areas through which the return flow from the gatewells to the turbine units can pass. Two configurations were modeled for this alternative. The first configuration included flow control plates in all three bays that blocked 25% of the open areas between the downstream sides of the gatewell beams and the intake gates. The second configuration included flow control plates in all three bays that blocked 50% of the open areas between the downstream sides of the gatewell beams and the intake gates.

As shown in Table 5-3, the plates are expected to reduce the flows through the VBS panels in all bays compared to the baseline condition. The flow through the bay A VBS (263 cfs) was not reduced to below the design target flow of 245 cfs, but the flow through the bay B VBS (239 cfs) was. The baseline flow through the bay C VBS at a unit flow of 18,000 cfs is already below the baseline flow through the bay A VBS at a unit flow of 15,000 cfs, so a flow control plate in bay C may not be necessary; this will have to be studied further as part of the DDR.

The CFD model results for the 25% blockage configuration are summarized in Figure 12 through Figure 14. It appears that the 25% blockage configuration slightly reduces the maximum velocity of the flow up the gatewell in bay A compared to the baseline-18,000 cfs condition, but not to the level of the baseline-15,000 cfs target. The general flow patterns appear to be similar to the baseline conditions, with areas of circulation on the sides of the VBSs and areas of high velocity through the upper portions of the VBSs. In addition, there appears to be similar turbulent kinetic energy in the gatewells compared to the baseline-18,000 cfs condition.

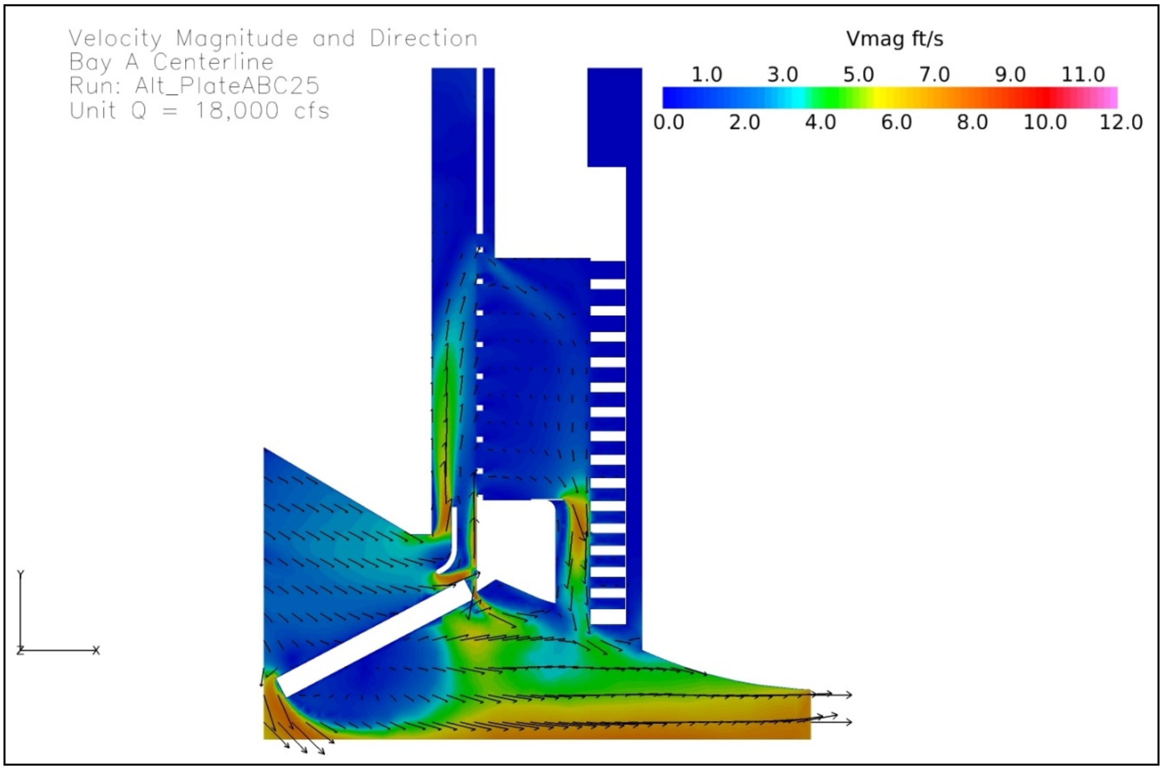

Figure 12. Alternative A3 (25% Blockage), Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

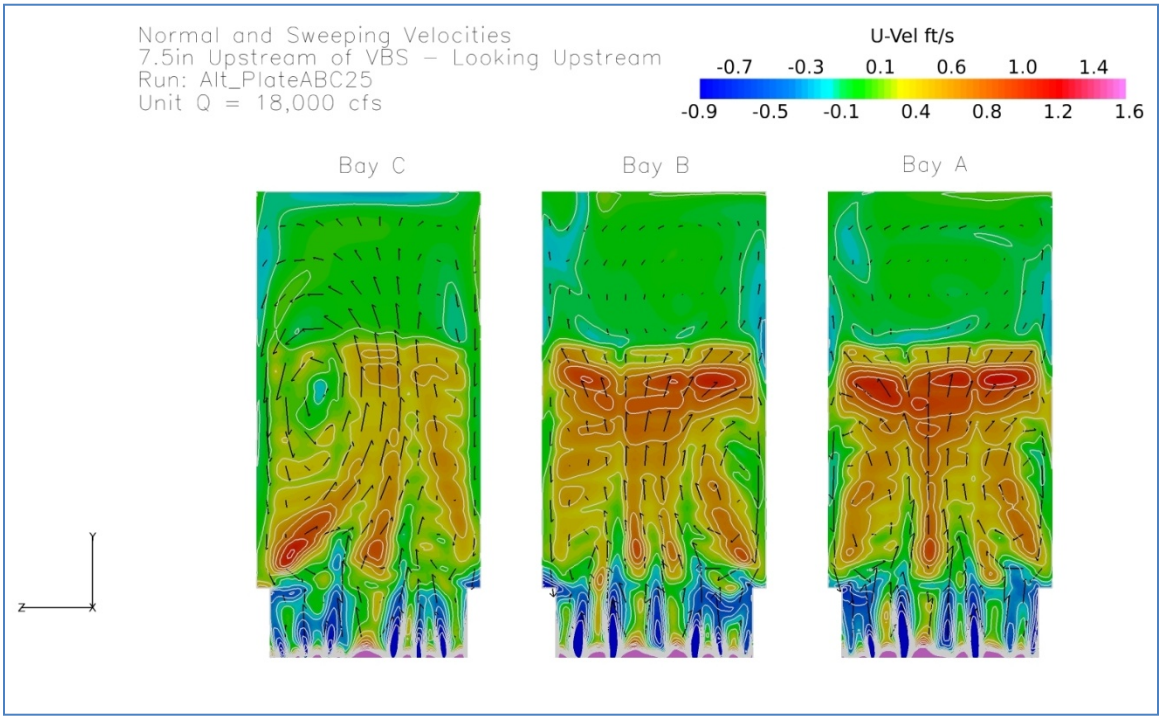

Figure 13. Alternative A3 (25% Blockage), Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

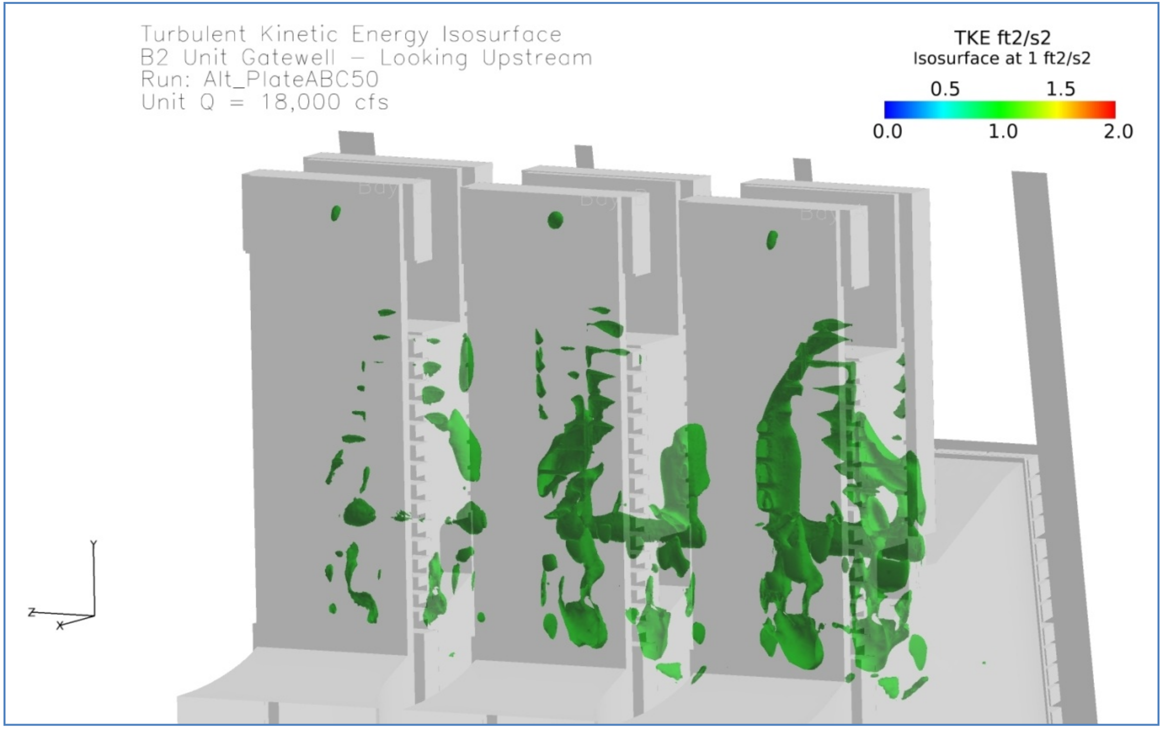

Figure 14. Alternative A3 (25% Blockage), Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

The 50% blockage configuration is expected to further reduce the flows through the VBS panels in all bays compared to the 25% blockage configuration. The flow through the bay A VBS (214 cfs) was reduced to below the design target flow of 245 cfs.

The CFD model results for the 50% blockage configuration are summarized in Figure 15 through Figure 17. It appears that the 50% blockage configuration produces a maximum velocity for the flow up the gatewell similar to the baseline-15,000 cfs target condition. The flow patterns appear to indicate a reduction in the areas of higher velocity through the upper portions of the VBSs, but the intensification of areas of high velocity through the lower corners of the VBSs. The CFD modeling also indicates that the circulation patterns within the gatewells are intensified. In addition, there appears to be a reduction in turbulent kinetic energy in the gatewells compared to the baseline-18,000 cfs condition, but not quite to the level observed in the baseline-15,000 cfs condition.

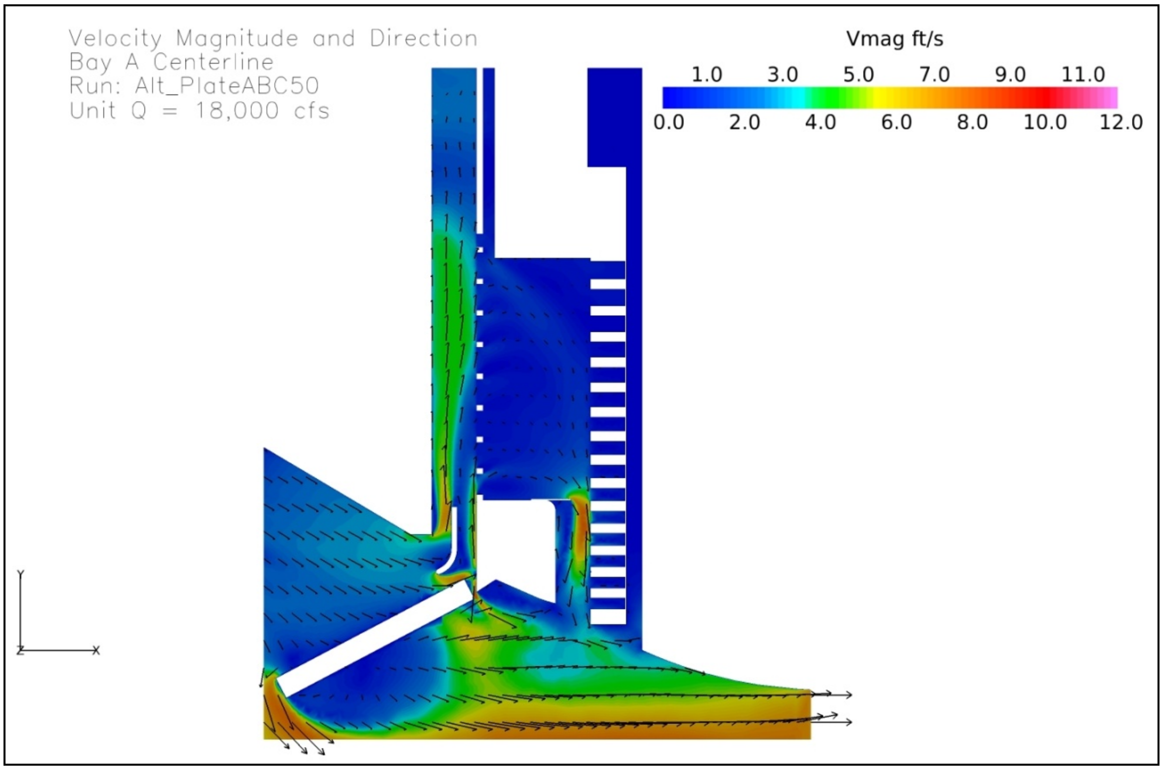

Figure 15. Alternative A3 (50% Blockage), Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

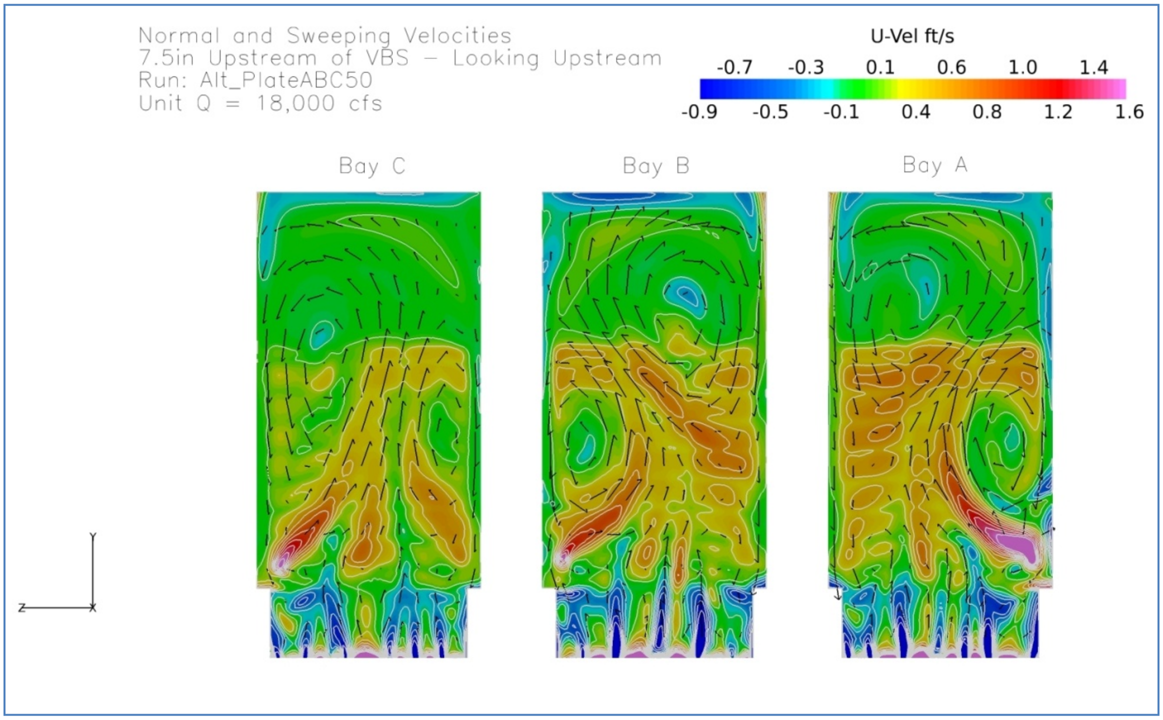

Figure 16. Alternative A3 (50% Blockage), Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

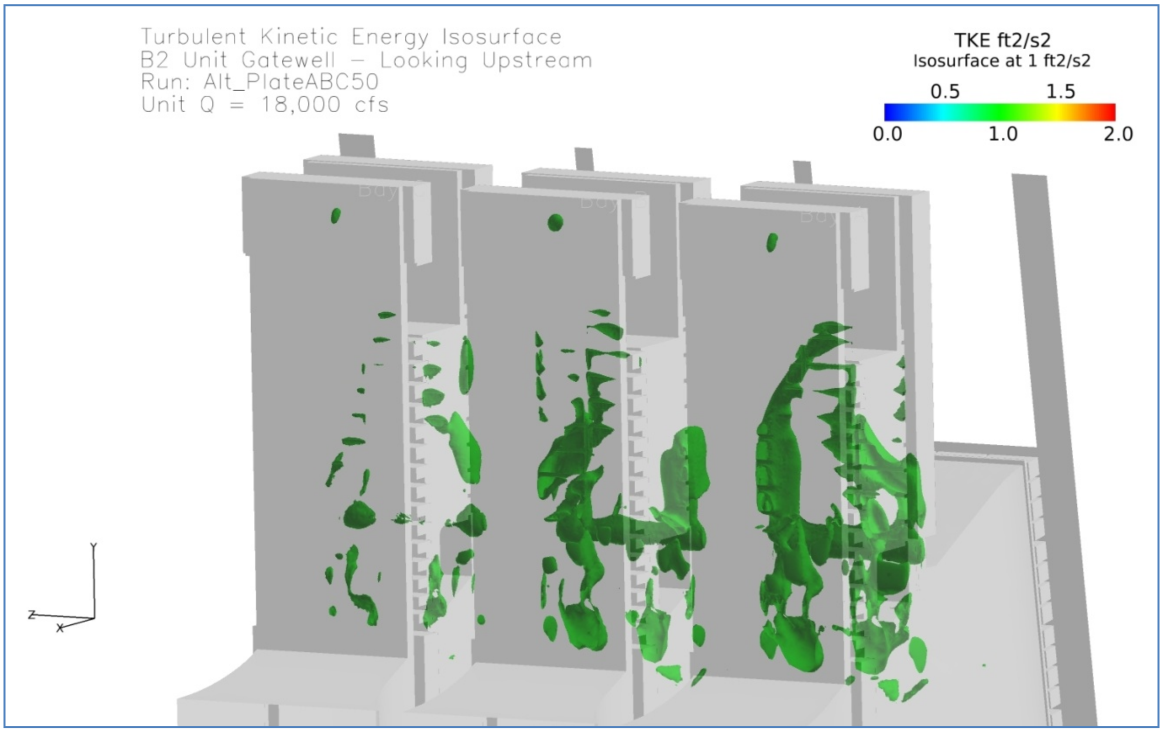

Figure 17. Alternative A3 (50% Blockage), Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

5.3.2. Alternative A6 – Remove Turning Vane

The alternative to remove the turning vanes was evaluated with the CFD model. As shown in Table 5-3, removing the turning vanes is not expected to result in reduced flows through the VBS panels, and might actually slightly increase the flows. The modeling indicates that the turning vanes do not intercept and guide additional flow up the gatewells beyond what the STSs have intercepted, and that they might act as minor impediments to the flow.

The model results for this alternative are shown in Figure 18 through Figure 20. The modeling indicates that removing the turning vane results in less evenly distributed flow up the gatewells compared to the baseline condition. The turning vanes direct some of the gatewell flow up the upstream sides of the gatewells. When the turning vanes are removed, the flow up the gatewells is concentrated on the downstream sides of the gatewells along the VBSs, which creates areas of low upward velocity, and possibly even downward flow, along the upstream sides of the gatewells.

It appears that removal of the turning vanes causes more flow to pass through the lower portions of the VBSs, creating areas of high approach velocity there. The areas of circulation on the sides of the VBSs seen in the baseline model runs appear to be diminished with this alternative. In addition, the modeling shows that removing the turning vanes causes an increase in the turbulent kinetic energy within the gatewells, concentrated mostly along the VBSs, and at the interfaces between the fast moving upward flow along the downstream sides of the gatewell and the low velocity areas along the upstream sides of the gatewells.

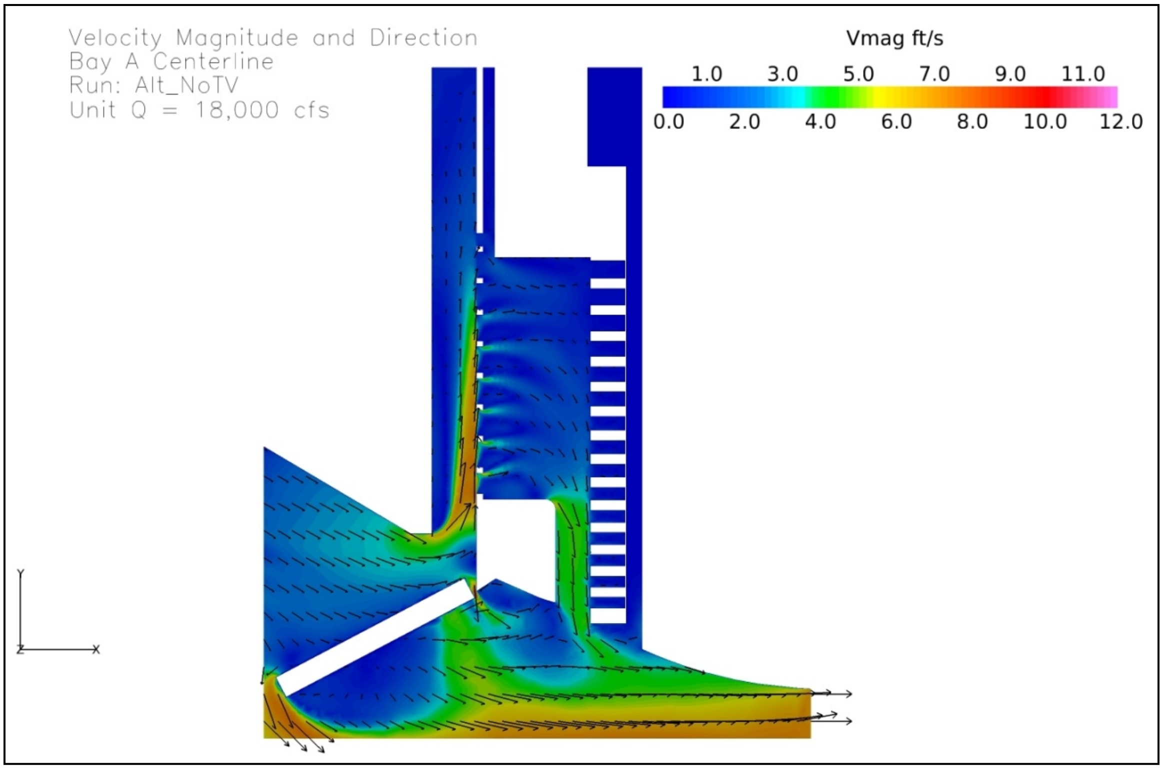

Figure 18. Alternative A6, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

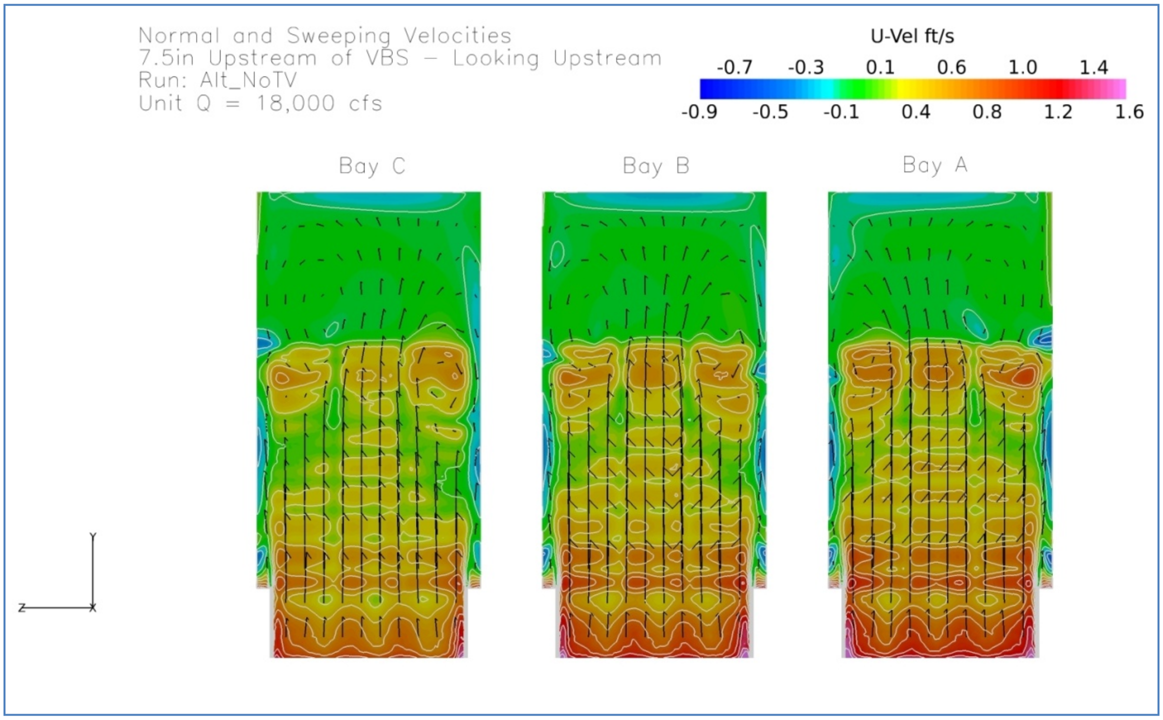

Figure 19. Alternative A6, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

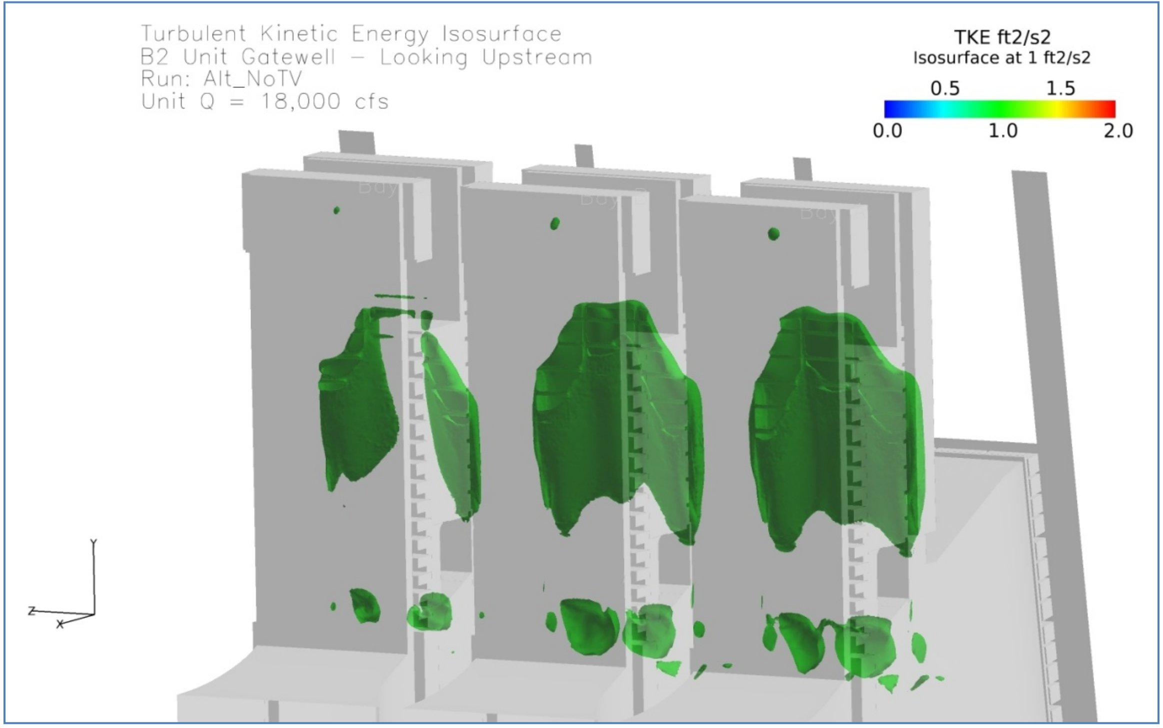

Figure 20. Alternative A6, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

5.3.3. Alternative A7 – Remove Gap Closure Device

The alternative to remove the gap closure devices was evaluated with the CFD model. As shown in Table 5-3, removing the gap closure device is expected to greatly reduce the flows through the VBS panels in all bays compared to the baseline condition. The flows through the bay A VBS (168 cfs) and bay B VBS (146 cfs) were reduced to significantly below the design target flow of 245 cfs.

The model results for this alternative are shown in Figure 21 through Figure 23. The modeling indicates that removing the gap closure devices results in less evenly distributed flow up the gatewells compared to the baseline condition. The gap closure device helps direct flow up the gatewells on the downstream sides of the turning vanes. When they are removed, there is very little flow that enters the gatewells on the downstream sides of the turning vanes; nearly all of the gatewell flow enters on the upstream sides of the turning vanes. This uneven distribution of flow into the gatewells creates circulation zones on the downstream sides of the turning vanes, and also zones of low velocity, and possibly circulation, on the upstream sides of the gatewells approximately midway up them.

It appears that the removal of the gap closure devices results in very unbalanced flow through the VBSs, with areas of high velocity through the lower portions of the VBSs. The areas of circulation along the VBSs appear to be intensified compared to the baseline condition. In addition, the modeling shows that removing the gap closure device causes an increase in the turbulent kinetic energy within the gatewells.

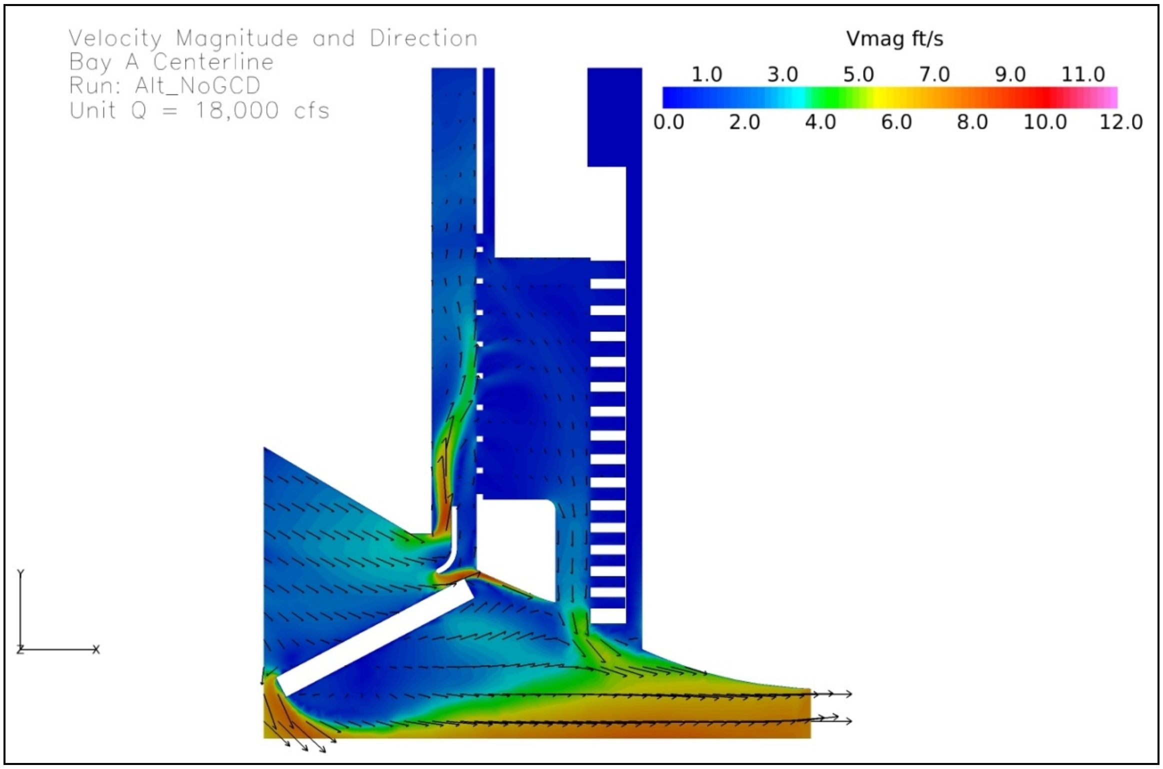

Figure 21. Alternative A7, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

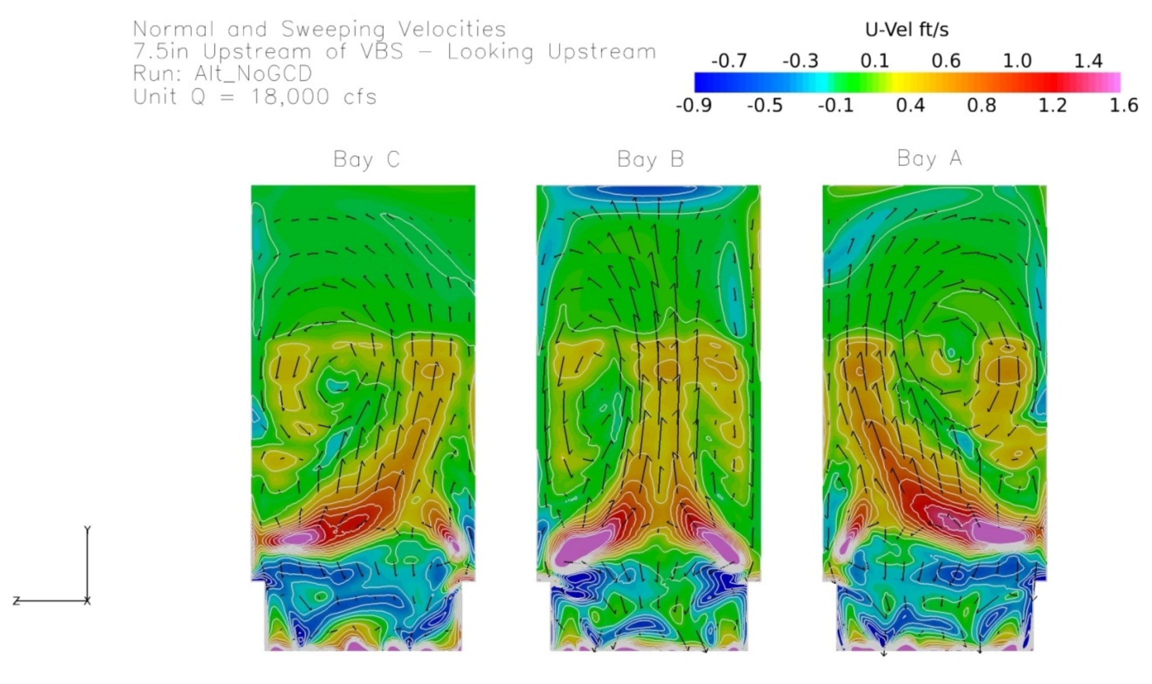

Figure 22. Alternative A7, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

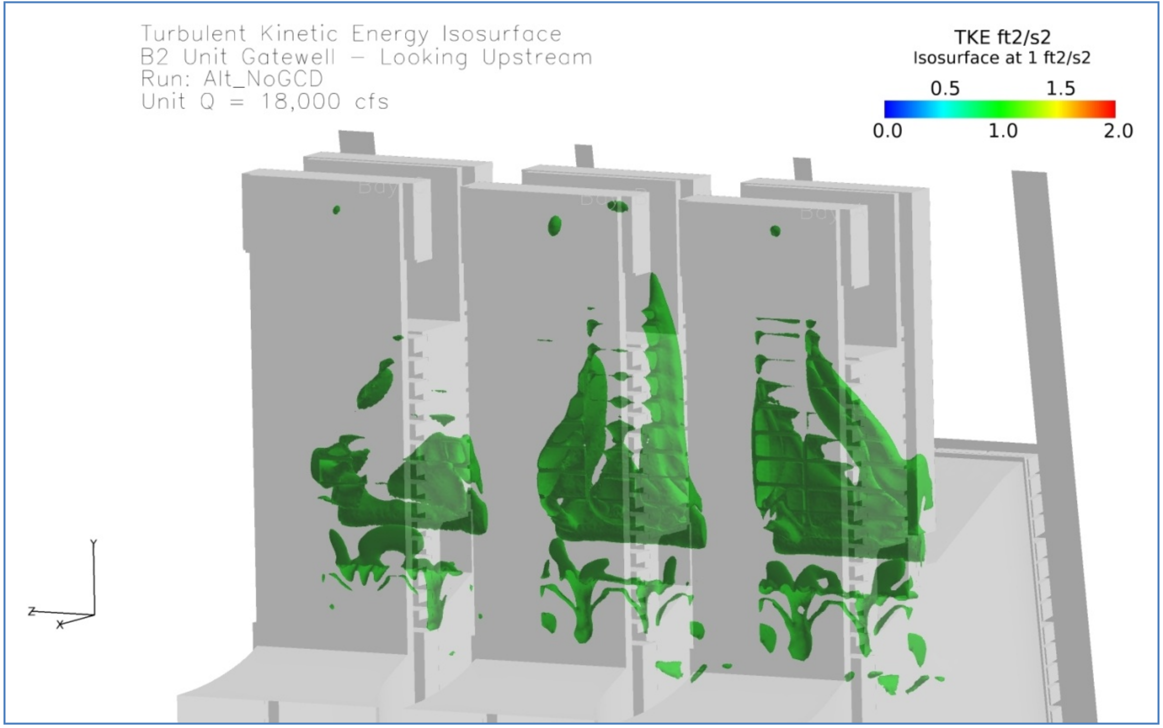

Figure 23. Alternative A7, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

5.3.4. Alternative A8 – Remove Submerged Traveling Screen and Turning Vane

The alternative to remove the submerged traveling screens (STSs) and turning vanes was evaluated with the CFD model. As shown in Table 5-3, removing the STSs and turning vanes is expected to reduce the flows through the VBS panels in all bays compared to the baseline condition. The flow through the bay A VBS (219 cfs) and bay B VBS (195 cfs) were reduced to below the design target flow of 245 cfs.

The model results for this alternative are shown in Figure 24 through Figure 26. The modeling indicates that removing the STSs and turning vanes results in less evenly distributed flow up the gatewells compared to the baseline condition. The resulting flow patterns in the gatewells are similar to those seen when just the turning vanes are removed (Alternative A6). The turning vane directs some of the gatewell flow up the upstream sides of the gatewells. When the turning vane is removed, the flow up the gatewells is concentrated on the downstream sides of the gatewells along the VBSs, which creates areas of low upward velocity, and possibly even downward flow, along the upstream sides of the gatewells.

It appears that removal of the STSs and turning vanes causes flow to pass mostly through the lower and upper portions of the VBSs, creating areas of higher velocity through the those portions of the VBSs. The areas of circulation on the sides of the VBSs seen in the baseline model runs appear to be diminished with this alternative. In addition, the modeling shows that removing the STSs and turning vanes causes a redistribution of the turbulent kinetic energy within the gatewells, concentrated mostly along the VBSs, and at the interfaces between the fast moving upward flow along the downstream sides of the gatewell and the low velocity areas along the upstream sides of the gatewells.

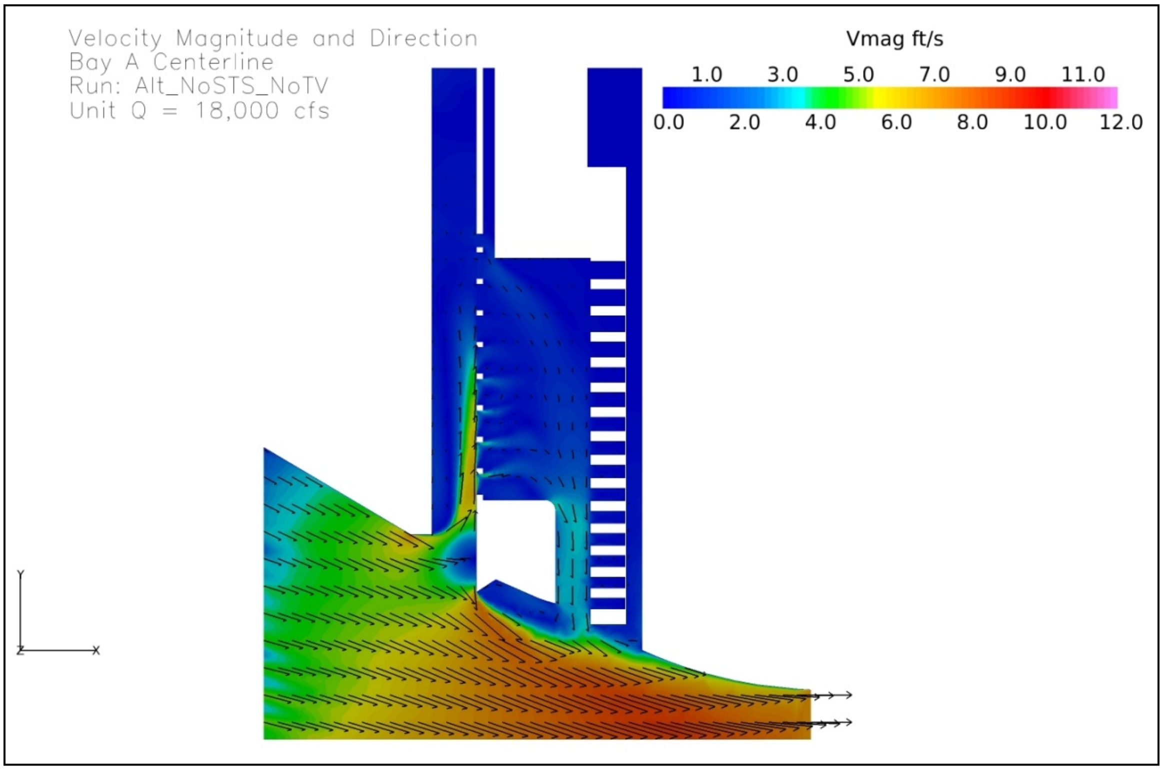

Figure 24. Alternative A8, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

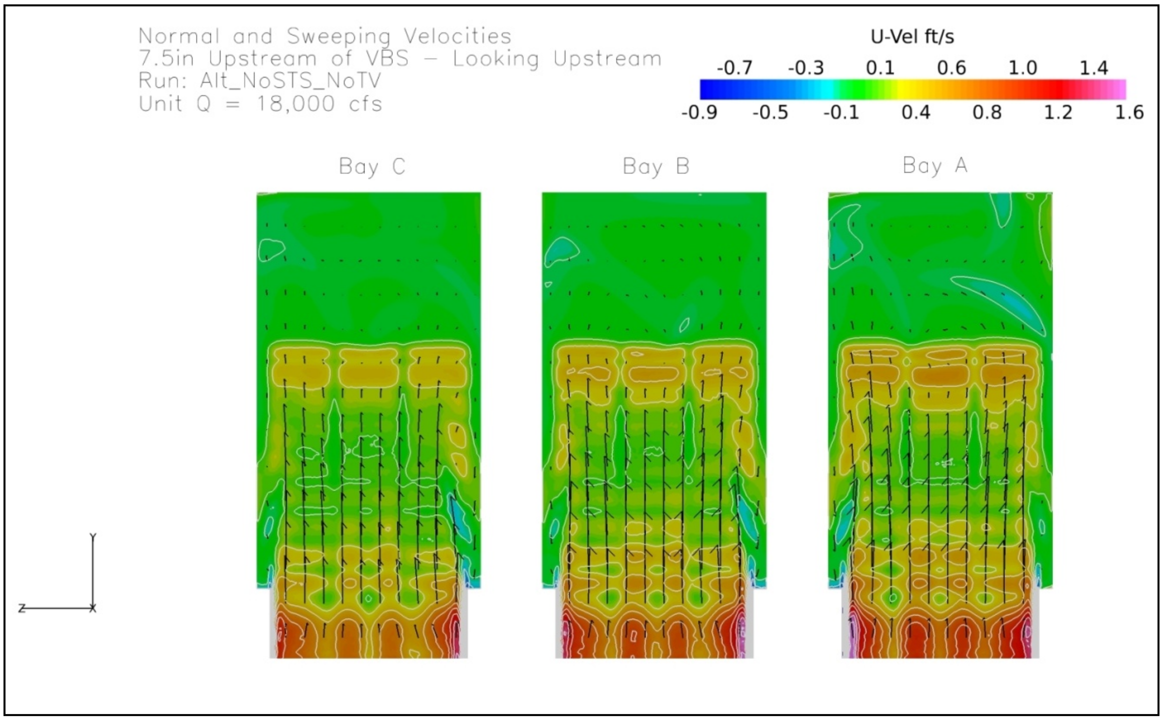

Figure 25. Alternative A8, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

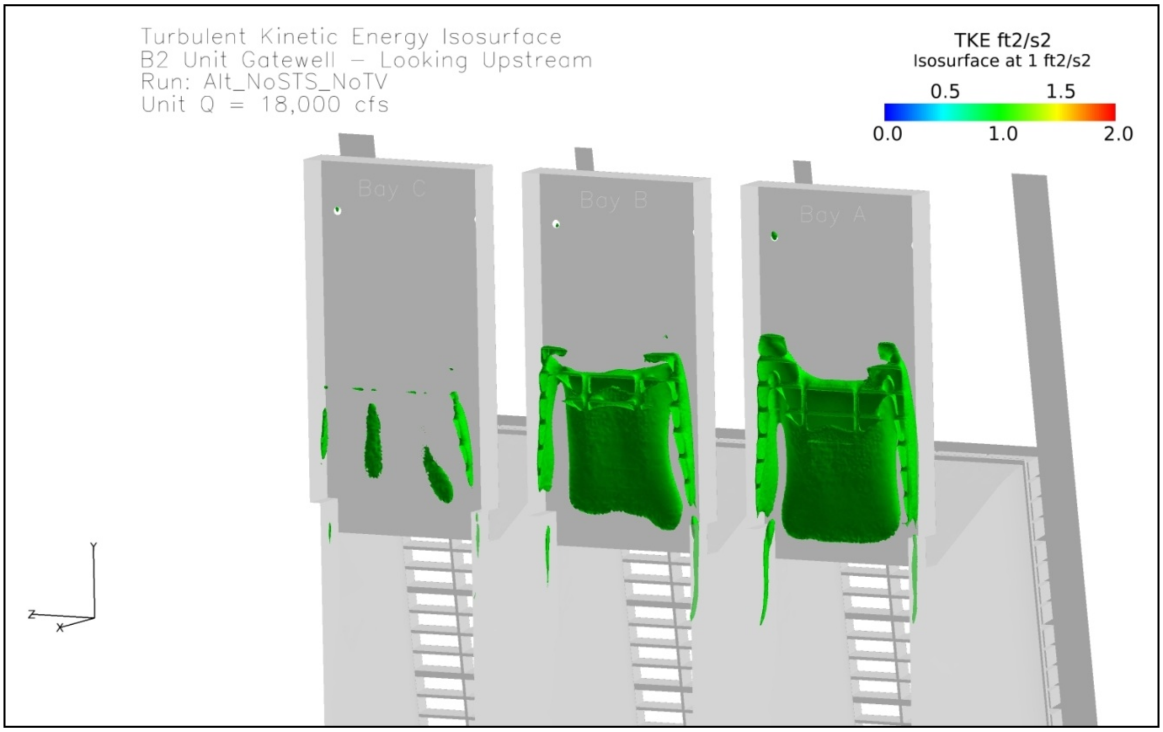

Figure 26. Alternative A8, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

5.3.5. Alternative B1 – Gate Slot Filler

The alternative to install gate slot fillers was evaluated with the CFD model. As shown in Table 5-3, installing gate slot fillers is not expected to result in reduced flows through the VBS panels, and might actually slightly increase the flows as a result of increased hydraulic efficiency within the gatewells.

The model results for this alternative are shown in Figure 27 through Figure 29. The modeling indicates that installing gate slot fillers will produce a very similar flow distribution up the gatewells compared to the baseline condition. The gate slot fillers may impact the flow patterns near the VBSs by producing areas of high velocity through the VBSs on the sides of the lower sections of the panels. It is possible that these differences in the flow patterns between the baseline and alternative runs are due to the variability in the model results at different model iterations. However, it is shown that the gate slot fillers do reduce turbulent kinetic energy with the gatewell.

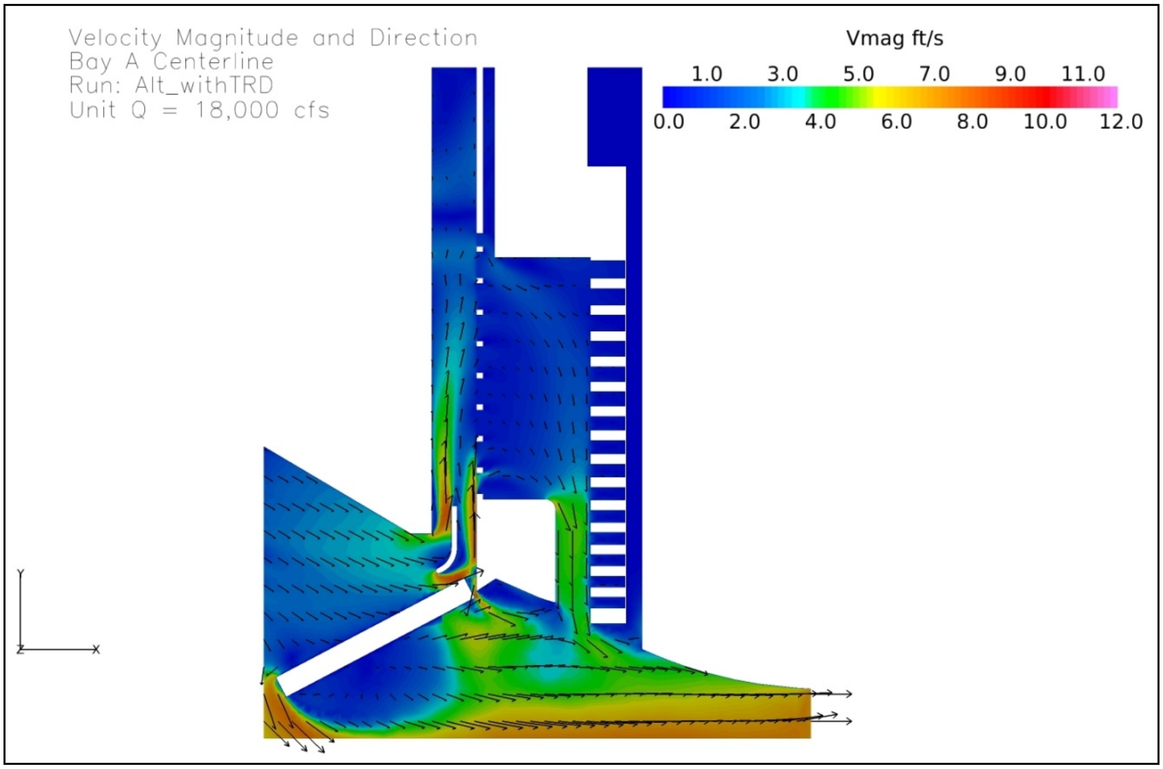

Figure 27. Alternative B1, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

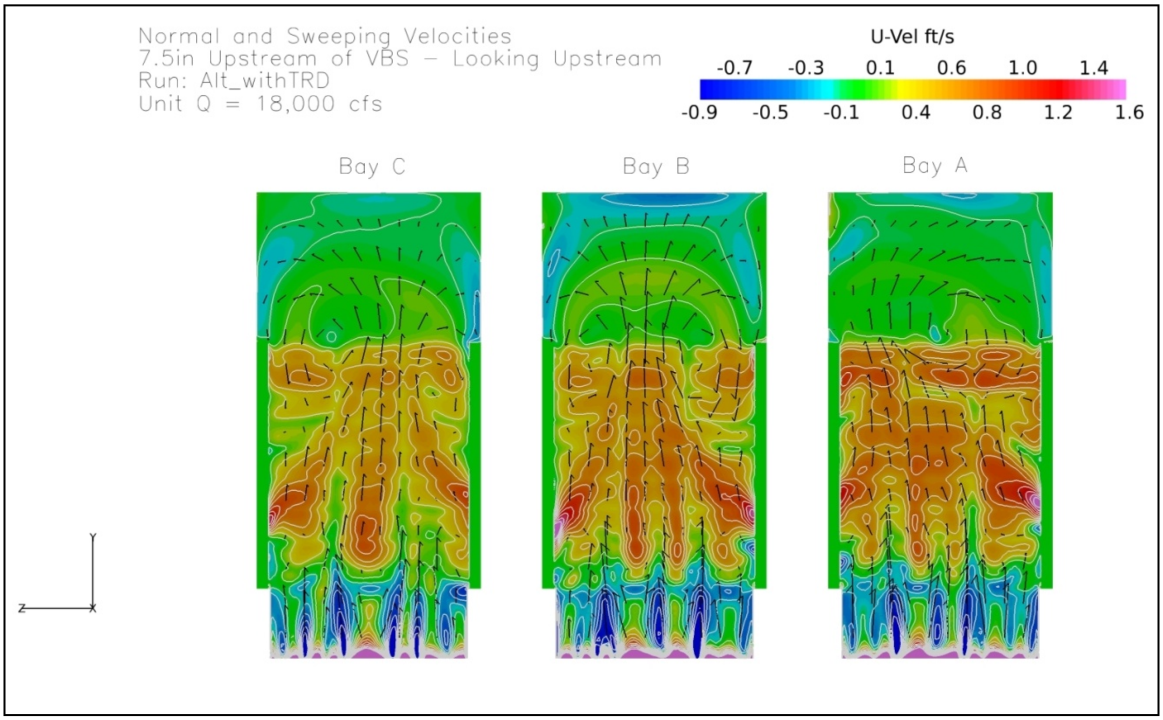

Figure 28. Alternative B1, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

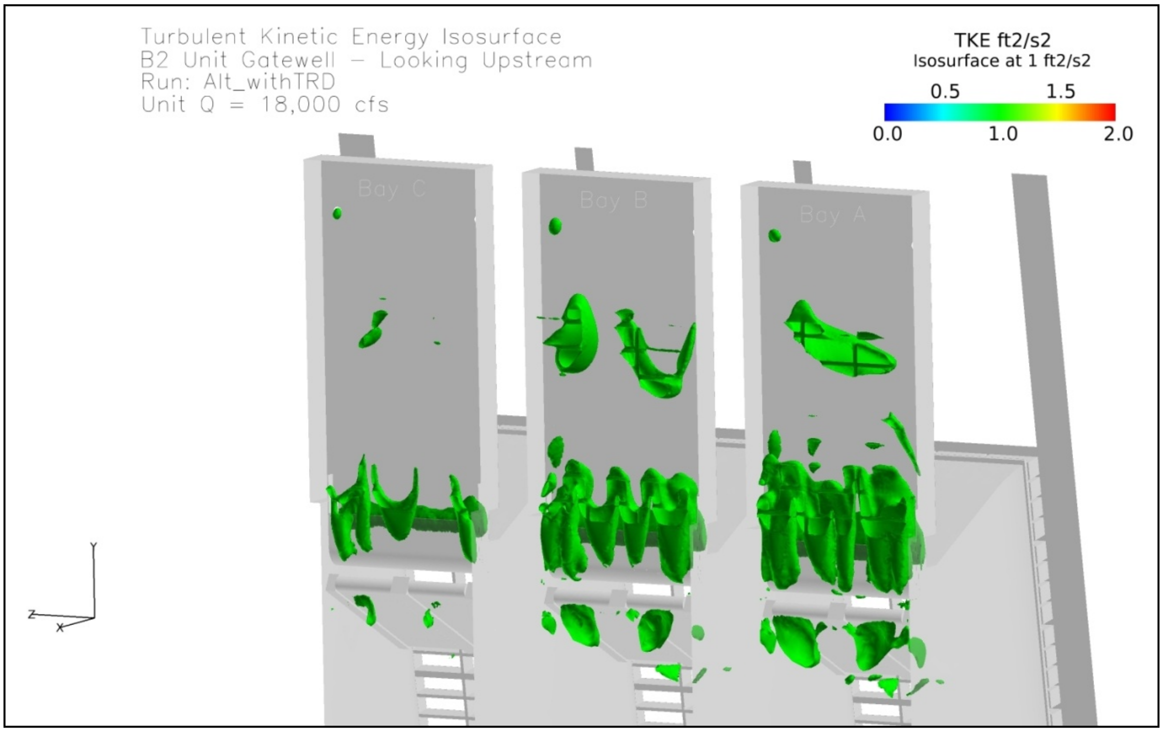

Figure 29. Alternative B1, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

6. 2014 VELOCITY DATA COLLECTION

6.1. PURPOSE

There have been two previous occurrences of velocity data collection in the gatewells at PH2, one by Pacific Northwest National Laboratory in 2010 (PNNL 2011), and one by Harbor and Alden in 2013 (Harbor and Alden 2013). While this data has proven to be insightful, there were several reasons that additional data was needed, so it was decided that additional velocity data would be collected in the gatewells in 2014. The purposes for the additional data include:

1. Validation of the flow patterns demonstrated by velocity data collected in 2013
2. Obtaining data when turbine flow is 18 kcfs
3. Validation of CFD model results
4. Obtaining data in B and C bays
5. Provide insight into the effects of a flow control plate and VBS panel modifications

The velocity data collected in 2013 demonstrated areas of high approach velocity on the upper panels of the VBS (Harbor and Alden, 2013). This flow pattern had not been observed in any of the previous modeling or field data. The PDT determined that it would be prudent to validate the existence of the flow pattern with another set of data.

Most of the concern about juvenile salmon survival in the gatewells is when the turbines are operating at the upper range. This operating range generally corresponds to a unit flow of about 18 kcfs during the out-migration period. The highest unit flow that the previous data collection efforts occurred at was about 17 kcfs, so there was no data at this critical unit flow condition. The PDT determined that it was essential to collect velocity data at a unit flow of 18 kcfs in order to have an indication of the hydraulic conditions within the gatewells during that operation.

As a result of the flow patterns demonstrated by the velocity data collected in 2013, it was decided that the CFD model used to evaluate design alternatives should be recalibrated to provide better correlation with the filed data (refer to Appendix B for more information on the recalibration of the CFD model) . It was also determined that an additional data set should be obtained in order to validate the recalibrated CFD model.

The bay A gatewells receive the highest flow for a given unit flow compared to the bay B and C gatewells, so most of the data collection at PH2 has been performed in the bay A gatewells. However, as the design progresses for improving survival in the gatewells, it is crucial to understand the hydraulic conditions within the bay B and C gatewells, so it was decided that data would be collected in those locations.

While all of the reasons described above certainly justified the need for additional velocity data, the PDT also recognized the opportunity to gain additional value from the data collection by preliminarily testing two of the configurations that were being considered for improving the hydraulic conditions within the gatewells. These configurations consisted of installing a flow control plate and modifying a VBS panel to reduce the areas of high approach velocity.

6.2. CONFIGURATIONS

Velocity data was collected at several configurations, including various bays, various unit flows, and with some modifications to the gatewells. The gatewell modifications included installing a flow control plate on the gatewell beam in Unit 15A that blocked 50% of the opening between the downstream side of the beam and the intake gate, as shown in Figure 30. The design for the flow control plate is included in Appendix C. The modifications made for testing also included completely blocking the two upper rows of panels on a spare VBS, as shown in Figure 31. All of the configurations at which velocity data was collected are summarized in Table 6-1.

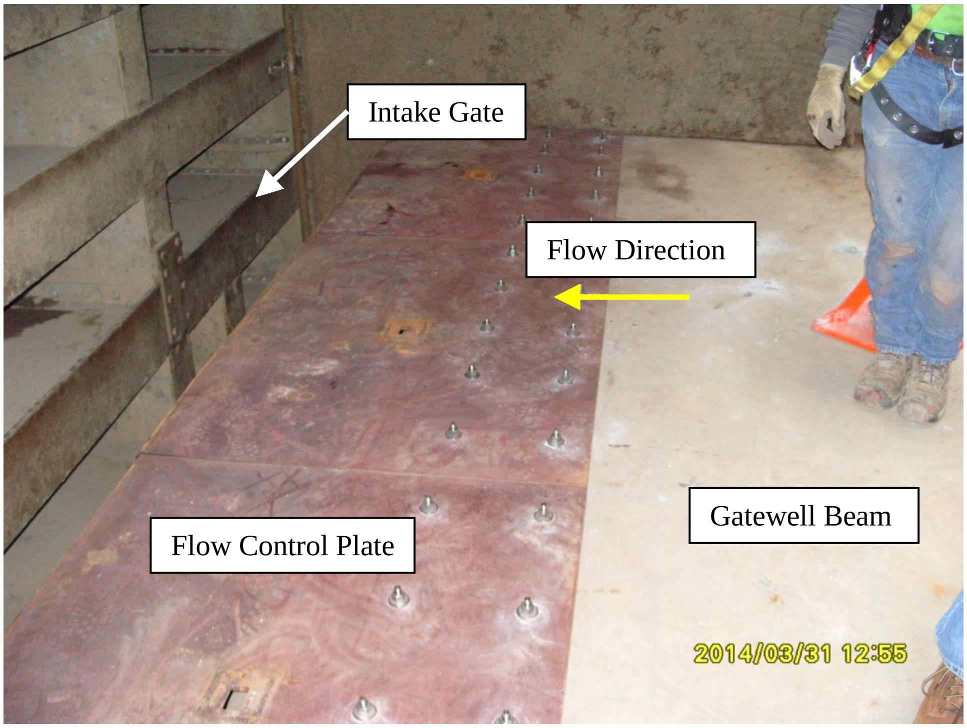

Figure 30. Flow Control Plate in Unit 15A

Figure 31. VBS in Process of Being Modified

Test	Location	Unit Flow	Description
1	14A	15.0 kcfs	Baseline – Med Flow
2	14A	17.9 kcfs	Baseline – High Flow
3	13C	17.8 kcfs	Baseline – High Flow
4	15A	18.1 kcfs	Flow Control Plate – High Flow
5	14A	17.9 kcfs	Modified VBS – High Flow
6	14B	16-17 kcfs	Baseline – Med/High Flow
7	15A	15 kcfs	Flow Control Plate – Med Flow
8	14A	15 kcfs	Modified VBS – Med Flow

Table 6-1. Configuration for Velocity Data Collection

6.3. DATA COLLECTION METHOD

The velocity data was collected by Harbor and Alden, the same consultants that collected the data in 2013. The same apparatus described in Section 2.1 was used to collect data for this effort, although a few modifications were made to equipment. The modifications include adding weight to the traversing beam to reduce buoyancy, reinforcing the frame, and refurbishing the winches that raise and lower the traversing beam. The data collection technique used was identical to that described in Section 2.1.

The data was originally planned to be collected in one continuous period over a few weeks, but an unexpected outage in Unit 15 in late April 2014 caused a delay in the start of the data collection that necessitated the need for two data collection periods, the first in early June and the second in August.

During the first data collection period, data was collected for Tests 1-5 in Table 6-1, and data was collected for the remaining tests in August.

6.4. RESULTS OF VELOCITY DATA COLLECTION

Only the data that was collected during the first data collection period in June was available at the time that this report was developed. The available data includes plots that show the magnitude of the velocity perpendicular to the VBS with vectors showing the flow direction and magnitude, and plots that show the root mean squared of all the fluctuations in the velocity data collected at a given point, which is an indication of turbulence intensity.

Figure 32 and Figure 33 show the results of the test for the baseline condition in Unit 14A with a unit flow of 15 kcfs. This data shows similar flow patterns to those seen in the 2013 data with areas of high approach velocity on the upper portion of the screen, and an area of circulation above the VBS. Also the data indicates turbulence intensity patterns that are similar to the 2013 data with areas of higher turbulence intensity along the edges of the VBS and upper portion of the gatewell.

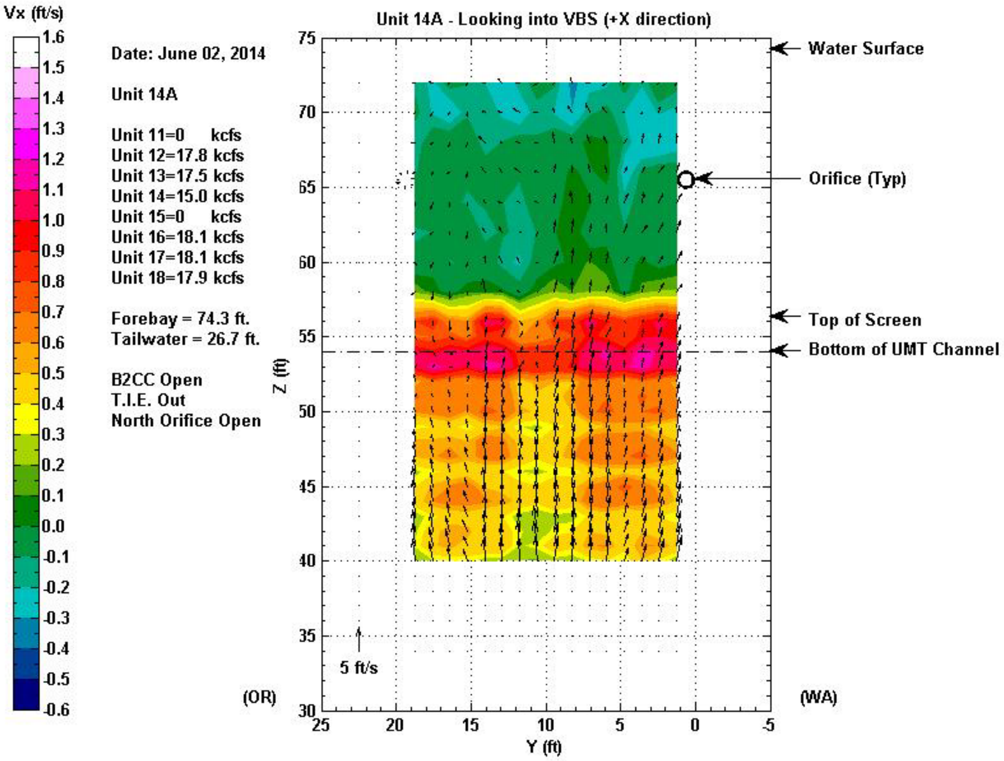

Figure 32. 14A Baseline Conditions, Unit Q=15 kcfs, VBS Normal Velocities and Flow Patterns

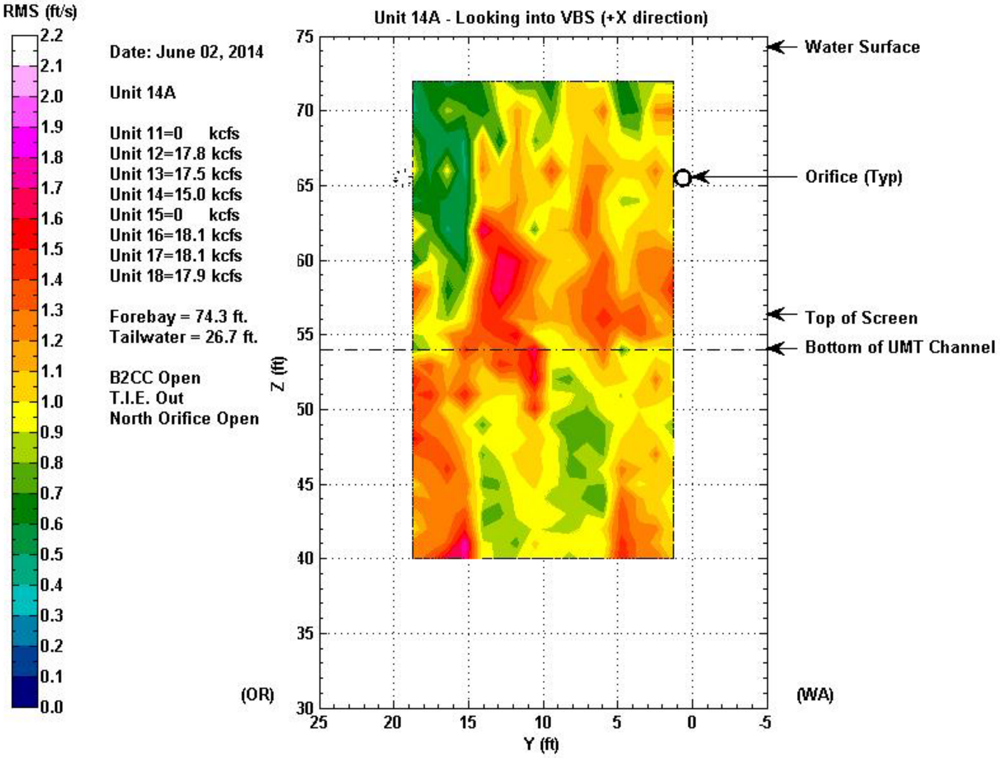

Figure 33. 14A Baseline Conditions, Unit Q=15 kcfs, RMS of Velocity Fluctuations

Figure 34 and Figure 35 show the results of the test for the baseline condition in Unit 14A with a unit flow of 17.9 kcfs. This data also shows flow and turbulence intensity patterns that are consistent with the 2013 data. Compared to the data from the test for the baseline condition in 14A with a unit flow of 15 kcfs, this data shows similar flow patterns, but with increases in both velocity magnitude and turbulence intensity, which was expected given that a higher unit flow results in more flow up the gatewells.

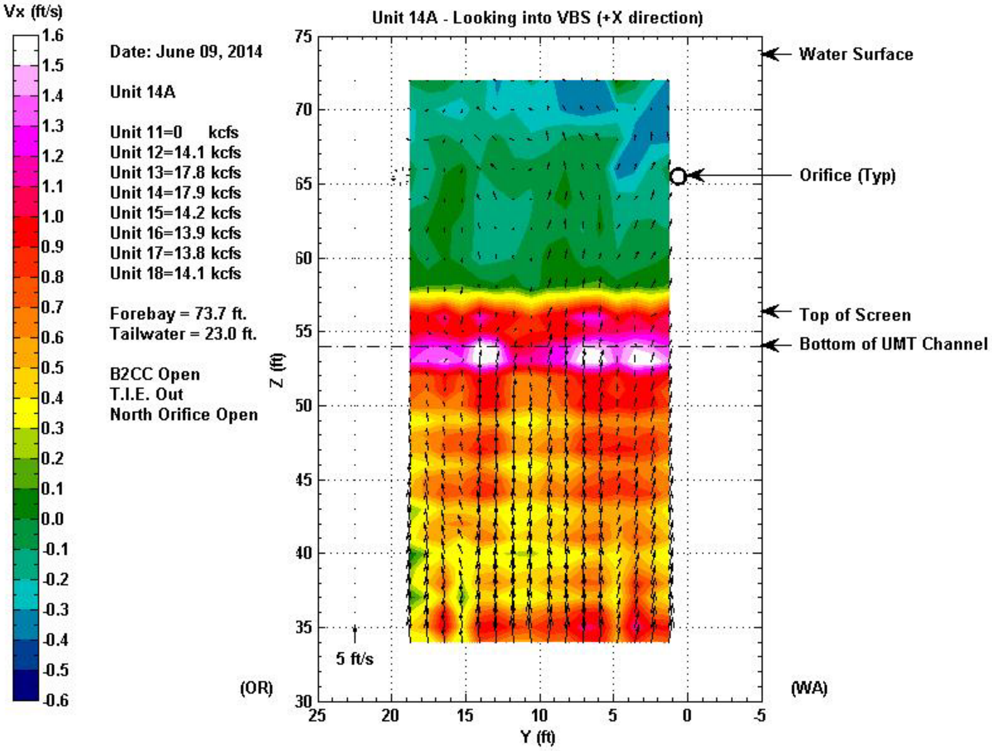

Figure 34. 14A Baseline Conditions, Unit Q=17.9 kcfs, VBS Normal Velocities and Flow Patterns

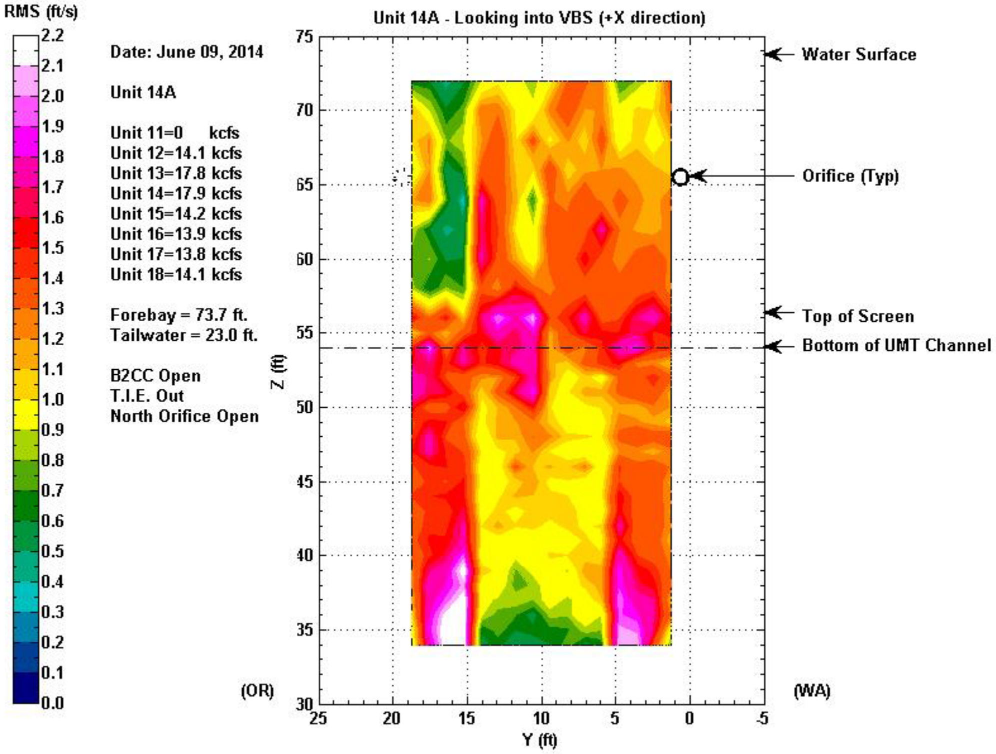

Figure 35. 14A Baseline Conditions, Unit Q=17.9 kcfs, RMS of Velocity Fluctuations

Figure 36 and Figure 37 show the results of the test for the baseline condition in Unit 13C with a unit flow of 17.8 kcfs. Like the other baseline data sets, this data also shows flow and turbulence intensity patterns that are consistent with the 2013 data. Compared to the data from the test for the baseline condition in Unit 14A with a unit flow of 17.9 kcfs, this data shows similar flow patterns, but with decreases in both velocity magnitude and turbulence intensity, which was expected given that the bay C flow is lower than the bay A flow for a given unit flow.

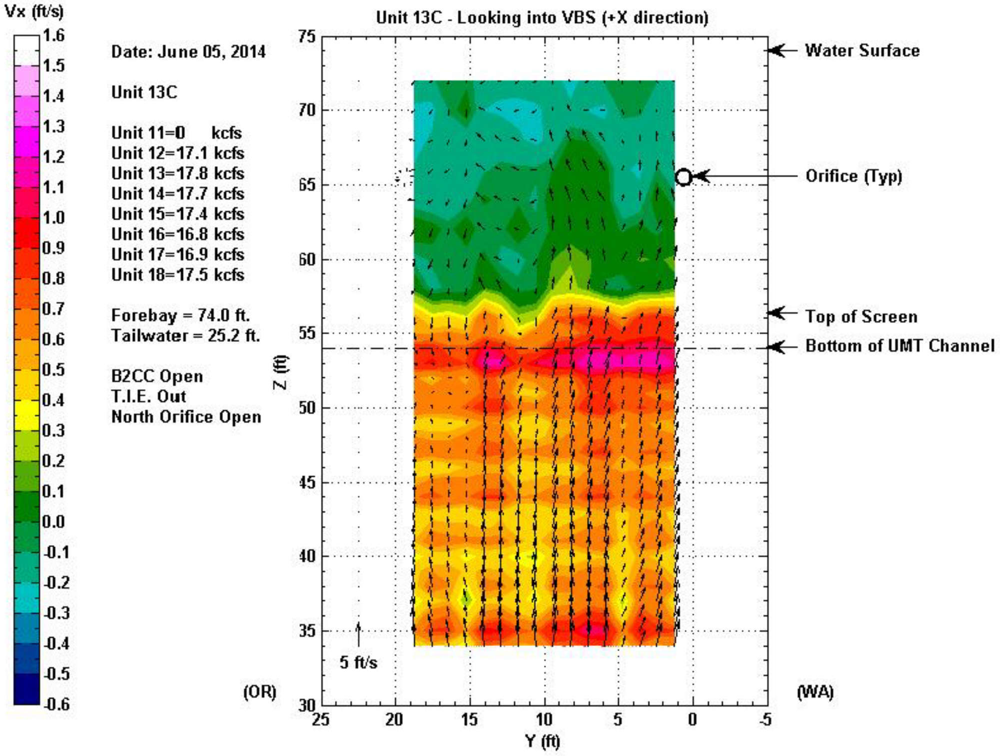

Figure 36. 13C Baseline Conditions, Unit Q=17.8 kcfs, VBS Normal Velocities and Flow Patterns

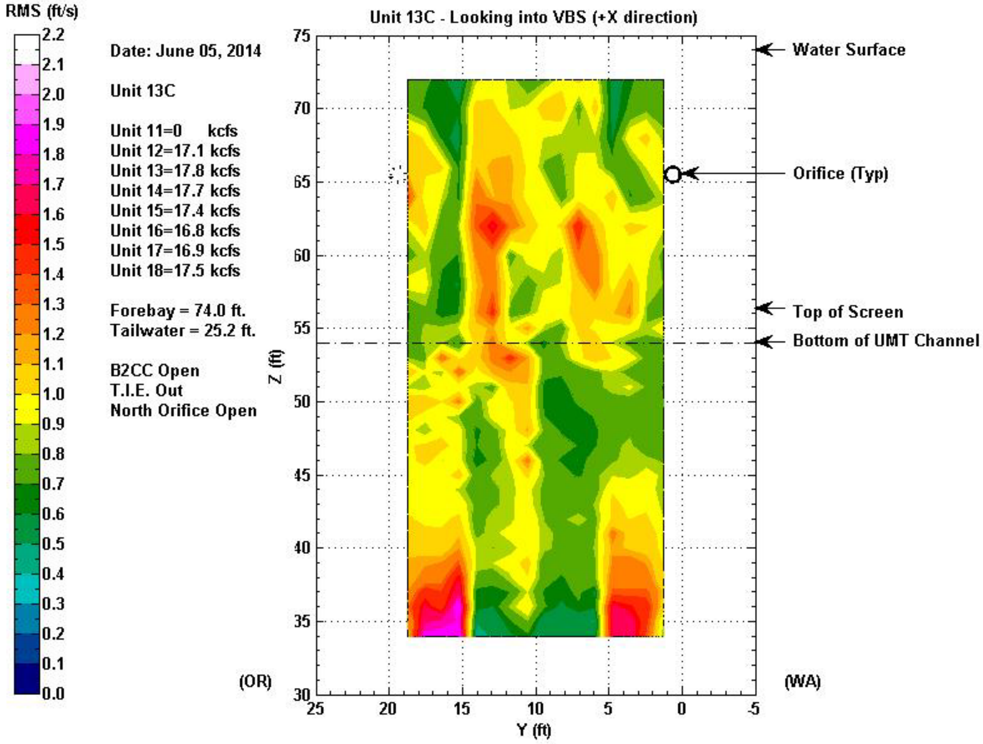

Figure 37. 13C Baseline Conditions, Unit Q=17.8 kcfs, RMS of Velocity Fluctuations

Figure 38 and Figure 39 show the results of the test for Unit 15A with the flow control plate and with a unit flow of 18.1 kcfs. Compared to the data from the test for the baseline condition in Unit 14A with a unit flow of 17.9 kcfs, this data shows similar flow patterns, but with decreases in both velocity magnitude and turbulence intensity, which was the desired effect of the flow control plate. The data indicates that the plate reduces the VBS approach velocities below those seen with the baseline conditions and a unit flow of 15 kcfs (Figure 32). However, although the data indicates that the turbulence intensity is reduced below the baseline conditions with a unit flow of 17.9 kcfs, it is not reduced to the level observed at the baseline conditions with a unit flow of 15 kcfs. In addition, although the flow control plate significantly reduces the areas of high approach velocity on the upper portion of the VBS panel, it does not completely eliminate them, as velocities in excess of 1 ft/s were observed in that region.

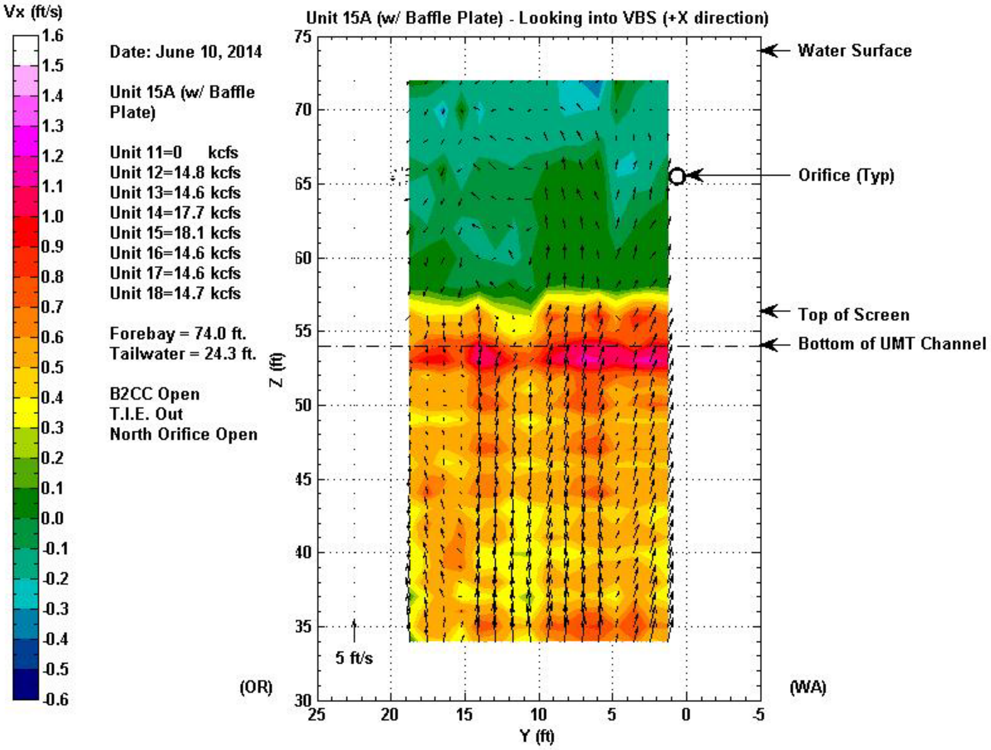

Figure 38. 15A Flow Control Plate, Unit Q=18.1 kcfs, VBS Normal Velocities and Flow Patterns

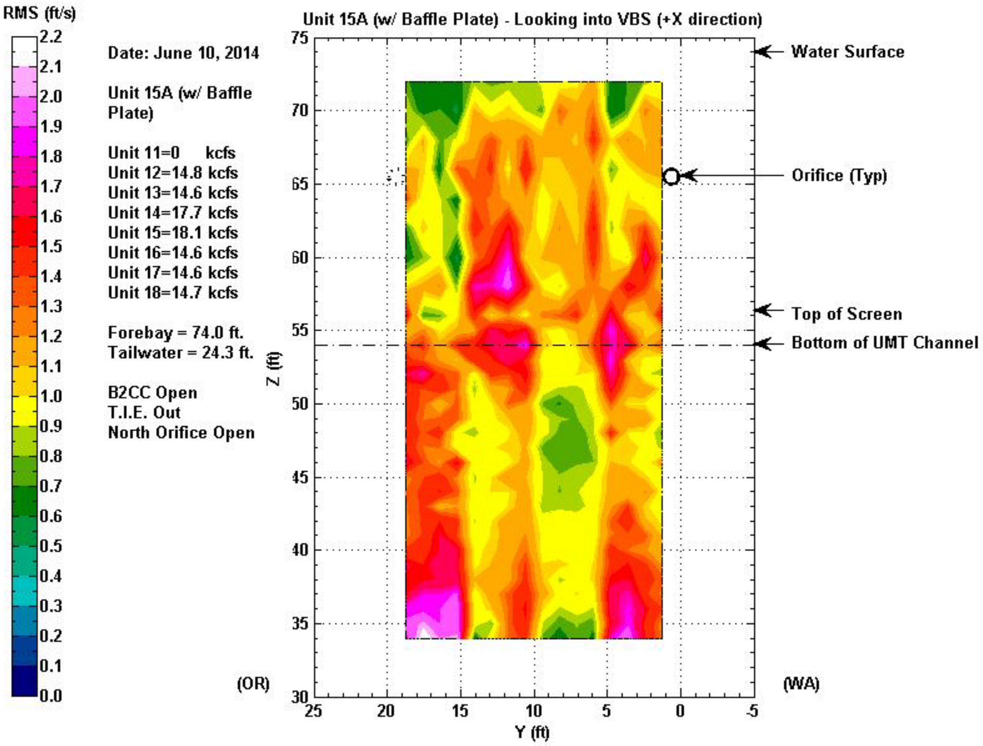

Figure 39. 15A Flow Control Plate, Unit Q=18.1 kcfs, RMS of Velocity Fluctuations

Figure 40 and Figure 41 show the results of the test for Unit 14A with the modified VBS panel and with a unit flow of 17.9 kcfs. Compared to the data from the test for the baseline condition in Unit 14A with a unit flow of 17.9 kcfs, this data shows that blocking the upper two rows of panels on the VBS results in a drastic drop in the screen approach velocity in that region. Figure 40 also demonstrates that the VBS modifications create areas of higher approach velocity along the lower region of the screen near elevation 35. The level of turbulence intensity within the gatewell appears to be similar to the baseline condition for the same unit flow.

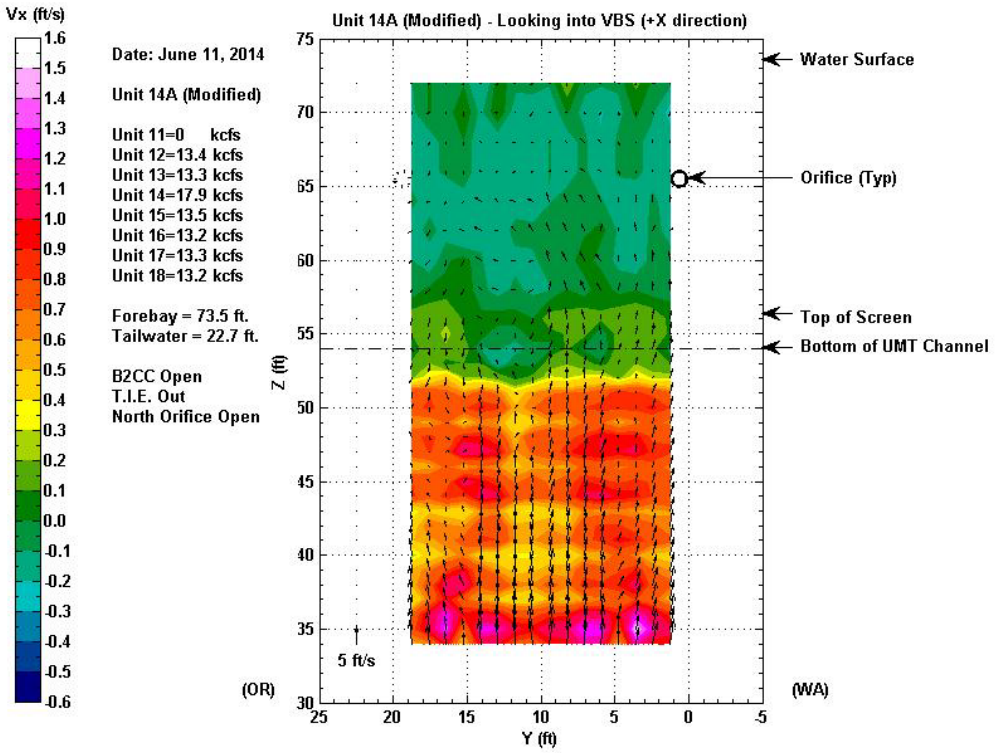

Figure 40. 14A Modified VBS, Unit Q=17.9 kcfs, VBS Normal Velocities and Flow Patterns

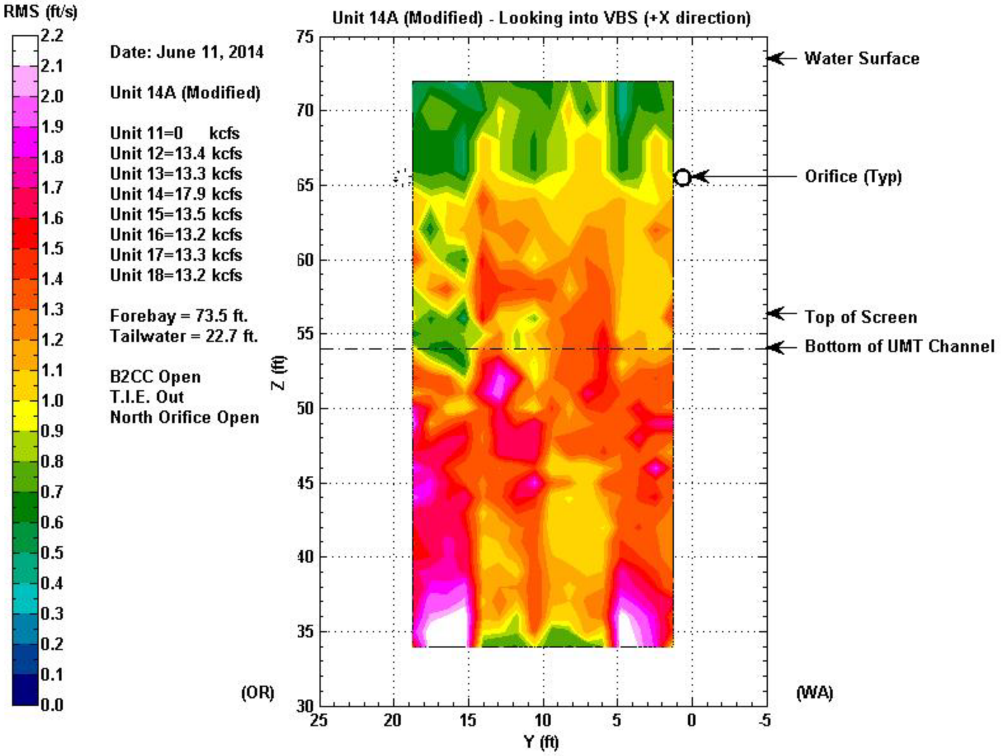

Figure 41. 14A Modified VBS, Unit Q=17.9 kcfs, RMS of Velocity Fluctuations

7. RECOMMENDATIONS

This study has reconsidered the alternatives that were developed as part of the EDR for improving juvenile salmon survival in the gatewells at PH2. As part of the process, the list of alternatives was refined to the following five alternatives that warranted further evaluation, as described in Section 4.

Flow control alternatives:
- A3 – Static Flow Control Plate
- A6 – Remove Turning Vane
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane

Flow pattern change alternative:
- B1 – Gate Slot Fillers

CFD models were developed for each of the five alternatives and for the baseline conditions. The results from the modeling were used to evaluate the performance of the alternatives compared to the baseline conditions. Of the five alternatives modeled, only the following three met the design criterion for flow through the VBS.

- A3 – Static Flow Control Plate
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane

Of the three alternatives that met the design criterion, alternative A3 – Static Flow Control Plate demonstrated a hydraulic environment within the gatewell that most closely resembled the target design condition (baseline bay A with unit flow of 15 kcfs). The other two alternatives produced hydraulic conditions in the area of the STS and in the gatewells which could have negative impacts on FGE and fish survival.

The velocity data that was collected in June 2014 (Harbor and Alden 2014) supports the results of the CFD modeling. The data indicates that the flow control plate reduces the flow up the gatewell, reduces the approach velocity for the VBS, and potentially reduces turbulence intensity in the gatewell, all of which are expected to improve survival in the gatewells.

The recommended alternative for further study as part of the DDR is a flow control plate. To meet the VBS flow design criteria, it is expected that a flow control plate that blocks approximately 50% of the opening between the gatewell beam and the intake gate will be required in bay A, and that a flow control plate the blocks approximately 25% of the opening will be required in bay B. It is also anticipated that a flow control plate will not be necessary in bay C as it appears to meet the VBS flow criteria without a plate at a unit flow of 18 kcfs. However, the exact dimensions and configurations of the plates will need to be determined as part of the DDR.

It is also recommended that alternative A5 – Modify Vertical Barrier Screen Plates (to Meet Velocity Criteria) be studied as part of the DDR. The velocity data that was collected in June 2014 (Harbor and Alden 2014) indicates that the although the flow control plate significantly reduces the areas of high approach velocity on the upper portion of the VBS panel, it does not completely eliminate them, as velocities in excess of 1 ft/s were observed in that region.

As part of the DDR, it is recommended that a prototype of the design that is developed for the flow control plate and VBS modifications be constructed. This prototype should be evaluated for biological and hydraulic performance prior to full implementation across the powerhouse.

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APPENDIX A

Relevant Correspondence

Appendix A – Relevant Correspondence

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1. Minutes for the 05 September 2013 FFDRWG Meeting
2. Minutes for Meeting Between USACE and NOAA on 25 November 2013
3. Minutes for the 13 August 2014 FFDRWG Meeting
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5. Review Comments from NMFS for 90% Supplement to the EDR 29 October 2014

CENWP-PM-E 05 September 2013

MEMORANDUM FOR THE RECORD

Subject: FINAL minutes for the 05 September 2013 FFDRWG meeting.

The meeting was held in NWP RDP 3rd Floor Meeting Room, Portland OR. In attendance:

Last	**First**	**Agency**	**Office/Mobile**	**Email**
Ament	Jeff	USACE-NWP		
Bettin	Scott	BPA		swbettin@bpa.gov
Bissel	Brian	CENWP-OD-B		Brian.m.bissel@usace.army.mil
Conder	Trevor	NOAA Fisheries		Trevor.conder@noaa.gov
Ebner	Laurie	USACE-NWP		
Eppard	Brad	CENWP-PM-E		Matthew.b.eppard@usace.army.mil
Fredricks	Gary	NOAA	503-231-6855	Gary.fredricks@noaa.gov
Hausmann	Ben	CENWP-OD-B	541-374-45998	Ben.j.hausmann@usace.army.mil
Kostow	Kathryn	ODFW		
Lee	Randy	USACE-NWP		Randall.t.lee@usace.army.mil
Langeslay	Mike	CENWP-PM-E	503-808-4774	Mike.j.langeslay@usace.army.mil
Lorz	Tom	CRITFC	503-238-3574	lort@critfc.org
Mackey	Tammy	CENWP-OD-TF	503-961-5733	Tammy.m.mackey@usace.army.mil
Medina	George	USACE-NWP	503-808-4753	George.J.Medina@usace.army.mil
Rerecich	Jon	CENWP-PM-E	541-374-7984	Jonathan.g.rerecich@usace.army.mil
Richards	Natalie	USACE-NWP	503-808-4755	Natalie.A.Richards@usace.army.mil
Royer	Ida	CENWP-OD-B		
Schlenker	Steve	USACE-NWP	808-503-4881	Stephen.j.schlenker@usace.army.mil
Traylor	Andrew	CENWP-OD-TF		Andrew.w.traylor@usace.army.mil
Warf	Don	PSMFC		dwarf@psmfc.org
Weiland	Mark	PNNL		

Hausmann, Kostow, Warf called in.

All documents may be found at http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/FFDRWG/FFDRWG.html

1. **Final Actions or recommendations from the 05 September 2013 NWP FFDRWG.**
   - **1.1.** June minutes were approved.
   - **1.2.** BON Spillway repairs (major rehab) will be an update at each NWP FFDRWG.
   - **1.3.** Special FFDRWG- FGE/orfices. **After further conversation, NOAA, CRITFC and BPA agreed with the reassessment of alternatives.**
   - **1.4.**

2. **Action Items from 05 September 2013 NWP FFDRWG.**
   - **2.1.** BON Spillway repair. **ACTION:** Ebner will provide a summary for FFDRWG.
   - **2.2.** BON AWS Trashrake. **ACTION:** Rerecich will send the report to attendees.

3. **Action Items from Last FFDRWG Meeting (06 June, 2013):**
   - **3.1. BON AFF:** J. Rerecich will take the lead in getting a “Lessons Learned” and future meeting/actions coordinated. *Discussed later in the agenda.*
   - **3.2. Avian Predation:** S. Ruckwardt will schedule and avian meeting with the region including NWW and NWD
   - **3.3. BON PH2 FGE:** BON Project Fisheries to get photos of the VBSs prior to the riggers cleaning the screens. *Completed.*

3.4. TSP BIT Report: Rerecich will send out revised BIT report to the region. *Sent by Trumbo on 27 June.*

3.5. BON Trashrake: Rerecich will send out the VE report and schedule a special FFDRWG to present and discuss. *To be discussed after the NWP FFDRWG meeting.*

4. Bonneville Spillway (Stilling Basin Erosion) . Ebner reported they are in the process of scheduling a spillway survey. Preferred dates would be 30 September – 11 October. Should only take about a day for both north and south sides of the spillway. Primary concern is the B-Branch side and the repairs completed last fall. Fredricks asked about the long term plan. Ebner said NWP is pushing for major rehab. Major rehab is a very slow process but we are moving forward. **Fredricks requested this be an update at each NWP FFDRWG.** Ebner said the erosion and rock moving write up should be available at the end of September. Fredricks said we really need to fix the spillway. We can talk about fish survival and moving flow through bays to help improve survival but this is a fish and a dam safety issue that needs to be fixed. He would like to know what the plan of action is and the anticipated schedule for repair. He doesn’t want to see us continue to alter spill patterns and potentially negatively impact fish. **ACTION:** Ebner will provide a summary for FFDRWG.

5. Lower Columbia River Survival Study. Eppard provided a brief background.

5.1. BON Multi-year Synthesis Analysis. Weiland gave a .ppt presentation.

5.1.1. Powerhouse Turbines. Weiland noted they used the fifth order polynomial to get the data to fit. Data was binned by the quarter % of the 1% range and Open Geometry. Comparisons may be made at PH1. At PH2, there were not many fish at the Open Geometry since there is no operating capacity above 1%. FFDRWG asked if Open Geometry was truly open geometry or generator limit. Fredricks said there is a specific definition for “open geometry”. Rerecich said for this analysis, he thought “open geometry” was the upper 1% and beyond. Bettin requested that we look at both open geometry and generator limit to see if they can detect a survival difference. FFDRWG discussed whether we would want to lump spring migrants or split them for analysis. Lumping or splitting would be partially determined by tailwater impacts and whether survival is similar between species. Lorz said he isn’t as concerned about lumping with the turbine data but we should not do that with the spillway unless survival between species is similar. Ebner said it would be interesting to see if the 2011 data was statistically different than the rest since that was a high year. Weiland said he will have to go back and slice and dice the data a little more. **NWP FFDRWG said to look at survival across tailwater elevations. If there is no difference, then lump.**

5.1.2. Spillway bays. Fish pass through every bay. Analysis was by bay and then by lumping bays. Bays were lumped 1-3 (higher deflectors), 4-7, 8-12, 13-15, and 16-18 (higher deflectors). The middle bays were lumped based on bathymetry and how flow moves through. Ebner prefers grouping the bays rather than looking at individual bays.

5.1.2.1. FFDRWG discussed potential surface passage at the BON spillway. Ebner and Bettin said it would be difficult. Ebner said there are structures (cables, concrete, etc) in the spillway that prevent the shape of the spillway weir; limitations to spillway capacity create a dam safety issue; forebay fluctuations create potential difficulties. Fredricks and Lorz didn’t see these issues as show stoppers, just issues that would need to be worked around with design.

5.1.2.2. Fredricks and Langeslay discussed whether BON has or has not met the Performance Standards. Langeslay said there are no plans to go in and do work on the spillway for survival improvements at this time.

5.2. BON. Refine scope based on sample sizes.

5.2.1. Spillway survival v. TW. First by species and then by groupings if appropriate. Analysis would be by bay and then by groupings noted above.

        - **5.2.2.** PH1 grouping by generation (generator limit, BOP, Q1-Q2, Q3-Q4) and potential lumping of species.
        - **5.2.3.** PH2 grouping by generation (as currently split out in the .ppt). No OG analysis. (Ebner will provide guidance as to why OG is not valid). Look at potential for lumping species.
        - **5.2.4.** TDA. Analysis of each bay; bays 1-8 and 9-12 and 13-22; 2011 bays 9-22 v 2012 bays 9-22; survival through bays 1-8 at 10K increments. May need to lump species to get enough fish.
    - **5.3. TDA spillwalls.** Looking at bays 1-8 and 9-22. Weiland reported there were more fish going through Bays 9-22 than he anticipated. Ebner asked how many of those fish passed in 2011 (high flow year). Fredricks would like to see inside the wall and outside the wall with a group of 9-12 and then 13-22. Fredricks would like to see more pressure on getting Bays 9-12 repaired. Ebner would like to see a comparison of 2011 bays 9-22 and 2012 bays 9-22. She would also like to see analysis of survival through bays 1-8 and flow. Weiland said he could do 10K increments if the GDACS data is correct. Ebner hesitated, said it would work for this analysis, but the accuracy is not at the same level as BON and JDA. She also stated that 24 kcfs increments would be all that is necessary since that is the amount of water that passes through 1 foot of gate opening on a spillway.

6. Bonneville Adult Fish Facility Mods. Rerecich provided a handout. The number of AFF MFRs was mentioned. Rerecich said it seemed the mortalities are fish that are coming in overnight and haven't been the sampled fish. He revisited the decision to remove the lower section of the return pipes; explaining the pipes were submerged due to the numbers of shad building up on the Valve 15 trash rack. This winter, the pipe sections will be reinstalled and slightly raised if possible, the baffle will be modified with overflow sections for fish to pass through, and the access to the Valve 15 drain will be modified to allow for easier cleaning. He noted any modifications may be challenging due to the space and configuration of the AFF. Rerecich noted there have been a lot of lamprey mortalities as well. These fish have fallen back since lamprey do not use the false weirs. Ament noted that the baffle went in at the same time the floor plating went in. If the shad plug Valve 15, there is no other route for the water to go with the plates in place. He said they will remove one and then the other to test this winter. Fredricks said he is concerned about the slope of the exit pipes, regardless of whether the pipes are submerged or not. Rerecich said they are going to test the piping for Valve 8 (south fish flume which is no longer used) to see if there is enough flow there to help push fish out of the return pipes.

- **6.1.** Weiland suggested we could use acoustic deterrents to keep shad out of the AFF. Shad hear at a higher frequency range than salmon (150-200 kHz). Lorz suggested checking the hearing level of lamprey before sticking anything in there. Weiland said tests showed shad avoided the noise while salmon were not affected. Fredricks seemed willing to try this at the entrance of the AFF ladder.
- **6.2.** Hausmann added that cormorants are in the upper section of the ladder and these birds are not bothered by people. The fish counter has reported more dead jacks floating downstream this year than in previous years.
- **6.3.** Fredricks asked if the flap could be modified so fish could get through easier.

7. B2 Orifices. This will be discussed in further detail later this afternoon. Medina provided a handout. The EDR is under review.

- **7.1.** Alternatives report

8. JDA Configuration and Operation Plan. Medina provided a handout.

- **8.1.** Permanent Top Spillway Weir (TSW) (Hanson)

9. B2 Corner Collector. Medina provided a handout.

- **9.1.** Corner Collector Repairs

10. Turbine Survival Program. Medina provided a handout.

11. **The Dalles East Adult Fish Ladder AWS Backup System.** Medina provided a handout. Lee reported the alternatives are being evaluated. DDR bumped to the end of the calendar year. Fredricks asked when the system would be constructed. He has heard rumors about there being some significant concerns with the design. Medina and Lee said there are questions but nothing that has indicated any show-stoppers. Medina said there may be a need for two continuous years for construction and cost seems to be creeping up. Despite those concerns, Medina still believes the goal can be accomplished.

12. **Lamprey Passage Projects**
    - **12.1. JDA South Count Station Lamprey Collection Structure.** Medina provided a handout. It should be completed the first week of September.
    - **12.2. Bonneville WA Shore Lamprey Flume System.** N. Richards provided a handout. Rerecich and Richards asked about the status of the BON ITS. Hausmann said it will be back in service in about two weeks. The cable will need to be replaced and the gate unjammed. 13BON51 will be finalized at the 12 September FPOM. Richards said the dive work will be completed this year and anything else will have to wait until the following winter work window. Bettin asked about the liability for the faulty design. Richards said NWP is going after the A&E firm for the costs. Costs include the foregone power.
    - **12.3.** Lamprey 10-year Plan Update (Langeslay/Tackley)
    - **12.4.** Lamprey Minor Fishway Modifications (Gibbons/Yazdani/Tackley)
    - **12.5.** Lamprey Passage Structure (LPS) development PDT (Tackley)

13. **The Dalles Adult PIT Detection Alternatives Study.** N. Richards provided a handout. The temporary detectors are working great. The PDT will work on making this permanent. Lorz and Fredricks asked if the PDT will be re-directed to work on JDA now. This had been discussed in SCT, but there was no resolution. Bettin noted that if we want to get it in this year, we will need to make a decision soon, before the lead time necessary to get contracts in place for installation next in water work period passes.

14. **John Day North Ladder Improvements**. N. Richards provided a handout. AWS pumps are still not working properly. The motor for pump 2 has been sent out for repair. Turns out the contractor didn't provide the equipment in the specs and the non-spec equipment has been failing.

15. **Avian Predation Actions.** Eppard reported for Ruckwardt. Fredricks said there needs to be a discussion as to whether or not birds should be discussed at FFDRWG. Lorz asked where the issues would be discussed, if not here. Eppard said there has been talk of moving it to the SRWG forum. Conder suggested changing the "Inland Avian group" to the "Basin Avian Group". Fredricks said sinking islands would still need to be discussed in FFDRWG, since it wasn't designed well in the first place, but research should go to SRWG.
    - **15.1. Malheur Island.** Essentially done and can be removed from the agenda.
    - **15.2. Summer Lake Island.** Fredricks and Eppard debated whether the island sunk first or just broke free and then was removed by NWP. Lorz, playing mediator, suggested we could agree the island is no longer. Fredricks said there were issues with owls and predation.
    - **15.3. S.F. Bay (Hayward and Don Edwards locations).** USACE has given up on Hayward but Don Edwards is on USFWS land so it may be promising. Fredricks said the Bear River NWR in Utah is looking promising as is a National Wildlife Refuge in the San Juan islands. Eppard noted that NWP is still seeking alternatives for potential coastal sites.
    - **15.4.** Estuary monitoring. Eppard said the final proposal isn't available until the management actions have been settled. Lorz said research on cormorants could continue. Eppard said there is a plan to select a management action and once one is selected, a proposal will be tailored to fit that. Fredricks clarified that Lorz is talking only about research. Lorz has requested that someone stop hovering over the toilet and make a decision one way or another.

Next NWP FFDRWG Meeting: Thursday October 3rd, 2013

Subject: FINAL minutes for the 05 September 2013 FFDRWG meeting.

The meeting was held in NWP RDP 3rd Floor Meeting Room, Portland OR. In attendance:

Last	First	Agency	Office/Mobile	Email
Bettin	Scott	BPA		swbettin@bpa.gov
Bissel	Brian	CENWP-OD-B		Brian.m.bissel@usace.army.mil
Conder	Trevor	NOAA Fisheries		Trevor.conder@noaa.gov
Ebner	Laurie	USACE-NWP		Laurie.l.ebner@usace.army.mil
Eppard	Brad	USACE-NWP		Matthew.b.eppard@usace.army.mil
Filan	Ben	USACE-NWP		Benjamin.j.filan@usace.army.mil
Fredricks	Gary	NOAA	503-231-6855	Gary.fredricks@noaa.gov
Henrie	Gary	USACE-NWP		Gary.s.henrie@usace.army.mil
Kostow	Kathryn	ODFW		
Lee	Randy	USACE-NWP		Randall.t.lee@usace.army.mil
Lorz	Tom	CRITFC	503-238-3574	lort@critfc.org
Mackey	Tammy	CENWP-OF-TF	503-961-5733	Tammy.m.mackey@usace.army.mil
Medina	George	USACE-NWP	503-808-4753	George.J.Medina@usace.army.mil
Rerecich	Jon	CENWP-PM-E	503-808-4779	Jonathan.g.rerecich@usace.army.mil
Roy	Liza	USACE-NWP		Elizabeth.W.Roy@usace.army.mil
Royer	Ida	CENWP-OD-B		Ida.M.Royer@usace.army.mil
Stricklin	Eric	USACE-NWP		Eric.t.stricklin@usace.army.mil
Traylor	Andrew	CENWP-OD-TF		Andrew.w.traylor@usace.army.mil

Kostow called in.

All documents may be found at http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/FFDRWG/FFDRWG.html

1. B2-FGE. Powerpoint available on the FFDRWG website. Rerecich gave a brief background on how we got to our current situation.
    1.1. Review/discussion of 2013 Hydraulic and Biological results. Ebner discussed the model data and results. CFD model calibrated to the 1:12 model. When conducting field tests; found fish in the areas with just wedge wire and not perf plate behind. Found hotspots across the panel when looking at field data.   The discovery of hot spots was a shock. Prototype data matched model data really well until we look at the upper two panels. Now the CFD model will need to be calibrated to the prototype instead of to the 1:12 model.
    1.2. Ebner said the team would like to alter the porosity of the upper two panels and test with 16-18 kcfs going through the unit. Bettin asked how much flow goes up the gatewell without a STS. No one knew of any measurements taken without the STS. Bettin and Fredricks agreed that there are a lot of fish that pass through the JBS without the STSs, however, the numbers of fish are still reduced than when STSs are installed. Ebner asked about pulling screens from A slot but leaving them in the B and C slots. ERDC will conduct the model test. Fredricks was not opposed to the idea but he was curious about how that flow would affect the other screens in the unit. Eppard asked if pulling screens would be a viable alternative. Fredricks said he thinks it would be since survival through the turbines is good for Chinook. Survival isn't as good for steelhead but steelhead survival through the B2CC is higher. Lorz asked when Unit 11 would return. Fredricks said Unit 11 would be a huge benefit, especially if it were designed properly.
    1.3. Ebner resumed her presentation. She stressed the need to establish a hydraulic baseline to work from. Without that, there isn't much to move forward on. Alternatives would be assessed once the hydraulic baseline is determined. Alternatives could include pulling all or just some screens, further modifications to the gatewell environment, etc. Fredricks said the work should be completed prior to the next Performance Standard test.

        - 1.3.1. Fredricks asked if it was necessary to go down the path presented. What about a flow control structure? He said he was willing to take the hit on FGE if it reduces the turbulence in the gatewell and increases survival.
        - 1.3.2. Medina pushed for working through the issues in a systematic manner, as laid out by Ebner. FFDRWG discussed the merits of waiting to get the hydraulic baseline v a flow control structure. Fredricks said waiting another five years to fix the problem is unacceptable. Bettin asked why the turbine couldn't be used as the model. Ebner said the data from the bottom two panels couldn't be gathered due to the lack of strength in the frame. That could be fixed. The other problem with testing in the prototype is that is allows testing of only one condition, part of a unit, etc.
    - 1.4. Path forward: investigation of alternatives (short/long term).
        - 1.4.1. NOAA Fisheries does not concur with the proposed path forward. Fredricks wants NWP to cut flows so that when the unit runs at 17K flows up the gatewell are equivalent to running the unit at 15K.
        - 1.4.2. Bettin asked about modifying one of the existing turning veins as a prototype. Once modified it would be allowed to be used in a slot and not returned to previous shape. NOAA was not opposed to this alternative. .
        - **1.4.3. After further conversation, NOAA, CRITFC and BPA agreed with the reassessment of alternatives.**

2. B2 Trashrake. Filan went through a powerpoint presentation. He provided a background on the project and explained why the new Trashrake built in 2004 was never put in service. He also discussed that their findings were that the project was not using the trashrake on a regular basis. . Lorz questioned if there would be funding for dredging. Mackey explained dredging has been classified as a routine maintenance activity and it has been added to the Fish Passage Plan as a required activity. There were concerns voiced by many that the O&M fund was already spread too thin.
    - 2.1. Review/discussion of VE report. **ACTION:** Rerecich will send the report to attendees.
    - 2.2. Path forward. Filan presented the DDR recommendations. Fredricks recommended make the cleaning teeth changeable in the event the trashracks are replaced with lamprey spacing. Everyone seemed to be comfortable with the plan to move forward with the DDR recommendations. The recommendations for BON to rake on a regular basis and to do a survey annually to determine if dredging is needed, will be included in the 2014 Fish Passage Plan.

Meeting Minutes

Project: Bonneville Powerhouse II Fish Guidance Efficiency
Purpose: Involve NMFS at PDT level and agree upon approach to achieving project objective
Date: 11/25/13, 9:00 am
Location: RDP 3rd Floor – Conference Room 3B
Minutes By: Seth Stevens (11/27/13)

Attendees:

☒ George Medina
☒ Laurie Ebner
☒ Randy Lee
☒ Amy Lynn
☒ Gary Henrie
☒ Jon Rerecich
☒ Seth Stevens
☒ Gary Fredricks
☒ Ed Meyer
☒ Trevor Conder (called in)

1. The project objective from the NOAA PDT members' perspective is to reduce the flow up the gatewells during high unit flows (>15k cfs). The localized areas of high velocity ("hot-spots") observed on the VBS are not necessarily a biological problem, and are a separate issue from the current objective. It should be noted that a reduction in unit flow could detrimentally impact turbine passed fish survival at lower flows. NOAA was willing to accept this potential risk in the short term to offset the known gatewell mortality levels.

2. NOAA's design criteria for the project consists of the following:
   a. At 15k cfs, fish survival is good; therefore, the maximum flow through the gatewells at high unit flows (>15k cfs) should not exceed the flow that exists with the current configuration when the unit flow is 15k cfs.
   b. Reducing FGE to achieve criteria a) above is okay; there is no minimum FGE flow requirement.
   c. Addressing the "hot-spots" on the VBS is not currently a concern of NOAA's, so localized velocities > 1.0 ft/s are acceptable if criteria a) above is met.

3. Discussion of model tools - CFD vs. physical model: NOAA supported use of the CFD if the USACE engineers say it can be used to compare flow control alternatives and reduction in the gatewell flow per criteria in 2.a.

4. The existing CFD model was calibrated to the physical model, which does not predict the exact performance of the gatewell as compared to field data, but USACE believes the CFD will be able to provide a relative comparison of flows for the design alternatives.

5. USACE is attempting to calibrate the CFD model using field data collected in the spring of 2013, and would like to collect additional field data in the spring of 2014 with the hope of providing for a more robust calibration. A CFD model calibrated to the field data would be a better analysis tool, providing more realistic alternatives to assist more effective decision making.

6. The CFD model will serve as the preliminary design tool to conduct a relative comparison between 3-4 flow control design alternatives. The selected alternative will be prototyped and field tested, both hydraulically and biologically.

7. NOAA's list of alternatives to be modeled is a follows:
   a. Install solid plate flow control device downstream of VBS
   b. Remove gap closure device
   c. Raise the STS and turning vane
   d. Modify turning vane

8. The goal for both USACE is to have the preferred alternative prototype tested in the spring of 2015.

9. NOAA is uncertain about modifications to the gap closure device and turning vane as potential corrections. NOAA requested USACE build and test a flow control device consisting of a solid plate mounted downstream of the VBS on the gatewell beam at elevation 31.0'.

10. USACE will provide NOAA with a plan for review for data collection in the spring of 2014. HD indicated we are currently unable to field measure gross flow up the gatewell at Bonneville. In general, USACE would like to collect velocity data at low and high unit flows (18k cfs) on the VBS panels in the A and C slots of Units 14 or 15 with the following gatewell configurations:
    a. Existing Conditions
    b. VBS panels 8 and 9 (upper two rows) completely blocked with a solid plate
    c. STSs and turning vanes removed from all three slots

11. NOAA commented that it is not likely that removing the STSs during May will be allowed.

12. NOAA commented that a possible window for pulling the STSs would be after the corner collector is operating (March 17), but before the Spring Creek release arrives at Bonneville (April 10). USACE expressed concern that the high unit flows needed for model calibration (18k cfs) might not be achievable during this time frame.

13. In parallel with pursuing a design to reduce gatewell flow, USACE will attempt to develop a design to correct the "hot-spots" on the VBS as long as it doesn't delay the design to reduce gatewell flow.

Action Items:

1. Jon to confirm that report for the spring of 2013 velocity data collection has been uploaded, and provide link to NOAA. *Completed on 11/25*
2. Jon will get unit outage schedule. *Completed on 11/25*
3. USACE will lay out the parallel investigation for flow control and FY14 testing.
4. USACE will provide NOAA with the plan for velocity data collection in spring of 2014.
5. Jon will coordinate scheduling with FFDRWG and FPOM.

CENWP-PM-E 13 August 2014

MEMORANDUM FOR THE RECORD

Subject: Final minutes for the 13 August 2014 FFDRWG meeting.

The meeting was held in NWP RDP 3rd Floor Meeting Room, Portland OR. In attendance:

Last	First	Agency	Office/Mobile	Email
Absolon	Randy	NOAA Fisheries		
Bettin	Scott	BPA		swbettin@bpa.gov
Conder	Trevor	NOAA Fisheries		Trevor.conder@noaa.gov
Duyck	Pat	USACE-NWP		Patrick.L.Duyck@usace.army.mil
Eppard	Brad	CENWP-PM-E		Matthew.b.eppard@usace.army.mil
Fredricks	Gary	NOAA Fisheries	503-231-6855	Gary.fredricks@noaa.gov
Hausmann	Ben	NWP-BON		Ben.j.hausmann@usace.army.mil
Keller	Paul	NWP-TDA		Paul.j.keller@usace.army.mil
Lut	Agnes	BPA		axlut@bpa.gov
Lorz	Tom	CRITFC		lort@critfc.org
Mackey	Tammy	CENWP-OD-TF	503-961-5733	Tammy.m.mackey@usace.army.mil
Medina	George	USACE-NWP	503-808-4753	George.J.Medina@usace.army.mil
Meyer	Ed	NOAA Fisheries		Ed.meyer@noaa.gov
Rerecich	Jon	CENWP-PM-E	541-374-7984	Jonathan.g.rerecich@usace.army.mil
Richards	Natalie	USACE-NWP	503-808-4755	Natalie.A.Richards@usace.army.mil
Royer	Ida	CENWP-OD-B		Ida.m.royer@usace.army.mil
Scott	Shane	NWPPC		shane@rainiercorp.com
Stevens	Seth	NWP		Seth.T.Stevens@usace.army.mil
Tackley	Sean	PM-E		Sean.C.Tackley@usace.army.mil
Traylor	Andrew	CENWP-OD-TF		Andrew.w.traylor@usace.army.mil
Wertheimer	Bob	PM-E		Robert.H.Wertheimer@usace.army.mil
Wright	Lisa	RCC		Lisa.S.wright@usace.army.mil
Wills	David	USFWS		David_Wills@fws.gov
Van Dyke	Erick	ODFW		Erick.s.vandyke@state.or.us
Zorich	Nathan	NWP-FFU		Nathan.a.zorich@usace.army.mil

Absolon, Keller, Lut, Richards, Scott, Wills, Zorich, called in.

Meeting documents may be found at http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/FFDRWG/FFDRWG.html

1. **Final Actions or recommendations from the 13 August 2014 NWP FFDRWG.**
   - 1.1. February 2014 meeting minutes were finalized.
   - 1.2. BON FGE alternatives. **FFDRWG gave concurrence to move forward with further investigations in the alternatives but they want the data and details to look at more in-depth.**
   - 1.3. Lamprey Minor Fishway Modifications. FFDRWG expressed concern with the loss of entrance weir depth. **The weir caps cannot affect the ability for the entrances to meet FPP depth criteria.**
   - 1.4. BON AFF Mods. **FFDRWG agreed that the mods made over the winter appear to have helped with mortality.** Right now the question is whether or not the release pipes should be reattached. Rerecich needs to have a decision by early fall.

Fredricks said he wouldn't worry about putting them back on right away. He said don't throw them away but no need to rush to re-attach. **FFDRWG would like to see the rest of the data before making that decision.**

1.5. Next FFDRWG may be January 2015.

2. Action Items

2.1. Completed items from 6 February 2014.

- **2.1.1.** BON FGE. Ebner said she will lay out a schedule as the season progresses and we have a better idea of what flows might look like. ***STATUS: completed.***
- **2.1.2.** BON FGE. Rerecich will update the MOC and send it to FPOM again. ***STATUS: completed.***
- **2.1.3.** JDA-S expansion joint repairs. Richards will send details and photos to Mackey for inclusion in the FPOM agenda. ***STATUS: completed.***
- **2.1.4.** BON AFF. Rerecich will set up a special NWP FFDRWG AFF meeting. ***STATUS: completed.***
- **2.1.5.** JDA Adult PIT. Eppard will schedule a conference call/meeting with NOAA Fisheries, NWP, and NWD to further discuss. ***STATUS: discussion moved to SCT.***

2.2. Outstanding action items from 6 February 2014.

- **2.2.1.** BON survival. NWP will put together some meetings to focus on the path forward for BON. The meeting will likely be in the March/April timeframe. Fredricks requested this be a COP discussion. ***STATUS:*** *Fredricks asked about the schedule. Tackley and Rerecich deferred to Eppard. Eppard will return to PM-E soon. Fredricks stressed the need to have a meeting sooner rather than later. PM-E will set up a meeting in September 2014.*

2.3. New items from 13 August 2014.

- **2.3.1.** **BON FGE.** Stevens will provide Rerecich cleaned up data by the end of next week. Rerecich will send it to FFDRWG. A draft report will be available soon.
- **2.3.2.** **BON FGE.** Rerecich will schedule a special FFDRWG once the cleaned-up data has been received and reviewed.
- **2.3.3.** **Lamprey. WS LFS AWS.** Tackley will ask a hydraulic engineer (Schlenker or Askelson) to attend the next NWP FFDRWG to go through the conditions in the area.
- **2.3.4.** **Lamprey. LPS development.** Tackley will schedule a meeting later.
- **2.3.5.** **JSATS.** Eppard will send an email with the information for accessing the website.
- **2.3.6.** **TDA AWS.** Rerecich will send the DDR out again.

3. B2-FGE (Medina/Stevens/ Rerecich)

3.1. Review/discussion of 2014 Hydraulic results. Stevens gave a .ppt presentation. The slides will be available at http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/FFDRWG/2014%20August%20FFDRWG/

3.2. Stevens showed the velocity data from the 2013 field data and the CFD model at 15kcfs (mid-range). Meyer questioned if the CFD data replicated the field data. The graphs looked different. Stevens explained that the scales are different and the colors are a little different but the hot spots show up in the same places. The view from the field data is looking into the VBS, the CFD is from the VBS into the gatewell. Rerecich explained that data is collected from Unit 14 and Unit 15 because they provide the best comparison between units since the flow is more direct into the units. 2013 data goes as high as 17kcfs. 2014 data is the first 18kcfs data collected. Stevens walked through more slides showing velocity and turbulence at baseline 15 and 18 kcfs, plate at 50% and 18 kcfs. No field data on the 25% plate.

3.3. Alternatives evaluation and recommendation for DDR. Stevens explained the flow control plate is recommended as the primary flow control method. He noted the different slots may have different methods. Along with the plate, there may need to be a modified TRD to address turbulence. He also said the team may investigate modifying upper panels on the VBS to reduce/eliminate hot-spots. Fredricks said the plate would need to be between 25-50%. He also recommended dumping the TRD. The team recognized the need to modify the TRD to be less labor intensive. Meyer asked how the team would determine if the C-slot needed a plate or not. Rerecich and Stevens explained the goal for A-slot and suggested if C-slot had similar conditions without a plate, then a plate wouldn't be needed. Meyer asked which slot was biologically tested. Rerecich explained the history of the testing and how the C-slot doesn't look as turbulent as the A-slot. There is a trade-off between flow control and guidance. He said he would like to preserve as much guidance as possible so if the C-slot doesn't need to be treated, there may not be a need to go to that expense and effort. C-slot field data has not yet been evaluated. Medina asked for concurrence from the Region to further investigate the proposed alternatives. He said the team would like to get something ready for testing in 2015. Fredricks asked for the data and a direct comparison between field data and CFD data. Stevens said he will clean up the field data and make that available to everyone. **ACTION:** Stevens will provide Rerecich cleaned up data by the end of next week. A draft report will be available soon. Conder asked if there is a linear relationship between guidance and flow control. Fredricks said we can get good guidance when screens are pulled. Rerecich suggested maybe we don't guide as well at high flows regardless. He said an unknown is how much will be lost through the gap if flow is restricted. Stevens provided some paper plots for Lorz and Fredricks to review. Stevens said the physical models were used to calibrate the CFDs but due to some issues, the team has relied more on field data. Lorz said he believes we may be on the right path but it appears to be a bit of a stab in dim light. Fredricks said the other option is to go after the VBS but we don't have that kind of time now. **FFDRWG gave concurrence to move forward with further investigations in the alternatives but they want the data and details to look at more in-depth. ACTION:** Rerecich will schedule a special FFDRWG in the fall.

3.4. Bettin asked if there is money for this. Does SCT need to provide more funds or are there funds still available. Medina said he thinks he has the funds but he will confirm that towards the end of the FY. Rerecich said he would love to put fish through a C-slot but with the trashracks available, it likely isn't feasible. Fredricks said Spring Creek fish has been the worse-case scenario. He suggested potentially testing with Spring Creek fish and not testing run of the river (ROR) fish. This would save costs and maybe time. Rerecich said he likes the descaling data from the ROR fish. Rerecich said the TRD testing appeared to show that mortality wasn't significant enough to continue on with ROR fish. FFDRWG agreed that C-slot testing is needed but there isn't a good option for doing that in 2015.

4. Lamprey Passage Projects. Update forms are available on the website.

4.1. Bonneville WA Shore Lamprey Flume System – Entrained Air (Tackley). Tackley talked through the update form. Bettin asked if the work will require a powerhouse outage. Tackley said he didn't know. The work won't be completed until 2016-17. One potential fix may be installing baffles in the AWS pipes. Bettin asked how many years the structure will be tested. Tackley figured the testing would continue through 2018 due to the hurdles encountered. Bettin asked what success looks like. Fredricks said the first thing is to get the system up to capacity flow. Tackley said a number that equals success hasn't been decided. He said that discussion will come into play with the extension of the system up to the forebay. Bettin asked if we shouldn't turn off the LFS for a couple of years until the fix can be made. Lorz said he is getting push back from the Tribes. They want to know why we haven't tested to see if the bubbles are even causing a problem for salmon. Fredricks said he isn't willing to allow greater than 50% AWS flow. He said he might change his mind if he knew what was occurring under the water. Bettin asked if there is a way to take video of the area to see what is happening. Meyer said if the bubbles are all the same size, it would be easy. We don't know if the bubbles are changing before they reach the surface. **ACTION:** Have a hydraulic engineer at the next NWP FFDRWG to go through the conditions in the area. Bettin asked if there is any value in shutting down the LFS in September, with the peak of the fall Chinook run. There was not a conclusion answer to this. Lorz and Conder suggested there may be a possibility of doing something in 2015-16 if the IHR testing doesn't go forward. After a glare from Mackey, Lorz clarified that he would be supportive if it was a really simple installation that takes only a day or two.

4.2. Lamprey Minor Fishway Modifications (Saldaña/Wilcox/Tackley). MOC 14BON54 received concurrence so the lamprey plating will be installed during winter maintenance. Weir caps will be fabricated and installed by BON. Welton is in the process of designing the caps. FFDRWG will have a chance to review the design prior to installation. Meyer asked about the height of the caps and noted that the WS entrance weirs often bottom out at low flows. He suggested putting them on the back or sides. FFDRWG expressed concern with the loss of entrance weir depth. **FFDRWG said the weir caps cannot affect the ability of the entrances to meet FPP depth criteria.**

4.3. Lamprey Passage Structure (LPS) Development (Saldaña/Stevens/Tackley). An overview photo is available on the website. Tackley talked through the construction schedule for BON. JDA-N would occur in 2017-18. Tackley said we will need to have a discussion about what would be acceptable as far as ramps and orifices. Tackley suggested a site visit to discuss concerns; this wouldn't occur until a concept is available to look at first. **ACTION:** Tackley will schedule a meeting later.

5. **JSATS.** Eppard reported that the JSATS website is up. If you want to access it, you need to register to get a username and password. Access is restricted by Eppard but the data is managed by University of Washington. Finalized data is available; this goes up to 2012 for NWP. NWW may have 2013 available. Eppard added that when you register you have to specify what information you want access to. He said this is a database where you can access the data but it will not query for you. **ACTION:** Eppard will send an email with the information for accessing the website. Fredricks asked what information would be available. Eppard thought river conditions when the fish passed would be available.

6. **The Dalles East Adult Fish Ladder AWS Backup System** (Duyck/Rerecich). Duyck provided an update. Duyck took over the PDT from Medina in May 2014. He talked through the schedule for the plans and specs. He anticipates contract and award by the end of FY15.

Duyck noted there are a number of dam safety concerns. Key issues include air entrainment, cofferdam, and construction sequence. More information and details will be provided as the plans and specs progress. FFDRWG will be kept abreast of these details. Lorz asked if lamprey have been considered. Bettin asked if the DDR has been sent out. **ACTION:** Rerecich will send the DDR out again.

7. **John Day North Ladder Improvements** (Richards/Boag/Welton/Tackley). Richards reported she is still working on getting the pump issue straightened out. It appears to be a design flaw. JDA is working on getting the plates on the VWW replaced. Conder asked what the issue is with the pumps and how long it will last. Richards reported pump #4 has failed and is in pieces. NWP will bring in a third party to get an objective analysis of why the pump has failed. It is the fifth failed pump. Right now we have five pumps in service and they appear to be working fine, however, there has been no warning before any of the previous pumps catastrophically fail. No action may be taken until the third party investigation is completed. Whatever is the issue, it appears to be systemic of all six pumps.

8. **B2 Fish Unit Trash Rake** (Stricklin/Filan/Rerecich). Rerecich reported that there was a hiccup in getting the ROV inspection on 5 August. The rake is being modified now. Rerecich showed a photo of the plate being modified to hold the brushes. FFDRWG made comments on the rake appearance. Doubt was expressed by many in attendance. The rake will be tested in the 2015 debris season. The FPP language has already been changed to restrict the floating option by BON. Lorz will propose some data collection ideas so the effectiveness of the rake may be evaluated. Van Dyke asked about the delays associated with these rake mods. Rerecich said the delay occurred in Contracting and that has pushed everything else back and could delay testing until this fall or possibly as late as March 2015.

9. **Bonneville Adult Fish Facility Mods** (Ament/Sipe/Schlenker/Rerecich). Rerecich gave a brief rundown of the recent mods. Shad season went much better in 2014 than in 2013. New sensors are getting installed so the water elevation with valve 15 at 20% doesn't trip the high water alarm in the control room. He then presented the differences in mortality numbers between 2013 and 2014. The spreadsheet will be available on the website. **FFDRWG agreed that the mods made over the winter appear to have helped with mortality.** Rerecich presented the spreadsheet he and Traylor developed that show the number of morts by species and by percent of the run. 2012 has not yet been entered into the spreadsheet but will. Right now the question is whether or not the release pipes should be reattached. Rerecich needs to have a decision by early fall. Fredricks said he wouldn't worry about putting them back on right away. He said don't throw them away but no need to rush to re-attach. **FFDRWG would like to see the rest of the data before making that decision.**
    - **9.1.** Lamprey in the trashracks. BON and PM-E are looking at providing plating to help lamprey out of the Valve 15 trashrack area. The flows are high enough that it would be difficult for lamprey to get out of that area once they are in there.

10. **Updates provided in the update forms, which may be found at** http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/FFDRWG/FFDRWG.html**.**
    - **10.1. Turbine Survival Program** (Medina/Rerecich).
    - **10.2. The Dalles Spillwall** (Ament).
    - **10.3. Bonneville Spillway - Stilling Basin Erosion** (Cutts/Ebner). Fredricks talked about scheduling another FFDRWG to discuss the Performance Test results and what needs to happen next. Rerecich said there is a new PDT that will look at major rehab for everything not in the powerhouse.

CENWP-PM-E 27 October 2014

MEMORANDUM FOR THE RECORD

Subject: DRAFT minutes for the 27 October 2014 FFDRWG meeting.

The meeting was held in NWP RDP 3rd Floor Meeting Room, Portland OR. In attendance:

Last	First	Agency	Office/Mobile	Email
Baus	Doug	RCC		Douglas.m.baus@usace.army.mil
Bettin	Scott	BPA		swbettin@bpa.gov
Ebner	Laurie	USACE-NWP		Laurie.l.ebner@usace.army.mil
Eppard	Brad	CENWP-PM-E		Matthew.b.eppard@usace.army.mil
Fredricks	Gary	NOAA Fisheries	503-231-6855	Gary.fredricks@noaa.gov
Lorz	Tom	CRITFC		lort@critfc.org
Mackey	Tammy	CENWP-OD-TF	503-961-5733	Tammy.m.mackey@usace.army.mil
Medina	George	USACE-NWP	503-808-4753	George.J.Medina@usace.army.mil
Meyer	Ed	NOAA Fisheries		Ed.meyer@noaa.gov
Rerecich	Jon	CENWP-PM-E	541-374-7984	Jonathan.g.rerecich@usace.army.mil
Royer	Ida	CENWP-OD-B		Ida.m.royer@usace.army.mil
Stevens	Seth	NWP		Seth.t.stevens@usace.army.mil
Wills	David	USFWS		David_wills@fws.gov
Wright	Lisa	RCC		Lisa.s.wright@usace.army.mil

Bettin, and Royer called in.

All documents may be found at http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/FFDRWG/FFDRWG.html

1. Final Actions or recommendations from the 27 October2014 NWP FFDRWG.

  1.1.

2. Action items from 27 October2014.

  2.1. ACTION: Rerecich will follow up with fish numbers needed for the biological testing. He will coordinate with Wills.

  2.2. ACTION: Wills will investigate getting the numbers of fish needed and keeping them at the desired size.

  2.3. ACTION: Rerecich will update the proposal and send it to SRWG. He will include the timing and size of fish.

3. BON FGE alternatives. FFDRWG gave concurrence to move forward with further investigations in the alternatives but they want the data and details to look at more in-depth. Rerecich went through the history of this project. Fredricks said this project has gone on too long. Ebner said the PDT wants to install plates in B slot, which will be different from A-slot. The biological test should occur in all three slots. Ebner felt there is a good solution for A-slot, B-slot has a different sized plate, and there is a belief there isn't a need for a plate in C-slot. Ebner further explained that there would be a need for the highest, constant Q for testing all three slots. This would fall in the May timeframe, right in the middle of fish passage season. NWP stressed the need to get measurements in all three slots (A, B, and C) under the same flow. Fredricks said he would like to see a biological test in B-slot. Ebner said she agrees but she wasn't sure we could get enough fish or have enough time to do that many tests this year. Fredricks asked if FY16 implementation is reasonable. Stevens and Ebner said Plans and Specs should be a quick turnaround. The challenge will be laying out a schedule for implementation. The unit will need to be dewatered and modified. Fredricks expects it would take years. Ebner said it won't be quite that bad. Fredricks said the issue isn't the fish side since we have an operation that works, we don't run the units at the upper end, and can continue until all units have been modified. Bettin noted that delay in implementation is a problem for BPA. Ebner said she believes the coordination for implementation will be the hardest part.

- **3.1.** Medina asked for concurrence that C-slot will not have a plate, but it will be biologically tested. Fredricks concurred but said he wants that option laid out in the DDR.
- **3.2.** Stevens said for FY15 we are putting a plate in 15 B-slot; Doing hydraulic testing in A, B, and C; Doing biological testing in A and C slots. VBS porosity plates will be modified for A, B, and C slots.
- **3.3.** A-slot plate will remain in place, but will eventually be replaced with stainless steel. B-slot will have a stainless steel plate installed. Rerecich clarified that A and C slots may not be biologically tested at the same time. Bettin asked if the unit will be available with the entire operating range in 2015 when it's not being tested and the answer was yes.
- **3.4.** **ACTION:** Rerecich will follow up with fish numbers needed for the biological testing. He will send that out to SRWG. Lorz asked about lamprey testing. Rerecich said there are no plans for lamprey testing, however, any changes to the gatewell that benefit salmon, should benefit lamprey.
- **3.5.** Baus asked if testing would occur for four weeks. Rerecich said yes, testing will occur during the month of April. Baus asked if the fish or the water is driving the test timing. Wills said in FY14, the test occurred prior to the normal Spring Creek spring releases. If the goal is to have the test period occur between the spring releases, getting little fish will take some additional planning. Getting larger fish may not be as difficult to obtain. Wills said fish may be held but maybe not on the hatchery grounds. Rerecich said it is important to target the high flow for C-slot and the best time to get that would be in mid – late May. Fredricks expressed concern about two different tests with different fish and different flows. Ebner said we can get the hydraulic conditions in April and we can definitely get it in May. Fredricks asked that all of the details are laid.
- **3.6.** **ACTION:** Wills will investigate getting the numbers of fish needed and keeping them at the desired size.
- **3.7.** Wills asked if there will be a table for flow through the slots with the plates installed. Ebner pulled up the baseline conditions for the VBS in the 14A-slot. There is a hot spot and it would be easy enough to correct. Fredricks would agree but doesn't want to see the plate work de-railed. Ebner said the porosity through the VBS will be worked on concurrently as the plate installation. Fredricks asked for a reminder as to where we are with the porosity plates. Ebner said in FY14, the test had solid porosity plates. That appeared to work ok. In FY15, the porosity will be tested in all three slots. Fredricks said he would like to see a design for the VBS porosity plates. Bettin asked if the VBS porosity plates increase the cost significantly. Stevens and Ebner said these changes are fairly minor and the Project will help with the work.
- **3.8.** Stevens asked if there was a possibility of getting hydraulic testing completed in May. Lorz and Fredricks discussed the potential for this. Bettin asked if June would be a possibility, when there are larger and fewer fish in the gatewells. The testing schedule would mimic the FY14 schedule. This would result in two hydraulic tests – one in March and one in June. Ebner explained the need to know the hydraulics in

B-slot prior to putting fish through the unit. June testing will require about four days of testing. This will be planned for 1 – 4 June to avoid impacts to the Little White Salmon releases in mid-June.

4. BON FGE Review of FFDRWG supplemental EDR.

4.1. Comments are due tomorrow. Fredricks has his comments started. He noted that many of his comments note that this project has taken a very long time and didn't utilize the physical model. Ebner, Medina, and Rerecich challenged that a wee bit saying this was a group effort and everything that is at the Project now was based on a physical model. Rerecich decided, since the Region was being so kind, to give a few extra days for comments. Ebner said she really needs to know if there are substantial comments sooner rather than later. FFDRWG didn't have any comments that might change the course of action. Everyone agreed we have a path forward.

4.2. A-slot plate blocks about 50% of the opening. B-slot will block about 25% of the opening. Ebner noted that the bolt pattern used in the A-slot was recommended for the B-slot so a larger plate could be used if needed.

4.3. Fredricks asked that the proposal be updated and sent out for review. **ACTION:** Rerecich will coordinate with NOAA Pasco and USFWS to update the proposal and send it to SRWG. ~~He~~ The proposal will include the timing and size of fish.

5. BON Orifices. Fredricks brought up the orifice project and asked for an update. Medina said there is an ATR review in progress. The ATR is reviewing the EDR and NWP is working on responding to comments from the ATR. Fredricks noted that this project has been in the works for a long time. Rerecich said his workload has been such that he wasn't able to prioritize orifices over FGE. Medina added that he hasn't budgeted for the Orifice PDT. Fredricks asked that this project get back on track so we can resolve it one way or another.

October 29, 2014

FILE MEMORANDUM

FROM: Gary Fredricks and Ed Meyer, NOAA Fisheries

SUBJECT: Bonneville FGE Post-construction 90% Supplemental EDR Review

We received the Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Program Post-construction supplement to the Engineering Documentation Report (EDR) 90% daft report for review on October 14, 2014. We have the following comments:

General comment: We are encouraged to see that the Corps has settled on recommending the flow control plate alternative for evaluation in resolving the fish condition and mortality issue at the Bonneville Dam Second Powerhouse bypass. This approach was shown to be promising at McNary Dam in the late 1990's and we agree that it is likely the best approach for the Bonneville Dam Second Powerhouse gatewell issue. Our one recommendation would be that Alternative A5 (VBS Porosity) should be mentioned in the conclusion and recommendation section since this issue is discussed in several sections of the EDR and Section 4.1.5., mentions that it will be carried forward for further consideration in the DDR.

Specific comments on Section 4.4., Biological Considerations:

1. Overall the execution of this section is somewhat unclear. Since there is no apparent attempt to model the specific loss of FGE for the various alternatives and what this means to project survival, we would recommend simply displaying a table of past study results (not just 2010 and 2011) of B2 JBS vs B2 Turbine survival (see table below). A following statement should be made regarding how the PDT used this comparative loss in FGE to rank alternatives.
2. We see little value in the TSP discussion since the link to this and the decision making process is not made clear.
3. The last bullet in section 4.4., regarding loss to FGE is unclear. For example, during low flow years, the constant spill level at this project would actually reduce B2 JBS passage fraction, not maximize it.

As a final general comment, we continue to believe that the pace of this project could have been improved if the Corps had approached design development with a physical model. The CFD approach appears to have not worked well (particularly in the case of the slot fillers). This is not particularly because of any fault with the CFD model itself, but because of the basic fact that this approach does not lend itself well to blending the biological and hydraulic expertise available in the region. If the flow control plate alternative recommended by this EDR does not prove up biologically, we recommend the Corps step back and reconsider the use of a physical model.

As a result of the October 27, 2014, Special FFDRWG meeting regarding this supplemental EDR, we understand the following:

1. Flow control plates will be in place in gatewells 15A and B for evaluation in spring 2015.
2. Gatewells 15A and 15C will be biologically evaluated in spring 2015 using fish from the Spring Creek National Fish Hatchery.
3. Gatewell 15B will not be evaluated biologically but the hydraulics will be assessed in 2015. Special high unit flow operations may be necessary to achieve this and will be specifically coordinated through the standard coordination process.
4. The results of these tests will be assessed and if favorable, plans and specifications will be prepared for full installation in the Second Powerhouse. NOAA anticipates that if all works favorably, full installation should be completed by 2018.

Please contact Gary Fredricks at (503) 231-6855 to discuss any of these comments. Thank you for the opportunity to comment.

B2 turbine and JBS survivals for all years we have data (RT and JSATS Studies).			
	B2 Turbine		B2 JBS
Chinook	Survival		Survival
2001	0.929		0.962
2004	0.951		0.97
2005	0.965		1.008
2008	0.979		1.017
2009	0.946		0.975
2010	0.957		0.981
2011	0.947		0.982
Steelhead			
2004	0.889		0.951
2005	0.868		0.956
2008	0.982		0.984
2009	0.946		0.964
2010	0.911		0.978
2011	0.919		0.94
Overall Average	0.937615		0.974462

APPENDIX B

Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Computational Fluid Dynamics Modeling Report for the Supplement to the EDR, November 2014

US Army Corps of Engineers®
Portland District

Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Computational Fluid Dynamics (CFD) Modeling Report for the Supplement to the EDR Report

Bonneville Lock and Dam

November 2014 Final Report

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APPENDICES

Appendix A Calculations for Theoretical Porosity Coefficients
Appendix B Quality Control Documentation

ABBREVIATIONS AND ACRONYMS

3D	three-dimensional
B2CC	Bonneville second powerhouse corner collector
CAD	computer-aided design
CFD	computational fluid dynamics
cfs	cubic feet per second
DSM	downstream migrant transportation
EDR	Engineering Documentation Report
FGE	fish guidance efficiency
ft/s	feet per second
ft^2/s^2	square feet per second squared
JBS	juvenile bypass system
kg/s	kilograms per second
NOAA	National Oceanic and Atmospheric Administration
PNNL	Pacific Northwest National Laboratory
STS	submerged traveling screen
TIE	turbine intake extension
TRD	turbulence reduction device
UMT	upstream migrant transportation
USACE	U.S. Army Corps of Engineers
VBS	vertical barrier screen

1. INTRODUCTION

1.1. BACKGROUND

In 1999, regional fisheries agencies agreed to pursue a phased approach to improve fish guidance and survival at Bonneville Dam PH2 by maximizing flow up the turbine intake gatewells, a guideline that has been used on similar programs to improve FGE. Typical juvenile fish bypass systems at lower Columbia River dams consist of submerged traveling screen (STS), gatewell orifice passage and turbine intake vertical barrier screens (VBS; Figure 1, Figure 2). The modifications at PH2 were completed in 2008 and included an increase in VBS flow area, installation of turning vanes to increase flow up the gatewell, addition of a gap closure device (GCD) to reduce fish loss at the STS, and allowances for the installation of an interchangeable VBS to allow for screen removal and cleaning without outages or intrusive gatewell dipping (Figure 3). Results of biological studies showed an increase in FGE by 21% for yearling Chinook and 31% for subyearling Chinook. Test fish conditions showed no problems with descaling and gatewell retention time (including fry) in a newly modified unit.

During the 2008 juvenile fish passage season, the SCNFH released hatchery subyearling Chinook salmon over a 3-month period (March, April, and May). Biological testing conducted by National Oceanic and Atmospheric Administration (NOAA) suggests that SCNFH subyearling Chinook salmon incurred high mortality and de-scaling when the newly modified units were operated at the upper 1% range (Gilbreath et al., 2012). Evidence suggests a relationship may exist between the operation of the powerhouse units (lower, mid, and upper 1%) and survival of the SCNFH subyearling Chinook salmon. A logical assumption would be that operating turbine units in the upper 1% range draws more water into the gatewell which creates a hydraulic environment there that is harmful to the fish. A detailed description of the lower, middle, and upper 1% turbine operating efficiency range can be found in the U.S. Army Corps of Engineers (USACE) Turbine Survival Program (TSP) Phase I and II Biological Index Testing (BIT) reports, as well as the current Fish Passage Plan (FPP).

In response to the results of the 2008 biological testing, the USACE developed preliminary alternatives for potentially reducing flow into the gatewells, and presented them to the regional fisheries agencies. The regional fisheries agencies agreed with the USACE analysis and approved the study to investigate and evaluate flow control and operational alternatives to increase juvenile salmon survival within the gatewells. The effort and results of that study are documented in *Engineering Documentation Report Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Program Post-Construction* (USACE, October 2013), referred to herein as the EDR.

The EDR evaluated both operational and structural alternatives to reduce juvenile salmon mortality and descaling in the gatewells. The operational alternatives included:

- Operate main turbine units at lower to mid 1% peak operating range during juvenile fish release.
- Open the second downstream migrant system gatewell orifice to decrease fish retention time in the gatewell.
- Construct a horizontal slot in place of the existing orifices or additional orifices to decrease fish retention time in the gatewell.

The structural alternatives considered included the following to reduce flow into the gatewell:

- Construct a device to control the flow up the gatewell. The device would be placed downstream of the VBS. Similar devices have been used at the John Day and McNary dams.
- Construct a sliding plate flow control device attached to the top of the gatewell beam.

- Modify the existing VBS perforated plates to result in a reduction of gatewell flow.
- Modify the turning vane and GCD.

One other structural alternative was considered that was not intended to reduce flow into the gatewell, but was intended to modify the flow pattern within the gatewell, resulting in a hydraulic environment that is less detrimental to juvenile salmon. This alternative, called a "gate slot filler" or "turbulence reduction device" (TRD), consists of solid members that are installed in the guide slots above the STS side frame to eliminate the sudden expansions that occur there. Computation fluid dynamics (CFD) modeling conducted as part of the EDR indicated that the sudden expansions above the STS side frame cause areas of flow circulation and high turbulence intensity. The CFD modeling conducted showed a reduction in flow circulation and turbulence intensity with the gate slot filler in place. It was hypothesized that the gate slot filler could improve juvenile salmon survival by improving the hydraulic environment within the gatewell by modifying flow patterns and reducing turbulence intensity. Additional benefits of this alternative were that the operating range of the turbines would not be affected, and that the existing fish guidance flow into the gatewells could be maintained. All of the other alternatives considered required either a reduction in turbine operating range, or a reduction in fish guidance flow into the gatewells.

The EDR recommended that a gate slot filler prototype be constructed and tested, both hydraulically and biologically. The EDR also recommended that the other alternatives in the report be reconsidered if the prototype did not result in satisfactory improvements in juvenile salmon survival within the gatewell.

A gate slot filler prototype was constructed and tested for biologic and hydraulic performance (Harbor and Alden 2013; Gilbreath et al. 2014) during the spring of 2013. The results of the testing indicated that the prototype did not lead to adequate improvements in juvenile salmon survival within the gatewell (Gilbreath et al. 2014). In addition, the results of the hydraulic testing demonstrated hydraulic conditions within the gatewell that were previously unknown and not predicted CFD model that was used to evaluate alternatives as part of the EDR. The unsatisfactory performance of the gate slot filler, along with the new hydraulic data, prompted the need for further study, which resulted in the CFD modeling effort documented herein.

1.2. OBJECTIVES

The USACE Portland District Hydraulic and Coastal Design Section carried out a modeling study to meet the following objectives:

1. Re-calibrate the CFD model to more accurately reflect the flow patterns observed in the 2013 field data collected by Harbor and Alden 2013.

2. Apply the re-calibrated model to characterize baseline hydraulic conditions in the B2 gatewells, including velocities, turbulence intensity, flow patterns, and flows for a range of turbine operating conditions.

3. Apply the re-calibrated model to support alternatives analysis for the Supplement to the EDR Bonneville Second Powerhouse Fish Guidance Efficiency (FGE) Program Post-construction.

2. CFD MODEL DEVELOPMENT

The CFD model used to evaluate alternatives as part of the EDR (USACE 2013) is a sectional model of a single powerhouse unit and was calibrated to data from a 1:12 physical model as there was no usable field data available at the time of the model development. Subsequent to the calibration of the model, velocity data was collected in gatewells at PH2 in the spring of 2013 (Harbor and Alden 2013) as part of the evaluation of the gate slot filler prototype recommended in the EDR (USACE 2013). The velocity data indicated flow patterns on the upstream side of the VBSs that had not previously been demonstrated by the 1:12 physical model or field testing. In particular, the 2013 data showed areas of high velocity, or “hot spots”, on the upper portion of the VBS panels for the medium (15.1 kcfs) and high (17.0 kcfs) unit flows.

Since CFD model used to evaluate alternatives as part of the EDR was calibrated to the 1:12 physical model data, it was also not predicting flow patterns similar to those indicated by the 2013 field data. It was decided that the 2013 field data was more indicative of the actual hydraulic conditions within the gatewells than the 1:12 physical model, and that the CFD model should be re-calibrated to the field data prior to using it to further evaluate alternatives.

As a general rule when evaluating results from a CFD simulation, the reviewer should consider the following. The hydraulic conditions within the gatewells are very dynamic in reality as well as in the CFD model. Depending on which model iteration data is obtained from, the velocities and flow patterns can change significantly. The CFD model was constructed with the intent of providing relative comparisons of gatewell hydraulic conditions between modeled improvement alternatives and modeled baseline conditions, and not with the intent to provide highly accurate representations of actual existing or future gatewell hydraulic conditions.

2.1. MODEL GEOMETRY MODIFICATIONS

As part of the modeling effort, the geometries of the significant features within the gatewells in the CFD model were compared to record drawings and field measurements. In general, the geometries of the concrete features, VBSs, and gap closure devices in the model were consistent with the record drawings and field measurements, but a few of the other features within the model were adjusted to more closely resemble the record drawings and field measurements.

The clear distance between the downstream vertical edge of the gatewell beam and the upstream vertical edge of the intake gate flange was 36-1/2” in the CFD model. The record drawings indicate that this distance should be 39-7/8”, and a field measurement confirmed the dimension obtained from the record drawings. The geometry of the intake gate flange in the CFD model was revised to reflect the clearance indicated on the record drawings. Increasing the clear space between the gatewell beam and the intake gate likely resulted in increased flow into the gatewells and through the VBS for a given turbine unit flow.

The turning vanes in the model were adjusted to reflect the record drawings and field measurements. The turning vanes were lowered approximately 8.0” and moved downstream approximately 4.7”. Repositioning the turning vanes in the model likely affected flow patterns within the gatewells, and likely resulted in increased flow into the gatewells and through the VBS for a given turbine unit flow.

Several changes were made to the STSs in the CFD model as a result of inspecting the record drawings and field measurements. The upstream ends of the screens were lowered approximately 4.9” and were moved downstream approximately 4.9”. The angles of the STSs were revised slightly from approximately 25.0° (measured from horizontal) to approximately 27.7°. The screen lengths were changed from 20.0’ to 20.5’. In addition, the internal frame geometries were revised to more accurately reflect the record drawings. It is likely that all of these changes to the STSs in the model resulted in increased flows into the gatewells and through the VBS for a given turbine unit flow. In particular, moving the STSs reduced the clear distances between the screens and the gap closures devices from approximately 13.2” to 7.4”. Lastly, the tops of the outer frames of the STSs were raised by 2.7’. This change affects where the sudden expansions into the gate slots occur and most likely affects the flow patterns within the gatewells.

Table 2-1. Record Drawings Referenced in Verification of Model Geometry

Structure	Documents
Intake Concrete	BDP-1-4-2/1, BDP-1-4-2/51, BDP-1-4-2/53, BDP-1-4-2/63, BDP-1-4-2/65, BDF-0-46/02, BDF-2-60/04, BDF-2-60/06
Intake Gates	BDP-1-5-2/8, BDP-1-5-2/9
STS	BDP-5-3-4/1, BDP-5-3-4/13 through BDP-5-3-4/29
Gap Closure Device	BDF-2-60/04
VBS	BDF-3-27/01, BDF-3-27/02, BDF-3-27/06, BDF-3-27/07
Turning Vane	BDF-0-60/15, BDF-0-60/16, BDF-0-60/17, BDF-0-60/18

Once the geometric changes were made to the model, the computational mesh for the model domain was developed using the mesh generation program in the Star CCM+ modeling software and consists of polyhedral (or many-sided) cells. The computation mesh was build with the flexibility to add or remove several features to the computation domain, including the STSs, turning vanes, gap closure devices, flow control plates, and gate slot fillers.

2.2. COMPUTATIONAL MESH REFINEMENT

After the initial computational mesh that was generated, it was evaluated for its sensitivity to refinements to the mesh. The first level of mesh refinement involved inspecting the mesh for areas with an inadequate number of cells across an opening. If there were fewer than five cells across an opening, then additional refinement was added in that area. This resulted in additional refinement at the trash racks.

The second level of mesh refinement involved inspecting the mesh for areas with an inadequate number of cells where rapid changes of velocity or flow direction were occurring. If a large change in velocity was observed across adjacent cells, then additional refinement was added in that area. This resulted in additional refinement at the upstream side of the turning vanes and in the gatewells.

The final level of mesh refinement involved evaluating the sensitivity of the gatewell hydraulics to cell resolution. The intent was to ensure that the cell resolution within the gatewells was adequate such that further refinement would not produce significantly different results. Model runs were conducted with the maximum cell size in the Bay A gatewell limited to 6-inches and 3-inches. The runs produced very similar flow patterns and nearly identical flows through the VBS, with 284 cfs through the VBS for the 6-inch resolution and 283 cfs through the VBS for the 3-inch resolution. Based on these runs, it was determined that a maximum cell size of 6-inches in all gatewells was an adequate resolution. The volume mesh that resulted from the refinements consisted of approximately 4.3 million cells and images of sectionals views of this mesh are shown in Figure 4 and Figure 5.

2.3. PREVIOUS CALIBRATION

The CFD model used for the evaluation of the alternatives as part of the EDR was calibrated to data from a 1:12 physical model (USACE 2013). The CFD model was calibrated by adjusting parameters associated with the STSs and VBSs such that the flow through the VBS panels in the model was in acceptable agreement with the physical model data.

The STS and VBS panels in the CFD model are represented by porous baffles that have two parameters (α and β) which affect the pressure drop across the panels through the following relationship (CD-adapco 2013):

$$\Delta p = -\rho(\alpha|v_n| + \beta)v_n$$

where

Δp	is the pressure drop across the porous baffle
ρ	is the fluid density
v_n	is the velocity normal to the baffle surface
α,	user-specified porosity coefficient defining the baffle resistance, unit-less
β	user-specified porosity coefficient defining the baffle resistance, units depend on units of other variables

The pressure drop across a baffle is related to the flow through the baffle, so altering the porosity coefficients (α and β) affects the flow through the baffle. The model was calibration by adjusting the porosity coefficients for the STSs and VBSs such that the flow through the VBS panels in the model was in acceptable agreement with the physical model data. The porosity coefficients for the VBS were then further refined to distribute flow more uniformly across the VBS panels, which was the flow pattern indicated by the physical model data. The resulting porosity coefficients are shown in Tables 2-2 and 2-3 below. Refer to the EDR (USACE 2013) for more detail regarding the previous modeling effort.

Table 2-2. Porosity Coefficients for VBS Panels from Calibration to Physical Model

Panel	Porosity	α	β
1 (top)	1.000	0.007	0.4
2	0.456	0.05	0.4
3	0.213	0.39	0.4
4	0.213	0.39	0.4
5	0.213	0.39	0.4
6	0.185	0.61	0.4
7	0.185	0.61	0.4
8	0.276	0.19	0.4
9 (bottom)	0.627	0.02	0.4

Table 2-3. Porosity Coefficients for STSs from Calibration to Physical Model

α	β
500	1

2.4. THEORETICAL POROSITY COEFFICIENTS

As a starting point to the calibration effort, theoretical porosity coefficients (α and β) for a VBS panel and STS were calculated. The total head loss through a VBS panel includes head loss through the screen and head loss through the porosity plate. The total head loss through a STS includes head loss through the top and bottom screen meshes and head loss through the internal porosity plate. The theoretical head losses through the VBS and STS are based on the following relationships:

Head Loss through Screen (or mesh): $h_s = k_s \left(\frac{V^2}{2g}\right)$

Head Loss through Porosity Plate: $h_p = k_p \left(\frac{V^2}{2g}\right)$

Total Head Loss through VBS Panel and STS: $h_L = h_s + h_p$, therefore $h_L = \left(k_s + k_p\right)\left(\frac{V^2}{2g}\right)$

where

k_s, k_p	loss coefficients through the screen (or mesh) and porosity plate, respectively; dependent on feature geometry
V	velocity normal to the screen
g	acceleration due to gravity

Applying the Bernoulli equation to a particle of water that passes from one side of the VBS or STS to the other at a constant elevation yields the following equation for pressure drop across the VBS or STS after simplification:

$$\Delta p = -\gamma h_L$$

where

γ specific weight of water

Substituting the equation for the total head loss through the VBS or STS into the equation for pressure drop across the panel yields the following after rearranging terms:

$$\Delta p = -\left(\frac{\rho}{2}\right)\left(k_s + k_p\right)V^2$$

where

A comparison of the equation above with the equation presented in Section 2.3 that STAR-CCM+ uses for the pressure drop across a porous baffle yields the following theoretical relationships for the porosity coefficients α and β:

$$\alpha = \left(\frac{1}{2}\right)\left(k_s + k_p\right) \text{ and } \beta = 0$$

α was calculated for each panel on the VBS and for the STS and the results are presented in tables 4-1 and 4-2 below.

Table 2-4. Theoretical Porosity Coefficients for VBS Panels

Panel	Porosity	α	β
1 (top)	1.000	11.00	0
2	0.456	13.90	0
3	0.213	34.00	0
4	0.213	34.00	0
5	0.213	34.00	0
6	0.185	41.00	0
7	0.185	41.00	0
8	0.276	22.00	0
9 (bottom)	0.627	11.65	0

Table 2-5. Theoretical Porosity Coefficients for a STS

α	β
4.90	0

The STSs were modeled with porous baffles on the top and bottom of the screen rather than one porous baffle to more accurately represent the flow through the structures. Half of the theoretical porosity coefficients were applied to each porous baffle.

For more detail on the derivation of the equations for the theoretical porosity coefficients and the calculations of the porosity coefficients, see Appendix A.

2.5. MODEL CALIBRATION RUNS

Several model calibration runs were performed in order to determine appropriate porosity coefficients (α and β) for the VBSs and STSs. The results of the model runs were compared to the hydraulic data collected in the spring of 2013 (Harbor and Alden 2013) by comparing the velocity magnitudes and directions predicted by the model to the field data. The model results were extracted at the locations that corresponded with the locations where the field data was taken. It was decided that the calibration runs would be based on the scenario with the gate slot fillers in because the flow patterns under this condition are less erratic. It was anticipated that some of the variability within the data would be eliminated by considering the more simplistic flow patterns, resulting in a more accurate calibration.

The initial calibration runs were focused on the sensitivity of the β coefficient. Based on the theoretical head loss through a VBS panel, β should be zero. However, there was a concern that a β of zero could cause mathematical errors in the model, for example, if it appeared as the denominator in an equation, so it was decided that β would be assigned an insignificant positive value. Several model runs were conducted with various β and constant α to determine what an appropriate value for β should be. The effect of β was determined by comparing the flow through the VBS panels for each model run. The flow through the panels was nearly identical (less than 1% difference) for β equal to 0.01 and 0.1, but for β of 1.0, the flow through the panels was reduced up to 4%, indicating that β was no longer insignificant. From this analysis, it was determined that β equal to 0.01 would not significantly impact the flow through the VBS and should be used going forward with the calibration effort.

The next focus of the calibration effort was to determine appropriate α coefficients for the VBS panels. Three runs were conducted to investigate the sensitivity of the α coefficients for the VBS panels while using the theoretical α coefficients for the STSs. The α coefficients used for each of the three runs are shown in Table 2-6 below. Run 1 considered the theoretical porosity coefficients; Run 2 considered 1/10th of the theoretical porosity coefficients; and Run 3 considered twice the theoretical porosity coefficients. All runs were conducted with a unit flow of 17,100 for comparison with field data collected in 2013 (Harbor and Alden 2013).

Table 2-6. VBS α Coefficients for VBS Panel Calibration Runs

Panel	Porosity	Run 1 - α	Run 2 - α	Run 3 - α
1 (top)	1.000	11.00	1.10	22.00
2	0.456	13.90	1.39	27.80
3	0.213	34.00	3.40	68.00
4	0.213	34.00	3.40	68.00
5	0.213	34.00	3.40	68.00
6	0.185	41.00	4.10	82.00
7	0.185	41.00	4.10	82.00
8	0.276	22.00	2.20	44.00
9 (bottom)	0.627	11.65	1.17	23.30

The resulting flows through the VBS panels for each of the VBS panel calibration runs are shown in Table 2-7 below. As expected, the lower porosity coefficients associated with Run 2 resulted in higher flows through the VBSs, and likewise, the higher porosity coefficients associated with Run 3 resulted in lower flows through the VBSs compared to Run 1.

Table 2-7. VBS Flow for VBS Panel Calibration Runs

Run	Unit Flow (kcfs)	Bay A VBS Flow (cfs)	Bay B VBS Flow (cfs)	Bay C VBS Flow (cfs)
1	17,100	287	254	211
2	17,100	346	306	254
3	17,100	251	225	185

The results from the first three calibration runs, shown in Figure 8 through Figure 10, were compared to the field data collected in 2013 (Harbor and Alden 2013), shown in Figure 7. In general, Run 1 with the theoretical porosity coefficients for the VBS panels demonstrated the best agreement with the field data. This run demonstrated areas of higher velocity perpendicular to the screen around the upper portion of the panel, which is apparent in the field data. Run 2 demonstrated areas of high velocity perpendicular to the VBS panel concentrated around the middle of the screen, and generally lower velocities on the upper portion of the panel, which is not consistent with the field data. The results from Run 3 demonstrate velocities perpendicular to the VBS that are substantially lower than exhibited in the field data. Based on these model runs, it was decided that the porosity coefficients from Run 1 would be used for the subsequent CFD runs.

A fourth VBS panel calibration run was conducted for the purpose of validation. This run considered the theoretical porosity coefficients and a unit flow of 15,000 cfs. The results are shown in Figure 11, and the corresponding field data is shown in Figure 6. The model produced results that demonstrate general agreement with the field data.

The final focus of the calibration effort was to investigate the sensitivity of the α coefficients calculated for the STSs. Two additional runs were conducted to investigate the sensitivity of the α coefficients for the STSs while using the theoretical α coefficients for the VBS panels. The α coefficients used for each of the runs are shown in

Table 2-8 below. Run 5 considered the theoretical porosity coefficients times ten, and Run 6 considered 1/10th of the theoretical porosity coefficients. All runs were conducted with a unit flow of 17,100 for comparison with field data collected in 2013 (Harbor and Alden 2013).

Table 2-8. STS α Coefficients for STS Calibration Runs

Run	STS α
1	4.9
5	50
6	0.50

The resulting flows through the VBS panels for each of the STS calibration runs are shown in Table 2-9 below. As expected, the higher porosity coefficient associated with Run 5 resulted in higher flows through the VBSs, and likewise, the lower porosity coefficient associated with Run 6 resulted in lower flows through the VBSs compared to Run 1. However, the changes in flow through the VBS panels were only 10-12% for Runs 5 and 6 compared with Run 1, so it was concluded that the flows through the VBS panels were not highly sensitive to the porosity coefficients for the STSs. Based on these model runs it was determined that the theoretical porosity coefficients used in Run 1 were adequate for subsequent model runs.

Table 2-9. VBS Flow for STS Calibration Runs

Run	Unit Flow (kcfs)	Bay A VBS Flow (cfs)	Bay B VBS Flow (cfs)	Bay C VBS Flow (cfs)
1	17,100	287	254	211
5	17,100	315	280	233
6	17,100	251	227	186

3. SECTIONAL CFD MODELING OF BASELINE CONDITIONS

Following calibration, the CFD model was run for unit flow conditions representing the low, medium, and high 1% efficiency unit operation as shown in Table 3-1. The runs were conducted with existing gatewell geometry to establish a hydraulic baseline for evaluation of alternatives.

Table 3-1. Baseline Run Outflow Conditions

Unit Flow (cfs)	Bay A Flow (cfs)	Bay B Flow (cfs)	Bay C Flow (cfs)
12,000	4,536	4,104	3,360
15,000	5,670	5,130	4,200
18,000	6,804	6,156	5,040

The 18,000 cfs unit flow provided a baseline for hydraulic conditions assumed to represent unfavorable flow conditions for fish passage at the high 1% efficiency range, while the 15,000 cfs unit flow provided a baseline for assumed minimally favorable hydraulic conditions for fish passage at the medium 1% efficiency range. The 12,000 cfs provided a low flow baseline for assumed favorable hydraulic conditions for fish passage at the low 1% efficiency range.

In each case, the model was run with prescribed outflow velocities at the downstream boundaries for bays A, B, and C corresponding to the flows in Table 3-1. The upstream boundary condition was prescribed inflow velocities corresponding to the flows in Table 3-1 plus an additional 33 cfs, which discharges into the downstream migrant transportation (DSM) channel through orifices in each of the three gatewells. In all runs, the north fish orifice was in operation in Bays A and B with an outflow of 11 cfs. A pressure boundary at the Bay C north fish orifice was specified to allow the flow to equalize in the model domain, resulting in an outflow of approximately 11 cfs at that location.

The CFD model results were post-processed using FieldView, a CFD model post-processing software program, and the results are discussed in the following sections. The CFD model-predicted VBS flows for each baseline flow condition considered are summarized in Table 3-2. Bay A has the highest flow of the three bays in each unit and therefore, the highest VBS and gatewell flow. The VBS flow for each bay was calculated from the CFD model results by converting the mass flux [lbs per second (lbs/s)] across the VBS baffles to flow (cfs).

Table 3-2. Baseline Runs VBS Flow Summary

Unit Flow (cfs)	Bay A VBS Flow (cfs)	Bay B VBS Flow (cfs)	Bay C VBS Flow (cfs)
12,000	186	177	146
15,000	245	222	183
18,000	294	267	220

3.1. LOW UNIT FLOW CONDITIONS – 12,000 CFS

The CFD model results for the low unit flow condition are summarized in Figure 14 through Figure 17 and show flow passing through the trash rack, with a portion of the flow passing up the gatewell, and the remainder passing into the intake. Flow up the STS accelerates to up to 5-6 feet per second (ft/s), with a portion of the flow returning to the intake between the gap closure device and the STS. The majority of the gatewell flow enters on the upstream side of the turning vane, and the remainder enters downstream of the turning vane along the gatewell beam. The flow that passes along the upstream side of the turning vane demonstrates flow separation downstream of the intake roof, as shown by the area of low velocity in Figure 15. Similarly, the flow that enters the gatewell along the gatewell beam demonstrates flow separation downstream of the lower end of the turning vane, as shown by the area of low velocity on the downstream side of the turning vane. The result is an uneven distribution of flow into the gatewell, which induces turbulence and irregular flow patterns.

As the flow passes above the turning vane, the gate slot width increases abruptly above the turning vane and STS side frame and the flow can not immediately expand to fill the volume. This sudden expansion induces turbulence and irregular flow patterns within the gatewell. An opposing circulation of flow upward and then downward on either side of each bay results as the flow expands downstream of the abrupt gate slot transition, as shown in Figure 16.

Normal velocities just upstream of the VBS are generally less than the 1 ft/s criteria, with some velocities approaching 1 ft/s in the circulation areas on either side of the VBS, as shown in Figure 16. Sweeping velocities up the VBS are generally positive (positive upward), but negative in the circulation on either side of the VBS. The general level of turbulence intensity in the gatewell is characterized by the turbulent kinetic energy isosurface plot shown in Figure 17. The isosurface plots show 3-D surfaces where the turbulent kinetic energy is at 1.0 ft^2/s^2; the volume inside the isosurface has higher turbulent kinetic energy, and the volume outside the surface has lower turbulent kinetic energy than the isosuface. For low flow conditions, regions with turbulent kinetic energy above 1.0 ft^2/s^2 are present downstream of the intake roof, on the upstream face of the turning vane, along the upstream side of the gatewell beam, and extending along either side of the VBS downstream of the gate slot expansion above the STS side supports.

3.2. MEDIUM UNIT FLOW CONDITIONS – 15,000 CFS

The CFD model results for the medium unit flow condition (15,000 cfs) are summarized in Figure 18 through Figure 21. The gatewell flow patterns for the 15,000 unit flow condition are generally similar to those for the low unit flow condition, but the velocity magnitudes and intensity of the turbulence in the gatewell are increased. As flow passes up the STS to the gap closure device and turning vane, velocities reach 7-8 ft/s (Figure 19) compared to 5-6 ft/s for the low unit flow condition. Figure 20 is a plot of VBS normal velocity and shows increased intensity in normal velocities with “hot spots” on the upper VBS panel in Bay A with velocities greater than 1 ft/s. Figure 20 also indicates that the positive sweeping velocities are concentrated to the center portion of the VBS, with negative sweeping velocities on the outer side portions in the circulation zones. Turbulent kinetic energy increased in the gatewell with increased unit flow as shown by the larger volume isosurfaces in Figure 21.

3.3. HIGH UNIT FLOW CONDITIONS – 18,000 CFS

The CFD model results for the high unit flow condition (18,000 cfs) are summarized in Figure 22 through Figure 25. The gatewell flow patterns for the 18,000 unit flow condition are generally similar to those for the low and medium unit flow condition, but the velocity magnitudes and intensity of the turbulence in the gatewell are further increased. As flow passes up the STS to the gap closure device and turning vane, velocities reach 8-9 ft/s (Figure 23) as compared to 5-6 ft/s for the low unit flow condition. Figure 24 is a pot of the VBS normal velocity and shows increased intensity in normal velocities with “hot spots” on the upper VBS panel in Bays A and B with velocities greater than 1 ft/s. Figure 24 also indicates that the positive sweeping velocities are concentrated to the center portion of the VBS, with negative sweeping velocities on the outer side portions of the VBS. Turbulent kinetic energy increased in the gatewell with increased unit flow as shown by the larger volume isosurfaces in Figure 25.

4. SECTIONAL CFD MODELING OF DESIGN ALTERNATIVES

The design alternatives considered as part of the Supplement to the Engineering Documentation Report consist of those listed below.

Flow control alternatives:

- A1 – Adjustable Louver Flow Control Device
- A2 – Sliding Flow Control Plate
- A3 – Static Flow Control Plate
- A4 – Modify VBS Perforated Plates (for Flow Control)
- A5 – Modify VBS Perforated Plates (to meet Velocity Criteria)
- A6 – Remove Turning Vane
- A7 – Remove Gap Closure Device
- A8 – Remove Submerged Traveling Screen and Turning Vane

Flow pattern change alternative:

- B1 – Gate Slot Fillers

Alternatives A1 and A2 were dismissed during the EDR due to their complexity, O&M requirements, and implementation time. For these reasons they were not modeled as part of this study.

Alternative A4 was determined to be too complex for designing with a CFD model so was not modeled as part of this study.

Alternative A5 is not intended to be a stand-alone improvement and is recommended for further consideration in conjunction with one of the other alternatives as part of the DDR. For these reasons it was not modeled as part of this study.

Alternatives A3, A6, A7, A8, and B1 were modeled using the sectional CFD model as described in the following sections. A summary of the flows through the VBS panels for each of the modeled scenarios is shown in Table 4-1 below. The design criterion that has been set for this study is that the flow through any VBS at any unit flow cannot exceed the flow though the Bay A VBS at a unit flow of 15,000 cfs. The Bay A VBS flow predicted by the CFD model for a unit flow of 15,000 cfs is 245 cfs, so that is the target that design alternatives evaluated with the CFD model are to be measured against.

Table 4-1. Design Alternative Runs VBS Flow Summary

Alternative	Unit Flow (cfs)	Bay A VBS Flow (cfs)	Bay B VBS Flow (cfs)	Bay C VBS Flow (cfs)
Design Target	18,000	Max. 245	Max. 245	Max. 245
A3 – Flow Control Plate (25%)	18,000	263	239	183
A3 – Flow Control Plate (50%)	18,000	214	193	154
A6 – Remove Turning Vane	18,000	301	273	221
A7 – Remove GCD	18,000	168	146	125
A8 – Remove STS & TV	18,000	219	195	161
B1 – Gate Slot Filler	18,000	303	266	221

4.1.1. Alternative A3 – Static Flow Control Plate

This alternative consists of installing solid plates that connect to the gatewell beams and cantilever toward the intake gates, restricting the areas through which the return flow from the gatewells to the turbine units can pass. Two configurations were modeled for this alternative. The first configuration included flow control plates in all three bays that blocked 25% of the open areas between the downstream sides of the gatewell beams and the intake gates. The second configuration included flow control plates in all three bays that blocked 50% of the open areas between the downstream sides of the gatewell beams and the intake gates.

The CFD model results for the 25% blockage configuration are summarized in Figure 26 through Figure 29. As shown in Table 4-1, the plates are expected to reduce the flows through the VBS panels in all bays compared to the baseline condition. The flow through the Bay A VBS (263 cfs) was not reduced to below the design target flow of 245 cfs, but the flow through the Bay B VBS (239) was. The baseline flow through the Bay C VBS at a unit flow of 18,000 cfs is already below the baseline flow through the Bay A VBS at a unit flow of 15,000 cfs, so it may be that a flow control plate in Bay C is not necessary; this will have to be studied further.

It appears in Figure 27 that the 25% blockage configuration slightly reduces the maximum velocity of the flow up the gatewell in Bay A compared to the baseline-18,000 cfs condition, but not to the level of the baseline-15,000 cfs target. The general flow patterns demonstrated in Figure 28 appear to be similar to the baseline conditions, with areas of circulation on the sides of the VBSs and areas of high velocity through the upper portions of the VBSs.

Figure 29 indicates similar turbulent kinetic energy in the gatewells compared to the baseline-18,000 cfs condition.

The CFD model results for the 50% blockage configuration are summarized in Figure 30 through Figure 33. The plates are expected further reduced the flows through the VBS panels in all bays compared to the 25% blockage configuration. The flow through the Bay A VBS (214 cfs) was reduced to below the design target flow of 245 cfs.

It appears in Figure 31 that the 50% blockage configuration produces a maximum velocity for the flow up the gatewell similar to the baseline-15,000 cfs target condition. The flow patterns demonstrated in Figure 32 appear to indicate a reduction in the areas of higher velocity through the upper portions of the VBSs, but the intensification of areas of high velocity through the lower corners of the VBSs. Figure 32 also indicates that the circulation patterns within the gatewells are intensified.

Figure 33 indicates a reduction in turbulent kinetic energy in the gatewells compared to the baseline-18,000 cfs condition, but not quite to the level observed in the baseline-15,000 cfs condition.

4.1.2. Alternative A6 – Remove Turning Vane

The alternative to remove the turning vanes was evaluated with the CFD model. The model results for this alternative are shown in Figure 34 through Figure 37. As shown in Table 4-1, removing the turning vanes is not expected to result in reduced flows through the VBS panels, and might actually slightly increase the flows. The modeling indicates that the turning vanes do not intercept and guide additional flow up the gatewells beyond what the STSs have intercepted, and that they might act as minor impediments to the flow.

It is shown in Figure 35 that removing the turning vane results in less evenly distributed flow up the gatewells compared to the baseline condition. The turning vanes direct some of the gatewell flow up the upstream sides of the gatewells. When the turning vanes are removed, the flow up the gatewells is concentrated on the downstream sides of the gatewells along the VBSs, which creates areas of low upward velocity, and possibly even downward flow, along the upstream sides of the gatewell.

Figure 36 shows that removal of the turning vanes causes more flow to pass through the lower portions of the VBSs, creating areas of high velocity through the lower portions of the VBSs. The areas of circulation on the sides of the VBSs seen in the baseline model runs appear to be diminished with this alternative. In addition, Figure 37 shows that removing the turning vanes causes an increase in the turbulent kinetic energy within the gatewells, concentrated mostly along the VBSs, and at the interfaces between the fast moving upward flow along the downstream sides of the gatewell and the low velocity areas along the upstream sides of the gatewells.

4.1.3. Alternative A7 – Remove Gap Closure Device

The alternative to remove the gap closure devices was evaluated with the CFD model. The model results for this alternative are shown in Figure 38 through Figure 41. As shown in Table 4-1, removing the gap close device is expected to greatly reduce the flows through the VBS panels in all bays compared to the baseline condition. The flows through the Bay A VBS (168 cfs) and Bay B VBS (146) were reduced to significantly below the design target flow of 245 cfs.

It is shown in Figure 39 that removing the gap closure devices results in less evenly distributed flow up the gatewells compared to the baseline condition. The gap closure device helps direct flow up the gatewells on the downstream sides of the turning vanes. When they are removed, there is very little flow that enters the gatewells on the downstream sides of the turning vanes; nearly all of the gatewell flow enters on the upstream sides of the turning vanes. This uneven distribution of flow into the gatewells creates circulation zones on the downstream sides of the turning vanes, and also zones of low velocity, and possibly circulation, on the upstream sides of the gatewells approximately midway up them.

Figure 40 shows that the removal of the gap closure devices results in very unbalanced flow through the VBSs, with areas of high velocity through the lower portions of the VBSs. The areas of circulation along the VBSs appear to be intensified compared to the baseline condition. In addition, Figure 41Figure 37 shows that removing the gap closure device causes an increase in the turbulent kinetic energy within the gatewells.

4.1.4. Alternative A8 – Remove Submerged Traveling Screen and Turning Vane

The alternative to remove the submerged traveling screens (STSs) and turning vanes was evaluated with the CFD model. The model results for this alternative are shown in Figure 42 through Figure 45. As shown in Table 4-1, removing the STSs and turning vanes is expected to reduce the flows through the VBS panels in all bays compared to the baseline condition. The flow through the Bay A VBS (219 cfs) and Bay B VBS (195 cfs) were reduced to below the design target flow of 245 cfs.

It is shown in Figure 43 that removing the STSs and turning vanes results in less evenly distributed flow up the gatewells compared to the baseline condition. The resulting flow patterns in the gatewells are similar to those seen when the just the turning vanes are removed (Alternative A6). The turning vane directs some of the gatewell flow up the upstream sides of the gatewells. When the turning vane is removed, the flow up the gatewells is concentrated on the downstream sides of the gatewells along the VBSs, which creates areas of low upward velocity, and possibly even downward flow, along the upstream sides of the gatewells.

Figure 44 shows that removal of the STSs and turning vanes causes flow to pass mostly through the lower and upper portions of the VBSs, creating areas of higher velocity through the those portions of the VBSs. The areas of circulation on the sides of the VBSs seen in the baseline model runs appear to be diminished with this alternative. In addition, Figure 45Figure 37 shows that removing the STSs and turning vanes causes a redistribution of the turbulent kinetic energy within the gatewells, concentrated mostly along the VBSs, and at the interfaces between the fast moving upward flow along the downstream sides of the gatewell and the low velocity areas along the upstream sides of the gatewells.

4.1.5. Alternative B1 – Gate Slot Filler

The alternative to install gate slot fillers was evaluated with the CFD model. The model results are shown in Figure 46through Figure 49. As shown in Table 4-1, removing the turning vanes is not expected to result in reduced flows through the VBS panels, and might actually slightly increase the flows as a result of increased hydraulic efficiency within the gatewells.

It is shown in Figure 47 that installing the gate slot fillers will produce a very similar flow distribution up the gatewells compared to the baseline condition. The turning vanes guide flow along the upstream side of the gatewells, and the STSs and gap closure devices guide flow along the downstream side of the gatewell. Figure 48 indicates that the gate slot fillers may impact the flow patterns near the VBSs by producing areas of high velocity through the VBSs on the sides of the lower sections of the panels. It is possible that these differences in the flow patterns between the baseline and alternative runs are due to the variability in the model results at different model iterations. However, Figure 49 indicates that the gate slot fillers do reduce turbulent kinetic energy with the gatewell.

5. CONCLUSIONS AND RECOMMENDATIONS

The various CFD model runs have provided significant insight into the hydraulic impacts of the various design alternatives compared to the baseline condition. The modeling indicates that Alternatives A6 (Remove Turning Vane) and B1 (Gate Slot Filler) do not reduce the flow through the VBSs and thus will not satisfy the design criteria. While Alternatives A7 (Remove Gap Closure Device) and A8 (Remove STS and Turning Vane) show a reduction in flow through the VBSs which satisfies the design criteria, but could reduce FGE. In addition, Alternatives A7 and A8 both produce highly uneven distributions of flow up the gatewells, resulting in more erratic hydraulic environments which could have negative impacts on fish survival. For the reasons given, the modeling indicates that Alternatives A6, A7, A8, and B1 will not adequately achieve the design goals for this project.

Alternative A3 – Static Flow Control Plate demonstrated a hydraulic environment within the gatewell that most closely resembled the target design condition (baseline with unit flow of 15 kcfs). This alternative demonstrated a reduction in flow through the VBS as well as a reduction in turbulent kinetic energy in the gatewells compared to the baseline condition with a unit flow of 18 kcfs. Consequently, as a result of the CFD modeling, the recommended alternative for further study to improve juvenile salmon survival in the gatewells is a static flow control plate.

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7. FIGURES

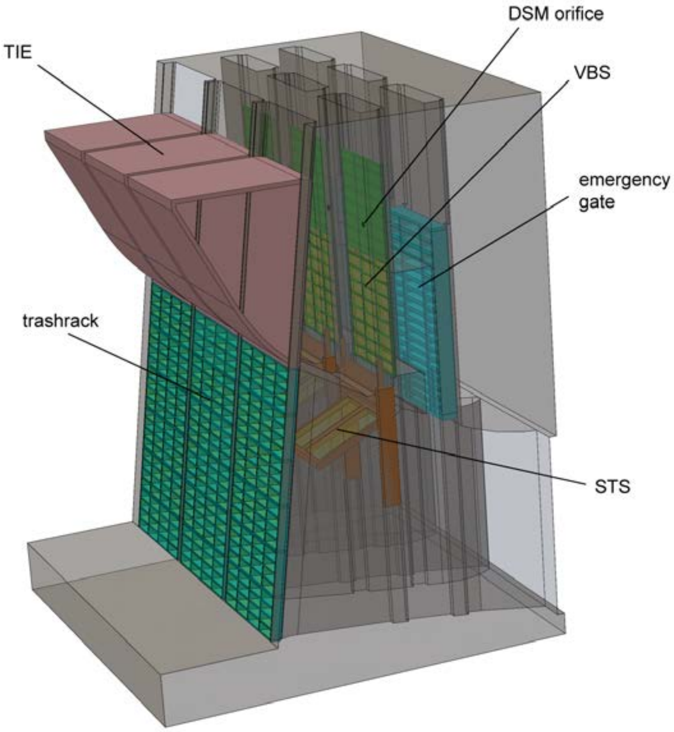


Figure 1. Isometric View of Turbine Unit

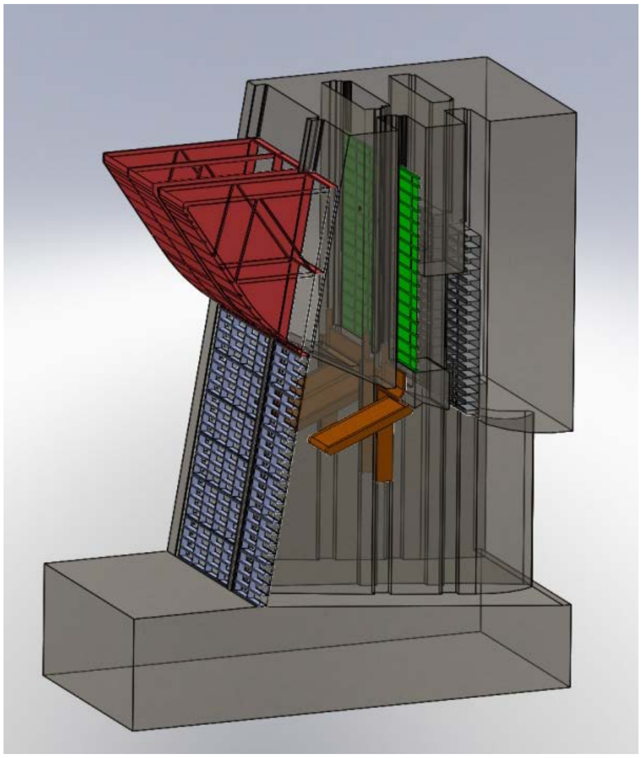


Figure 2. Section View of Turbine Unit

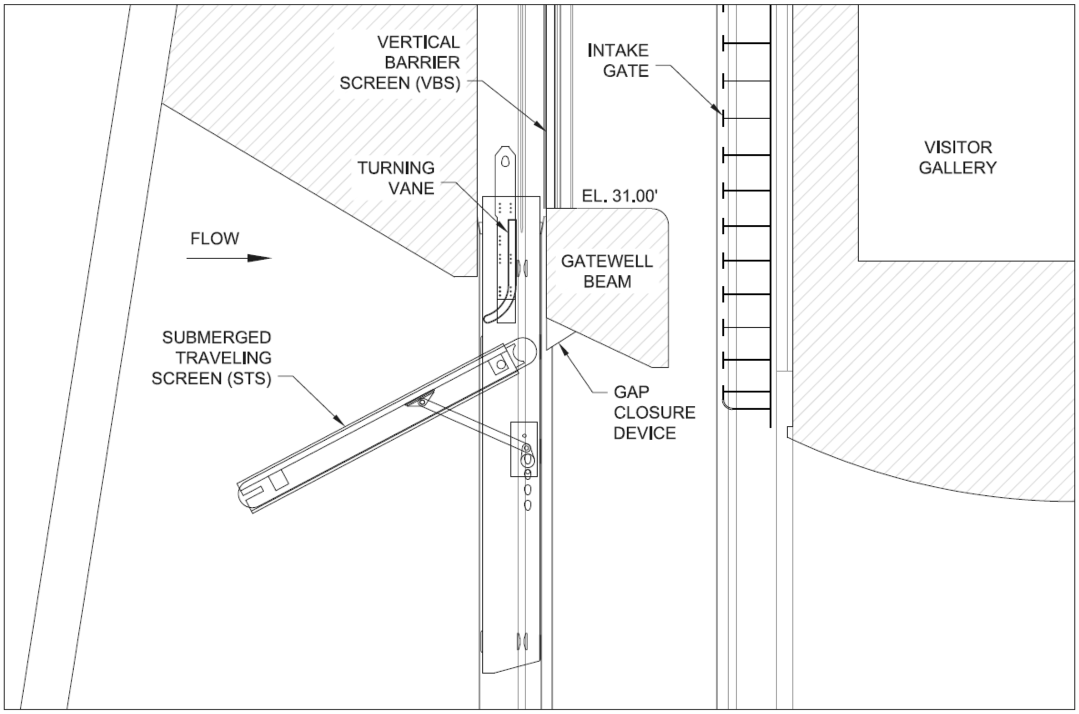


Figure 3. Gatewell Entrance

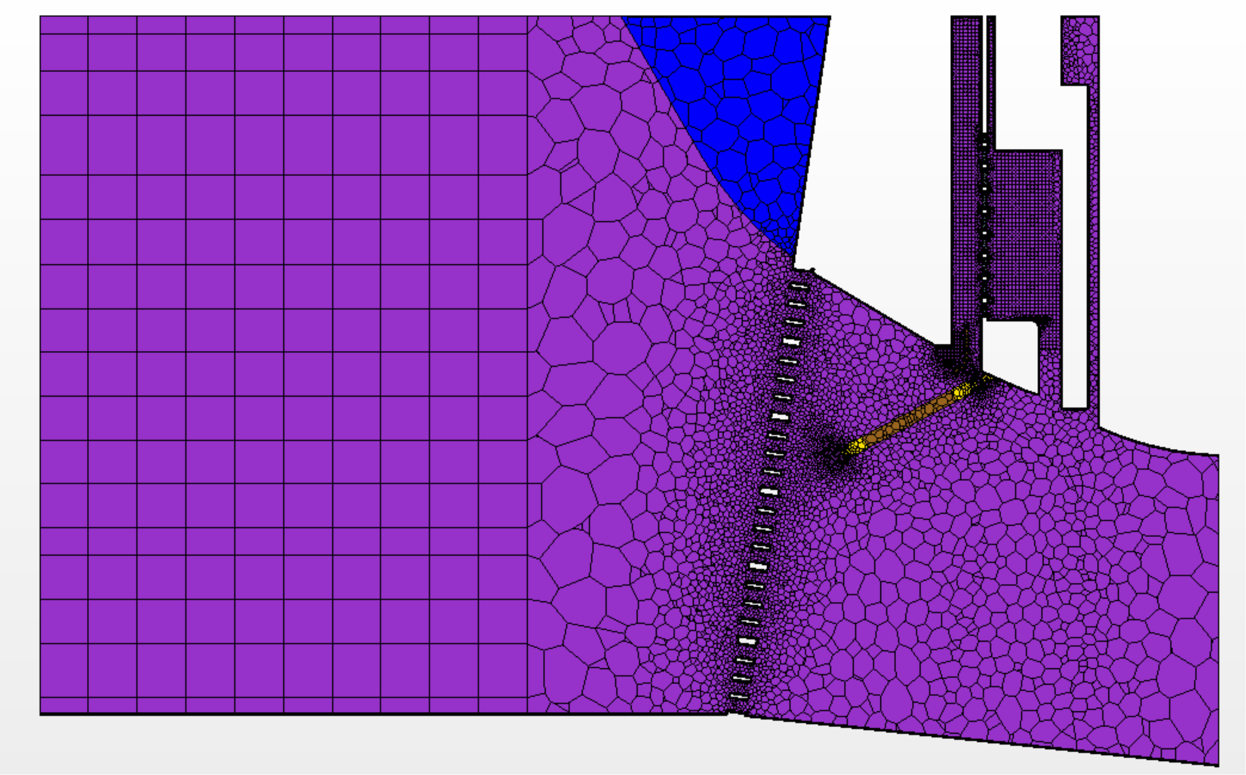


Figure 4. CFD Volume Mesh – Section View

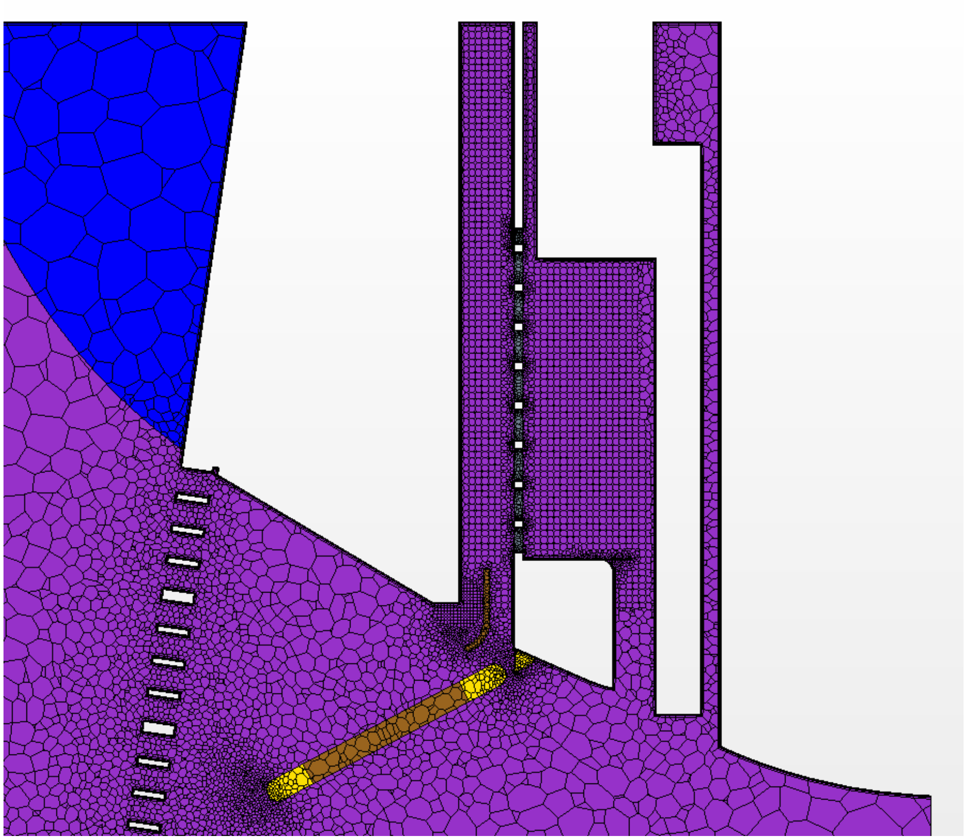


Figure 5. CFD Volume Mesh – Zoomed Sectional View

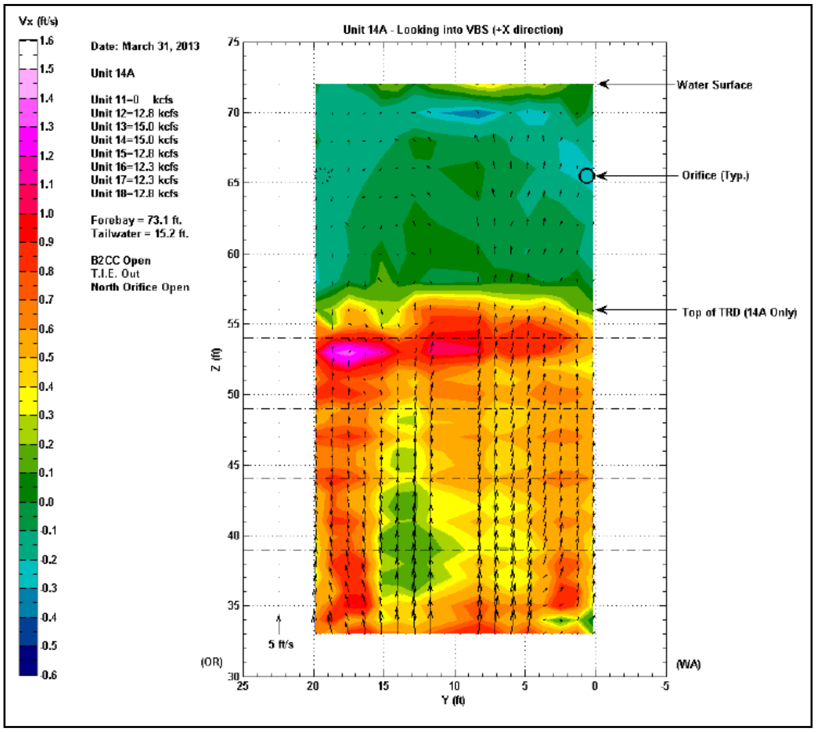


Figure 6. 2013 Field Data, Unit 14A with TRD, Unit Q=15 kcfs, VBS Normal Velocities and Flow Patterns (from Harbor and Alden 2013)

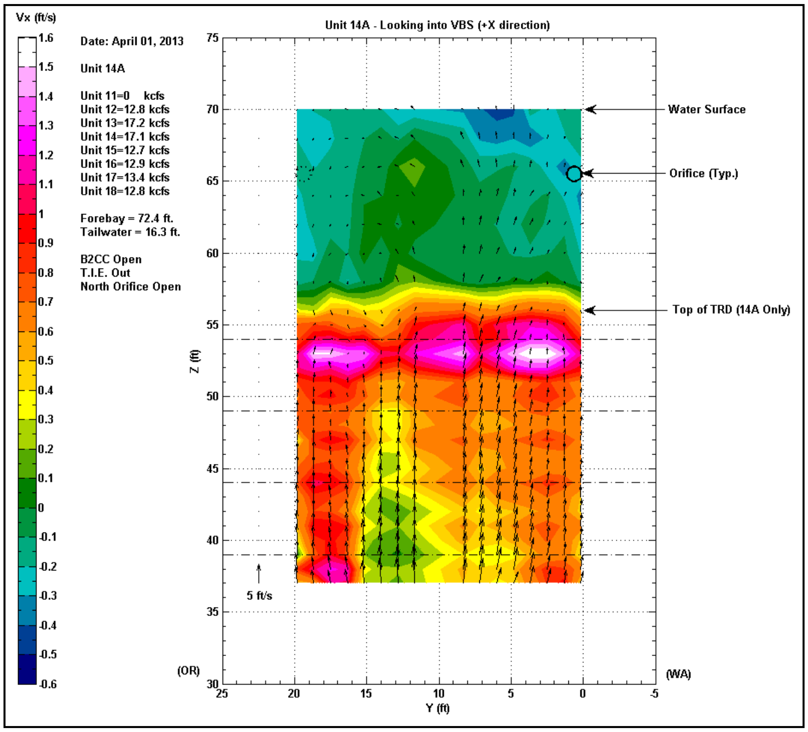


Figure 7. 2013 Field Data, Unit 14A with TRD, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns (from Harbor and Alden 2013)

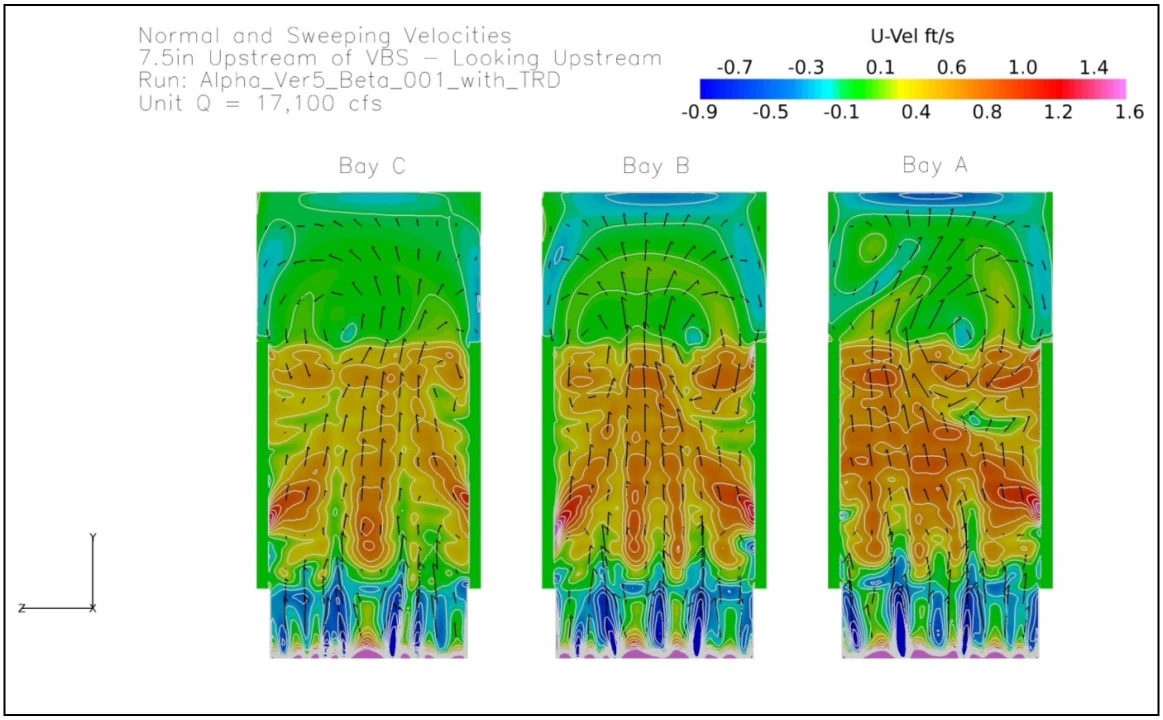


Figure 8. Calibration Run 1, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns

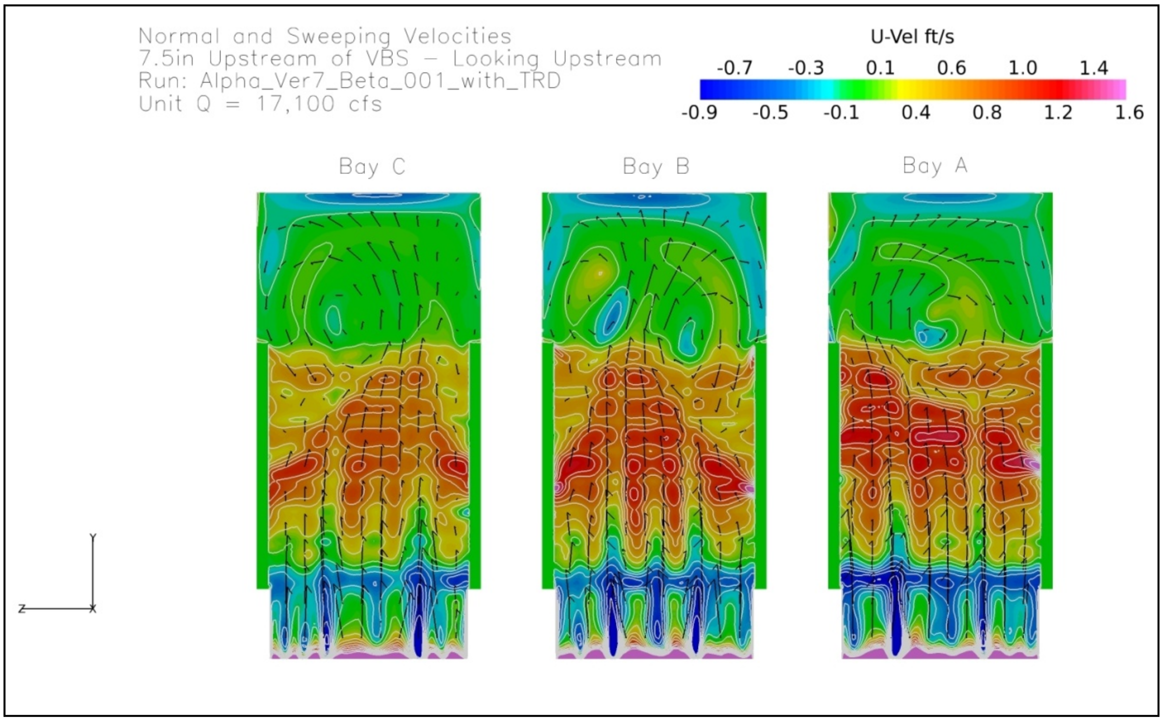


Figure 9. Calibration Run 2, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns

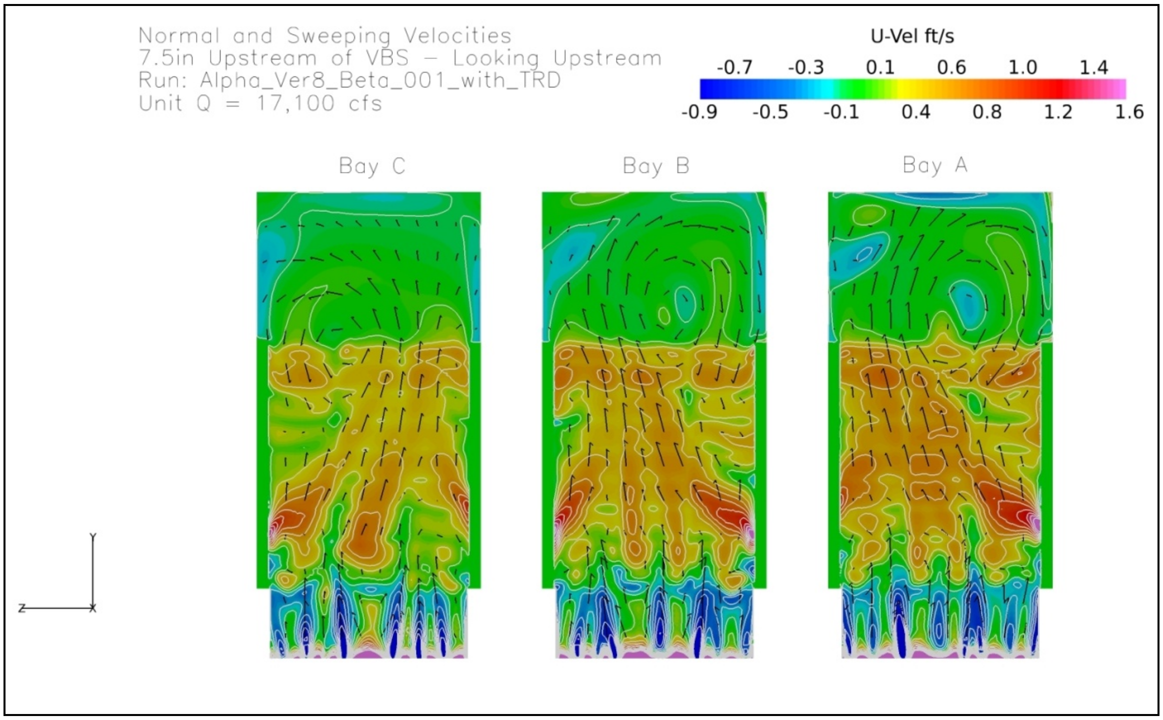


Figure 10. Calibration Run 3, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns

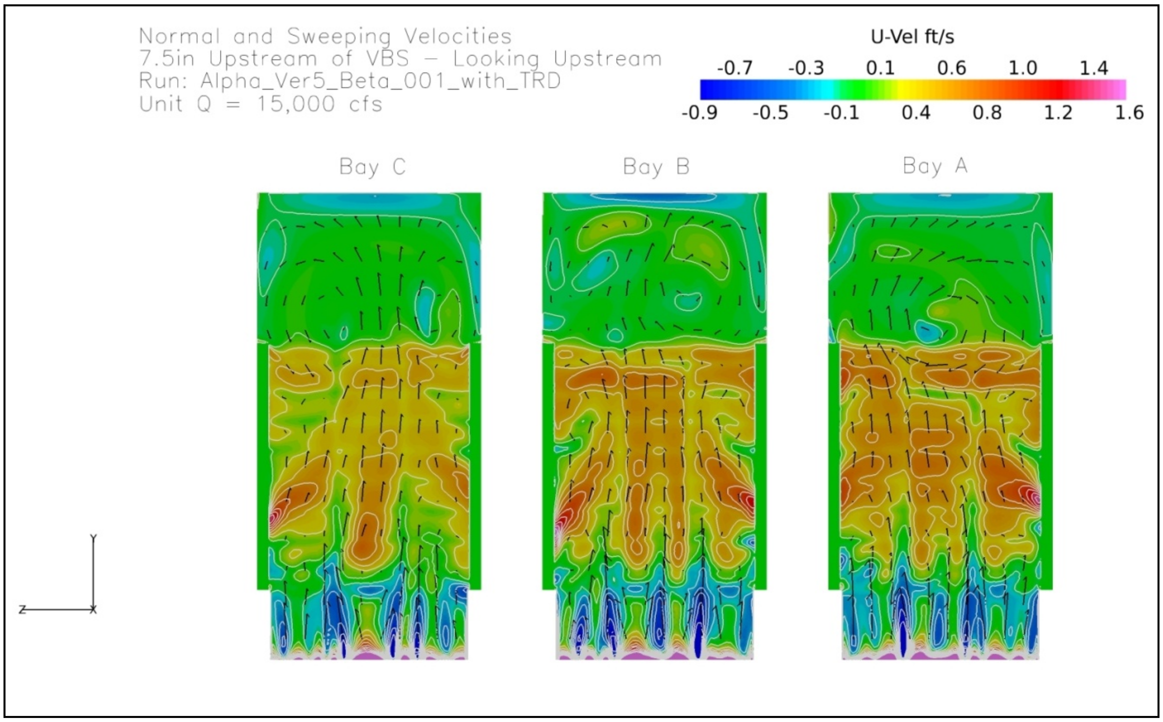


Figure 11. Calibration Run 4, Unit Q=15 kcfs, VBS Normal Velocities and Flow Patterns

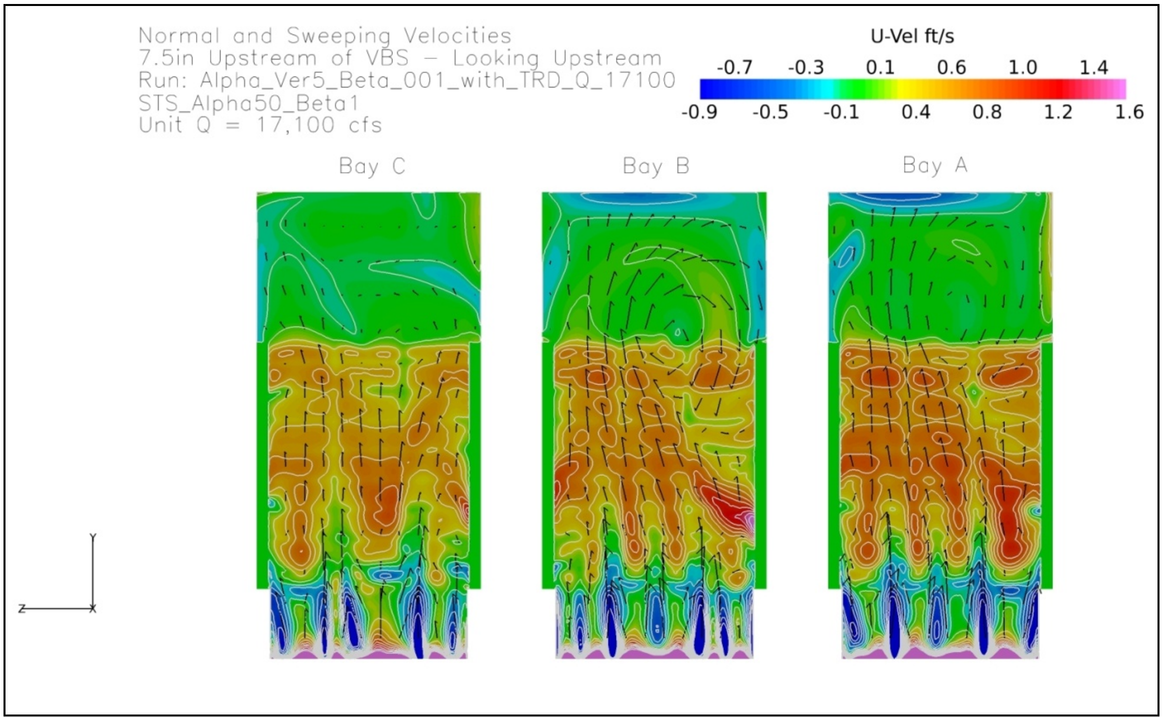


Figure 12. Calibration Run 5, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns

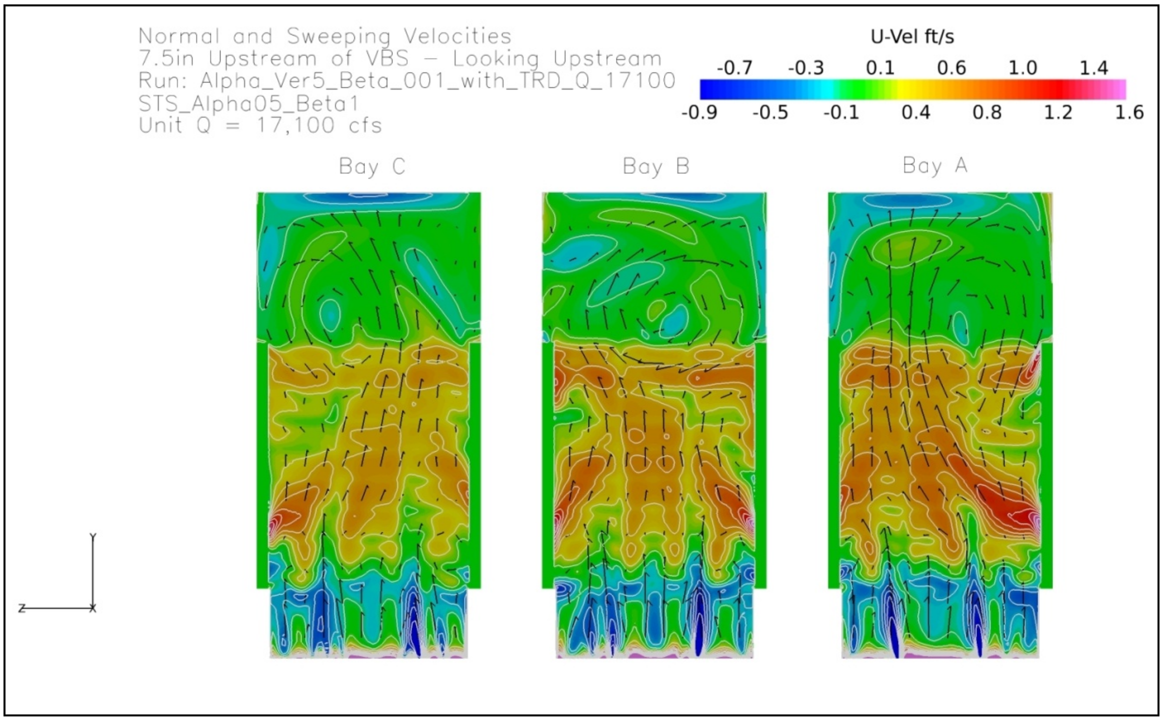


Figure 13. Calibration Run 6, Unit Q=17.1 kcfs, VBS Normal Velocities and Flow Patterns

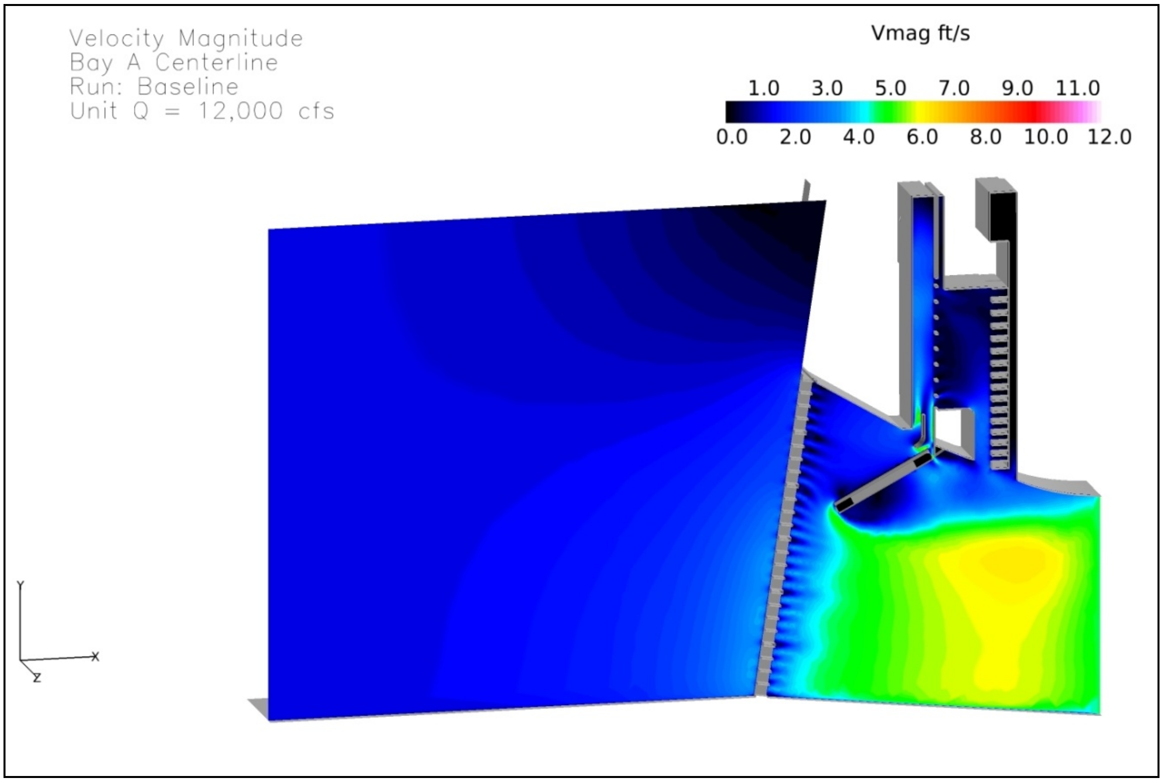


Figure 14. Baseline Conditions, Unit Q=12 kcfs, Bay A Centerline Velocity Magnitude

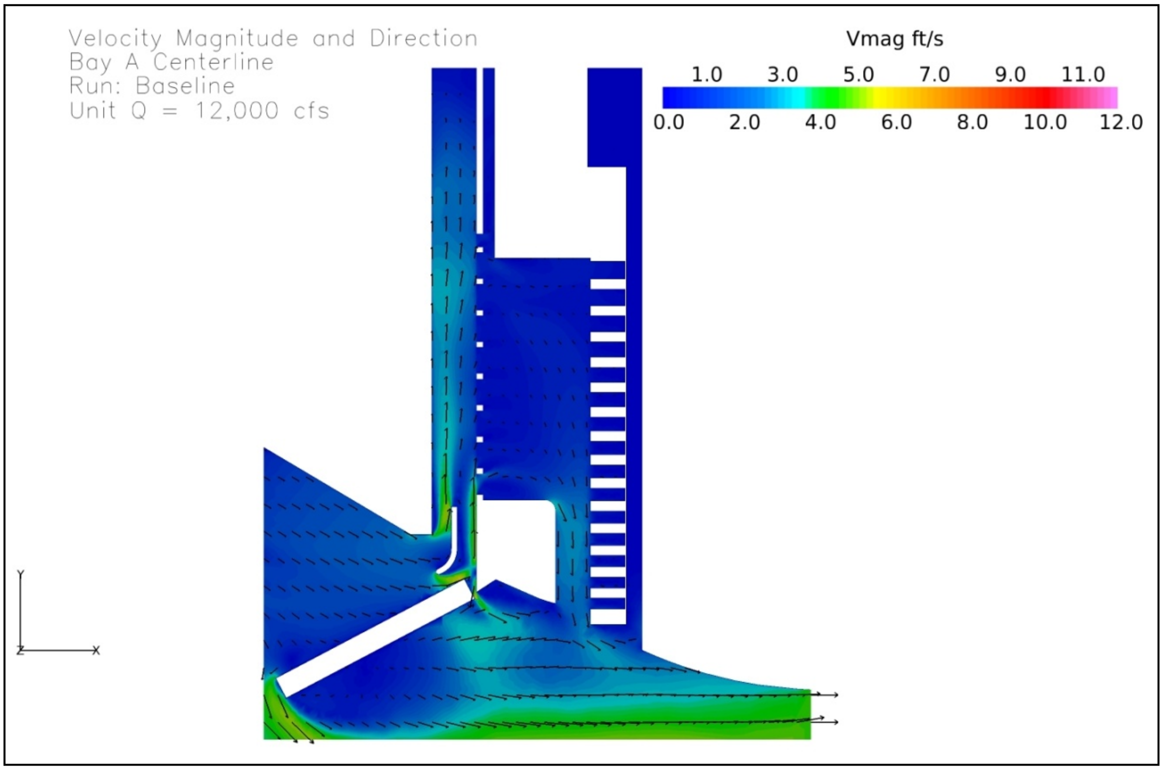


Figure 15. Baseline Conditions, Unit Q=12 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

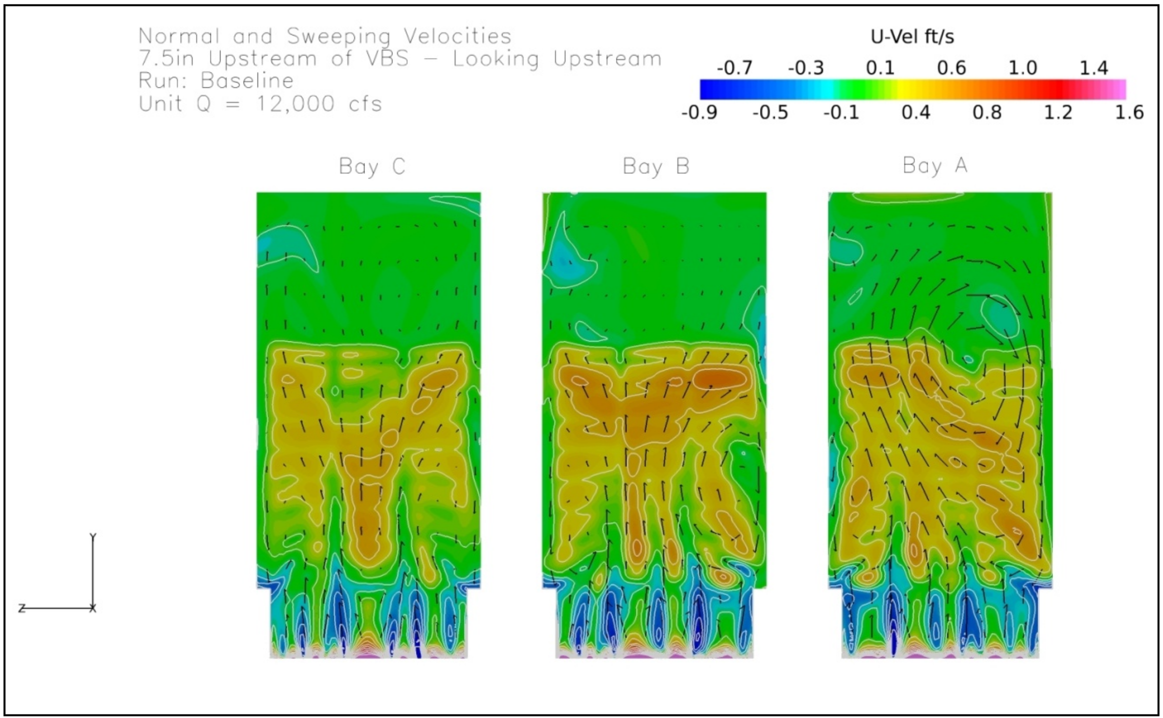


Figure 16. Baseline Conditions, Unit Q=12 kcfs, VBS Normal Velocities and Flow Patterns

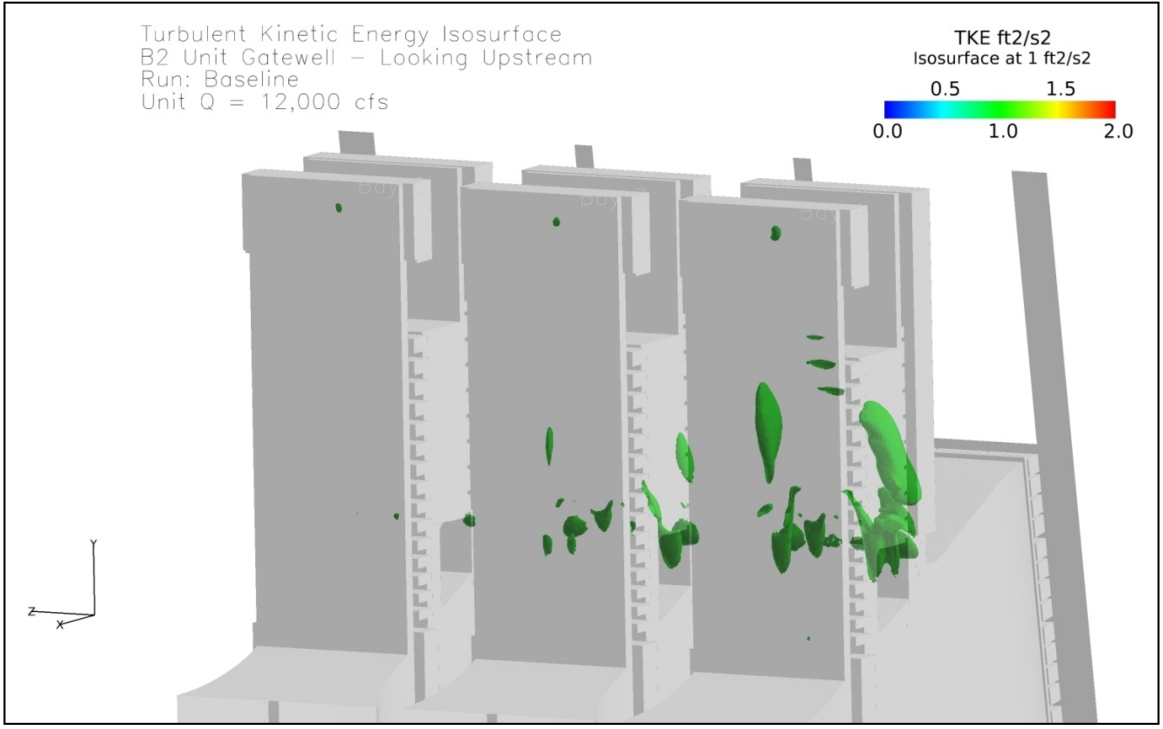


Figure 17. Baseline Conditions, Unit Q=12 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

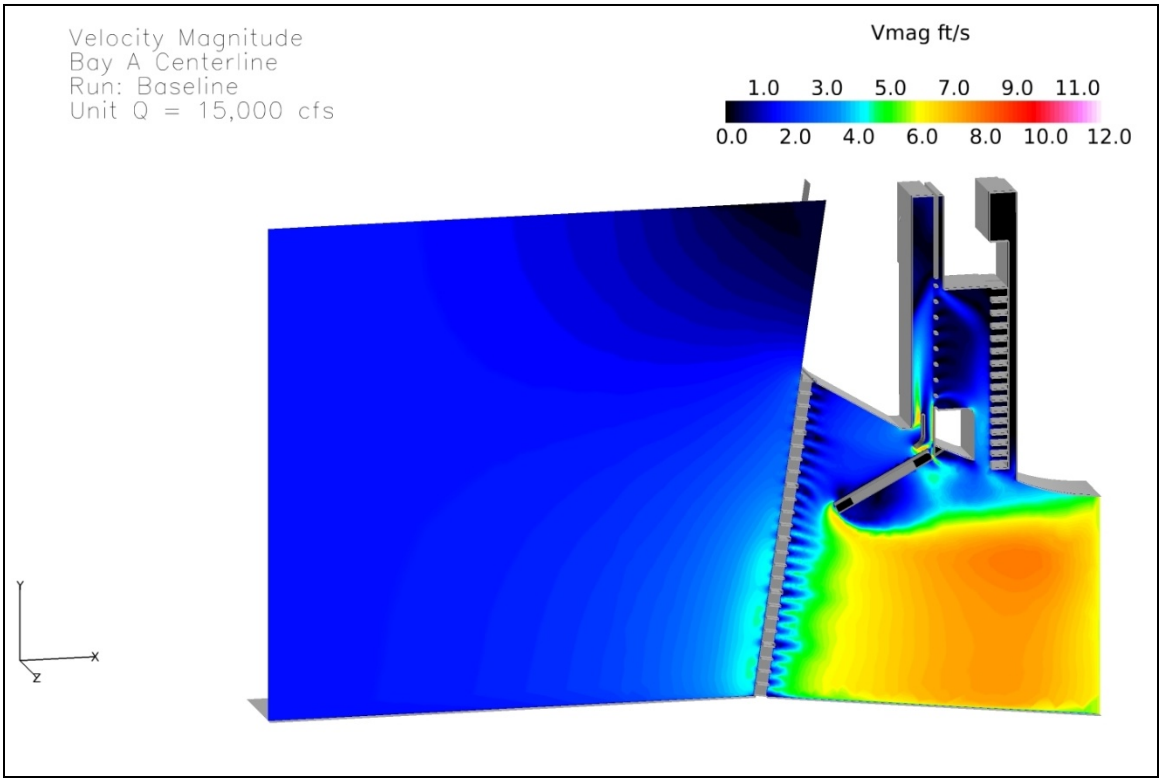


Figure 18. Baseline Conditions, Unit Q=15 kcfs, Bay A Centerline Velocity Magnitude

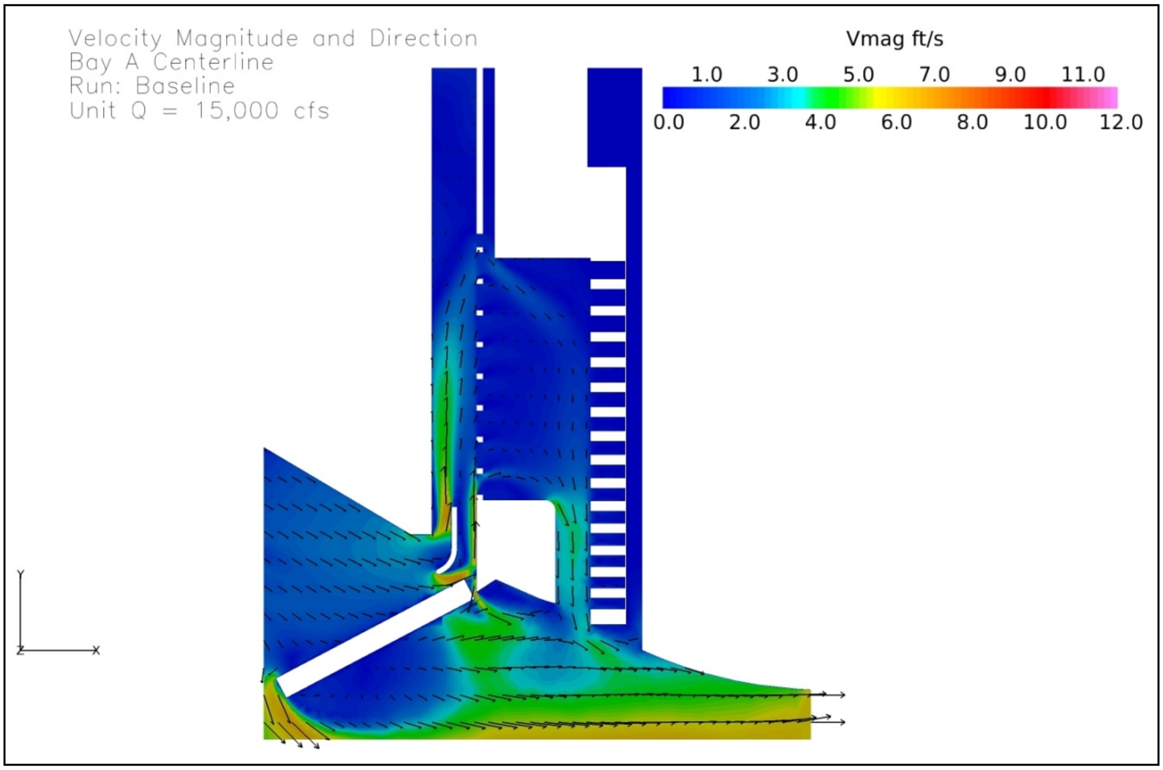


Figure 19. Baseline Conditions, Unit Q=15 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

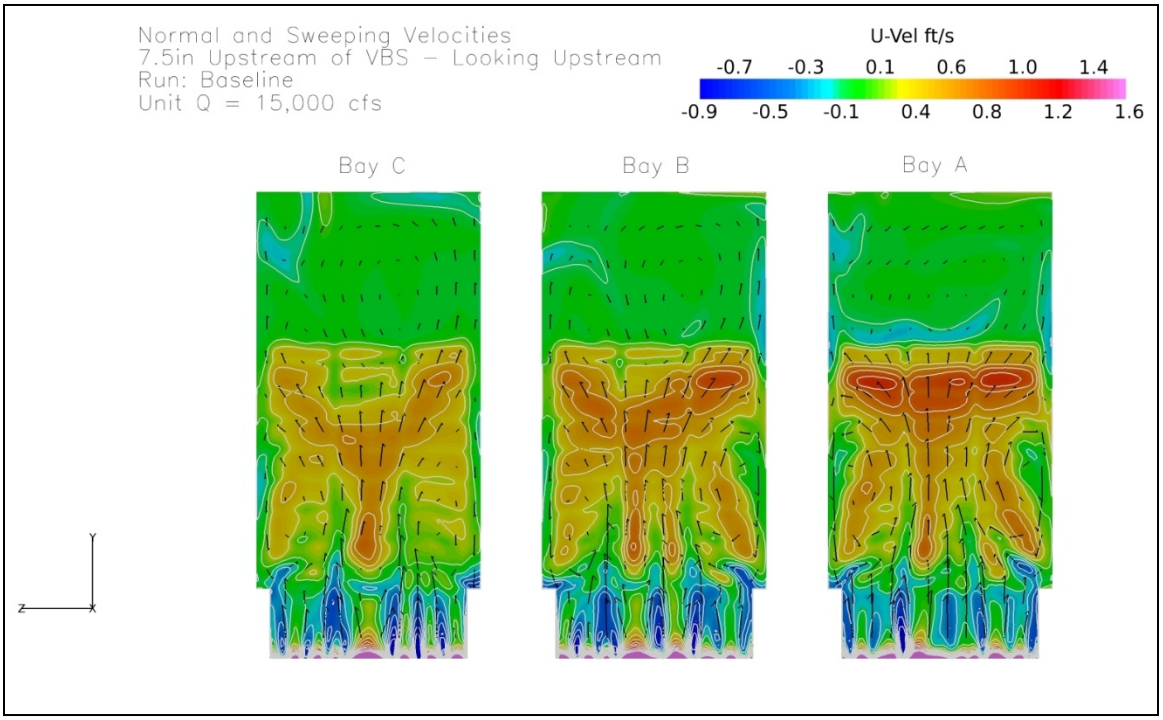


Figure 20. Baseline Conditions, Unit Q=15 kcfs, VBS Normal Velocities and Flow Patterns

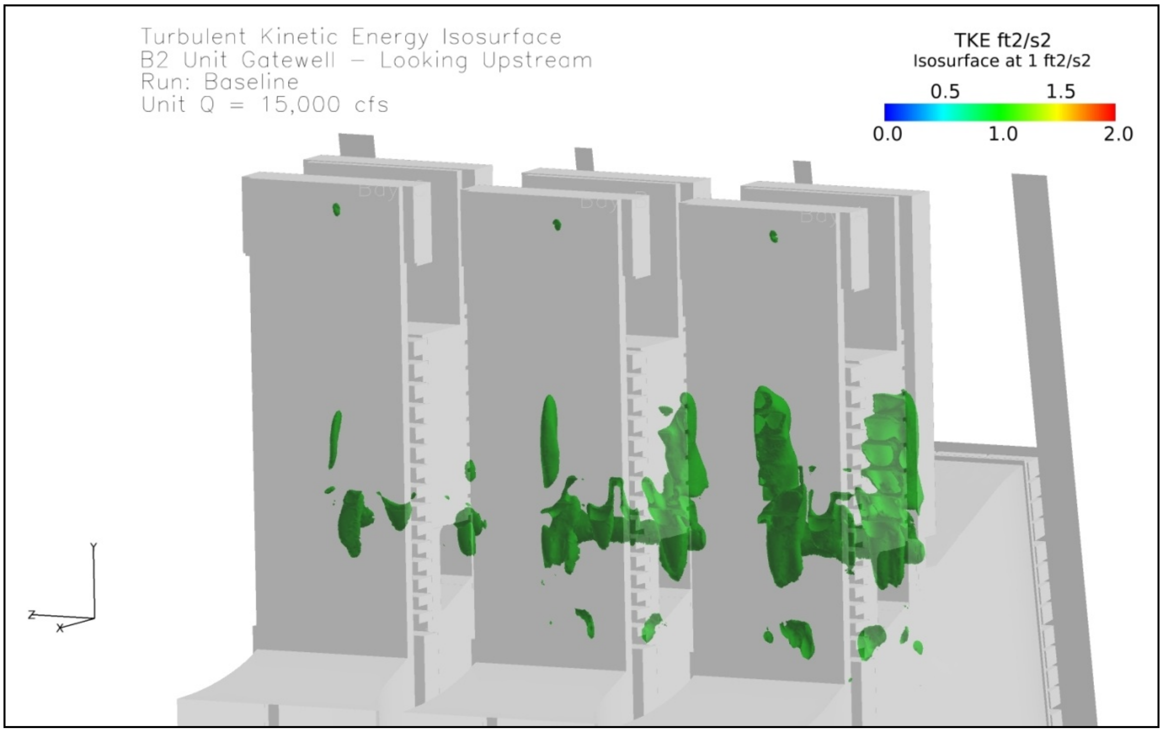


Figure 21. Baseline Conditions, Unit Q=15 kcfs, Turbulent Kinetic Enery Isosurface (1 ft^2/s^2)

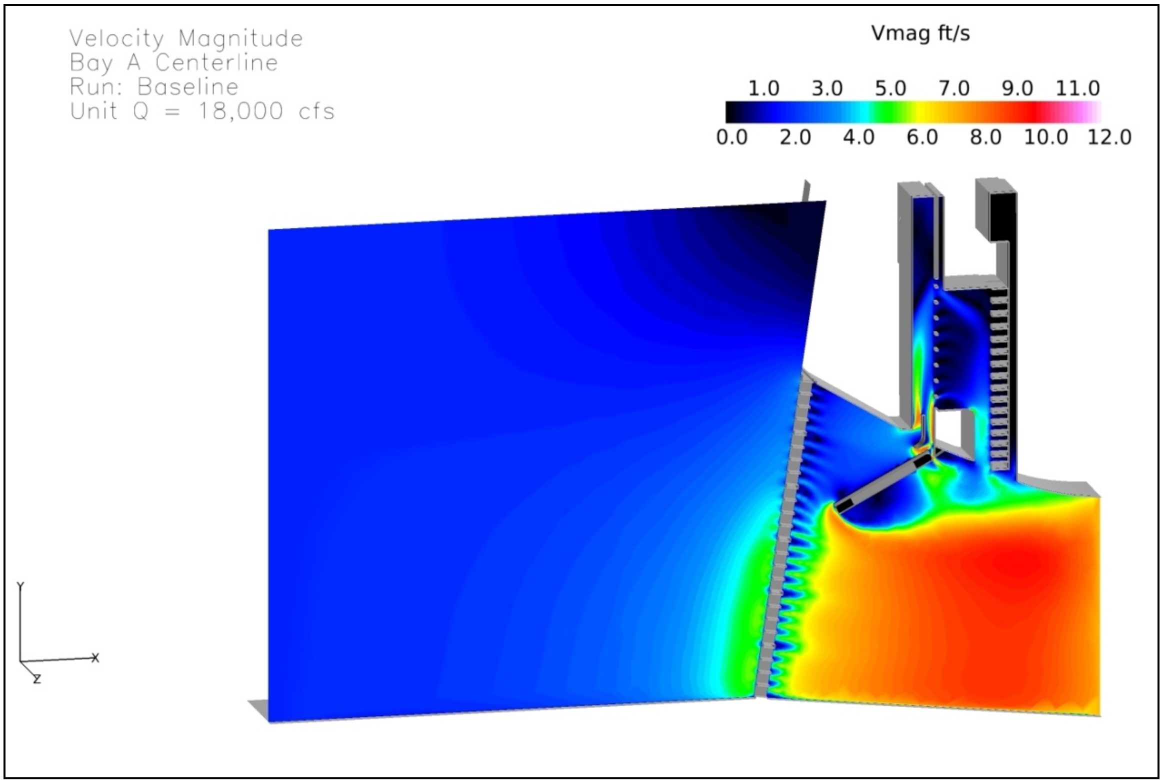


Figure 22. Baseline Conditions, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

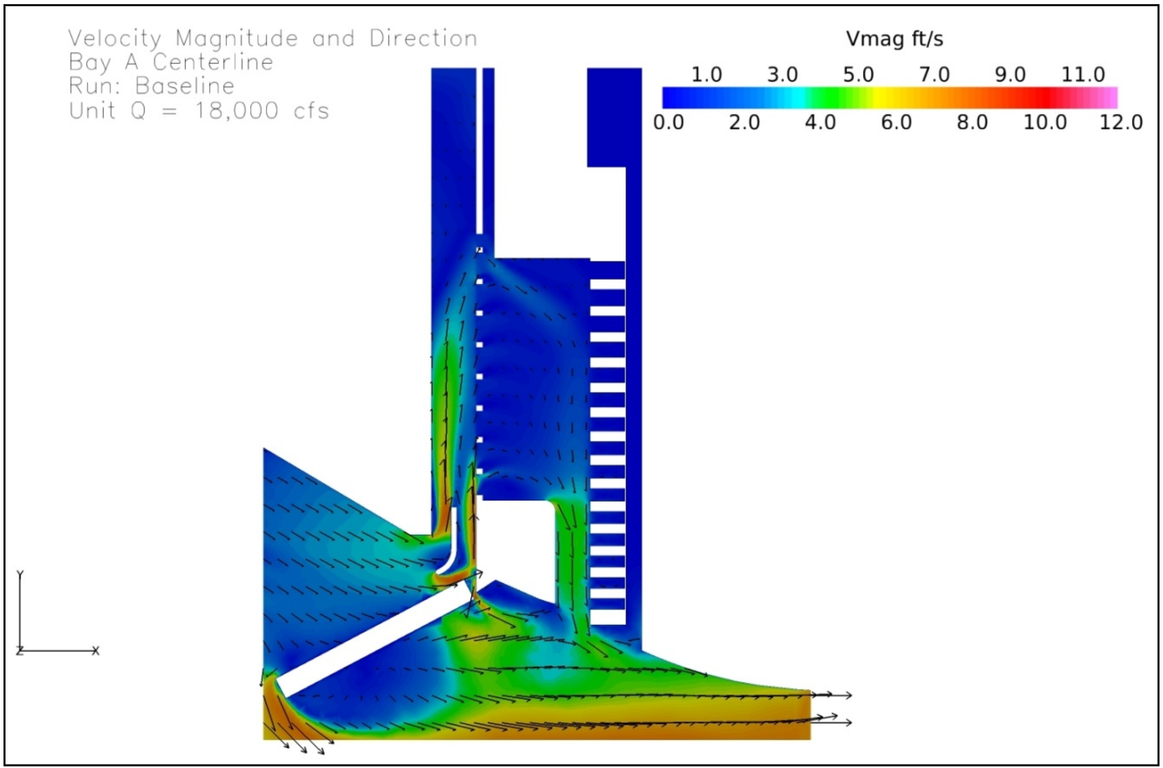


Figure 23. Baseline Conditions, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

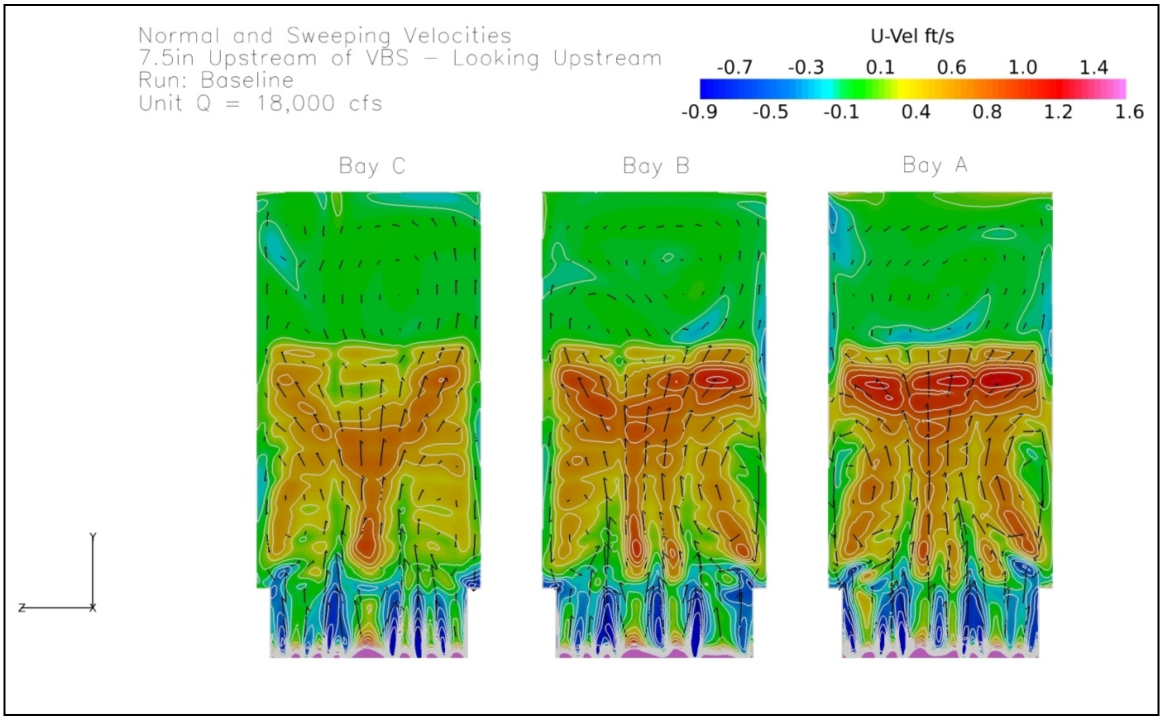


Figure 24. Baseline Conditions, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

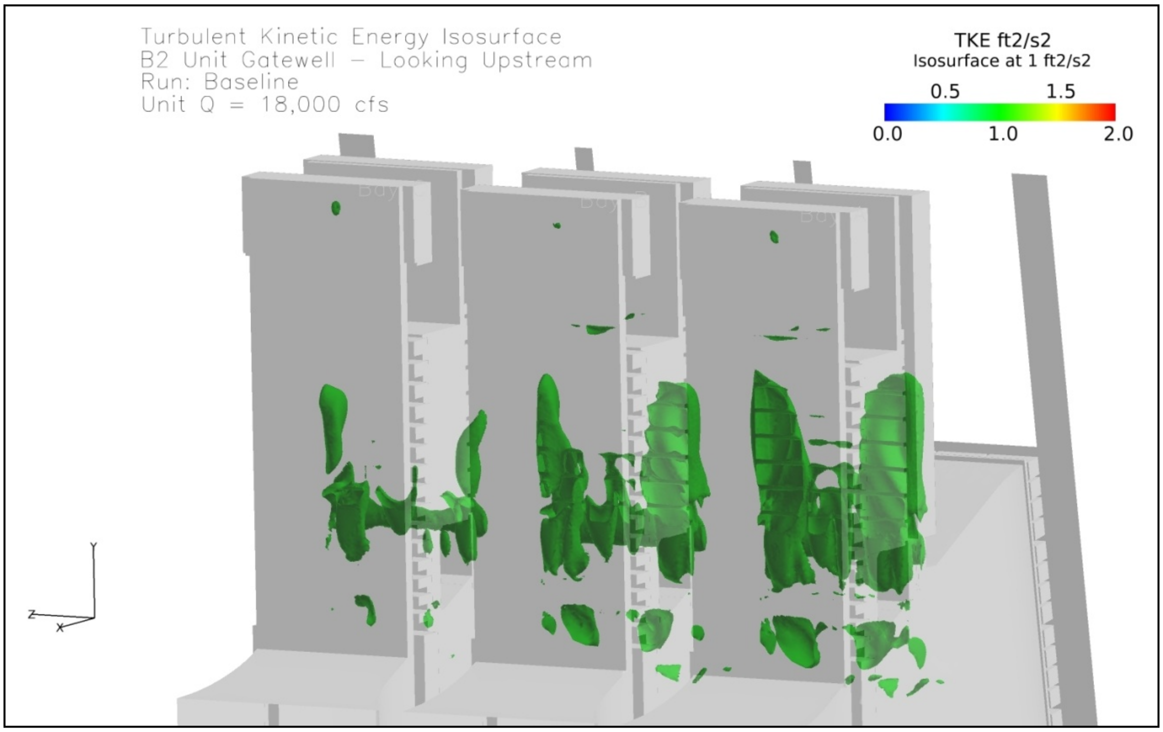


Figure 25. Baseline Conditions, Unit Q=18 cfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

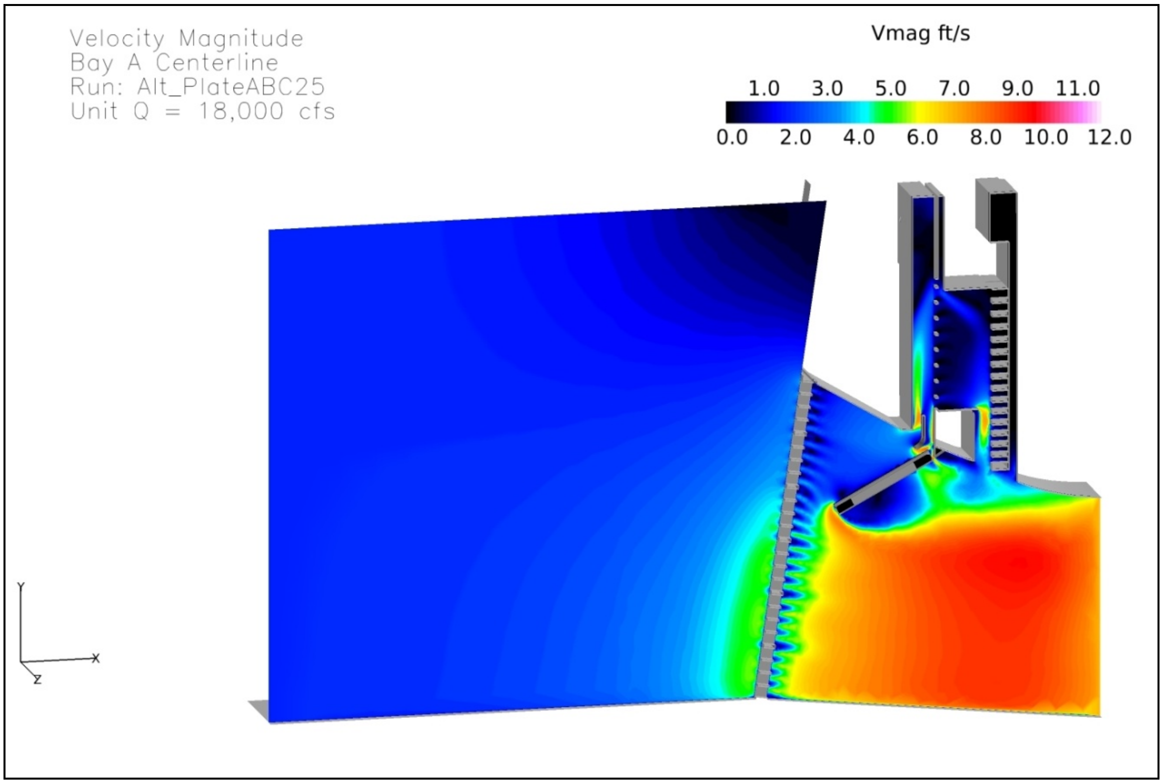


Figure 26. Alternative A3 (25% Blockage), Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

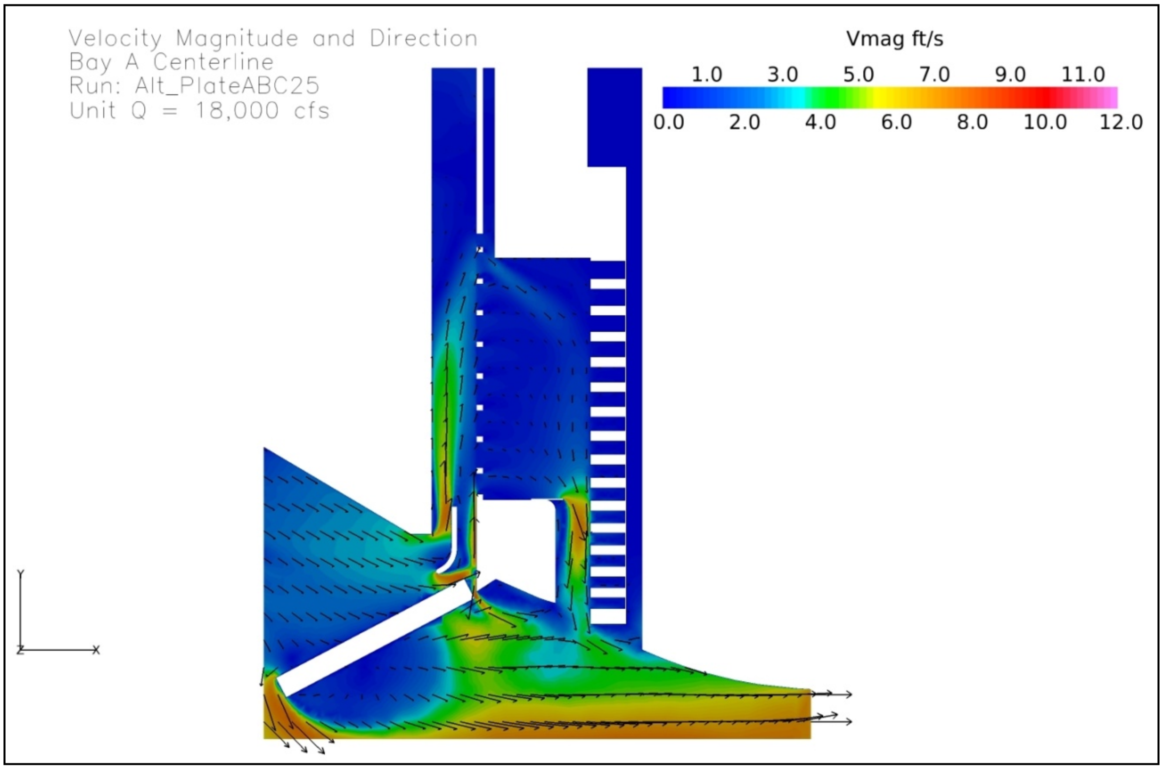


Figure 27. Alternative A3 (25% Blockage), Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

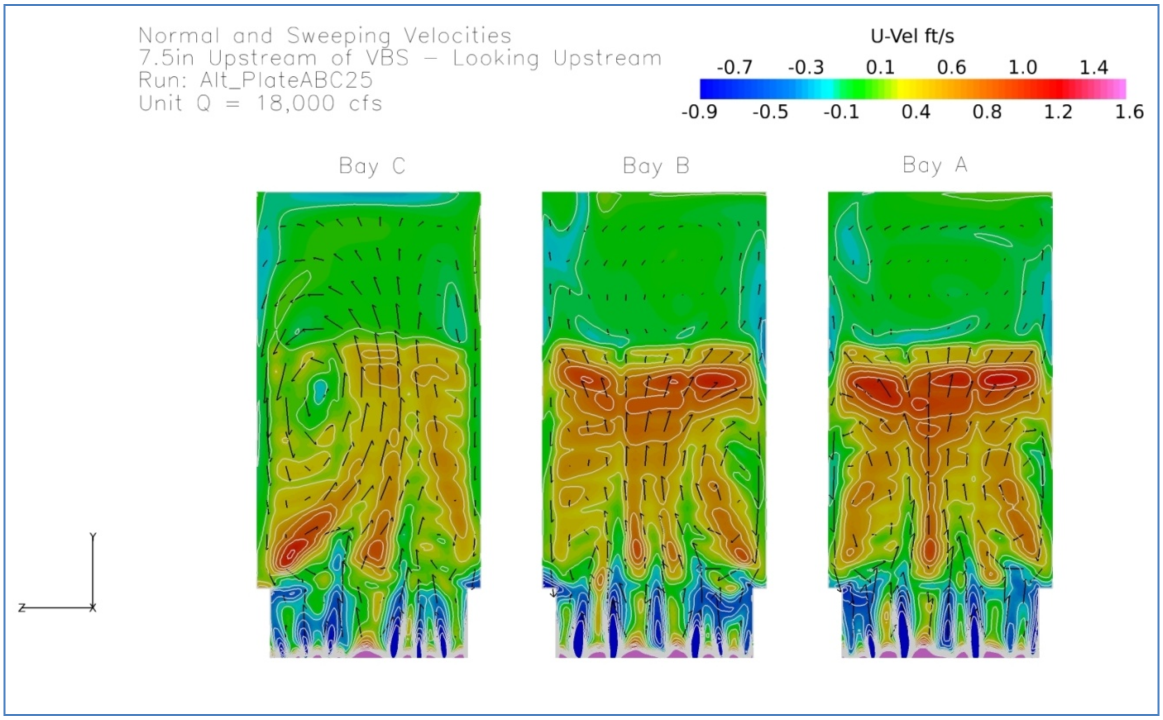


Figure 28. Alternative A3 (25% Blockage), Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

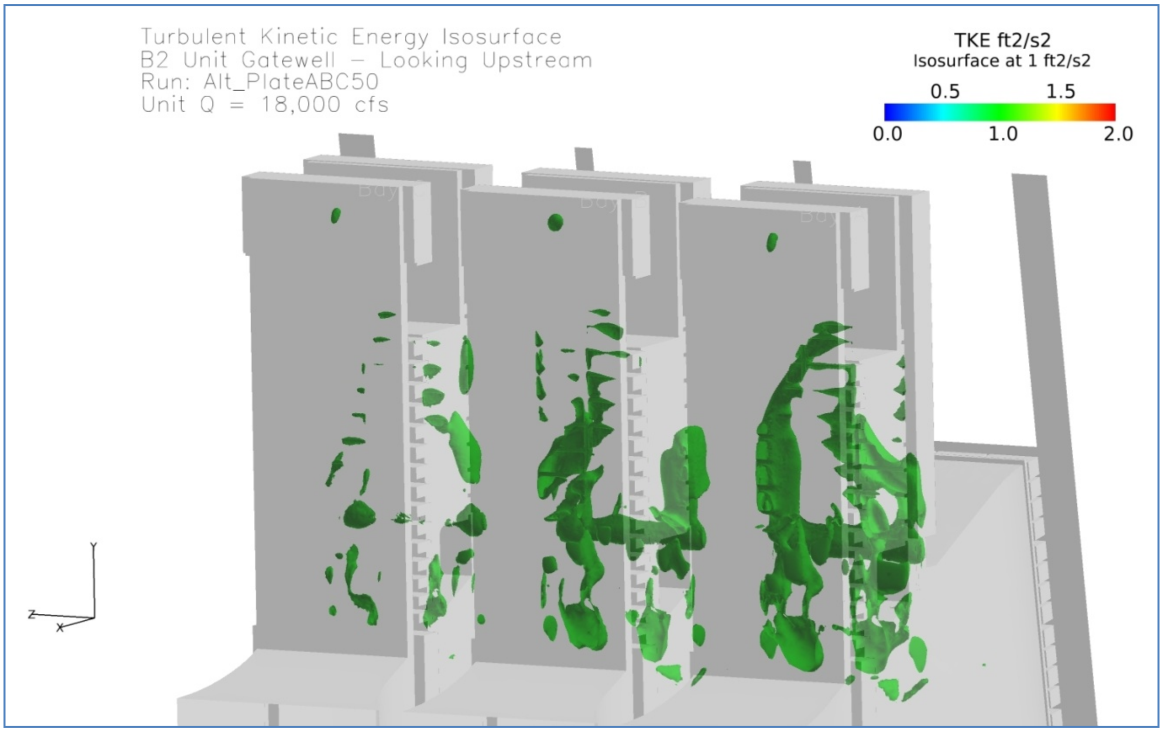


Figure 29. Alternative A3 (25% Blockage), Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

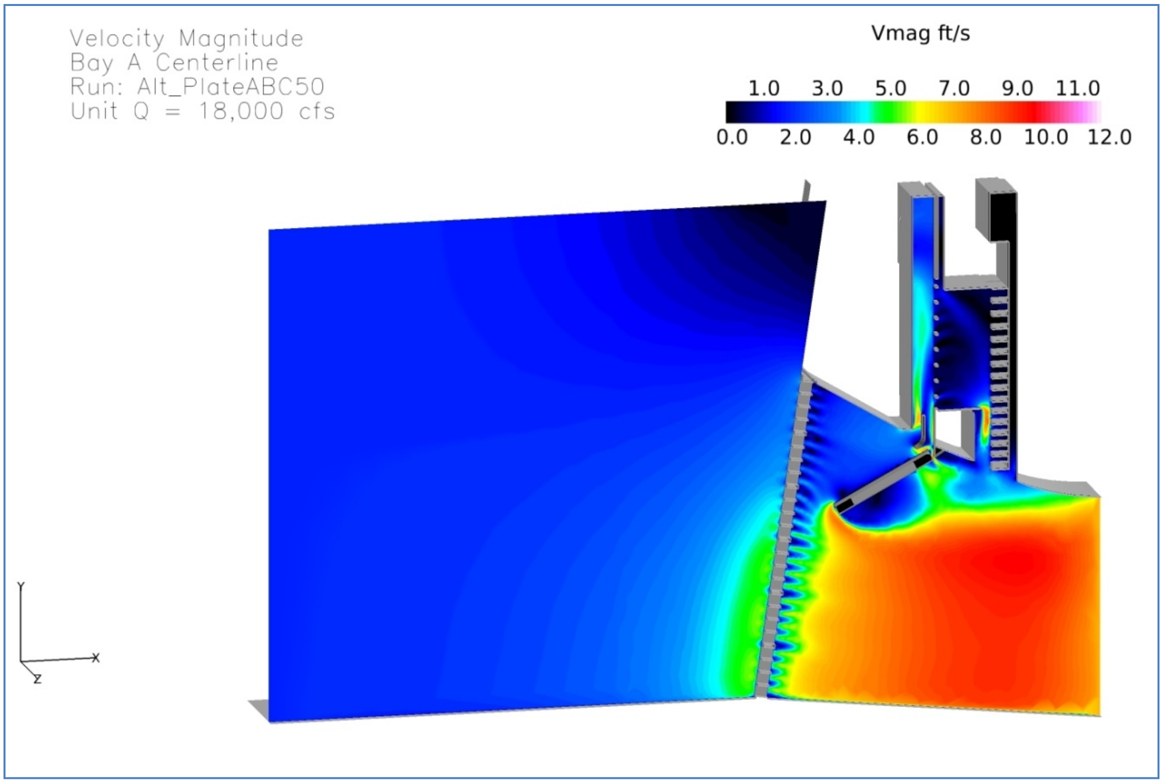


Figure 30. Alternative A3 (50% Blockage), Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

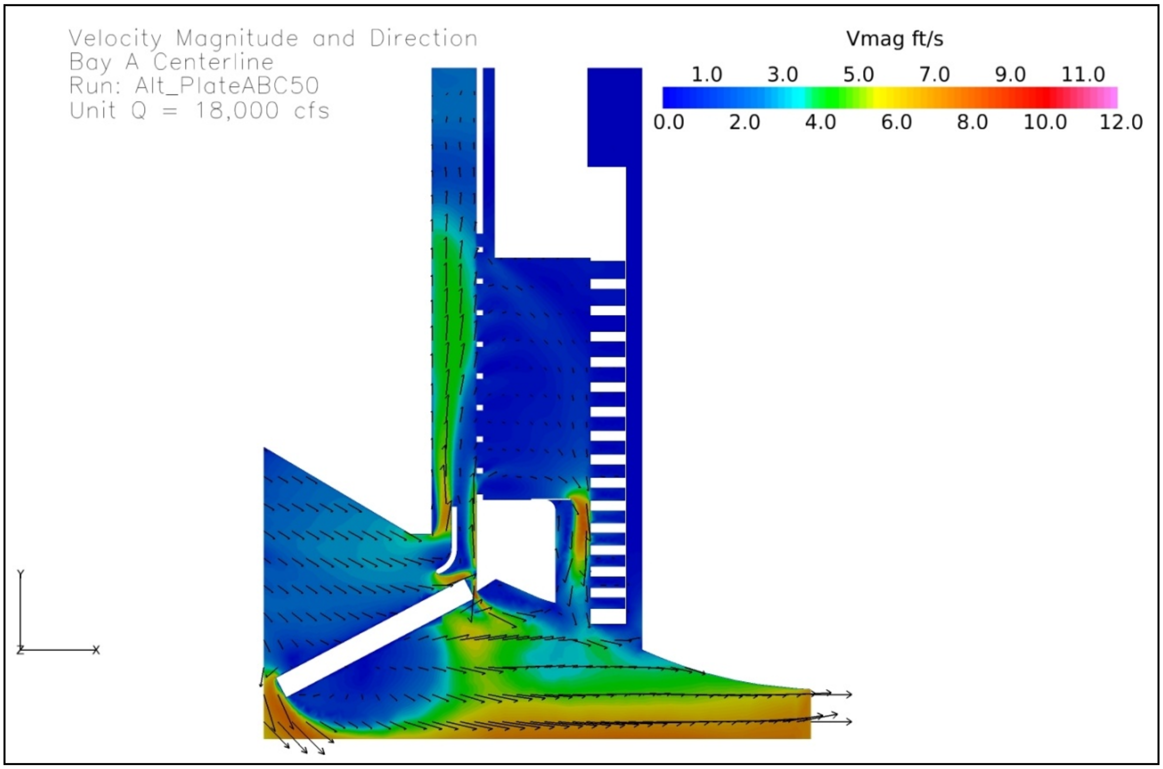


Figure 31. Alternative A3 (50% Blockage), Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

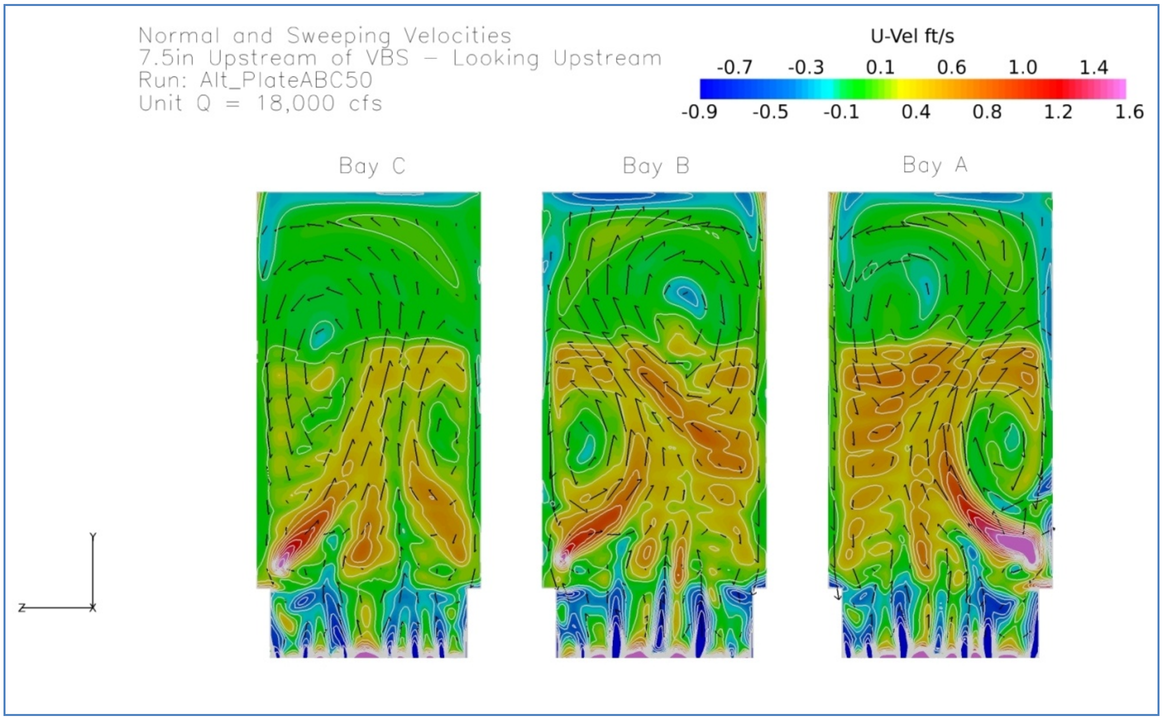


Figure 32. Alternative A3 (50% Blockage), Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

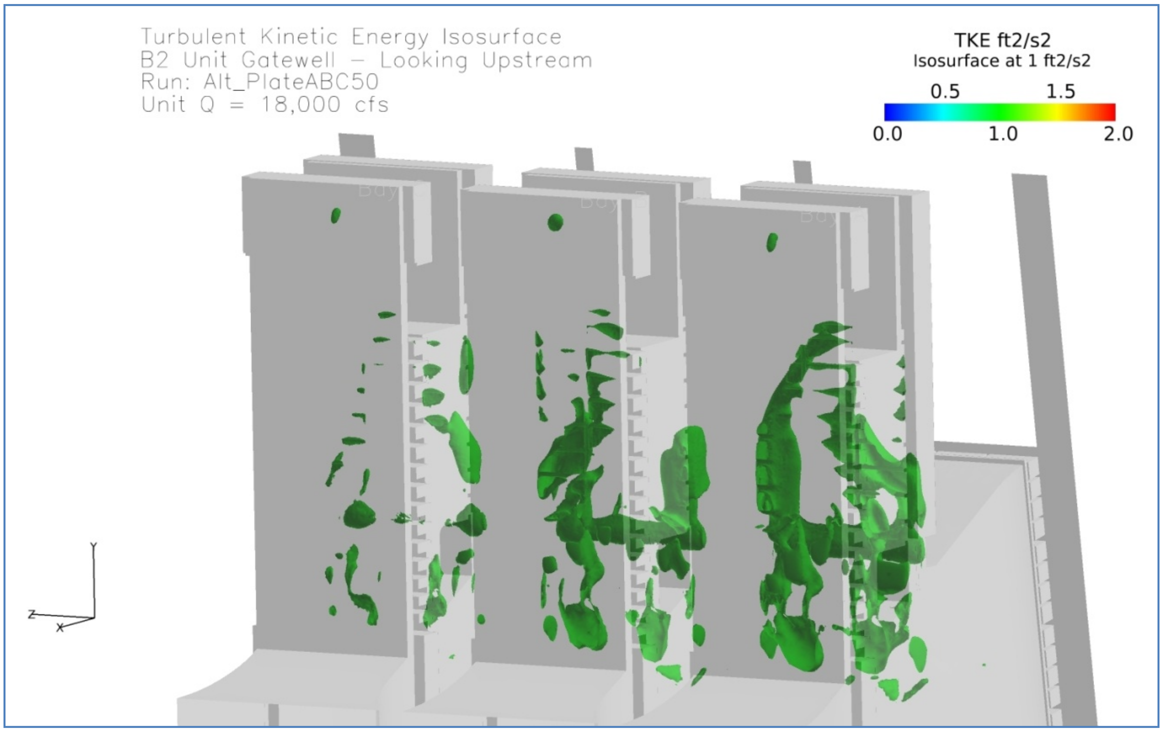


Figure 33. Alternative A3 (50% Blockage), Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

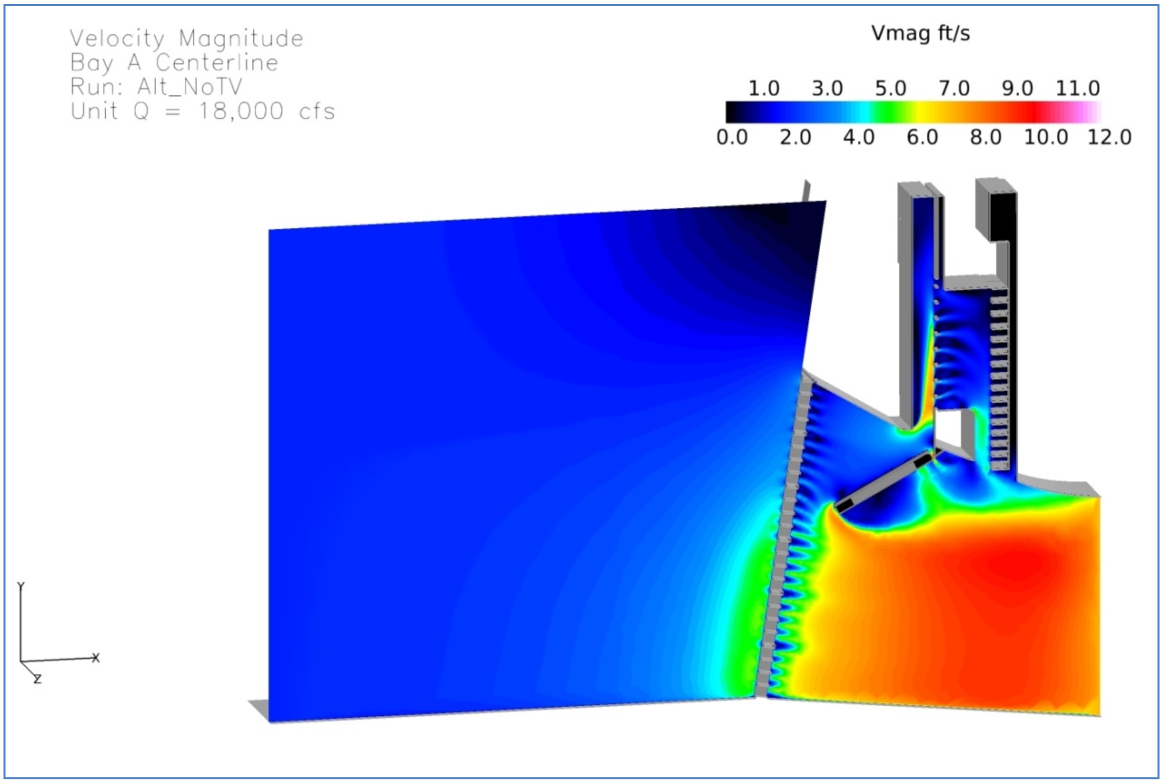


Figure 34. Alternative A6, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

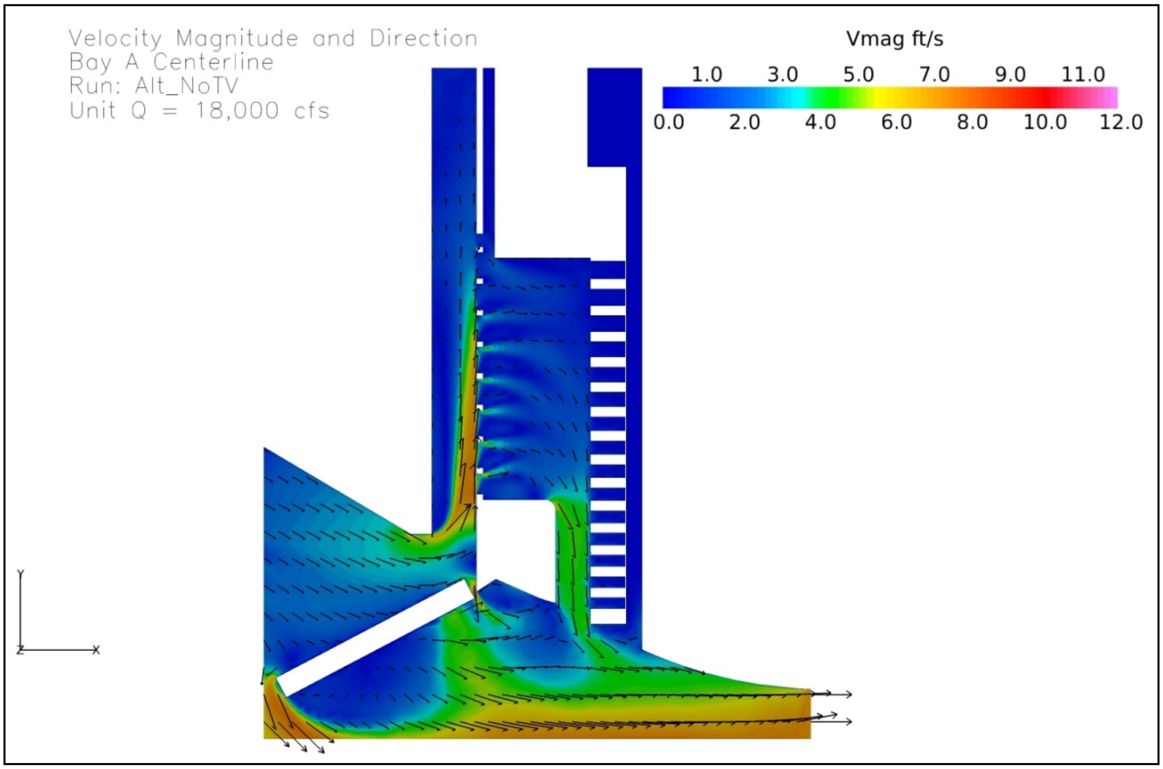


Figure 35. Alternative A6, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

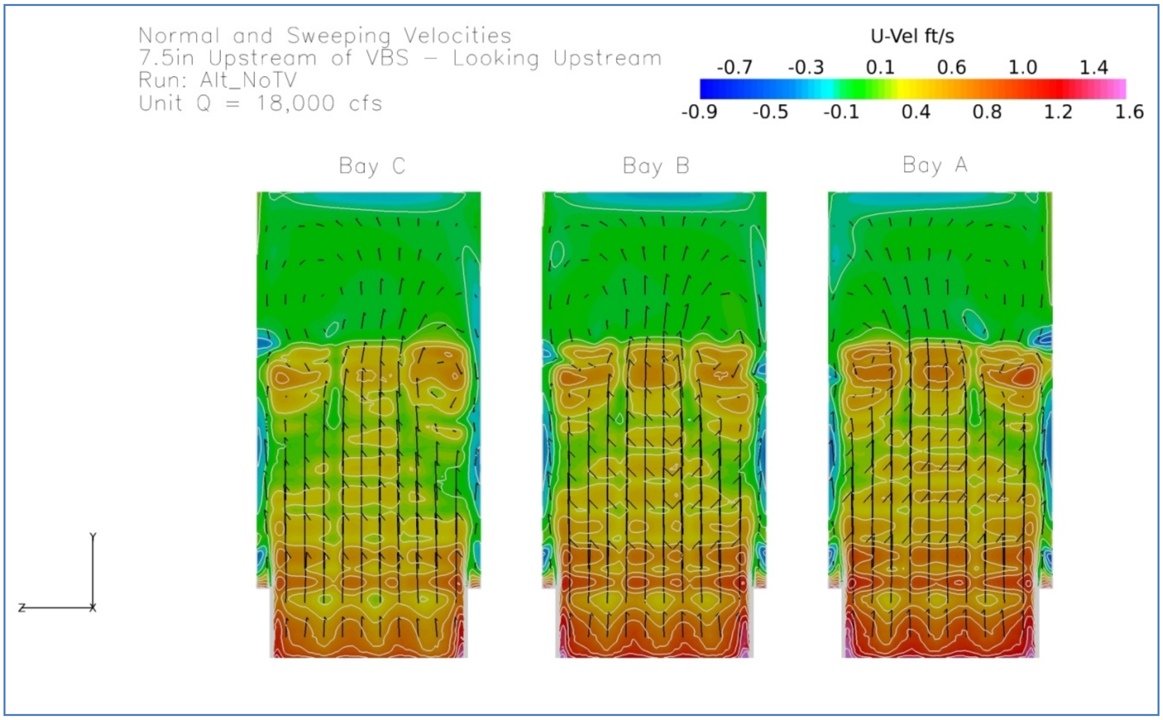


Figure 36. Alternative A6, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

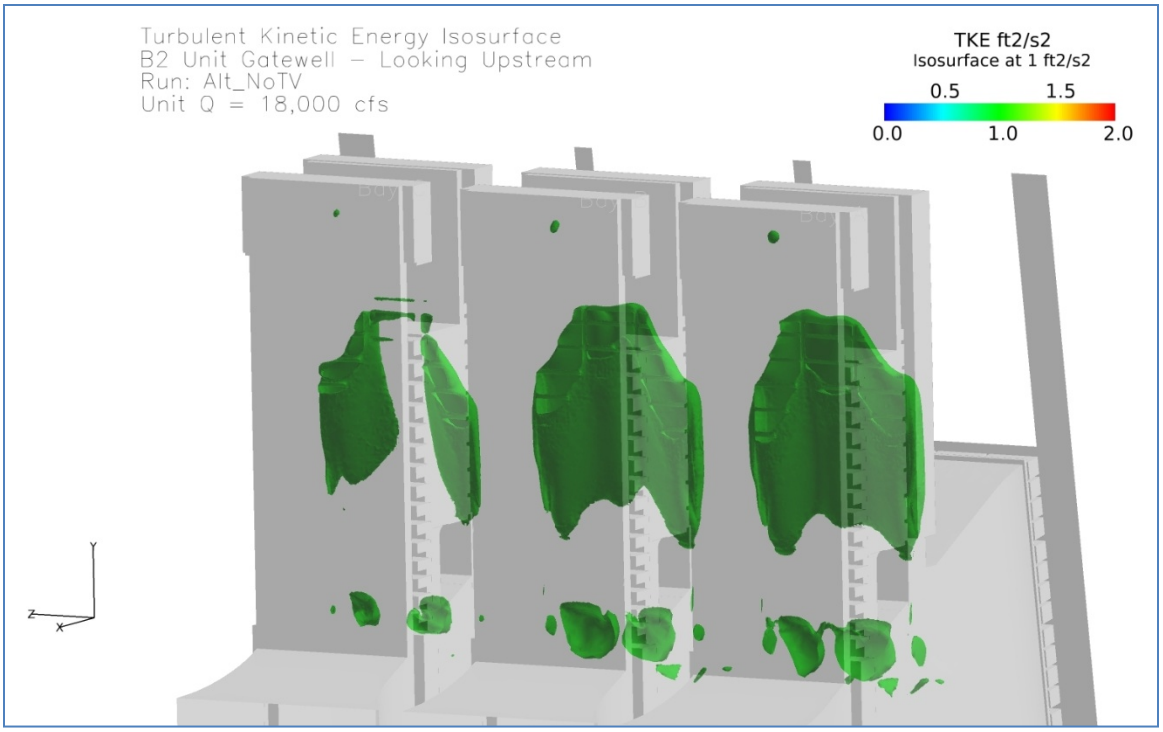


Figure 37. Alternative A6, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

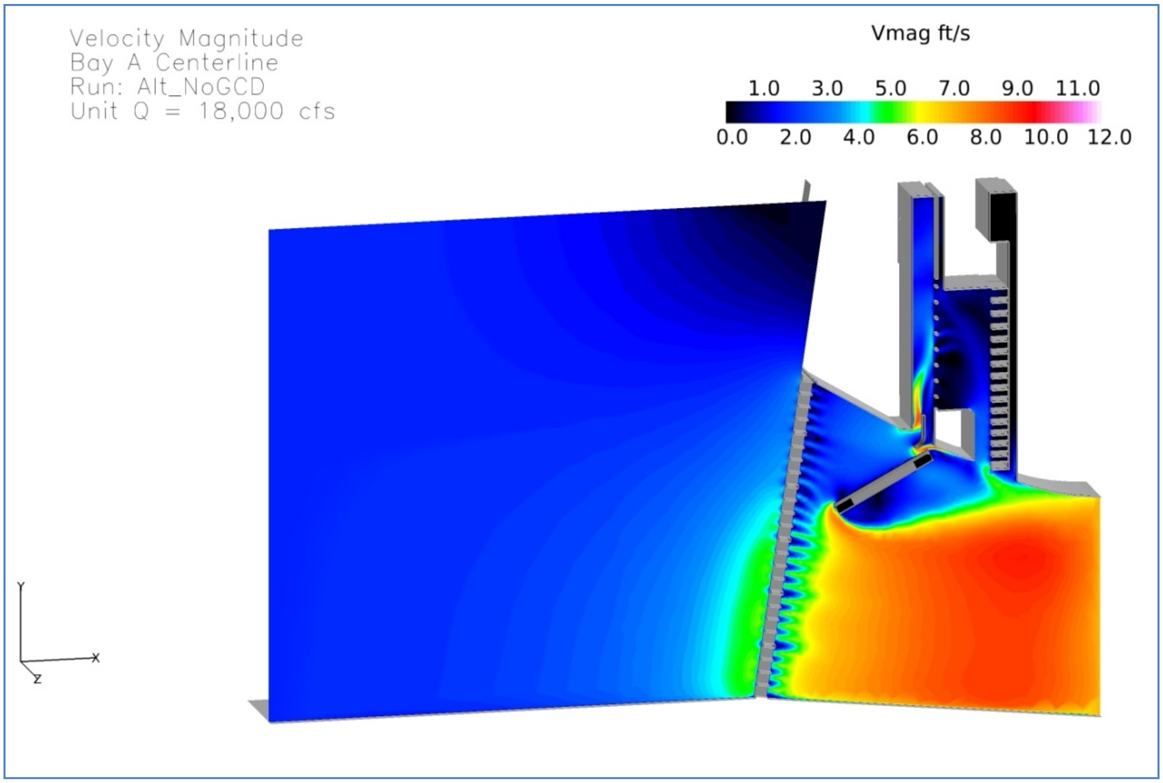


Figure 38. Alternative A7, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

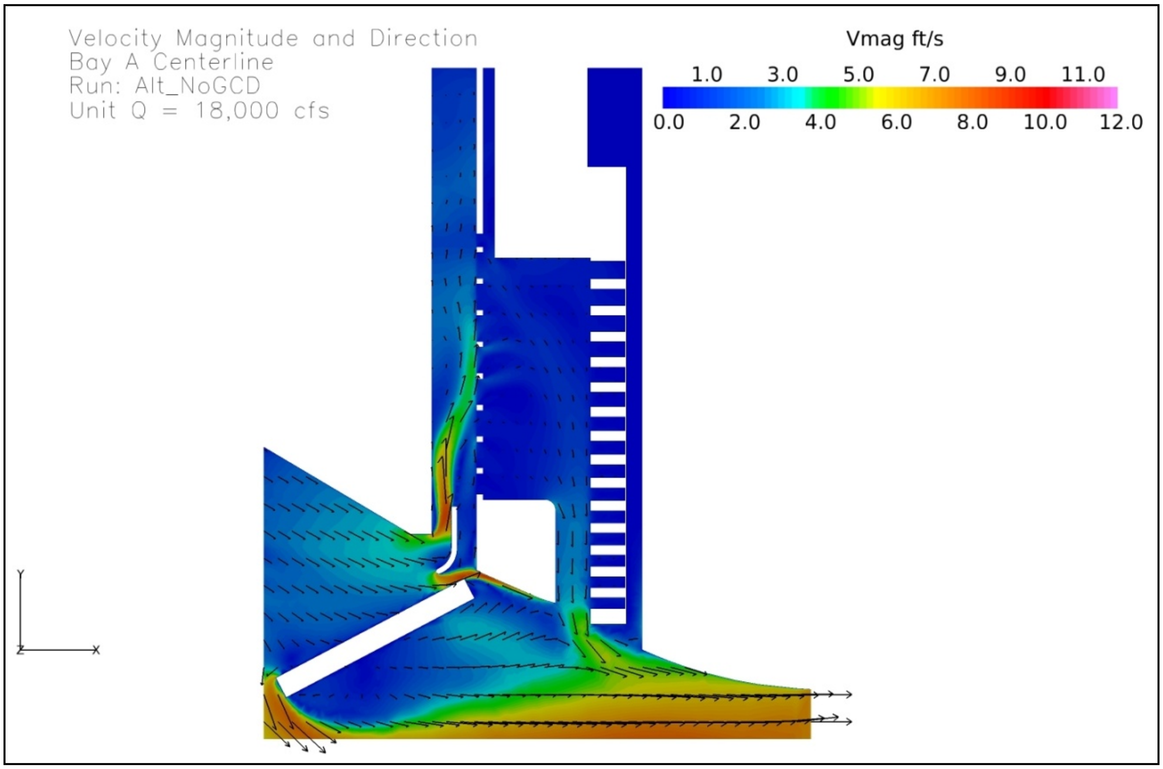


Figure 39. Alternative A7, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

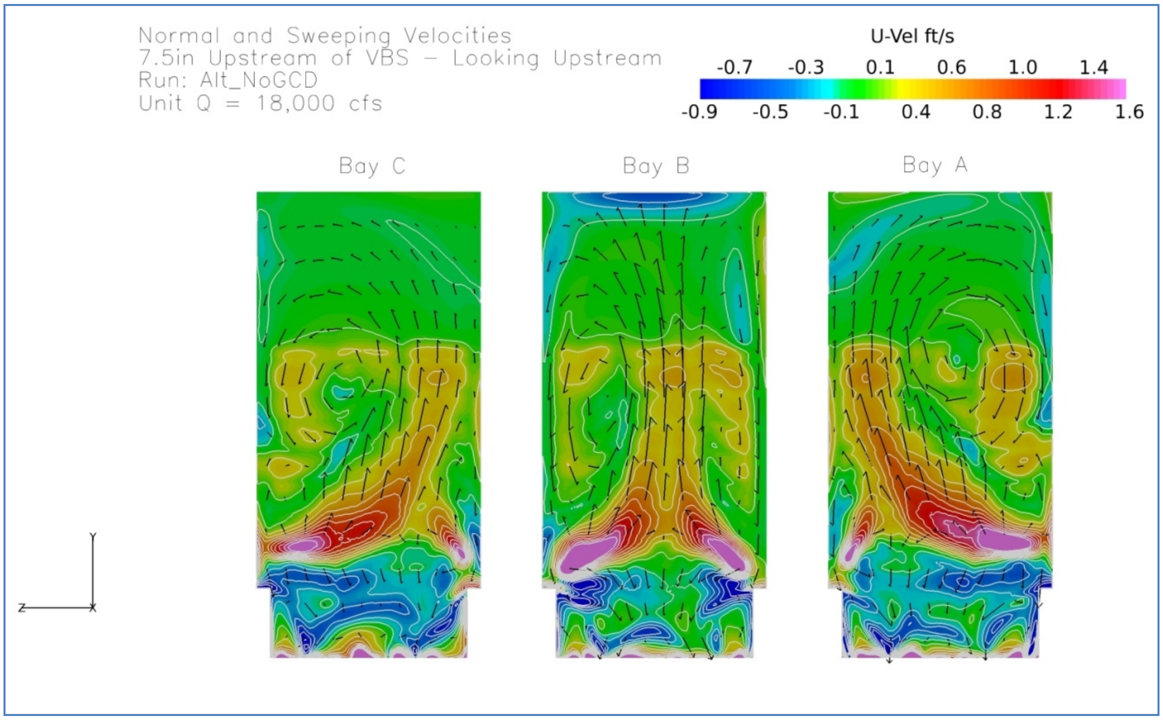


Figure 40. Alternative A7, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

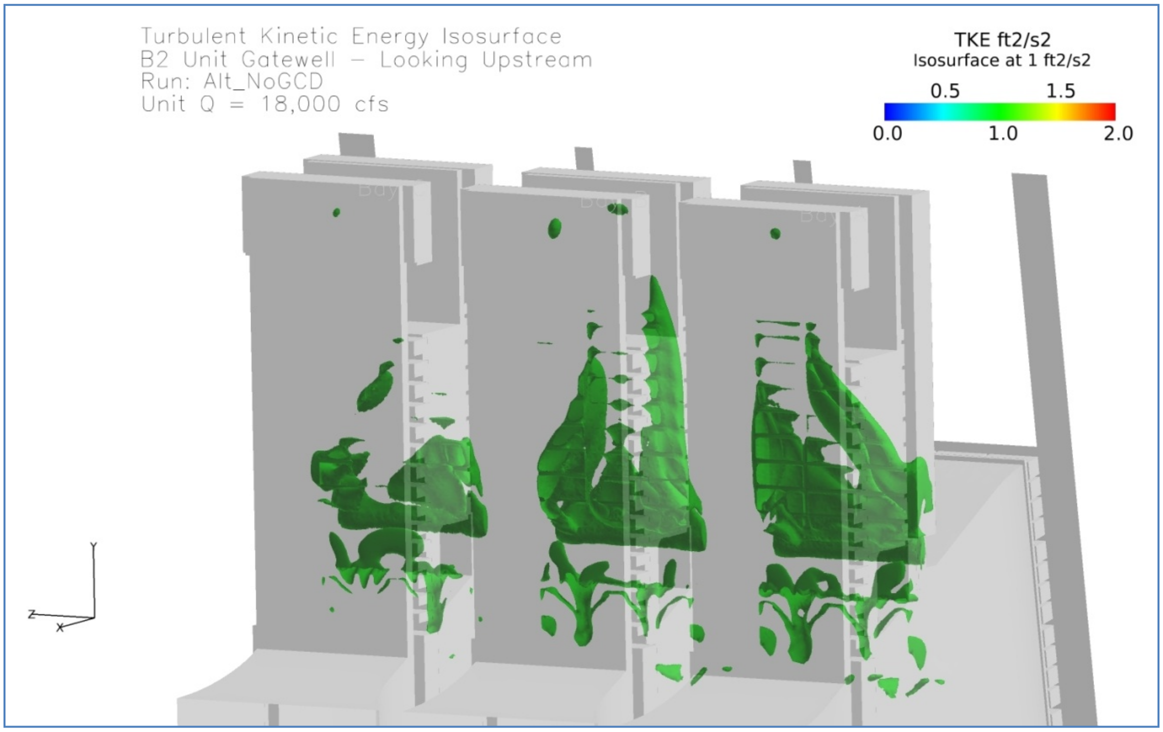


Figure 41. Alternative A7, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

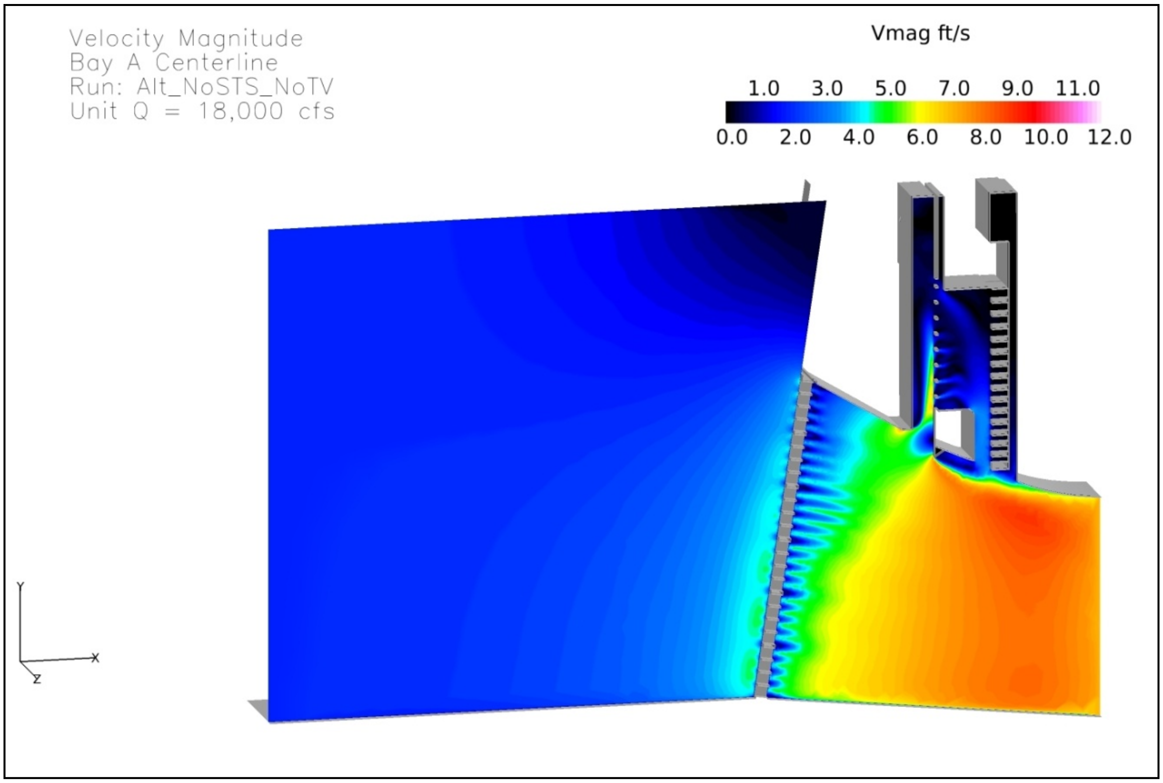


Figure 42. Alternative A8, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

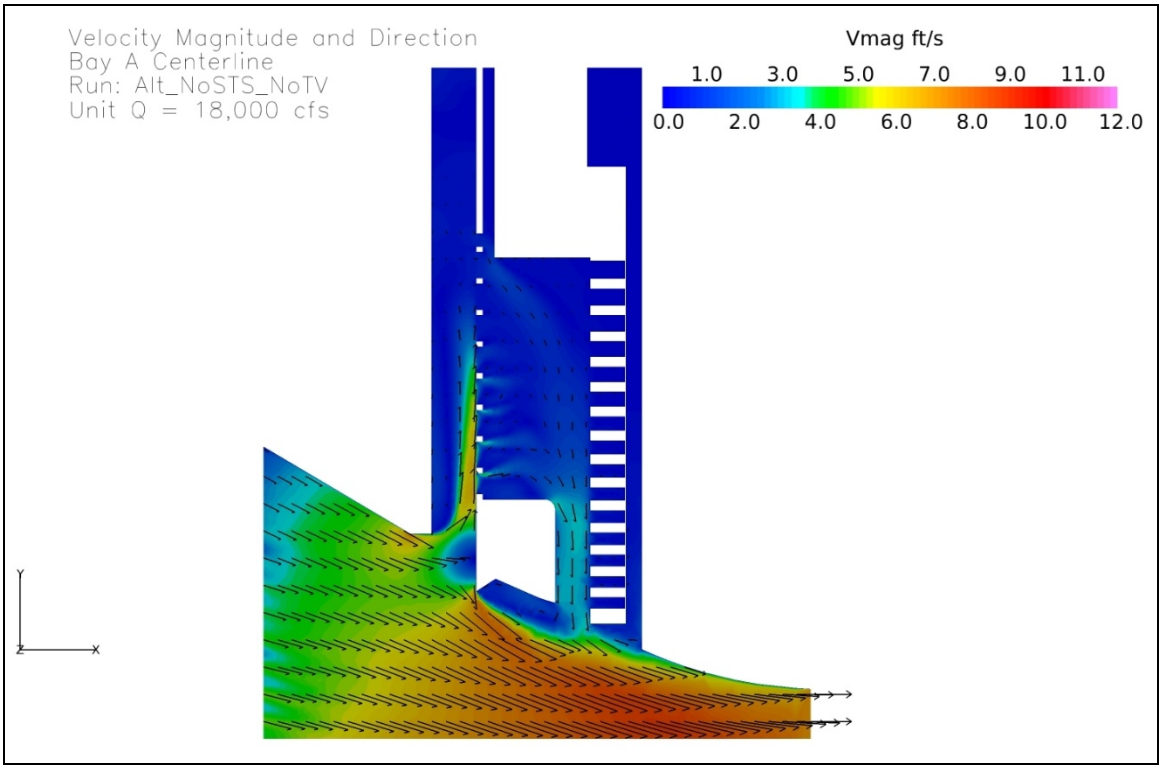


Figure 43. Alternative A8, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

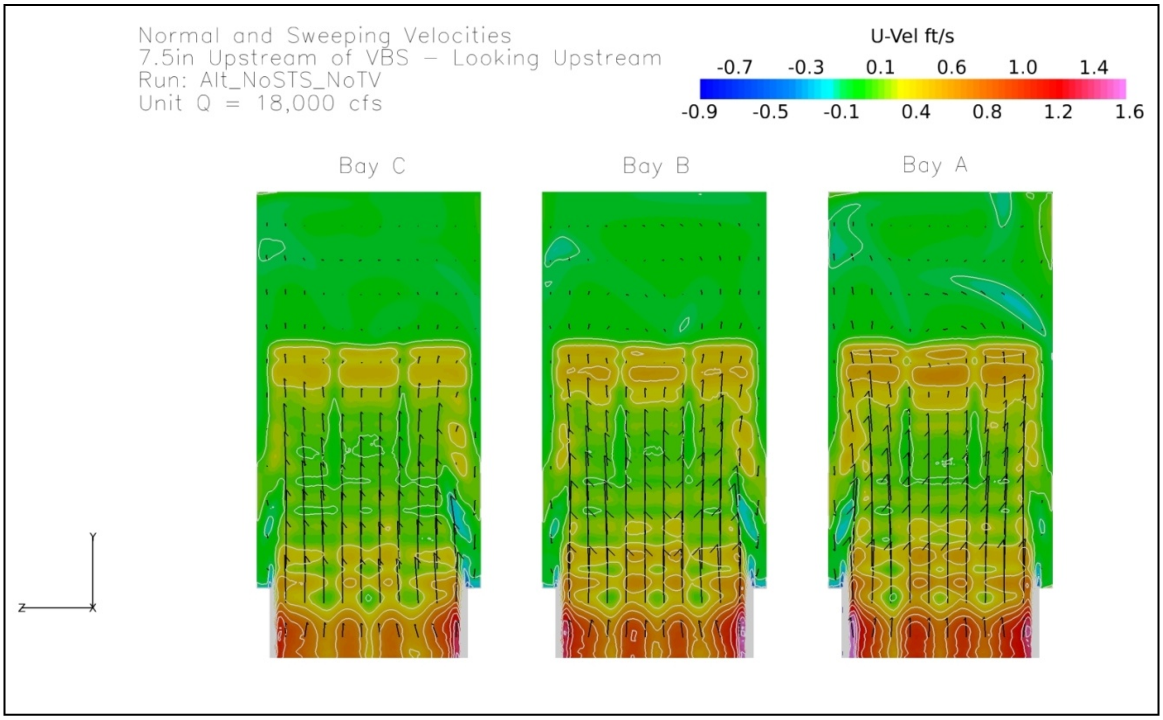


Figure 44. Alternative A8, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

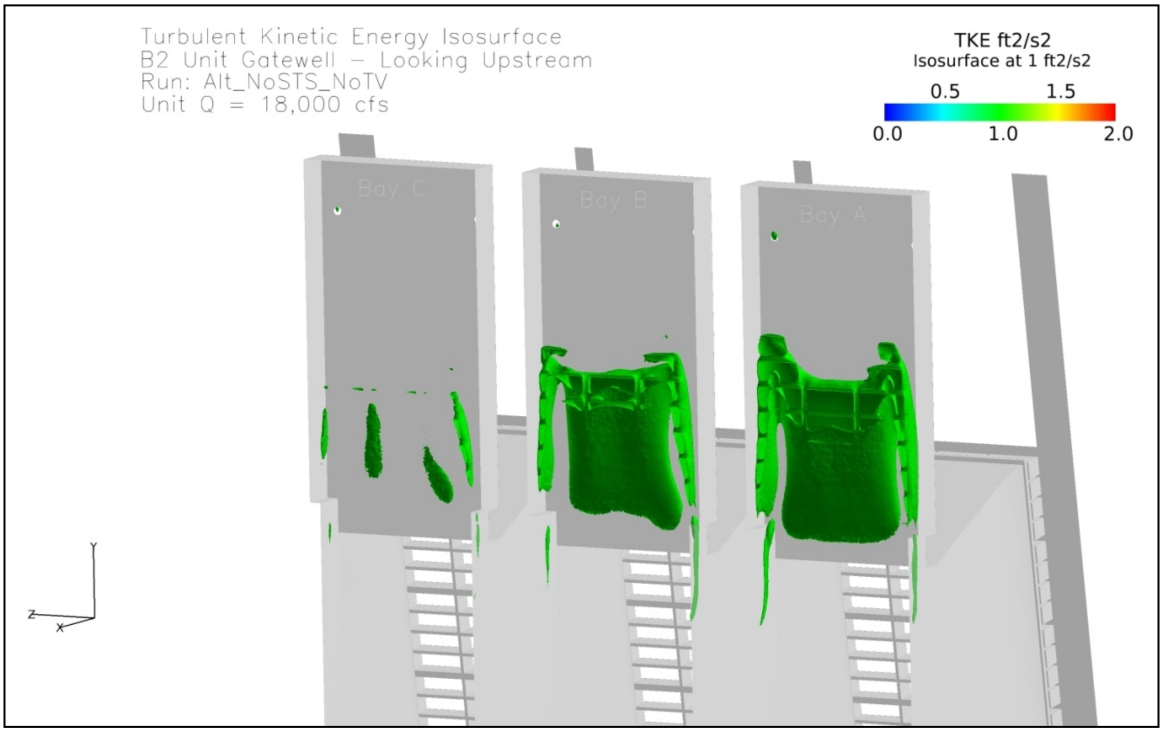


Figure 45. Alternative A8, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

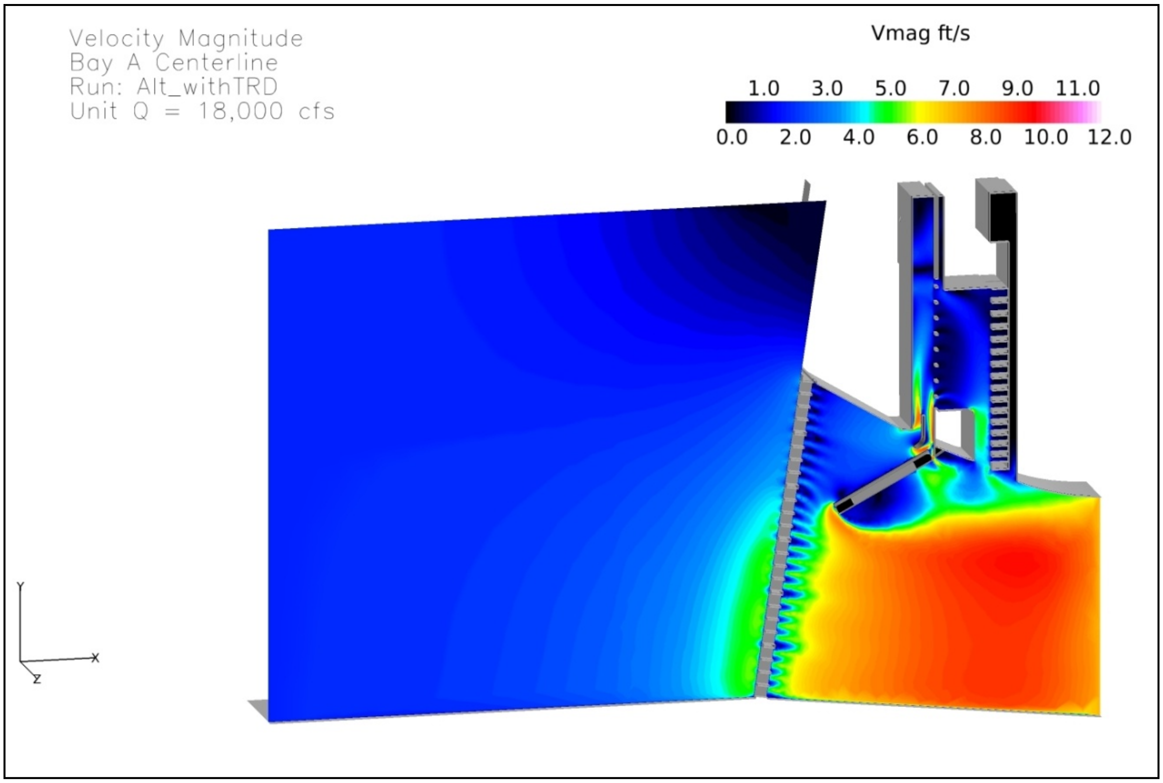


Figure 46. Alternative B1, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude

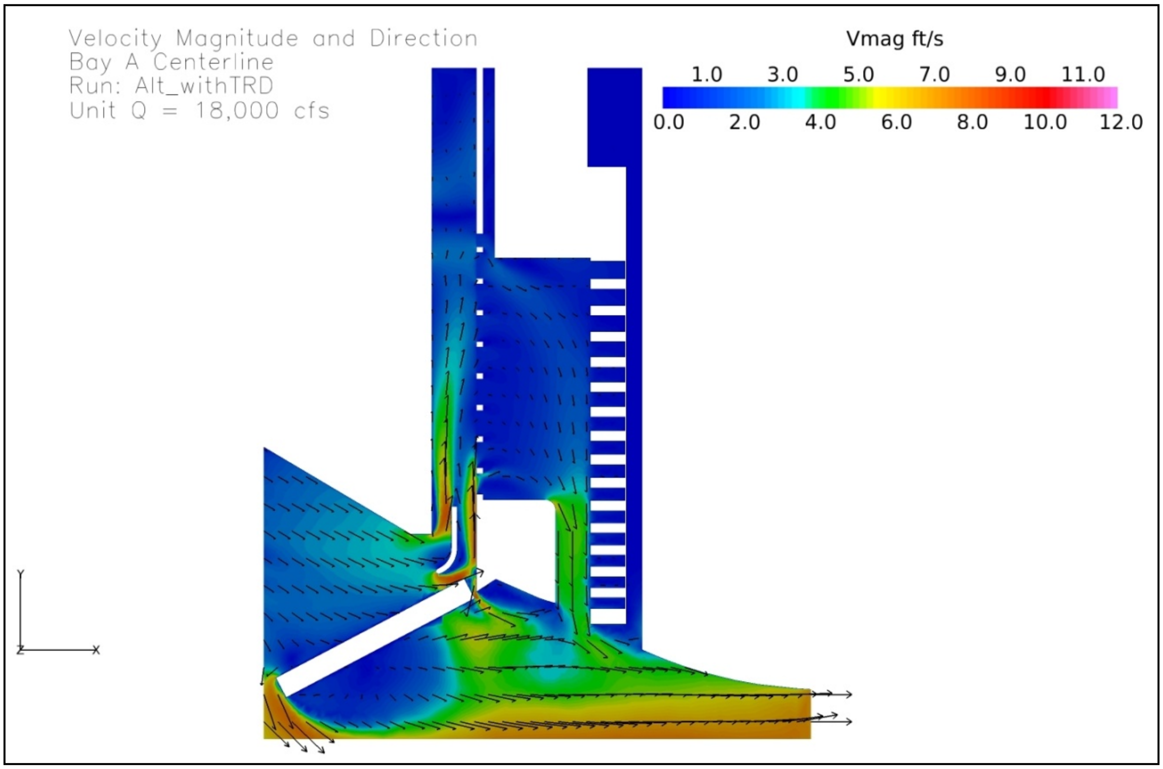


Figure 47. Alternative B1, Unit Q=18 kcfs, Bay A Centerline Velocity Magnitude and Flow Patterns

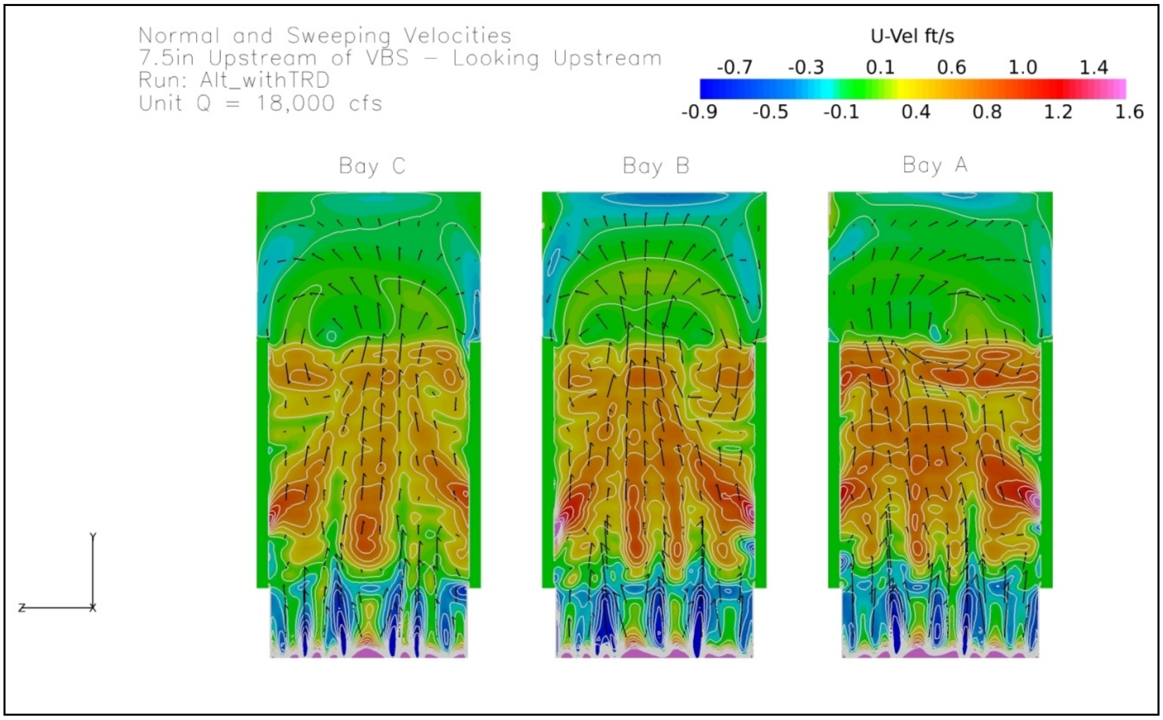


Figure 48. Alternative B1, Unit Q=18 kcfs, VBS Normal Velocities and Flow Patterns

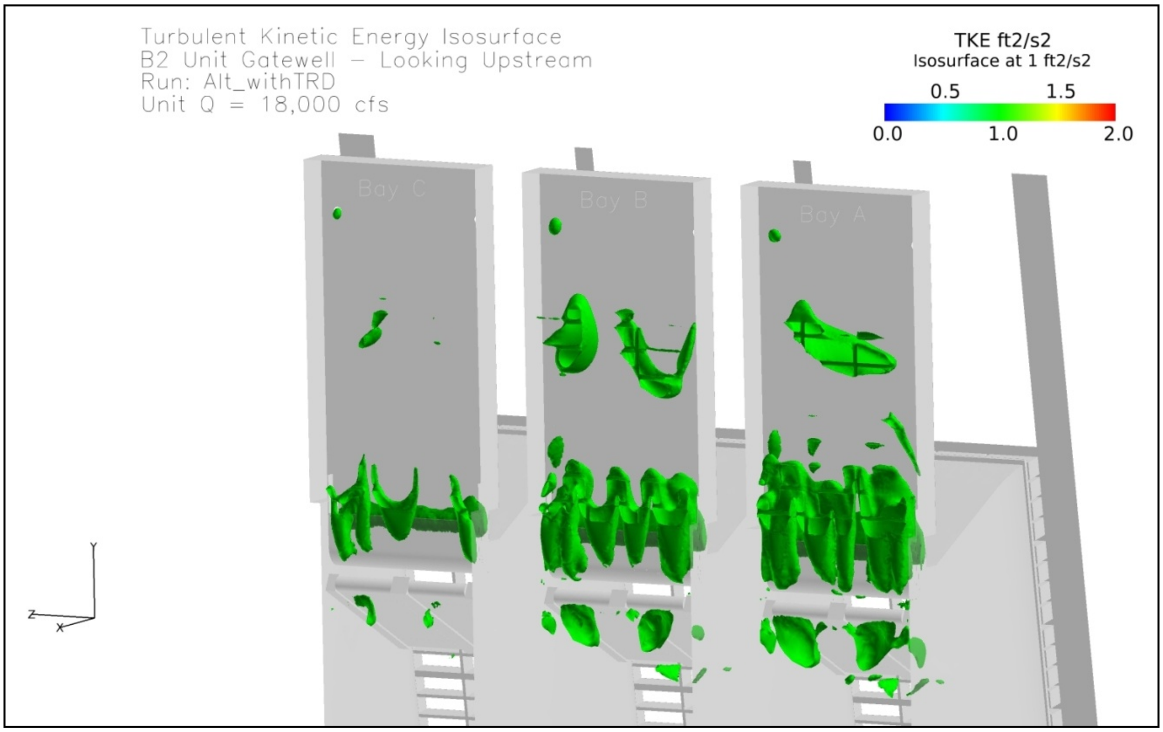


Figure 49. Alternative B1, Unit Q=18 kcfs, Turbulent Kinetic Energy Isosurface (1 ft^2/s^2)

CFD Report
APPENDIX A

Theoretical Porosity Coefficients

PROJECT: Bonneville 2nd Powerhouse FGE	**COMPUTED BY:** STS	**DATE:** 10/25/2013
SUBJECT: Theoretical Head Loss through VBS	**CHECKED BY:** LLE	**SHT.** 1 **OF** 5 **PART:**

CALCULATION COVER SHEET

These calculations solve for the theoretical head loss through the VBS screen and porosity plates at each panel, and then calculate the theoretical α and β in the Star-CCM+ equation for head loss through a porosity baffle.

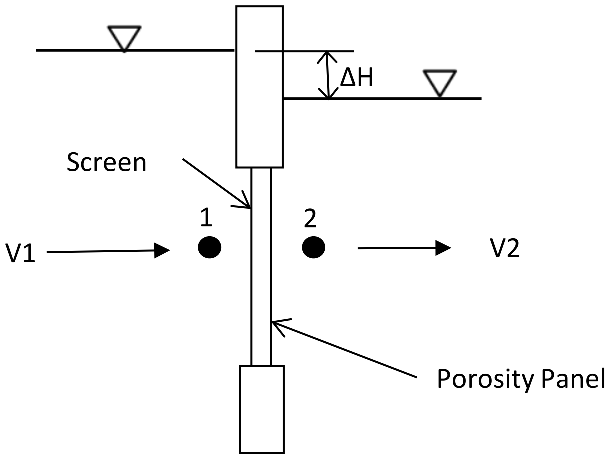
Results:

Review Comments:

Revision History:

Revision	Date:	Purpose	Checked By	Date
Original	10/22/2013			
rev 1	12/31/2013	Calculate alpha for metric units		
rev 2	7/3/2014	Updated for Star-CCM+ equation		
rev 3				

Theoretical Head Loss through VBS Screen and Porosity Plate



Consider the flow from 1 to 2 above using the Bernoulli equation:

$$z_1 + \frac{v_1^2}{2g} + \frac{p_1}{\gamma} = z_2 + \frac{v_2^2}{2g} + \frac{p_2}{\gamma} + h_L$$

Assumptions:

1. $z_1 = z_2$
2. $v_1 = v_2$

Simplifying and Rearranging:

$$\frac{p_2}{\gamma} - \frac{p_1}{\gamma} = -h_L \Rightarrow p_2 - p_1 = -\gamma h_L \Rightarrow \Delta p = -\gamma h_L$$

Define Head Loss Term:

The total head loss is due to head loss that occurs through the screen and also through the porosoity plate.

$$h_L = h_s + h_p \quad \text{where:} \quad h_s = k_s\left(\frac{V^2}{2g}\right) \quad \text{and} \quad h_p = k_p\left(\frac{V^2}{2g}\right)$$

So: $$h_L = (k_s + k_p)\left(\frac{V^2}{2g}\right)$$

Substituting: $$\Delta p = -\gamma(k_s + k_p)\frac{V^2}{2g} \Rightarrow \Delta p = -\left(\frac{\gamma}{2g}\right)(k_s + k_p)V^2$$

$$\Rightarrow \Delta p = -\left(\frac{\rho}{2}\right)(k_s + k_p)V^2$$

In Star-CCM+, VBS screen and porosity panel will be modeled as a porous baffle. The head loss through a porous baffle is calculated with the following equation (CD-Adapco):

$$\Delta p = -\rho(\alpha V^2 + \beta V)$$

Comparing the theoretical head loss equation derived above to the head loss eqaution for a porous baffle yields:

$$\alpha = \left(\frac{1}{2}\right)\left(k_s + k_p\right) \quad \text{and} \quad \beta = 0$$

Theoretical α for Each VBS Panel

Gravity, g:	32.2 ft/s^2	9.81 m/s^2
Specific Weight Water, γ:	62.4 lb/ft^3	9,810 N/m^3

Screen Loss Coefficient

Screen Porosity:	0.27 (Assumed based on NMFS criteria, needs to be confirmed)
Loss Coefficient, k_s:	22 (Miller, Fig 14.3)

Porosity Plate Loss Coefficient From Miller, Fig 14.3

Porosity	k_p
0.185	60
0.213	46
0.276	22
0.456	5.8
0.627	1.3

Panel	Porosity	k_p	α
1	1.000	0.0	11.00
2	0.456	5.8	13.90
3	0.213	46.0	34.00
4	0.213	46.0	34.00
5	0.213	46.0	34.00
6	0.185	60.0	41.00
7	0.185	60.0	41.00
8	0.276	22.0	22.00
9	0.627	1.3	11.65

References

1. Miller, Donald S. *Internal Fow Systems* . BHRA Fluid Engineering, 1978.
2. CD-Adapco. User Guide Star-CCM+ Version 8.02.

VBS Head Loss Table - Screen and Porosity Plate Losses

V (ft/s)	Screen ΔP_s (psi)	Porosity Plate ΔPp (psi) n=0.185	n=0.213	n=0.276	n=0.456	n=0.627
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.10	0.001	0.004	0.003	0.001	0.000	0.000
0.20	0.006	0.016	0.012	0.006	0.002	0.000
0.30	0.013	0.036	0.028	0.013	0.004	0.001
0.40	0.024	0.065	0.050	0.024	0.006	0.001
0.50	0.037	0.101	0.077	0.037	0.010	0.002
0.60	0.053	0.145	0.111	0.053	0.014	0.003
0.70	0.073	0.198	0.152	0.073	0.019	0.004
0.80	0.095	0.258	0.198	0.095	0.025	0.006
0.90	0.120	0.327	0.251	0.120	0.032	0.007
1.00	0.148	0.404	0.310	0.148	0.039	0.009
1.10	0.179	0.489	0.375	0.179	0.047	0.011
1.20	0.213	0.581	0.446	0.213	0.056	0.013
1.30	0.250	0.682	0.523	0.250	0.066	0.015
1.40	0.290	0.791	0.607	0.290	0.076	0.017
1.50	0.333	0.908	0.696	0.333	0.088	0.020
1.60	0.379	1.034	0.792	0.379	0.100	0.022
1.70	0.428	1.167	0.895	0.428	0.113	0.025
1.80	0.480	1.308	1.003	0.480	0.126	0.028
1.90	0.534	1.457	1.117	0.534	0.141	0.032
2.00	0.592	1.615	1.238	0.592	0.156	0.035

VBS Head Loss Table - Total Head Loss

	Total *ΔP* (psi)					
V (ft/s)	n=0.185	n=0.213	n=0.276	n=0.456	n=0.627	n=1.000
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.10	0.006	0.005	0.003	0.002	0.002	0.001
0.20	0.022	0.018	0.012	0.007	0.006	0.006
0.30	0.050	0.041	0.027	0.017	0.014	0.013
0.40	0.088	0.073	0.047	0.030	0.025	0.024
0.50	0.138	0.114	0.074	0.047	0.039	0.037
0.60	0.199	0.165	0.107	0.067	0.056	0.053
0.70	0.270	0.224	0.145	0.092	0.077	0.073
0.80	0.353	0.293	0.189	0.120	0.100	0.095
0.90	0.447	0.371	0.240	0.152	0.127	0.120
1.00	0.552	0.458	0.296	0.187	0.157	0.148
1.10	0.668	0.554	0.358	0.226	0.190	0.179
1.20	0.795	0.659	0.426	0.269	0.226	0.213
1.30	0.932	0.773	0.500	0.316	0.265	0.250
1.40	1.081	0.897	0.580	0.367	0.307	0.290
1.50	1.241	1.030	0.666	0.421	0.353	0.333
1.60	1.413	1.171	0.758	0.479	0.401	0.379
1.70	1.595	1.322	0.856	0.541	0.453	0.428
1.80	1.788	1.482	0.959	0.606	0.508	0.480
1.90	1.992	1.652	1.069	0.675	0.566	0.534
2.00	2.207	1.830	1.184	0.748	0.627	0.592

PROJECT: Bonneville 2nd Powerhouse FGE	**COMPUTED BY:** STS	**DATE:** 4/18/2014
SUBJECT: Theoretical Head Loss through STS	**CHECKED BY:** LLE	**SHT.** 1 **OF** 4 **PART:**

CALCULATION COVER SHEET

These calculations solve for the theoretical head loss through the submerged traveling screen (STS) screen and then calculates the theoretical α and β in the Star-CCM+ equation for head loss through a porosity baffle. The head loss throug the STS includes loss through the two meshes and a porosity plate.

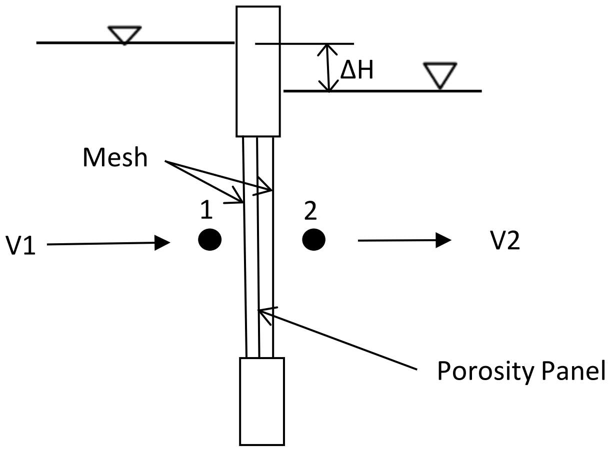
Results:

Review Comments:

Revision History:

Revision	Date:	Purpose	Checked By	Date
Original	4/18/2014			
rev 1	7/3/2014	Updated for Star-CCM+ equation		
rev 2				
rev 3				

Theoretical Head Loss through STS Screen



Consider the flow from 1 to 2 above using the Bernoulli equation:

$$z_1+\frac{v_1^2}{2g}+\frac{p_1}{\gamma}=z_2+\frac{v_2^2}{2g}+\frac{p_2}{\gamma}+h_L$$

Assumptions:

1. $z_1 = z_2$
2. $v_1 = v_2$

Simplifying and Rearranging:

$$\frac{p_2}{\gamma}-\frac{p_1}{\gamma}=-h_L \Rightarrow p_2-p_1=-\gamma h_L \Rightarrow \Delta p=-\gamma h_L$$

Define Head Loss Term:

The total head loss is due to head loss that occurs through the screen and also through the porosoity plate.

$$h_L=h_s+h_p \quad \text{where:} \quad h_s=k_s\left(\frac{V^2}{2g}\right) \quad \text{and} \quad h_p=k_p\left(\frac{V^2}{2g}\right)$$

So: $$h_L=(k_s+k_p)\left(\frac{V^2}{2g}\right)$$

Substituting: $$\Delta p=-\gamma(k_s+k_p)\frac{V^2}{2g} \Rightarrow \Delta p=-\left(\frac{\gamma}{2g}\right)(k_s+k_p)V^2$$

$$\Rightarrow \Delta p=-\left(\frac{\rho}{2}\right)(k_s+k_p)V^2$$

In Star-CCM+, the STS screen will be modeled as a porous baffle. The head loss through a porous baffle is calculated with the following equation (CD-Adapco):

$$\Delta p=-\rho(\alpha V^2+\beta V)$$

Comparing the theoretical head loss equation derived above to the head loss eqaution for a porous baffle yields

$$\alpha = \left(\frac{1}{2}\right)\left(k_s + k_p\right) \quad \text{and} \quad \beta = 0$$

Theoretical α for STS:

Gravity, g :	32.2	ft/s^2	9.81	m/s^2
Specific Weight Water, γ :	62.4	lb/ft^3	9,810	N/m^3

Mesh Loss Coefficient

Mesh Porosity	0.5	(Assumed based on visual observation)
Loss Coefficient, k_s :	2	(Miller, Fig 14.7)

Porosity Plate Loss Coefficient

Plate Porosity:	0.46	(Based on Record Drawings BDP-5-3-4/27)
Loss Coefficient, k_p :	5.8	(Miller, Fig 14.3)

Total Loss Coefficient

Loss Coefficient, k_T : 9.8

Theoretical Alpha, α: 4.90

References

1. Miller, Donald S. *Internal Fow Systems* . BHRA Fluid Engineering, 1978.
2. CD-Adapco. User Guide Star-CCM+ Version 8.02.

STS Head Loss Table

	Head Loss (psi)		
V (ft/s)	Mesh	Porosity Plate	Total
0.00	0.000	0.000	0.000
0.20	0.001	0.002	0.003
0.40	0.004	0.006	0.011
0.60	0.010	0.014	0.024
0.80	0.017	0.025	0.042
1.00	0.027	0.039	0.066
1.20	0.039	0.056	0.095
1.40	0.053	0.076	0.129
1.60	0.069	0.100	0.169
1.80	0.087	0.126	0.214
2.00	0.108	0.156	0.264
2.20	0.130	0.189	0.319
2.40	0.155	0.225	0.380
2.60	0.182	0.264	0.446
2.80	0.211	0.306	0.517
3.00	0.242	0.351	0.593
3.20	0.276	0.400	0.675
3.40	0.311	0.451	0.762
3.60	0.349	0.506	0.855
3.80	0.389	0.564	0.952
4.00	0.431	0.624	1.055

CFD Report
APPENDIX B

Quality Control Documentation

US Army Corps of Engineers ®
Portland District

Memorandum for File: CFD QA/QC

Date: 03-Sep-2014
Project: B2 FGE VBS CFD
Subject: QA/QC, Boundary Conditions
To: Seth Stevens, Hydraulic and Coastal Design Section
Reviewer: Aaron Litzenberg, Hydraulic and Coastal Design Section

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Purpose and Description

The purpose of this QA/QC effort was to check the accuracy of the boundary conditions for 36 different model runs. The CFD model is for the Bonneville Second Powerhouse Fish Guidance Efficiency Velocity Barrier Screens, which help to enhance fish passage through the penstocks of the dam by guiding them away from the turbines and up to a lower mortality fish passage option. The model is being used to test different alternatives for evening out the flow through the velocity barrier screens to increase the guidance efficiency of the system.

Reviewer Comments

There were three different methods for checking the boundary conditions of each run. The first method was to export the summary file from STAR-CCM and print the entire report. This was done for the first model run only, for documentation purposes.

For the remaining calibration, grid development, validation, and baseline runs, the summary output files were compared to the original output summary file by using the Diff option (which runs through the terminal of the Linux CFD computers). This comparison tool takes the .html summary files and compares them line by line, outputting a text file with the differences. These text files were then printed for documentation.

Since the alternatives model runs were comparatively different than the original calibration file used for Diff comparison, the alternatives runs were checked using their output summary files. Only the upstream and downstream values were highlighted and printed for documentation, as these model runs were originally based on other models runs and the interface values should not have been changed.

Conclusions and Recommendations

All checked boundary conditions were found to be correct. The only differences found were the names of model runs, specifically with:
Alpha_Ver5_Beta_001_with_TRD_Q_17100_STS_Alpha05_Beta**00**1@03000.sim,
Alt_PlateABC25_Q18~~**3**~~000@03000.sim, and
Alt_All**VBS**Blocked_Q18000@03000.sim .

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 8/20/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver5_Beta_001_with_TRD_Q_17100@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_Beta_001_with_TRD_Q_17100		
Run Description: VBS calibration run using theoretical alphas and beta = 0.01 for VBS and STS; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: 1.940653803 ft/s** ✓
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -2.05932 m/s** ✓
Boundary Name: Out_B	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.63733 m/s** ✓
Boundary Name: Out_C	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.29891 m/s** ✓
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_A_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_B_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet** ✓	**Pressure: 1.0 atm** ✓
Boundary Name: Orifice_C_S	**Boundary Type: Wall** ✓	
Interfaces - Porous Baffle:	A | B | C	A | B | C
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45** ✓ | ✓ | ✓	**Porous Viscous Resistance: 0.01** ✓ | ✓ | ✓
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft	**Reference pressure: 0.0 atm**	
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 8/20/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver7_Beta_001_with_TRD_Q_17100@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver7_Beta_001_with_TRD_Q_17100		
Run Description: VBS calibration run using (theoretical alphas)/10 and beta = 0.01 for VBS and theoretical alpha and beta = 0.01 for STS; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: 1.940653803 ft/s ✓
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -2.05932 m/s ✓
Boundary Name: Out_B	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.63733 m/s ✓
Boundary Name: Out_C	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.29891 m/s ✓
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -4.43 m/s ✓
Boundary Name: Orifice_A_S	Boundary Type: Wall ✓	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -4.43 m/s ✓
Boundary Name: Orifice_B_S	Boundary Type: Wall ✓	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet ✓	Pressure: 1.0 atm ✓
Boundary Name: Orifice_C_S	Boundary Type: Wall ✓	
Interfaces - Porous Baffle:	A | B | C	A | B | C
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 1.10 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 1.39 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 3.40 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 3.40 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 3.40 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 4.10 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 4.10 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 2.20 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 1.17 1.165 | 1.165 | 1.165	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 8/20/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver8_Beta_001_with_TRD_Q_17100@06000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver8_Beta_001_with_TRD_Q_17100		
Run Description: VBS calibration run using (theoretical alphas)*2 and beta = 0.01 for VBS and theoretical alpha and beta = 0.01 for STS; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: 1.940653803 ft/s ✓
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -2.05932 m/s ✓
Boundary Name: Out_B	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.63733 m/s ✓
Boundary Name: Out_C	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.29891 m/s ✓
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -4.43 m/s ✓
Boundary Name: Orifice_A_S	Boundary Type: Wall ✓	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -4.43 m/s ✓
Boundary Name: Orifice_B_S	Boundary Type: Wall ✓	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet ✓	Pressure: 1.0 atm ✓
Boundary Name: Orifice_C_S	Boundary Type: Wall ✓	
	A | B | C	A | B | C
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 22.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 27.80 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 68.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 68.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 68.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 82.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 82.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 44.00 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 23.30 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45 ✓ | ✓ | ✓	Porous Viscous Resistance: 0.01 ✓ | ✓ | ✓
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 8/20/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver5_Beta_001_with_TRD_Q_15000@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_Beta_001_with_TRD_Q_15000		
Run Description: VBS calibration run using theoretical alphas and beta = 0.01 for VBS and STS; TRD in; Unit Flow = 15,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: 1.702786939 ft/s ✓
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.80643 m/s ✓
Boundary Name: Out_B	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.43625 m/s ✓
Boundary Name: Out_C	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -1.13939 m/s ✓
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -4.43 m/s ✓
Boundary Name: Orifice_A_S	Boundary Type: Wall ✓	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet ✓	Velocity Magnitude: -4.43 m/s ✓
Boundary Name: Orifice_B_S	Boundary Type: Wall ✓	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet ✓	Pressure: 1.0 atm ✓
Boundary Name: Orifice_C_S	Boundary Type: Wall ✓	
Interfaces - Porous Baffle:	A B C	A B C
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45 ✓ ✓ ✓	Porous Viscous Resistance: 0.01 ✓ ✓ ✓
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 8/20/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver5_Beta_001_with_TRD_Q_17100_STS_Alpha50_Beta1@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_Beta_001_with_TRD_Q_17100_STS_Alpha50_Beta1		
Run Description: STS alpha sensitivity run using theoretical alphas and beta = 0.01 for VBS and alpha = 50 and beta = 0.01 for STS; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: 1.940653803 ft/s** ✓
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -2.05932 m/s** ✓
Boundary Name: Out_B	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.63733 m/s** ✓
Boundary Name: Out_C	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.29891 m/s** ✓
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_A_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_B_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet** ✓	**Pressure: 1.0 atm** ✓
Boundary Name: Orifice_C_S	**Boundary Type: Wall** ✓	
Interfaces - Porous Baffle:	A B C	A B C
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 25** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 25** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenburg		**Parent File:**
Date: 8/20/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
	Beta 001	
Run Information:		
File: Alpha_Ver5_Beta_001_with_TRD_Q_17100_STS_Alpha05_Beta1@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_Beta_001_with_TRD_Q_17100_STS_Alpha05_Beta1		
Run Description: STS alpha sensitivity run using theoretical alphas and beta = 0.01 for VBS and alpha = 0.50 and beta = 0.01 for STS; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: 1.940653803 ft/s** ✓
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -2.05932 m/s** ✓
Boundary Name: Out_B	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.63733 m/s** ✓
Boundary Name: Out_C	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.29891 m/s** ✓
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_A_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_B_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet** ✓	**Pressure: 1.0 atm** ✓
Boundary Name: Orifice_C_S	**Boundary Type: Wall** ✓	
Interfaces - Porous Baffle:	A B C	A B C
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 0.25** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 0.25** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 8/20/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver5_Q17000@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_Q17000		
Run Description: VBS calibration run using theoretical alphas and beta = 0.01 for VBS and STS; Unit Flow = 17,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: 1.92932681 ft/s** ✓
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -2.04728 m/s** ✓
Boundary Name: Out_B	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.62775 m/s** ✓
Boundary Name: Out_C	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -1.29131 m/s** ✓
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_A_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet** ✓	**Velocity Magnitude: -4.43 m/s** ✓
Boundary Name: Orifice_B_S	**Boundary Type: Wall** ✓	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet** ✓	**Pressure: 1.0 atm** ✓
Boundary Name: Orifice_C_S	**Boundary Type: Wall** ✓	
<u>Interfaces - Porous Baffle:</u>	A | B | C	A | B | C
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65** ✓ ✓ ✓	**Porous Viscous Resistance: 0.01** ✓ ✓ ✓
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver7_Q17000@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver7_Q17000		
Run Description: VBS calibration run using theoretical alphas and beta = 0.01 for VBS and STS; Unit Flow = 17,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 1.92932681 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.04728 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.62775 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.29131 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 1.10**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 1.39**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 3.40**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 3.40**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 3.40**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 4.10**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 4.10**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 2.20**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 1.17**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenburg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver8_Q17000@06000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver8_Q17000		
Run Description: VBS calibration run using theoretical alphas and beta = 0.01 for VBS and STS; Unit Flow = 17,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.92932681 ft/s
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.04728 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.62775 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.29131 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 27.80	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 68.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 68.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 68.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 82.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 82.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 44.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 23.30	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver5_STS05_Q17000@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_STS05_Q17000		
Run Description: STS alpha sensitivity run using theoretical alphas and beta = 0.01 for VBS and alpha = 0.50 and beta = 0.01 for STS; TRD in; Unit Flow = 17,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.92932681 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.04728 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.62775 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.29131 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 0.25	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 0.25	Porous Viscous Resistance: 0.01
	manually check these	
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alpha_Ver5_STS50_Q17000@03000.sim		
Location: /home/liza/BON/2014_Updates/Calibration/Alpha_Ver5_STS50_Q17000		
Run Description: STS alpha sensitivity run using theoretical alphas and beta = 0.01 for VBS and alpha = 50 and beta = 0.01 for STS; TRD in; Unit Flow = 17,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.92932681 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.04728 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.62775 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.29131 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 25	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 25	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: B2FGE_modified_Baseline_No_Slot_Refinement_Q17100@03000.sim		
Location: /home/liza/BON/2014_Updates/Grid_Development/No_Slot_Refinement		
Run Description: Grid sensitivity run with no additional refinement in gatewell area; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.940653803 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.05932 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.63733 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.29891 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: B2FGE_modified_Baseline_All_Slots_Refinement_Q17100@03000.slm		
Location: /home/liza/BON/2014_Updates/Grid_Development/All_Slot_Refinement		
Run Description: Grid sensitivity run with maximum cell size of 6" in gatewell areas; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 1.940653803 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.05932 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.63733 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.29891 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: B2FGE_modified_Baseline_A_Slot_Refinement_Q17100@03000.sim		
Location: /home/liza/BON/2014_Updates/Grid_Development/A_Slot_Refinement		
Run Description: Grid sensitivity run with maximum cell size of 3" in Bay A gatewell and no additional refinement in Bays B and C; TRD in; Unit Flow = 17,100 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 1.940653803 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.05932 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.63733 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.29891 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Baseline_Panels1_2_Blocked_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Validation/Panel1_2_Blocked		
Run Description: Validation run with upper two panels of VBS blocked in all bays to compare to Spring 2014 field data; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_2	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft	Reference pressure: 0.0 atm	
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

* manually ~~#~~ check this

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Baseline_PlateA50_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Validation/Plate_A50		
Run Description: Validation run with flow control plate in Bay A with 50% blockage to compare to Spring 2014 field data; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft	**Reference pressure: 0.0 atm**	
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Baseline_Q12000@03000.sim		
Location: /home/liza/BON/2014_Updates/Baseline/Q12000		
Run Description: Baseline; Unit Flow = 12,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.362977133 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.44514m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.14900 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -0.91151 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Baseline_Q15000@03000.sim		
Location: /home/liza/BON/2014_Updates/Baseline/Q15000		
Run Description: Baseline / Validation; Unit Flow = 15,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.702786939 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.80643 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.43625 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.13939 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Baseline_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Baseline/Q18000		
Run Description: Baseline / Validation; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

#check manually

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_PlateABC25_Q12000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_PlateABC25/Q12000/		
Run Description: Flow control plate in all slots blocking 25% of opening; Unit Flow = 12,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 1.362977133 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.44514m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.14900 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -0.91151 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_PlateABC25_Q15000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_PlateABC25/Q15000/		
Run Description: Flow control plate in all slots blocking 25% of opening; Unit Flow = 15,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 1.702786939 ft/s**
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.80643 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.43625 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.13939 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014 ✓ 18000		
Run Information:		
File: Alt_PlateABC25_Q18~~[illegible]~~000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_PlateABC25/Q18000/		
Run Description: Flow control plate in all slots blocking 25% of opening; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_PlateABC50_Q12000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_PlateABC50/Q12000/		
Run Description: Flow control plate in all slots blocking 50% of opening; Unit Flow = 12,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 1.362977133 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.44514m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.14900 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -0.91151 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft	**Reference pressure: 0.0 atm**	
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/4/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_PlateABC50_Q15000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_PlateABC50/Q15000/		
Run Description: Flow control plate in all slots blocking 50% of opening; Unit Flow = 15,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 1.702786939 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.80643 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.43625 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.13939 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_PlateABC50_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_PlateABC50/Q18000/		
Run Description: Flow control plate in all slots blocking 50% of opening; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/13/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_Plate_A50_B25_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_Plate_A50_B25/		
Run Description: Flow control plate in Bay A blocking 50% of opening and in Bay B blocking 25% of opening, and nothing in Bay C; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_Plate_A50_B25_NoTV_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_Plate_A50_B25_NoTV/		
Run Description: Flow control plate in Bay A blocking 50% of opening and in Bay B blocking 25% of opening, and nothing in Bay C; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_Plate_AB25_PanelsBlocked_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_Plate_AB25_PanelsBlocked/		
Run Description: Flow control plate in Bays A and B blocking 25% of opening and upper panels on VBS in all bays blocked; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_2	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_Plate_AB25_Panels34_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_Plate_AB25_Panels34/		
Run Description: Flow control plate in Bays A and B blocking 25% of opening and upper panels on VBS in all bays blocked; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_Plate_AB25_NoTV_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_Plate_AB25_NoTV/		
Run Description: Flow control plate in Bays A and B blocking 25% of opening no turning vane; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
<u>Upstream Boundaries:</u>		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
<u>Downstream Boundaries:</u>		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
<u>Interfaces - Porous Baffle:</u>		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
<u>Interfaces:</u>		
<u>Water surface boundary:</u>		
<u>Wall boundaries:</u>		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_NoTV_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_NoTV/		
Run Description: No turning vane; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft	Reference pressure: 0.0 atm	
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_NoGCD_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_NoGCD/		
Run Description: No gap closure device; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	**Porous Inertial Resistance: 2.45**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft **Reference pressure: 0.0 atm**		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_NoSTS_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_NoSTS/		
Run Description: No STS; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		**Parent File:**
Date: 9/3/14		**B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim**
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_NoSTS_NoTV_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_NoSTS_NoTV/		
Run Description: No STS and no turning vane; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: 2.042596745 ft/s**
Downstream Boundaries:		
Boundary Name: Out_A	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -2.16771 m/s**
Boundary Name: Out_B	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.72350 m/s**
Boundary Name: Out_C	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -1.36727 m/s**
Boundary Name: Orifice_A_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_A_S	**Boundary Type: Wall**	
Boundary Name: Orifice_B_N	**Boundary Type: Velocity Inlet**	**Velocity Magnitude: -4.43 m/s**
Boundary Name: Orifice_B_S	**Boundary Type: Wall**	
Boundary Name: Orifice_C_N	**Boundary Type: Pressure Outlet**	**Pressure: 1.0 atm**
Boundary Name: Orifice_C_S	**Boundary Type: Wall**	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	**Porous Inertial Resistance: 11.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_2	**Porous Inertial Resistance: 13.90**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_3	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_4	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_5	**Porous Inertial Resistance: 34.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_6	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_7	**Porous Inertial Resistance: 41.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_8	**Porous Inertial Resistance: 22.00**	**Porous Viscous Resistance: 0.01**
Interface Name: VBS_Baffle_(A,B,C)_9	**Porous Inertial Resistance: 11.65**	**Porous Viscous Resistance: 0.01**
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information:		
File: Alt_withTRD_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_withTRD/		
Run Description: Baseline condition with TRD in place in all units; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Porous Inertial Resistance: 11.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_2	Porous Inertial Resistance: 13.90	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_3	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_4	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_5	Porous Inertial Resistance: 34.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_6	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_7	Porous Inertial Resistance: 41.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_8	Porous Inertial Resistance: 22.00	Porous Viscous Resistance: 0.01
Interface Name: VBS_Baffle_(A,B,C)_9	Porous Inertial Resistance: 11.65	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

CFD Model Run Setup & QC		
Reviewer: Aaron Litzenberg		Parent File:
Date: 9/3/14		B2FGE_modified_Baseline_All_Slots_Refinement_Q17100.sim
Model Run Prepared By: Seth Stevens		
Date: 8/2014		
Run Information: All VBS Blocked		
File: Alt_~~AllPanelsBlocked~~_Q18000@03000.sim		
Location: /home/liza/BON/2014_Updates/Alternatives/Alt_~~AllPanelsBlocked~~/		
Run Description: Baseline condition with TRD in place in all units; Unit Flow = 18,000 cfs		
Model Grid:		
Date of previous grid QC:		
Geometric features are correct (dimension, shape, level of detail):		
Level of grid resolution in area of interest is adequate:		
Prism layer is appropriate (thickness, location, number of layers):		
Overall number of grid cells:		
No discontinuities (cracks, missing interfaces, or baffles):		
Grid type (hex, poly, trim, etc.):		
Notes on specific grid details for this run:		
Boundary Conditions:		
Upstream Boundaries:		
Boundary Name: Inlet	Boundary Type: Velocity Inlet	Velocity Magnitude: 2.042596745 ft/s
Downstream Boundaries:		
Boundary Name: Out_A	Boundary Type: Velocity Inlet	Velocity Magnitude: -2.16771 m/s
Boundary Name: Out_B	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.72350 m/s
Boundary Name: Out_C	Boundary Type: Velocity Inlet	Velocity Magnitude: -1.36727 m/s
Boundary Name: Orifice_A_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_A_S	Boundary Type: Wall	
Boundary Name: Orifice_B_N	Boundary Type: Velocity Inlet	Velocity Magnitude: -4.43 m/s
Boundary Name: Orifice_B_S	Boundary Type: Wall	
Boundary Name: Orifice_C_N	Boundary Type: Pressure Outlet	Pressure: 1.0 atm
Boundary Name: Orifice_C_S	Boundary Type: Wall	
Interfaces - Porous Baffle:		
Interface Name: VBS_Baffle_(A,B,C)_1	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_2	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_3	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_4	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_5	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_6	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_7	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_8	Boundary Type: Wall	
Interface Name: VBS_Baffle_(A,B,C)_9	Boundary Type: Wall	
Interface Name: Fluid Domain/STS_(A,B,C)_DS_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interface Name: Fluid Domain/STS_(A,B,C)_US_Baffle	Porous Inertial Resistance: 2.45	Porous Viscous Resistance: 0.01
Interfaces:		
Water surface boundary:		
Wall boundaries:		
Physics:		
Steady state or transient run: Steady State		
Physics set up properly (include summary report, physics portion):		
Reference altitude: (0, 172,0) ft Reference pressure: 0.0 atm		
Notes:		
Results:		
Residuals/# Iterations:		
Velocity magnitude:		
Flow patterns:		
Water surface (if free surface):		
Check mass flux at boundaries:		

APPENDIX C

Flow Control Plate Design Calculations

PROJECT: Bonneville Second Powerhouse Fish Guidance Efficiency	**COMPUTED BY:** STS	**DATE:** 10/21/2014
SUBJECT: Hydraulic Load Calculations for Bay 15A Prototype Flow Control Plate	**CHECKED BY:** LLE 10/21/2014	**SHT. OF** 1 5 **PART:**

CALCULATION COVER SHEET

These calculations are for the expected hydraulic loads on a proposed flow control plate to be installed in Bay A of Unit 15 at Bonneville Second Powerhouse. These calculations account for a load from flow past the plate during a load rejection, as well as a load from a pressure wave induced from a load rejection. The calculations also include natural frequency and forcing frequency calculations to estimate the potential for induced vibration in the plate. The exact bolt placement will be determined at the time of construction based on a field rebar locate; for that reason, the natural frequency calculations were performed for two possible bolt placement scenarios.

Results:

Based on field data and CFD modeling, a flow of 500 cfs past the plate was determined to be an appropriate design case. This load case, along with a load rejection, produces a load of about 3.17 kips/ft along the center of the exposed area of the bottom of the plate. In addition, the natural frequency of the plate was calculated to be much greater than the forcing frequency produced by the flow and load rejection pressure wave, so hydraulic induced vibration is not expected to be a concern for the proposed plate.

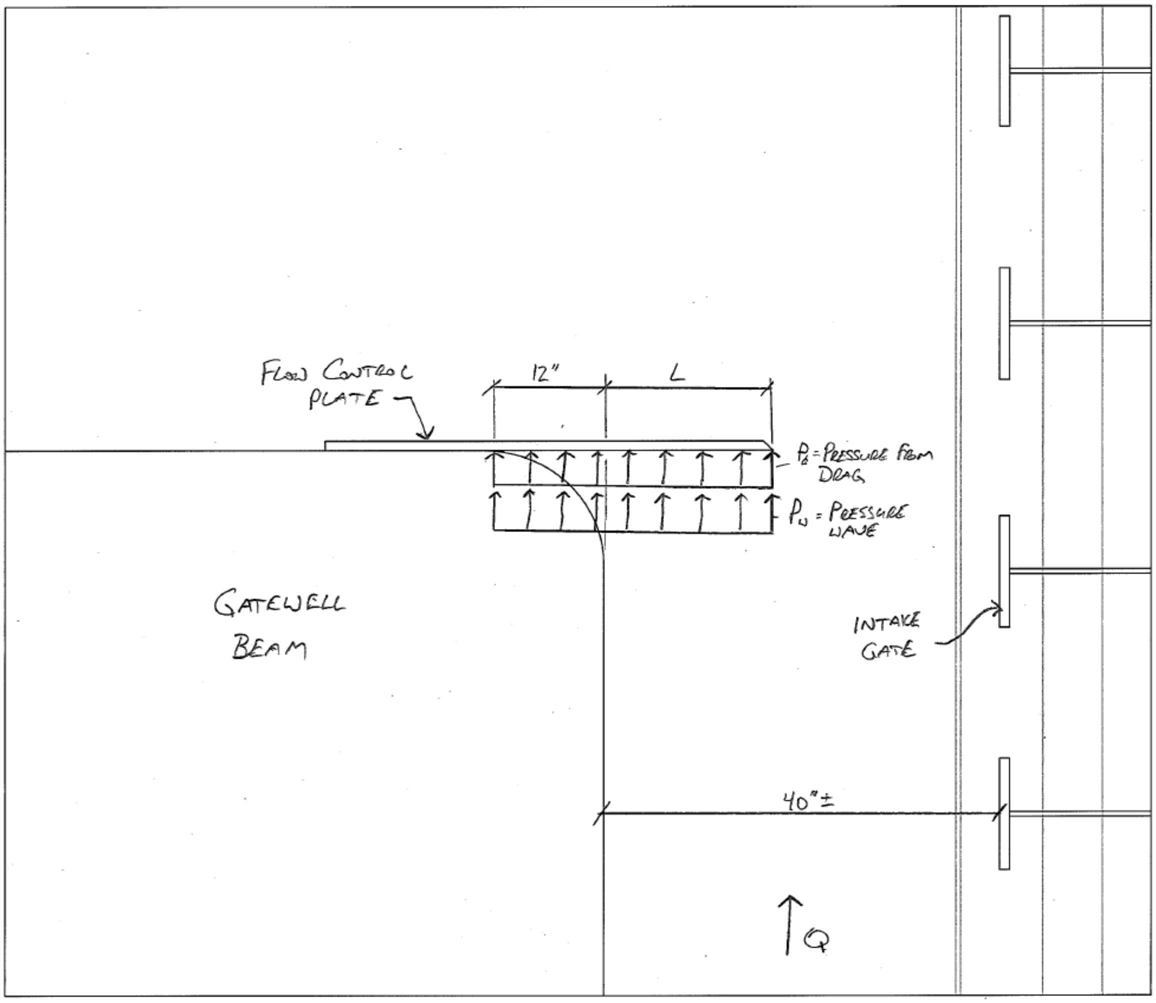
Review Comments:

Revision History:

Revision	Date:	Purpose	Checked By	Date
Original				10/21/2014
rev 1				
rev 2				
rev 3				

Load Rejection Load Calculations

A load rejection will apply two pressure loads to the plate: (1) Pd - pressure from the drag force from flow moving past the plate and (2) Pw - a pressure wave induced from a load rejection. These loads are calculated per foot of plate width.



Drag Force Load

The pressure from a drag force on the plate is calculated with the following equation:

$$P_d = C_d \frac{1}{2} \rho V^2 \qquad \text{(from Fox and McDonald)}$$

where

P_d, Pressure from Drag Force

C_d, Drag Coefficient: 1.18 (Flat Plate Normal to Flow, from Fox and McDonald)

ρ_w, Density of Water: 1.94 slugs/ft^3

V, Velocity of Water

Pressure Wave Load

The pressure wave (Pw) magnitude on the plate is based observations of water reaching the 90' deck during a load rejection. The normal water surface elevation in the gatewell is approximately 74', so the pressure wave adds about 16' of head to the system. For these calculations, 17' of head will be the assumed magnitude of the pressure wave. The pressure wave was caculated with the following equation:

$$P_w = H\gamma$$

where

P_w, pressure wave

H, head: 17 ft

γ, specific weight of water: 62.4 lbs/ft^3

Load Calculations

Intake Gate Chamber Opening Dimensions:

Width: 20.00 ft

Length: 3.33 ft

Beam Radius: 12.00 in

Plate Length, L: 17.00 in (from edge of gatewell beam)

Q (cfs)	V (ft/s)	P_d (psf)	P_w (psf)	Total Pressure (psf)	Total Force (lbs/ft)	
100	1.50	3	1060.8	1,063	2,570	
200	3.00	10	1060.8	1,071	2,588	
300	4.50	23	1060.8	1,084	2,620	
400	6.00	41	1060.8	1,102	2,663	
500	7.50	64	1060.8	1,125	2,719	<Design Case
600	9.00	93	1060.8	1,154	2,788	
700	10.50	126	1060.8	1,187	2,869	
800	12.00	165	1060.8	1,226	2,962	
900	13.50	209	1060.8	1,269	3,068	
1000	15.00	258	1060.8	1,318	3,186	

Natural Frequecy Calculations

The natural frequency of a plate is calculated with the following equation:

$$fn = \frac{\lambda^2}{2\pi L^2}\sqrt{\frac{EI}{m}}$$

(Blevins and Au-Yang page 2-23)

where

fn , natural frequency of the plate
λ , a non-dimensional parameter that varies with the boundary condition of the member
L , length of plate
E , modulus of elasticity: 4,320,000,000 psf
I , area moment of inertia
m , mass per unit length of plate

Plate Parameters - 32 in Plate

Length, *L* :	32	in (min. distance from end of plate to first bolt)
Width, *b* :	1	ft
Thickness, *a* :	1	in
Volume, *vol* :	0.222	ft^3
Density Steel, ρ_s :	15.2	slugs/ft^3
Mass of Steel, m_s :	3.38	slugs
Mass of Water, m_w :	0.43	slugs
I :	4.82E-05	ft^4

Plate Parameters - 36 in Plate

Length, *L* :	36	in (min. distance from end of plate to first bolt)
Width, *b* :	1	ft
Thickness, *a* :	1	in
Volume, *vol* :	0.250	ft^3
Density Steel, ρ_s :	15.2	slugs/ft^3
Mass of Steel, m_s :	3.80	slugs
Mass of Water, m_w :	0.49	slugs
I :	4.82E-05	ft^4

		fn (hz)	
Mode	λ	L=32 in	L=36 in
1	1.87510407	18	14
2	4.69409113	115	86
3	7.85475744	323	241
4	10.99554073	633	471

λ reference: Blevins and Au-Yang page 2-23

Forcing Frequecy Calculations

The forcing frequency for a plate is calculated with the following equation:

$$fs = \frac{SV}{D}$$ (Blevins 1990 page 47)

where

fs , forcing frequency

S , Strouhal number, dimensionless constant: 0.2 (Blevins 1990 Fig 3-7)

V , flow velocity approaching plate

D , plate length

		L=32 in, Mode 1			L=36 in, Mode 1		
Q (cfs)	V (ft/s)	fs	fn/fs	Vred (V/fn/d)	fs	fn/fs	Vred (V/fn/d)
100	1.50	0.11	163.59	0.03	0.10	137.10	0.04
200	3.00	0.23	81.80	0.06	0.20	68.55	0.07
300	4.50	0.34	54.53	0.09	0.30	45.70	0.11
400	6.00	0.45	40.90	0.12	0.40	34.27	0.15
500	7.50	0.56	32.72	0.15	0.50	27.42	0.18
600	9.00	0.68	27.27	0.18	0.60	22.85	0.22
700	10.50	0.79	23.37	0.21	0.70	19.59	0.26
800	12.00	0.90	20.45	0.24	0.80	17.14	0.29
900	13.50	1.01	18.18	0.28	0.90	15.23	0.33
1000	15.00	1.13	16.36	0.31	1.00	13.71	0.36

To avoid resonance or lock-in, criteria must be met below:

fn/fs > 5 OK for all cases

Vred < 1 OK for all cases

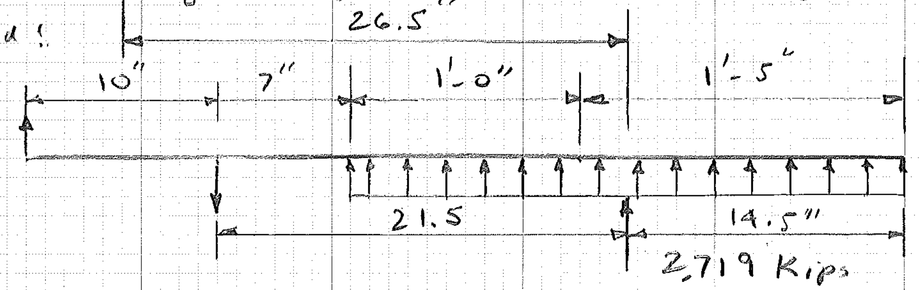
References

1. Fox, R.W. and McDonald, A.T. 1998. Introduction to Fluid Mechanics, Fifth Edition. John Wiley & Sons, Inc. New York, NY.
2. Saha, A.K. 2013. Direct numerical simulation of two-dimensional flow past a normal flat plate. J. Eng. Mech. 139: 1894-1901.
3. Blevins, R.D. 1990. Flow-Induced Vibration, 2nd Ed. Krieger Publishing Company. Malabar, FL.
4. Blevins, R.D. and Au-Yang, M.K. 2009. Flow-Induced Vibration with Failure Analysis Considerations. Course Manual. ASME Continuing Education Institute.

U.S. ARMY CORPS OF ENGINEERS OFFICE SYMBOL:

PROJECT: Bonneville Powerhouse II FGE	**COMPUTED BY:** Mehdi Roshani	**DATE:** 10/20/14
SUBJECT: (Steel) Flow Control Plate (Prototype)	**CHECKED BY:** MAA 10/22/14	**SHT.** 1 **OF** 6 **PART:**

Check istalled plates based on revised loading:
Pressure wave load is significantly larger than drag load, so only consider upward load!



The original design used Factor of 1.6 based on ASCE 7-05 2.3.2 which was conservative.
Based on ETL 1110-2-584 Table E-1
$\gamma_{Hd} = 1.6$ could be considered also

$M_u = 1.6 \times 2.719 \times 21.5 = 93.53$ K-in

$M_n = F_y Z$ AISC F11-1

$Z = \frac{bt^2}{4} = \frac{12 \times 1^2}{4} = 3$ in^3

$\phi M_n = .9 \times 36 \times 3 = 97.2$ K-in $> M_u = 93.53$ K-in O.K
(ASTM A36)

Anchor bolts:

$T = 1.6 \times \frac{26.5''}{10} \times 2.719 = 11.53$ Kips

Use Stainless steel Hilti HDA-TR-30 M16×190/40 or approved equal.
Anchor every 1 ft.
Allowable nonseismic Tension per bolt for $f'_c = 4000$ psi is

Concrete Breakout: 13.49 Kips > 11.53 Kips O.K.

U.S. ARMY CORPS OF ENGINEERS OFFICE SYMBOL:

PROJECT: Bonneville Powerhouse II FGE	**COMPUTED BY:** Mehdi Roshani	**DATE:** 11/10/14
SUBJECT: Existing Flow Control Plate Anchor Design Plate	**CHECKED BY:** MAA 11/12/14	**SHT.** 1 **OF** 1 **PART:**

Concrete Breakout strength for installed plate

Anchors : HDA-TR-30-M16 × 190 × 40

ACI-318-11 :

$$\phi N_{cbg} = \phi \frac{A_{nc}}{A_{nco}} \psi_{ec,N} \times \psi_{ed,N} \times \psi_{c,N} \times \psi_{cp,N} N_b \quad (D\text{-}4)$$

$1.5\, h_{ef} = 1.5 \times 7.48 = 11.22$

$A_{nco} = 9\, h_{ef}^2 = 9 \times 7.48^2 = 503.55''$

$A_{nc} = 12 \times 11.22 \times 2 = 269.28$

$N_b = k_c \lambda_a \sqrt{f'_c}\, h_{ef}^{1.5}$ (D-6)

$k_c = 24$ per manufacture Table 2-HDA (D.5.2.2)

$\lambda_a = 1$ Undercut Anchor (D.3.6)

$N_b = 24 \times 1 \times \sqrt{4000} \times 7.48^{1.5} = 31.052$ kips

$\psi_{ec,N} = 1$ No eccentricity D.5.2.4

$\psi_{ed,N} = 1$ (D-9)

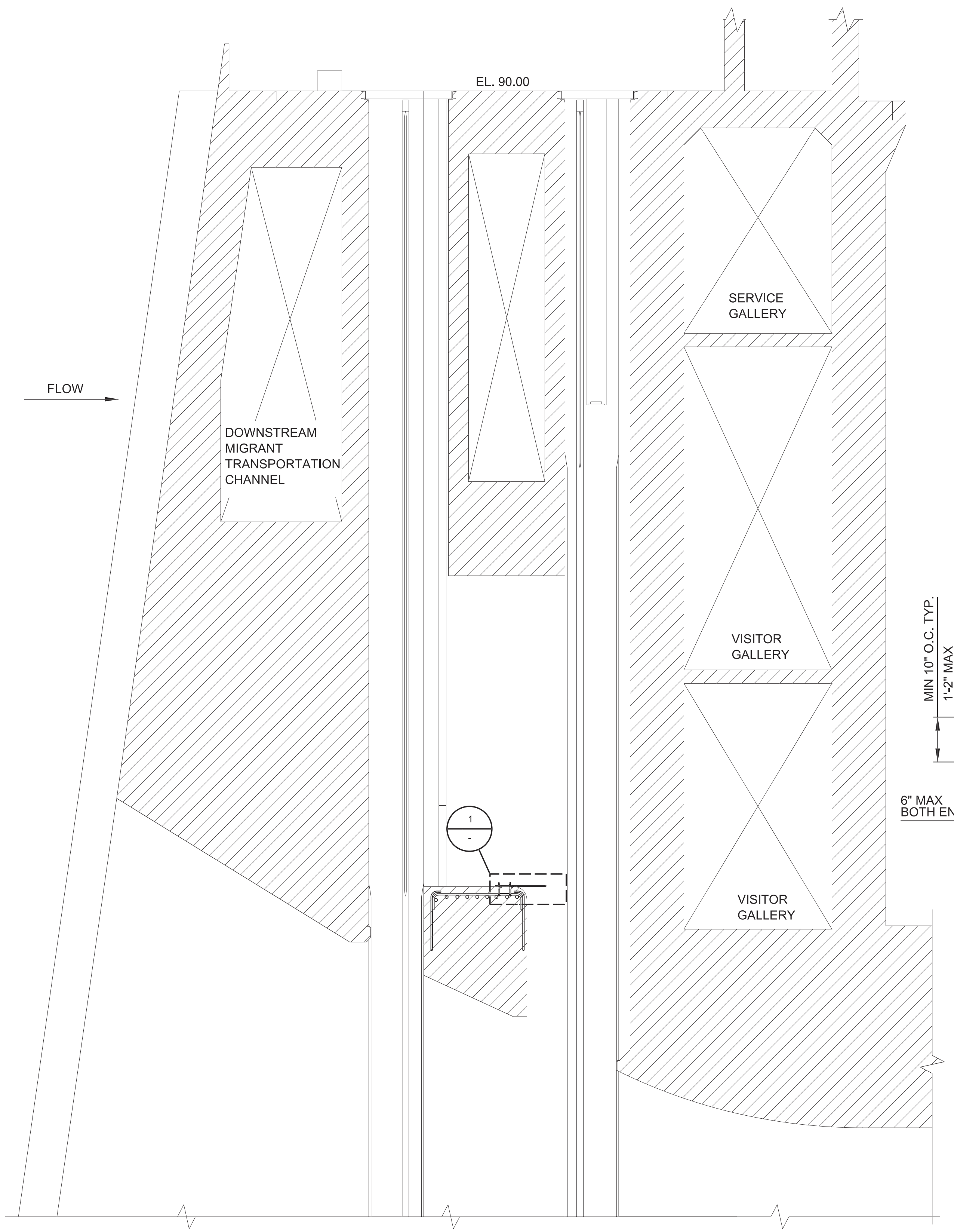
$\psi_{c,N} = 1.25$ per manufacturer Table 2-HDA

$\phi = .65$ (Medium Sensitivity to installation & Medium reliability) (D.4.4)

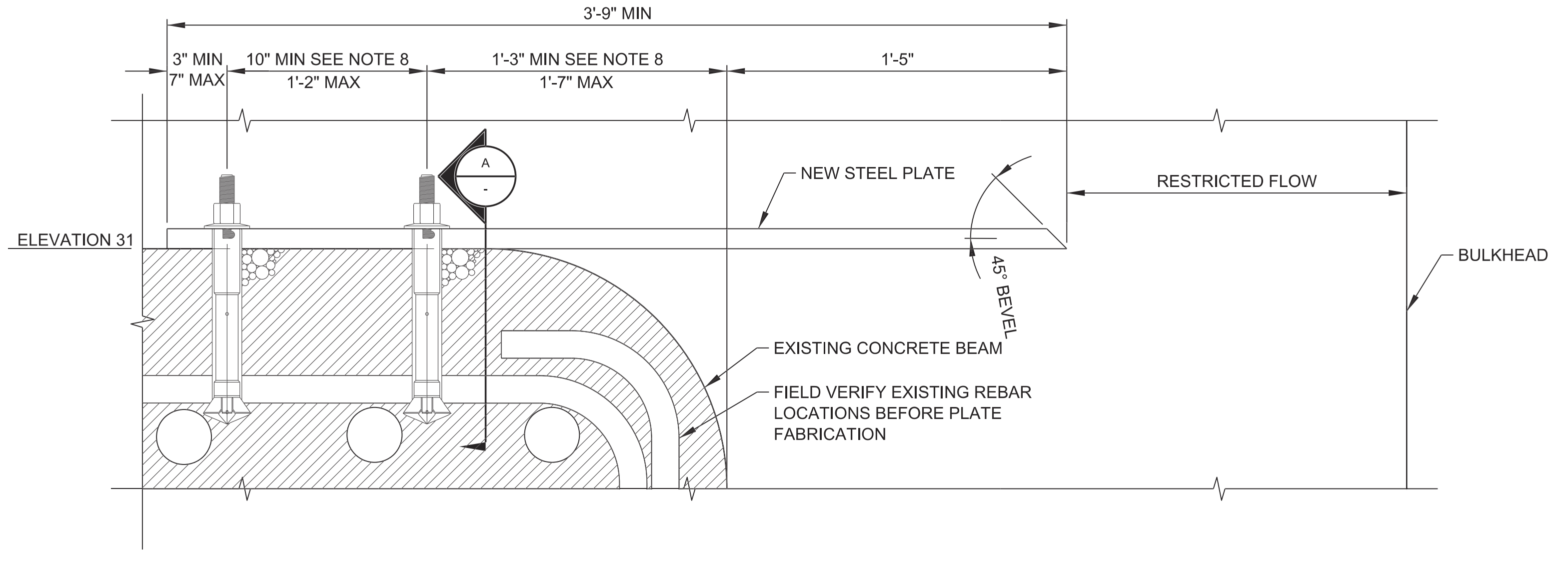
$C_{ac} = 2.5\, h_{ef} = 2.5 \times 7.48 = 18.7''$ (D.8.6)

$C_{a,min} = 12 + 7 = 19'' > 18.7''$ $\psi_{cp,N} = 1$ (D-11)

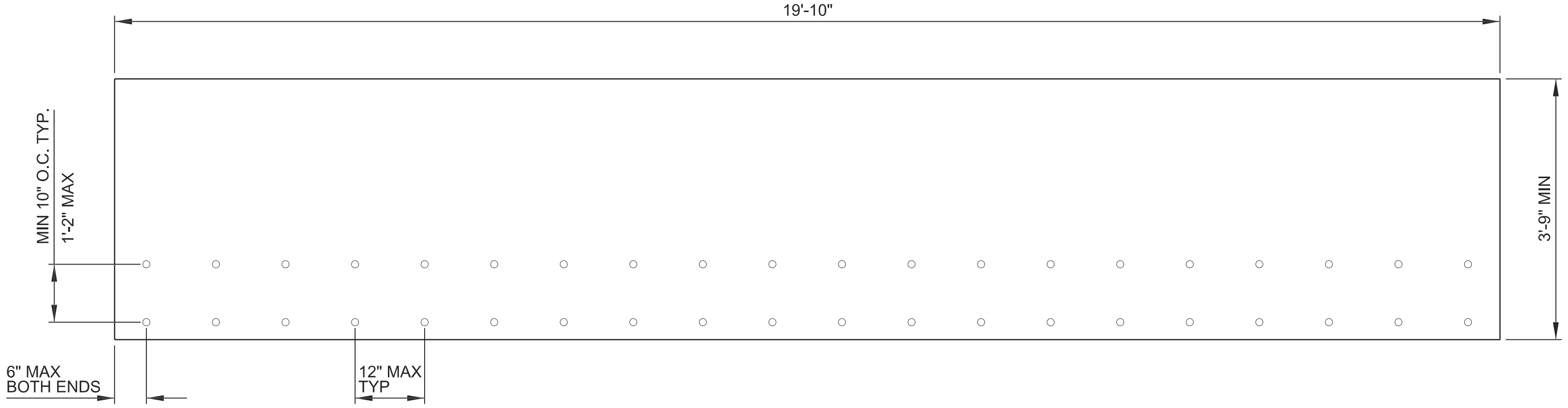
$$\phi N_{cbg} = .65 \times \frac{269.28}{503.55} \times 1 \times 1 \times 1.25 \times 1. \times 31.052 = 13.49 \text{ kips}$$



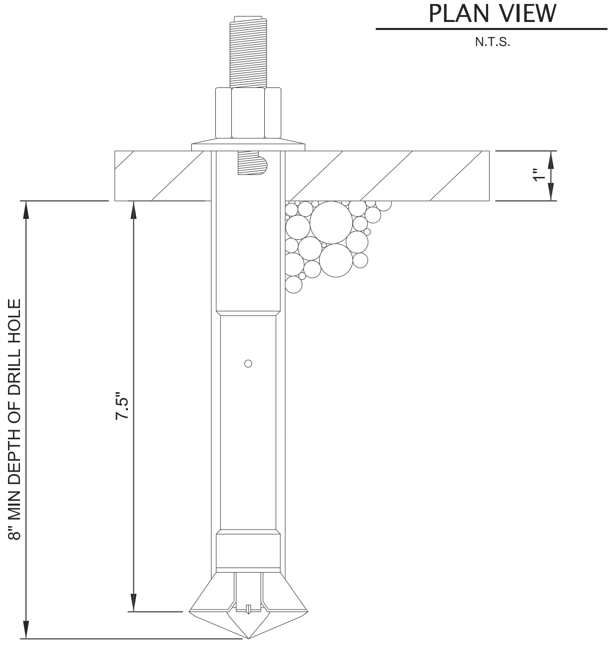
A SLOT, UNIT 15
N.T.S.



1 DETAIL
N.T.S.



PLAN VIEW
N.T.S.



A SECTION
N.T.S.

NOTES:
1. FIELD VERIFY DIMENSIONS BEFORE PLATE FABRICATION
2. ALL PLATES SHALL CONFORM TO ASTM A36, Fy 36 KSI.
3. ALL ANCHOR BOLTS SHALL BE STAINLESS STEEL HILTI HDA-TR 30 M16x190/40 OR APPROVED EQUAL.
4. ANCHOR BOLTS SHALL BE INSPECTED, TESTED, AND INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
5. NOMINAL PLATE HOLE DIMENSIONS FOR EACH ANCHOR BOLT SHALL BE 1¼ INCH +$\frac{1}{16}$ -0.0
6. REFFERENCE EXISTING REBAR ON DWG BDF-2-60/04 SEE INFORMATIONAL DRAWING (FIO)
7. ANCHOR BOLTS MINIMUM EMBEDMAENT DEPTH IS 7.5 INCHES.
8. THE CONTRACTOR SHALL MAP EXISTING EMBEDED REBAR LOCATIONS AT PLATE INSTALLATION AND SUBMIT A REPORT TO THE CONSTRUCTION OFFICE BEFORE FABRICATION AND INSTALLATION OF PLATE AND ANCHOR BOLTS.
9. THE CONTRACTOR SHALL LOCATE THE EXISTING REBAR AND ADJUST PLATE HOLES AND ANCHOR BOLT LOCATIONS TO AVOID EXISTING REBAR BEFORE PLATE FABRICATION AND DRILLING FOR THE ANCHOR BOLTS.
10. THE CONTRACTOR SHALL HAVE THE OPTION OF FABRICATING THE 19'-10"LONG PLATE IN SMALLER SECTIONS AND FIELD BUTT THE SECTIONS FOR A TOTAL DIMENSION AT 19'-10".
11. THE CONTRACTOR SHALL DESIGN AND INSTALL PERMANENT LIFTING EYES FOR THE PLATE SECTIONS.
12. THE CONTRACTOR SHALL USE ROTARY IMPACT HAMMER DRILLS FOR THE ANCHOR BOLTS.
13. TOTAL PLATE WEIGHT IS APPROXIMATELY 3,037 LBS.

US Army Corps
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PORTLAND DISTRICT

BCOE REVIEW

MARK	DESCRIPTION	DATE	APPR.

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT
PORTLAND, OREGON

AE / CONTRACTOR NAME
AE / CONTRACTOR ADDRESS
AE / CONTRACTOR (CITY, STATE)
AE / CONTRACTOR ID

DESIGNED BY: JEFFREY HICKS
DATE: 01/31/2014
DWN BY: G2ECDACW
CKD BY: G2ECDMR9
SOLICITATION NO.: W9127N-14-R-0026
SUBMITTED BY: MATTHEW D. HANSON, P.E.
CONTRACT NO.:
PLOT SCALE: 1:1
PLOT DATE: $$$DATE$$$$
DRAWING NUMBER:
SIZE: ANSI D
FILE NAME: plate and anchor design (2).dgn

BONNEVILLE LOCK AND DAM
SECOND POWERHOUSE
FISH GUIDANCE EFFICIENCY

TURBINE INTAKE
FLOW CONTROL PLATE

SHEET
IDENTIFICATION
S-501
SHEET 0 OF 0

APPENDIX D

Construction Cost Estimate

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: B2 FGE Post Construction Supplement to EDR 2014
PROJECT NO: Mark2
LOCATION: Bonneville Powerhouse 2, Washington

DISTRICT: NWP Portland District
PREPARED: 10/16/2014
POC: CHIEF, COST ENGINEERING, Eileen Horiuchi

This Estimate reflects the scope and schedule in report; Supplement to the EDR B2 FGE Program Post-Construct 9/14

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**				**TOTAL PROJECT COST (FULLY FUNDED)**				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: 1-Oct-14 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
03	RESERVOIRS	$0	$0	-	$0	-	$0	$0	$0	$0		$0	$0	$0
04	DAMS	$1,586	$492	31%	$2,078	1.8%	$1,615	$501	$2,115	$0		$1,726	$535	$2,262
05	LOCKS	$0	$0	-	$0	-	$0	$0	$0	$0		$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$0	$0	-	$0	-	$0	$0	$0	$0		$0	$0	$0
07	POWER PLANT	$0	$0	-	$0	-	$0	$0	$0	$0		$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$1,586	$492		$2,078	1.8%	$1,615	$501	$2,115	$0		$1,726	$535	$2,262
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0		$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$382	$80	21%	$462	1.0%	$386	$81	$467	$0		$399	$84	$483
31	CONSTRUCTION MANAGEMENT	$231	$49	21%	$280	2.1%	$236	$50	$285	$0		$247	$52	$299
	PROJECT COST TOTALS:	$2,199	$620	28%	$2,819		$2,236	$631	**$2,867**	$0		$2,373	$671	$3,044

CHIEF, COST ENGINEERING, Eileen Horiuchi

PROJECT MANAGER, George Medina

CHIEF, REAL ESTATE, Enrique Godinez

CHIEF, PLANNING,xxx

CHIEF, ENGINEERING, Lance Helwig

CHIEF, OPERATIONS, xxx

CHIEF, CONSTRUCTION, Karen Garmire

CHIEF, CONTRACTING,xxx

CHIEF, PM-PB, xxxx

CHIEF, DPM, xxx

ESTIMATED FEDERAL COST:	**100%**	**$3,044**
ESTIMATED NON-FEDERAL COST:	**0%**	**$0**
ESTIMATED TOTAL PROJECT COST:		**$3,044**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: B2 FGE Post Construction Supplement to EDR 2014
LOCATION: Bonneville Powerhouse 2, Washington
This Estimate reflects the scope and schedule in report; Supplement to the EDR B2 FGE Program Post-Construct 9/14

DISTRICT: NWP Portland District PREPARED: 10/16/2014
POC: CHIEF, COST ENGINEERING, Eileen Horiuchi

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**				**TOTAL PROJECT COST (FULLY FUNDED)**				
		Estimate Prepared:			10/16/2014	Program Year (Budget EC):			2014					
		Effective Price Level:			1-Oct-2014	Effective Price Level Date:			1 OCT 13					
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	RISK BASED CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	TOTAL ($K) *J*	Mid-Point Date *P*	INFLATED (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
	ALT 3A Flow Ctr Plates & VBS Adj													
			$0		$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
06	FISH & WILDLIFE FACILITIES	$1,586	$492	31%	$2,078	1.8%	$1,615	$501	$2,115	2016Q3	6.9%	$1,726	$535	$2,262
			$0		$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
			$0		$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
			$0		$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$1,586	$492	31%	**$2,078**		$1,615	$501	$2,115			$1,726	$535	$2,262
01	LANDS AND DAMAGES		$0		$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	$40	$8	21%	$48	1.0%	$40	$8	$49	2014Q1	1.8%	$41	$9	$50
0.0%	Planning & Environmental Compliance	$0	$0	21%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
10.0%	Engineering & Design	$159	$33	21%	$192	1.0%	$161	$34	$194	2014Q1	1.8%	$163	$34	$198
0.5%	Reviews, ATRs, IEPRs, VE	$8	$2	21%	$10	1.0%	$8	$2	$10	2014Q1	1.8%	$8	$2	$10
0.0%	Life Cycle Updates (cost, schedule, risks)	$0	$0	21%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Contracting & Reprographics	$32	$7	21%	$39	1.0%	$32	$7	$39	2014Q1	1.8%	$33	$7	$40
5.0%	Engineering During Construction	$79	$17	21%	$96	1.0%	$80	$17	$97	2015Q3	7.7%	$86	$18	$104
2.0%	Planning During Construction	$32	$7	21%	$39	1.0%	$32	$7	$39	2015Q3	7.7%	$35	$7	$42
2.0%	Project Operations	$32	$7	21%	$39	1.0%	$32	$7	$39	2014Q1	1.8%	$33	$7	$40
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$159	$33	21%	$192	2.1%	$162	$34	$196	2015Q3	4.8%	$170	$36	$206
2.0%	Project Operation:	$32	$7	21%	$39	2.1%	$33	$7	$40	2015Q3	4.8%	$34	$7	$41
2.5%	Project Management	$40	$8	21%	$48	2.1%	$41	$9	$49	2015Q3	4.8%	$43	$9	$52
	CONTRACT COST TOTALS:	$2,199	$620		**$2,819**		$2,236	$631	$2,867			$2,373	$671	**$3,044**

MII_FlowControlPL_A3

Estimated by	Portland District
Designed by	Portland District
Prepared by	Ricky Russell
Preparation Date	10/6/2014
Effective Date of Pricing	10/1/2014
Estimated Construction Time	480 Days

Description	Quantity	UOM	ContractCost
Project Cost Summary Report			**1,585,919**
			1,585,919.50
06 01 Fish Facilities at Dams	**1.00**	**EA**	**1,585,919**
01 Mob/Demob	**1.00**	**LS**	**50,143**
			74,220.69
02 Flow control Plate in place at Gate Slot A	**8.00**	**EA**	**593,766**
			69,760.40
03 Flow control Plate in place at Gate Slot B	**8.00**	**EA**	**558,083**
			15,996.99
04 Change Perf Plates on VBS per VBS	**24.00**	**EA**	**383,928**

Bonneville Second Powerhouse
Fish Guidance Efficiency (FGE) Program Post Construction
Supplement to the Engineering Documentation Report.
Cost Estimate 2014
by RLR.

Brief Background

From 2005 to 2008 changes were made to the B2 JBS to improve FGE. Changes included installing in each intake a turning vane, a gap closure plate, enlarging the open for the VBS (between the upstream and downstream gate slots), and a new VBS. Afterward dead juvenile salmon were seen in the gate slot during the Spring Creek Hatchery releases with high (about 18 kcfs) turbine flows, prompting efforts to improve juvenile salmon survival within the gate well. In spring of 2013 a Gate slot filler was tested in one slot, but did not adequately improve survival. In spring of 2014, a flow control plate was tested in one slot and demonstrated a hydraulic environment closest to the target condition.   The Supplement to the EDR looked at alternatives and recommends install flow control plates.

Alternative A3 (flow control plates) met the design criteria for flow through the VBS and demonstrated a hydraulic environment within the gate well closest to the target condition. The other alternatives did not meet the design criteria and or could have negative impacts on FGE and Fish survival. Therefore only cost for Alt A3 were estimated. The other alternatives are not recommended due to lack of technical merit irrespective of their cost.

October 9, 2014
October 16, 2014 revised
Narrative of Cost Estimate for
Alternative A3 Flow control Plates
for

Supplement to the EDR
B2 FGE Post-construction

Near North Bonneville, Skamania County, Washington State

1. Project Description:
This alternative is to bolt a stainless steel plate on the concrete "beam" at the bottom of the opening between the upstream and downstream gate slots for the intakes to the turbines. The steel plate projects horizontally downstream into the area of the downstream gate slot. This restricts the area through which the return flow from the gatewells to the turbine units can pass.
Slot "A" of each unit would have "50% plates" which have a width of 3'-9".
Slot "B" of each unit would have "25% plates" which have a width of 3'-0".
Slot "C" of each unit would NOT have a plate.
There are 8 Main Units, each have 3 sets of slots (A, B, & C)
The two Fish units have 2 slots each and assumed to have NO flow control plates added.
Assume the top 2 rows of the "Perf Plates" on the VBS are replaced with new Perf plates with 1" dia perforations with varying porosities (20-50%). Assume Type 304 stainless steel for the material, 1/4" thickness. The VBS Panels on the main units will be changed for a total of 24 slots. No change for the VBS panels at the Fish Units.

2. Basis of Design and Estimate:

a. Basis of Design:
Draft Report, "Supplement to the EDR, B2 FGE Post-construction dated September 2014.

b. Basis of Estimate.
The estimate for this project was developed using information provided by the PTD, and information in the report. Experience from the installation for testing of the prototype Flow reduction plate and associated costs are used. The estimate is a MCACES MII Version 4.2

c. Assumptions for the Cost Estimate:
The work by an 8a contractor includes Steel Plate installation. Each plate is assumed to be, 1" thick by 19'-10" long. 50% plates are 3'-9" wide and 25% plates are 3'-0" wide. Plate are installed in the downstream intake slot from the intake deck. The plate will be attached to the existing concrete piece above the turbine intake. This concrete surface is the bottom of the opening where the VBS is located and is about 40 or so feet below the Intake deck. The contractor is to identify the location of the existing rebar and place the new anchor bolts to miss the existing rebar.

Changes to the VBS will happen on the intake deck. The VBSs are removable. The estimate assumes minimal handling of the VBSs by raising them to the intake deck so the top 2 rows of the perf plates can be accessed from the deck. A crane is assumed in the estimate, (or temporary jig) is needed to hold the VBS while changing out the Perf Plates, since the dogging been is at the level of the top row of plates.

The Cost estimate incorporates the following assumption:
1. Contractor’s shop is 100 miles or less from the site.
2. Workmen will access the work location for the flow plate installation and work from a man basket on a crane on the intake deck.
3. A separate crane is used for material handling due to safety requirement that personnel cannot be supported by the same crane supporting the working load.
4. Government forces will dewater the slot.
5. Rule of thumb markups were used for HOOH & JOOH on the high end of the typical ranges. This is typical of 8a contractor’s.
6. The estimate includes Mobilization and Demob to account for the costs to initiate and end the project, coordination activities, initial set up and customization of equipment, field offices, jigs, storage sheds, etc.
7. Due to complexities of coordinating Main Unit outages of all the units (one at a time) for the full powerhouse, assume 3 interim pauses in the work flow. Cost for this are assumed to include items for re-fielding critical equipment 3 times, while other miscellaneous minor costs are covered with the Job Office Overhead Markups.

3. <u>Construction Schedule</u>:

Assume unit outages can be schedule to *average* 1 per month so work can progress a controlled pace. Total construction duration to be 12 months, with three interim pauses in work flow due to Main Unit dewatered availability constraints

Typical work durations for schedule (assume 5 day work weeks.)
1 week to dewater a unit (5 days)
1 days to setup at a slot
3 days to map rebar, report & mark drill locations (VBS work done while awaiting report)
1 days to install plate in slots (includes adjusting plate to match rebar markings, drill, bolting down)
1 days to move & set up at next slot
4 days to map & install
5 days to move, map, install @ 3rd slot.
2 days to clean up & water up unit.

Typical total 22 work days (1 month) per unit. The contract could work concurrently in 3 slots completing a unit in 2 weeks, but unit availability assumes a 12 month duration....

a. <u>Overtime</u>.
Assume no Overtime since durations estimate are generous.

b. Construction Windows.

Assume no confining work Window. Project can have one unit down and dewatered and still operate JBS. Assume first priority units would be available during IWWP via control scheduling of outages.

c. Acquisition Plan.

Assume bids but limited to 8a small business procurement.

4. Subcontracting Plan.

This cost estimate assumes the prime contractor be experience in heavy construction and provides cranes for access and material handling, and uses own crews for installation.

Subcontract for rebar location work.

5. Project Construction.

a. Site Access.

Bonneville Powerhouse Two: The Contractor's vehicles and construction equipment will enter into the project via the Washington State side via Highway 14. Minor staging areas and minor storage can be located at the work on the north shore.

6. Contingencies by Feature or Sub-Feature. See Abbreviated risk analysis.

7. Functional Costs:

Functional costs for Engineering and Design and Construction Management associated with this work were assumed typical default values as follows:

a. 01 Account - Lands and Damages: N/A all work on existing project and in the type of regular operations and maintenance.

b. 30 Account - Planning, Engineering and Design:

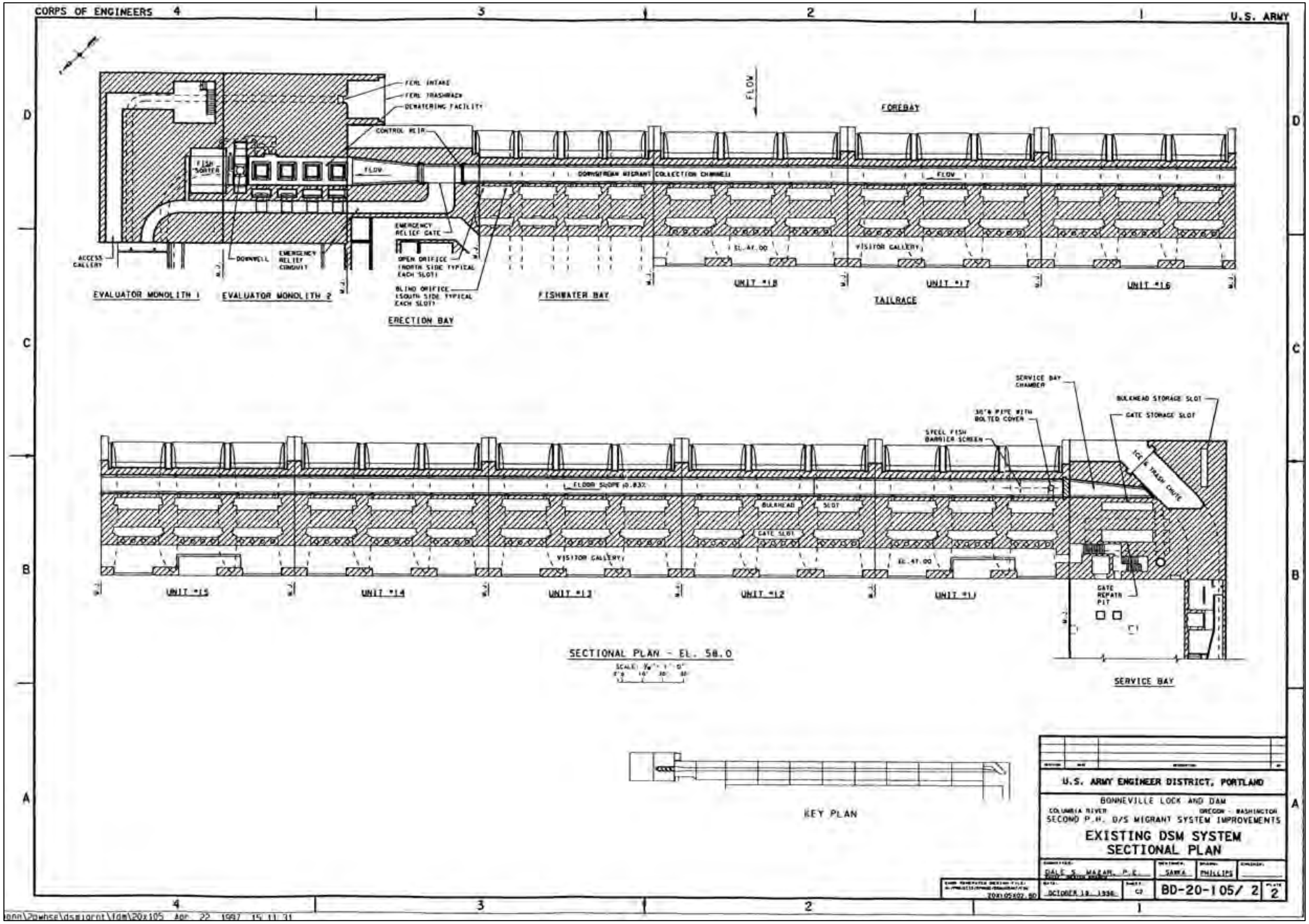
Assume Environmental Compliance budget not applicable because this work of the type of regular operations of Bonneville Dam. Minor budget/effort for is covered in the Eng & Design 10%.

Program Management:	**2.5%**
Planning & Environmental Compliance:	**n/a**
Engineering & Design:	**10.0%**
Reviews, ATRs, IEPRs, VE:	**0.5%**
Life Cycle Updates (cost, schedule, risks):	**0.0%**
Contracting & Reprographics:	**2.0%**
Engineering During Construction:	**5.0%**
TOTAL	**24%**

c. <u>31 Account - Construction Management:</u> This account covers construction management of the proposed modification.

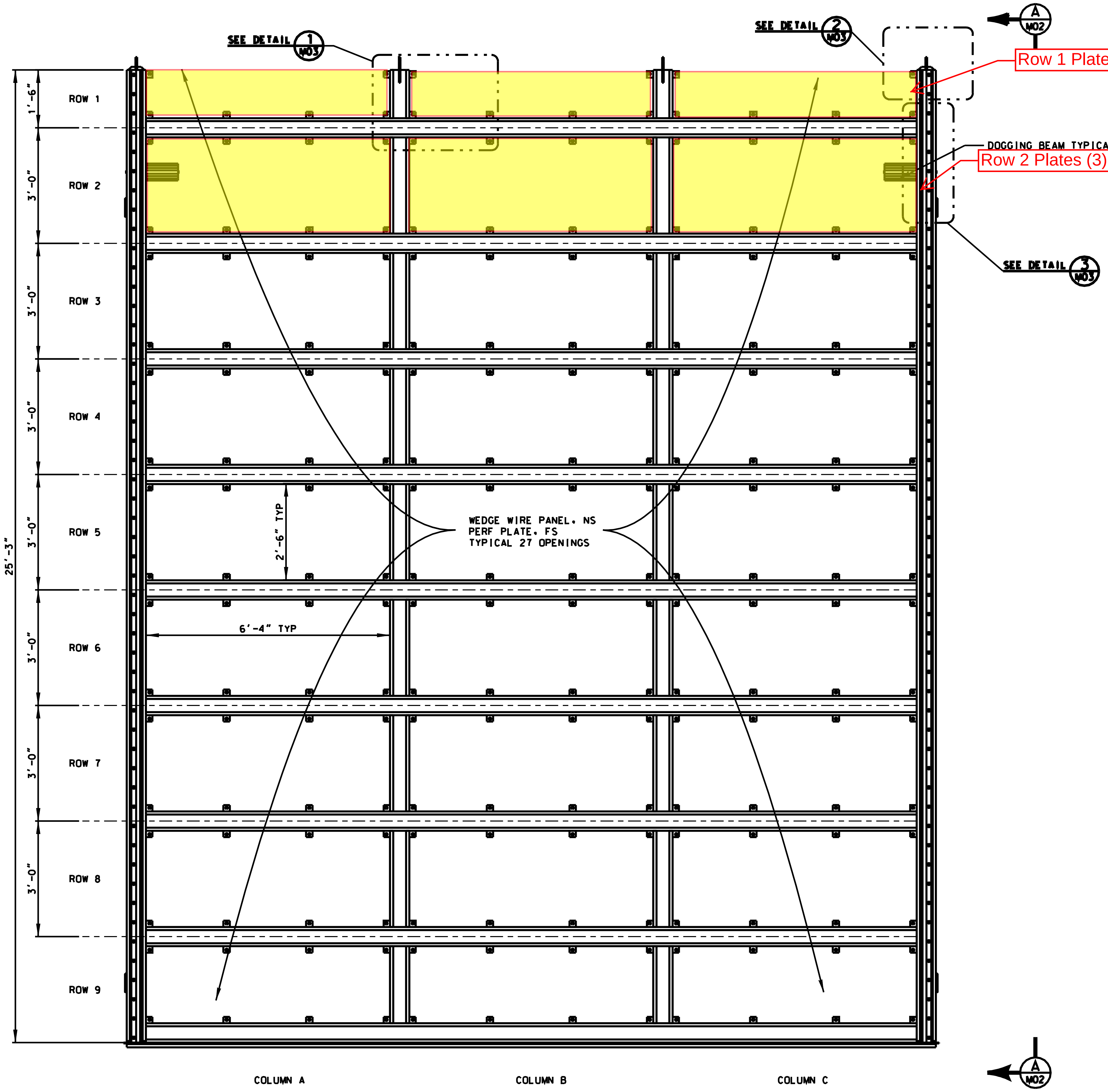
Supervision & Assurance:	10%
Project Operation	2%
Program Management	2.5%
TOTAL:	14.5%

B2 Intake Gate Slots Plan View Note: 8 Main units with 3 intake slots each plus 2 fish units with 2 intakes each. Only Main Units will have changes. (No change for Fish Unit slots)



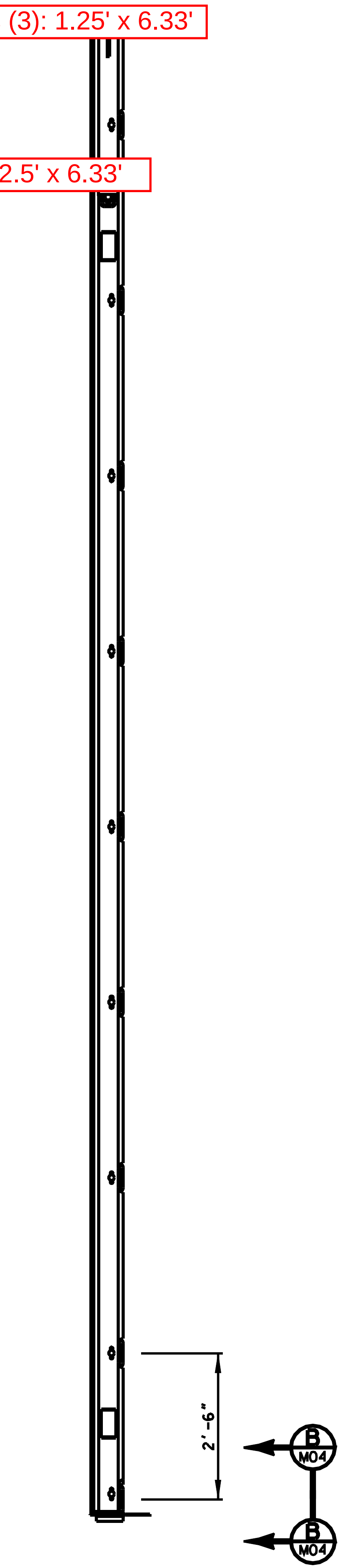
ITEM DESCRIPTION	QUANTITY	REFERENCE
LOWER FRAME ASSEMBLY	1	M02
FRAME CONNECTING PINS	4	M03
UPSTREAM SEAL ASSEMBLY	1	M04
BOTTOM SEAL ASSEMBLY	1	M05
PROFILE WIRE	27	M06
PERF PLATE	24	M07
ROLLER ASSEMBLY	18	M09

QUANTITIES LISTED ABOVE ARE REQUIRED FOR ONE VBS AND EACH MAIN UNIT REQUIRES THREE VBS.



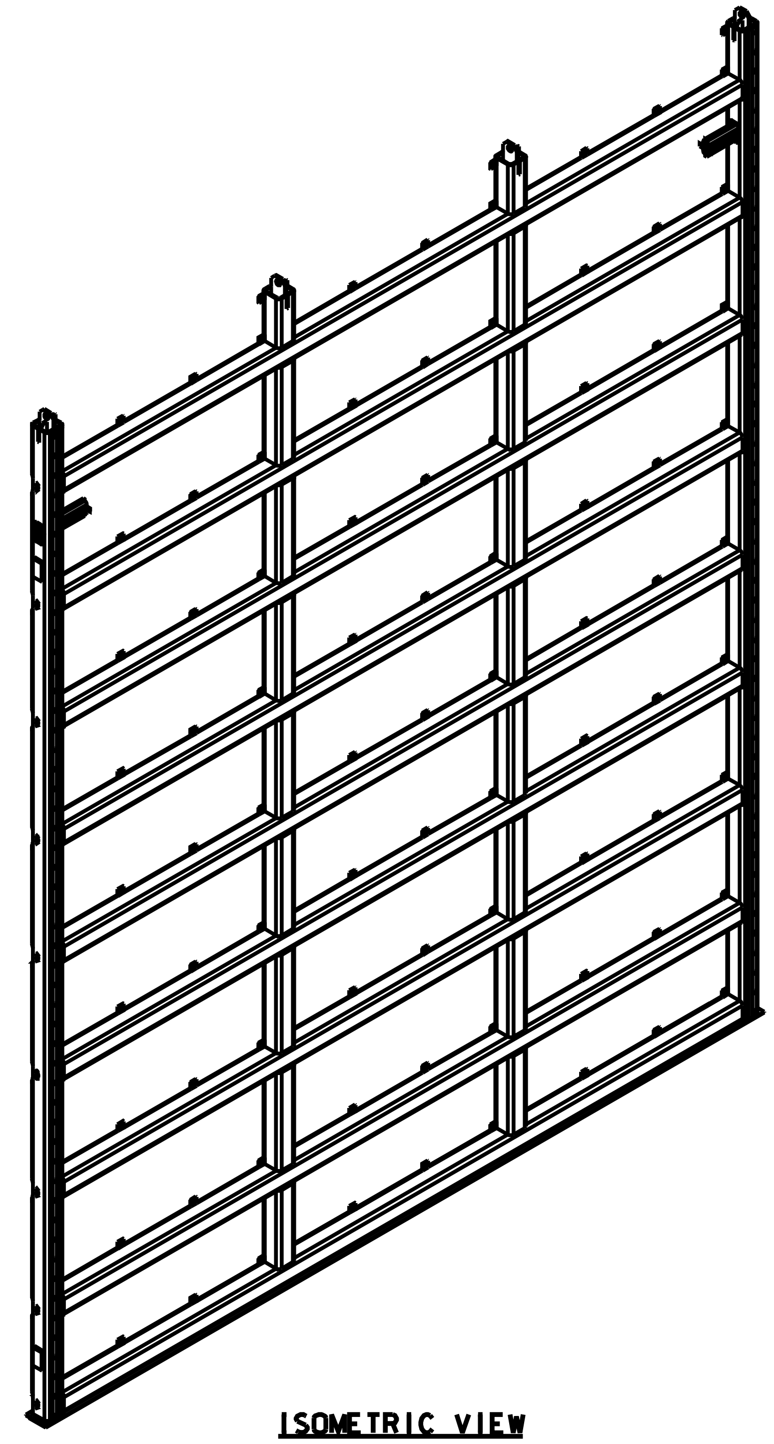
LOWER FRAME - LOOKING DOWNSTREAM

SCALE: 3/8"=1'-0"



VIEW A M02

SCALE: 3/8"= 1'-0"



ISOMETRIC VIEW

SCALE: NOT TO SCALE

NOTES:

1. ALL HSS STRUCTURAL MEMBERS A500 GRADE B. HSS 6x6x1/2"
2. ABRASIVE BLAST EXTERIOR FRAME SURFACES. PAINT INSIDE AND OUTSIDE OF FRAME SURFACES PER 09900.
3. AFTER FABRICATION, VBS PANELS SHALL BE WITHIN +/- 1/8" OF SPECIFIED DIMENSIONS DIAGONALLY, VERTICALLY, AND HORIZONTALLY.
4. FRAMES SHOULD BE INTERCHANGEABLE. MEETING TOLERANCE ON THE CONNECTING PIN HOLES IS CRITICAL.
5. NS: NEAR SIDE. FS: FAR SIDE.

SCALE: 3/8"= 1'-0"
12" 0 2' 4' 6'

US Army Corps
of Engineers
Portland District

Revision	Date	Description	By

Designed by:
J. CALNON

Date:
14 JUNE 05

Drawn by:
R. METTLER

CADD File Name:
BDM002F27C00.DGN

Checked by:
R. WRIDGE

Technical Manager:
M. SAWKA

Submitted by:
RONALD S. WRIDGE, P.E.
Chief, Mechanical Design

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
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FISH GUIDANCE EFFICIENCY PROGRAM
GATEWELL AND VBS MODIFICATIONS
MECHANICAL VBS

VBS LOWER FRAME

DRAWING STATUS:
FINAL

DRAWING NO.
BDF-3-27/02

SHEET
M02

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	Stock Number	Item Description	Size	Status	Price Each	Totals
1	P51	1 (1.00) thick T304 Stainless Steel Plate - Dull Mill Finish	4x8 Ft. ▾	✓ In Stock	$5,136.00	$5,136.00
1	P514	1/4 (.250) thick T304 Stainless Steel Plate - Dull Mill Finish	4x8 Ft. ▾	✓ In Stock	$1,253.44	$1,253.44
					Sub-Total:	$6,389.44
					Shipping:	$0.00
					Total:	* $6,389.44

Notice: Due to current market conditions, prices are subject to change without notice.
* - Orders in KY are subject to a 6% sales tax.

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B2 FGE Suppliment EDR
10-10-2014

Stain Less Steel Cost.

Metalsdepot.com T304 4'x8'x1" $\$5136^{00}$

Price Per ft² $\frac{\$5136}{4'(8')} = \underline{\underline{160.50\ \$/SF}}$ $\div \frac{40.8\#}{SF} = \boxed{\$3^{93}/lbs}$

✓ to trim a Shape

3'-9" wide $3.75'(160.5\ \$/sf) + \$10/ft = \underline{\underline{\$612/ft.}}$

3'-0" wide $3.0'(160.5\ \$/SF) + \$10/ft = \underline{\underline{492\ \$/ft.}}$

B2 FGE Suppliment EDR

10-10-2014

SS 1/4" PL for Perf Plate.

$$\frac{\$1253.44}{4' \times 8'} = 39.17\ \$/ft^2 \quad \text{say } \underline{\underline{\$40/SF}} \Rightarrow \left(3.84\ \$/lbs\right)$$

Punch 1"φ holes. for 50% Porosity

Assume ~15 min per Plate Setup + ~20 holes punc per Min.

∴ Ave ~6' long Plates.

Punch Setup

$$\underbrace{\frac{144 \frac{in^2}{ft^2} (.50)}{(1'')^2 \frac{\pi}{4} \frac{in^2}{hole}}} \frac{min}{20\ holes} + \frac{15\ min}{6'}$$

$$\underbrace{92 \frac{holes}{ft^2} \frac{1\ min}{20\ holes}}_{4.6} + 2.5\ min/ft$$

say 5 min + 3 min = 8 min per ft shop time.

@ 75 \$/hr

$$\frac{8}{60}(75) = \longrightarrow \underline{\underline{10\ \$/ft^2 \text{ to punch}}}$$

APPENDIX E

Agency Technical Review Comments