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Idaho State University

**A COMPARISON OF 2-D VERSUS 2-D/3-D NUMERICAL
MODELS OF AN OXBOW RECONNECTION ON THE PORTNEUF
RIVER**

By

Garrett Scott Thompson

A thesis

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Committee Approval

To the Graduate Faculty:

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Abstract

A Comparison of 2-D Versus 2D/3-D Numerical Models of an Oxbow Reconnection on the Portneuf River

Thesis Abstract – Idaho State University (2021)

The case study for this thesis was in Pocatello, Idaho. The objective of this paper was to provide recommendations for culvert additions for reconnection of historical oxbows along the Portneuf River in South Pocatello. The reconnection of the oxbows will provide flood storage and mitigation. Another objective was to compare the results of a HEC-RAS 2-D surface water model with a combined 2-D and 3-D surface water model in FLOW-3D.

Total hydrographs with return periods of 2, 5, 10, 25, and 100 were developed as the flood events and all were modeled in HEC-RAS. The 25-year return period hydrograph was used to compare FLOW-3D and HEC-RAS results.

A 4ft inlet culvert is recommended with an upstream invert at an elevation of 4467 ft and the downstream invert was placed at 4466 ft. Four 1 ft culverts are recommended at the outlet. Three culverts placed at the maximum floodplain WSE of 4470.5 ft to act as emergency outlets. The culvert at the lower elevation was used as the main outlet culvert. This culvert was placed at an elevation of 4461 ft.

Water surface elevations within FLOW-3D were lower than HEC-RAS by an average of 3.6ft. Velocities within FLOW-3D were higher than HEC-RAS by an average of 0.52 fps. Depths within FLOW-3D were than HEC-RAS by an average of 1.23 ft. Results produced from HEC-RAS were determined to be more reliable than those of FLOW-3D. Due to a volume loss of 12% the FLOW-3D results were considered unreliable and unsuccessful.

Chapter 1 -Introduction

This chapter provides the purpose and background necessary to fully understand the contents of the thesis below. This includes a specific explanation of the project location along the Portneuf River in Pocatello Idaho. After this the proposed modifications that provide the basis for this project are explained. Finally, the historic flooding along the Portneuf are highlighted.

1.1 Purpose

There are a few objectives for the research presented in this thesis. The first objective is to compare results of 2-Dimensional unsteady water models produced with HEC-RAS and FLOW-3D of a section of the Portneuf River in Pocatello Idaho. The next objective is to evaluate the feasibility of restoring historic Portneuf River Oxbows and the Portneuf River Flood Plain east of the Union Pacific Railroad between South 2nd Ave and Hildreth Road. The reconnection of the oxbows will provide floodplain storage during peak flood events. Figure 1 illustrates reconnection of an oxbow (Harelson, 2019).

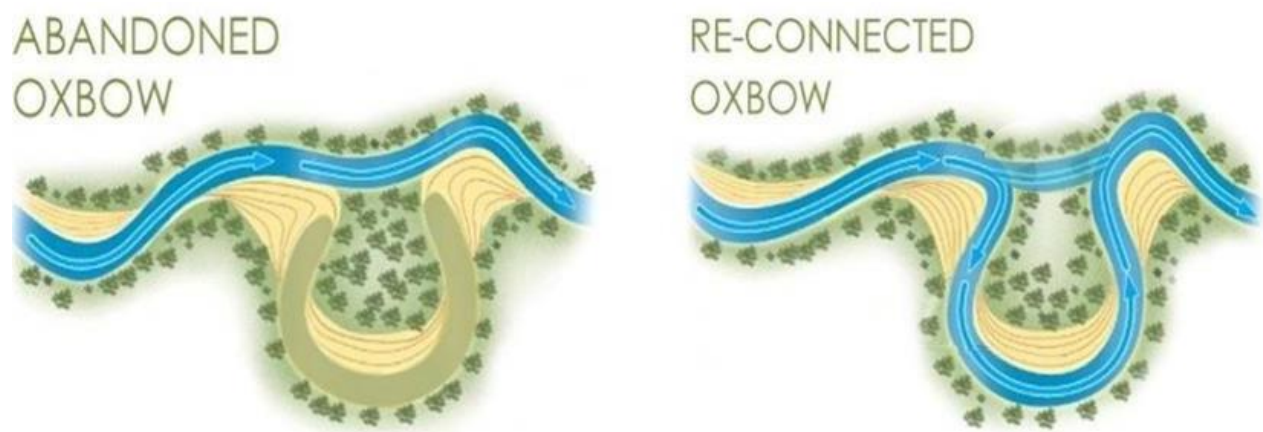


Figure 1 – Diagram of oxbow rehabilitation (Harelson, 2019)

Portneuf River at the south end of Pocatello, near Edson Fichter pond includes two historical meanders oxbows as shown in Figure 2. The study presented here considers the feasibility of rehabilitating both oxbows by diverting flows at Point 1 ($42^{\circ} 49' 12''$ N, $112^{\circ} 23' 55''$ W); connecting the first and second oxbows by excavating a channel from point 2 to point 3 and returning flows to the river at point 4 ($42^{\circ} 49' 28''$ N, $112^{\circ} 24' 19''$ W) (Harelson, 2019).



Figure 2 – Diversion, excavation, and returning locations

The intent of the reconnecting the oxbows is to use them as a flood storage basin in the event of a flood. The flood storage is to dampen peak flood flows to allow redesign of several portions of the river downstream of the project location. The areas of redesign would allow better recreational access to the river throughout Pocatello. Inlet and outlet culvert alignments are presented in Figure 3. Figure 4 shows the project location and the locations for channel redesign.

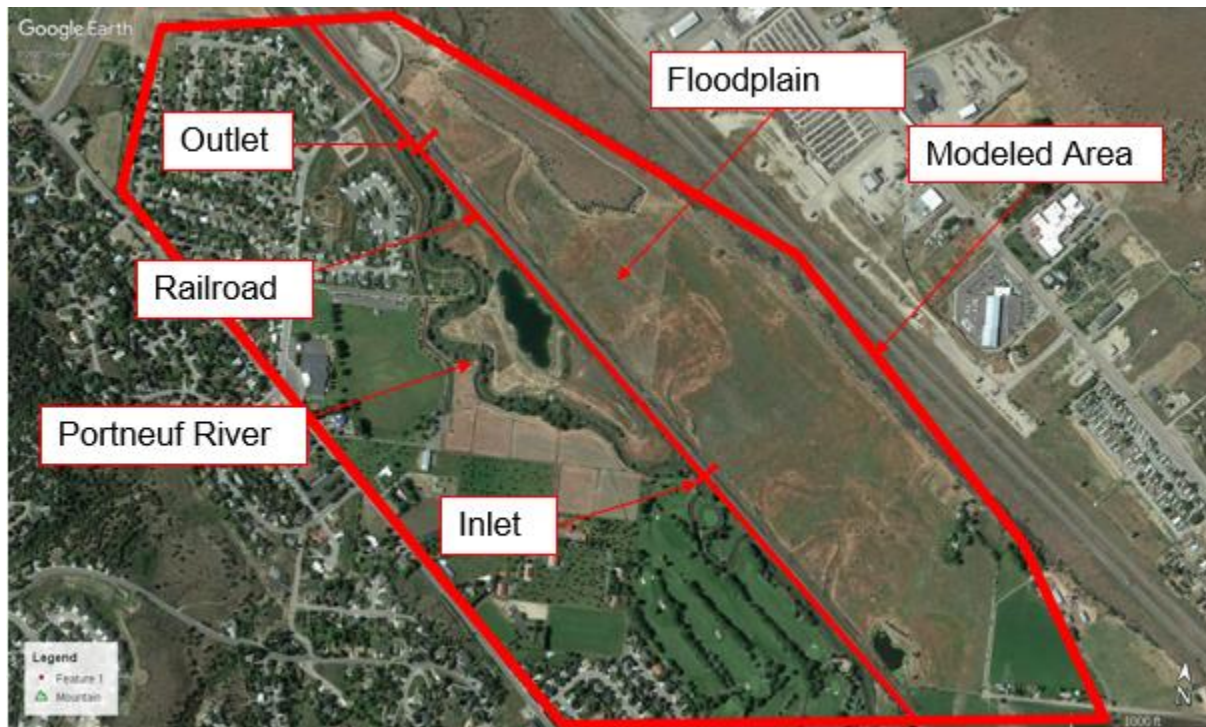


Figure 3 – Model area and culvert locations

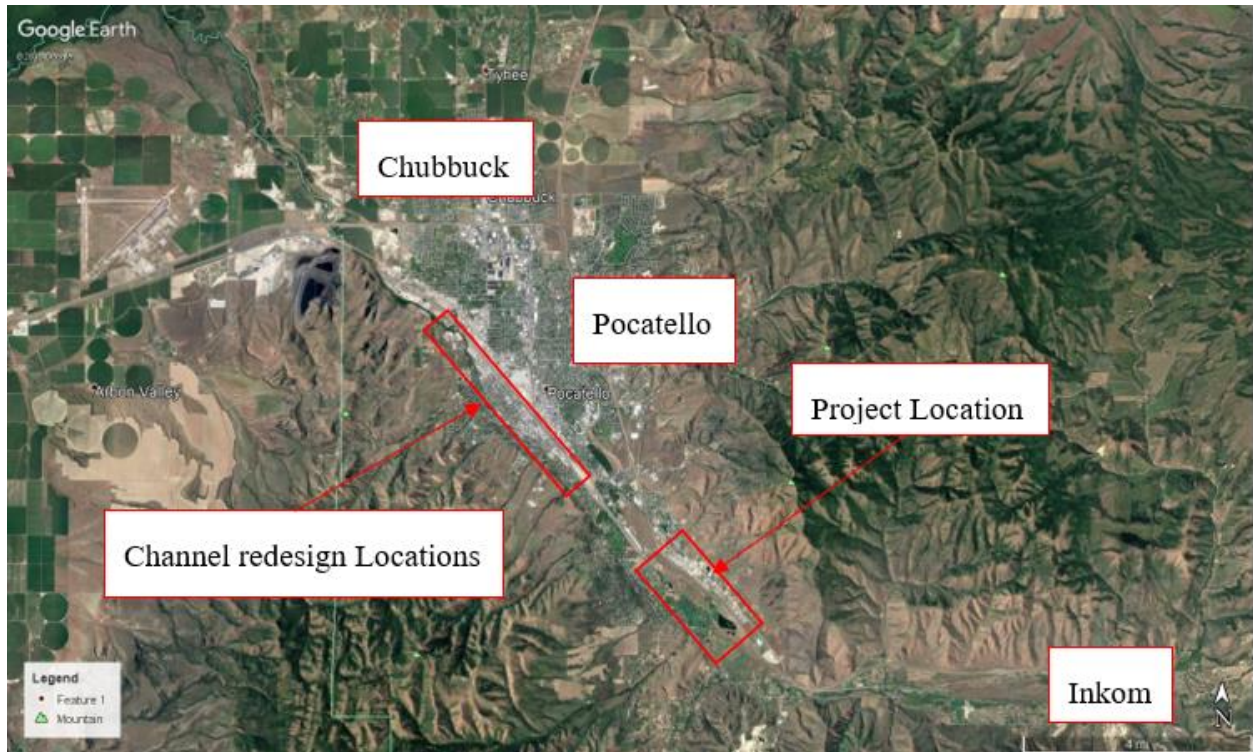


Figure 4 – Project location

1.2 Proposed Connection Channel

The proposed channel connecting the oxbows from point 2 to point 3 mimics a trapezoidal channel with a ten-foot-wide pedestrian pathway as shown in Figure 5. This would require approximately 113,300 cubic yards of excavation (Harelson, 2019). Figure 6 shows that proposed Army Core of Engineering Rehabilitation Plan (City of Pocatello, 2015).

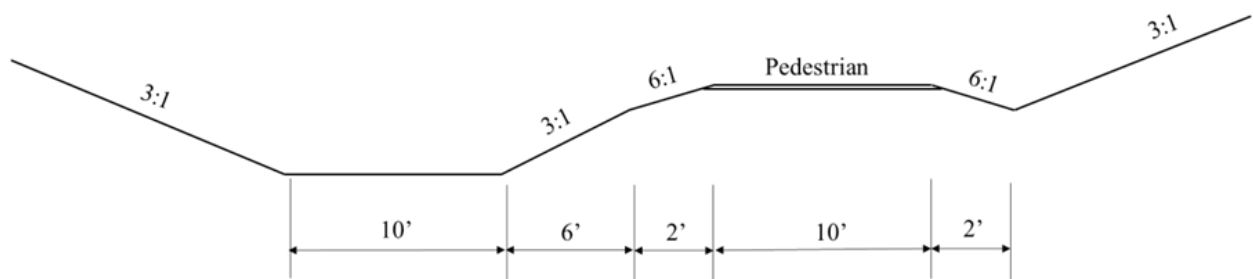
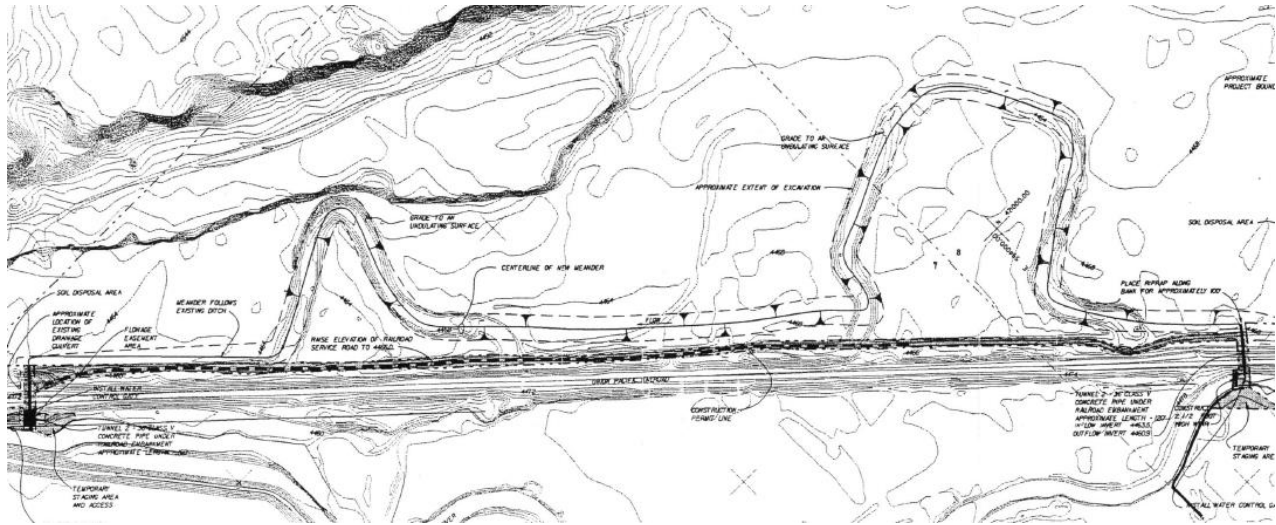


Figure 5 – Proposed connection channel (Harelson, 2019)



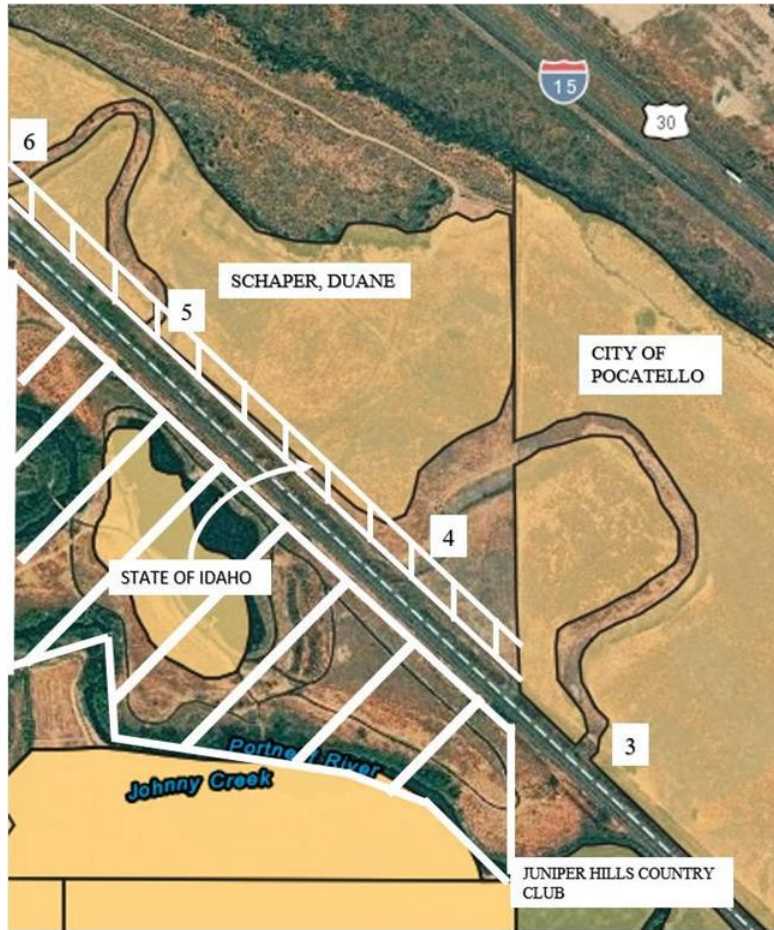


Figure 7 – Land ownership (Harelson, 2019)

1.4 Current Water Rights

The Portneuf River is a fully appropriated stream system (FASS). This means that there is insufficient supply for new water right applications and the analysis of the legal basis for diverting the river flows is beyond the scope of this study. Current water rights for the six properties within the project location are displayed in Figure 8. Table 1 summarizes the water rights pertaining to Figure 8. Three irrigation groundwater rights for the surrounding floodplains and golf course.



Figure 8 – Current water rights (Harelson, 2019)

The only current water rights to the Portneuf River are owned by the State of Idaho and are primarily used for Wildlife preservation and inflow to the Edson Fichter Pond. Idaho Fish and Game owns groundwater rights to maintain the water level of the Pond (Idaho Department of Water Resources, 2020; Idaho Department of Water Resources, 2020).

Table 1 – Water right summary table

No	Water right number	Owner	Priority date	Source	Water use	Diversion rate
1	29-2494	City of Pocatello	7/17/1966	Ground Water	Irrigation	1.55 cfs
2	29-8011	Corey Snow	04/5/1990	Ground Water	Irrigation	0.2 cfs
3	29-13998	Fish & Game	02/9/2011	Ground Water	Recreation storage	47 AFA*
4	29-13648	State of Idaho	1/26/1912	Portneuf River	Wildlife	2 cfs
5	29-2137A	State of Idaho	7/15/2003	Portneuf River	Wildlife	0.24 cfs
6	29-4433	Juniper Hills	3/31/1960	Ground Water	Irrigation	2.27 cfs
						*AFA = acre-feet annually

1.5 Portneuf History/Background

1.5.1 Introduction

The Portneuf river meanders 111 miles from the mountains above Chesterfield Reservoir through four Idaho counties and connects to the American Falls Reservoir. The Portneuf Watershed composes of 1300 square miles. The Portneuf watershed is shown in Figure 9. The stretch of river focused on in this report is from the Portneuf Gap to the Cheyenne Bridge.

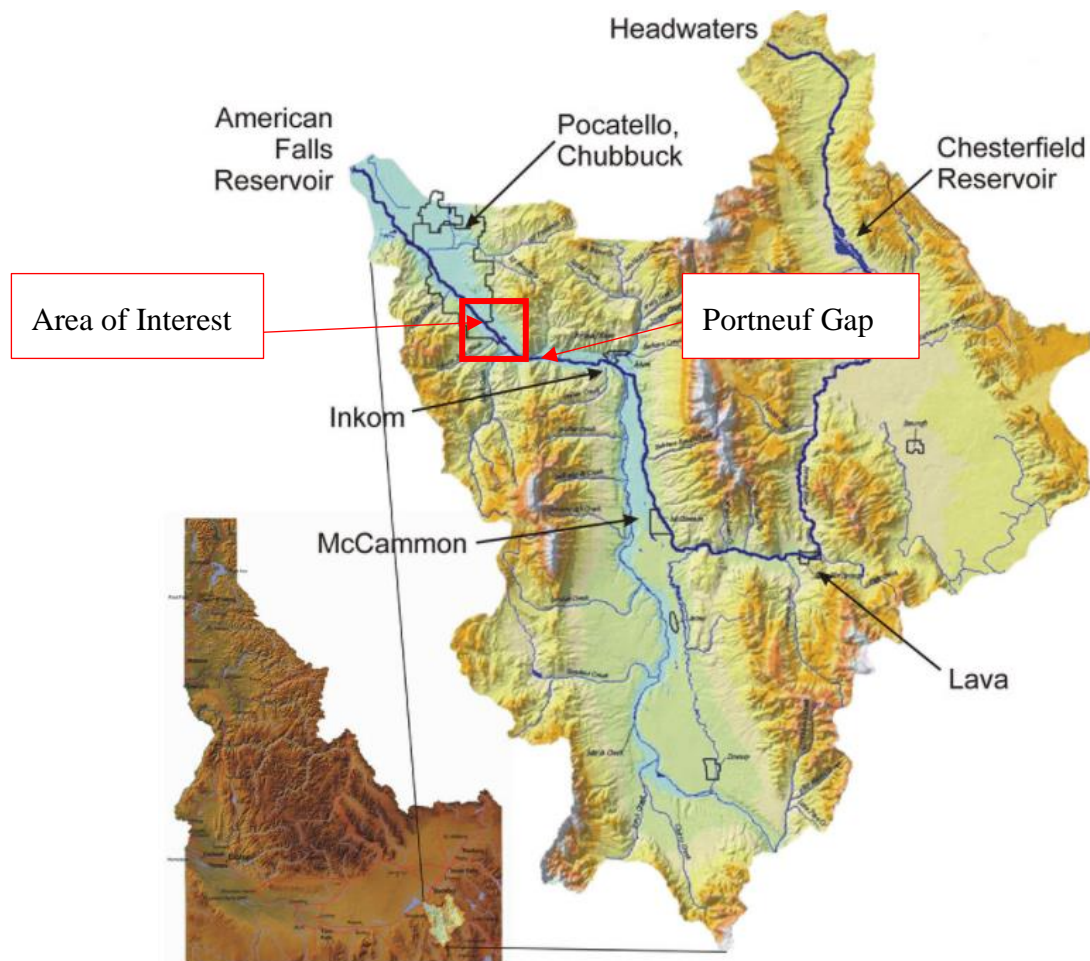


Figure 9 – Portneuf Watershed (IORC, 2021)

1.5.2 Historical Flooding and Channel Modifications

The first modifications to the natural process of the Portneuf river began from 1878 to 1882 when the Union Pacific Railroad was constructed along the Portneuf River. The modifications included straightening and cutting off historical river meanders. After the railroad was established the Pocatello Townsite was created in 1888 and consisted of a grid running parallel with the railroad. The townsite plan placed house and street lots directly over the river. The combination of the construction of the railroad and the townsite plan reduced floodplain area to almost zero throughout Pocatello as shown in Figure 10 (City of Pocatello, 2015).

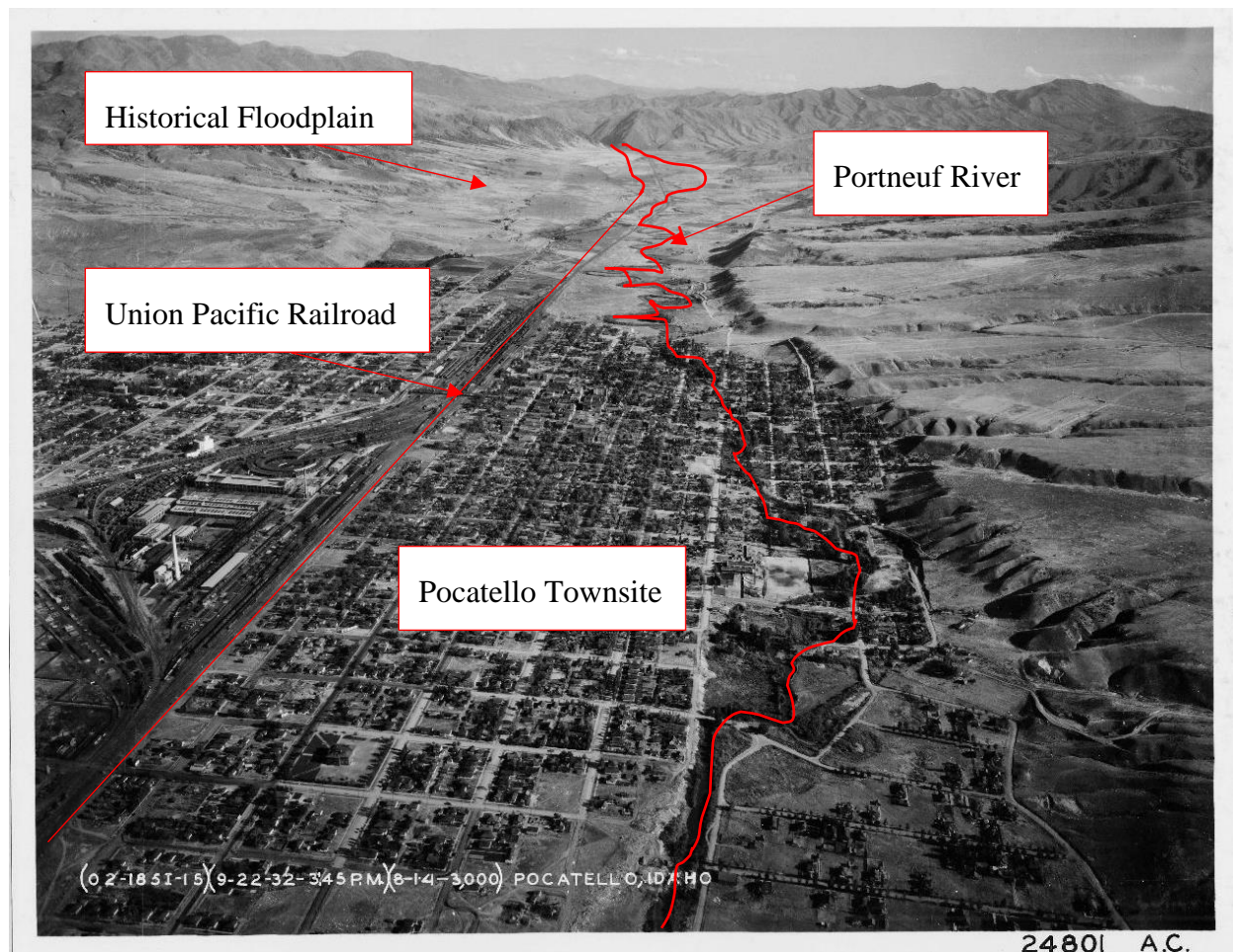


Figure 10 – Portneuf Townsite 1932 (City of Pocatello, 2015)

During 1962 Pocatello had significant flooding along the Portneuf river. During this flooding peak flows were 2990 cubic feet per second. Figure 11 shows the Raymond Park flooding looking South. Significant flooding occurred throughout the Portneuf Valley, and sandbags were used to create temporary levees for the flood waters throughout the town as shown in Figure 12 (City of Pocatello, 2015).



Figure 11 – Raymond Park Flooding 1962 (City of Pocatello, 2015)



Figure 12 – Sandbag Levee Construction 1962 (City of Pocatello, 2015)

Due to this flooding between 1966 and 1968 the Army Core of Engineers conducted a six-mile flood control project through the city of Pocatello. The project included one and a half mile of open top rectangular box culvert and about four and a half miles of levees up and downstream of the concrete channel. Figure 13 shows photos during construction of the concrete channel modifications (City of Pocatello, 2015).



Figure 13 – Concrete Channel Modification 1967 (City of Pocatello, 2015)

Construction of the levee modifications are shown in Figure 14. These modifications restricted access to the Portneuf and made the river unnavigable for recreation access. Much of the natural aquatic life and water quality of the river have been deteriorated due to the flood mitigation project.



Figure 14 – Levee Channel Modification 1967 (City of Pocatello, 2015)

The new channel highly restricts recreation access to the river and has lost many of its beneficial meanders due to channel straitening during the flooding mitigation project. The loss of meanders within the river has had a negative effect on the vegetation, wildlife, wetland, and aquatic habitat (City of Pocatello, 2015). Now that the history of the Portneuf River and significant historical flood events have been presented an introduction of the software programs used for modeling is discussed next.

Chapter 2 -Literature Review HEC-RAS and FLOW-3D Background

The contents of this chapter include the literature review of similar computational fluid dynamic comparisons that have previously been completed. This will provide background and insight on steps that have been taken in previous studies. After this an introduction of the basics of HEC-RAS will be explained. Then the governing equations behind HEC-RAS computations will be presented. Following this an introduction of FLOW-3D will be discussed along with the governing equations behind the program.

2.1 Introduction

Computational Fluid Dynamics (CFD) is the methodology for solve complex fluid motion problems. CFD combines the disciplines of engineering fluid dynamics, mathematics, and computer science. CFD is used for a wide variety of applications. In its early history, CFD it was primarily used in areas of aeronautics and astronautics. Recently it has been applied in several other applications such as fluid mechanics, heat transfer and also found in process, chemical, civil, and environmental applications (Tu, 2008).

In this study, two different CFD software packages are used to simulate the Portneuf River with culvert modifications. The objective of this study was to compare the results of a HEC-RAS (Hydrologic Engineering Center – River Analysis System) 2D (two-dimensional) model with a combined 2D and 3D model in FLOW-3D along with model flood inundation extents to analyze the performance of culvert additions from the river to the adjacent Oxbows. Challenges within FLOW-3D were encountered. These issues surfaced during the transfer of the DEM from HEC-RAS and conversion of file formatting to FLOW-3D and are discussed in detail in Section 4.3. These issues changed direction of the thesis to a comparison of a HEC-RAS 2D model and a 2D

shallow water model in FLOW-3D. The 2D shallow water model was chosen due to unrealistic computation times estimated when running the model with a 3D mesh incorporated at the inlet and outlet locations. The results from both models were then compared with each other, and a base HEC-RAS model without culvert modifications.

There are several other studies that compare different CFD software packages including HEC-RAS vs. FLOW-3D. A brief review of past studies will be discussed to provide an introduction in CFD model comparison studies, and information that is used during this thesis.

2.1.1 Environment Agency 2D Hydraulic Model Benchmark Study

The leading public body protecting and improving the environment in England is the Environment Agency. The Environment Agency conducted a 2D hydraulic benchmark study 2D hydraulic model study comparing 19 different software packages listed in Table 2.

Table 2 – Environment Agency 2D Software Package Comparison List (Environment Agency, 2013)

Software Name	Developer	Version
ANUGA (2009)	Geoscience Australia and Australian Nation University	1.1beta_7501
Ceasg	Ceasg Flow Modeling (Amazi Consulting Ltd)	1.12
Flowroute-iTM	Ambiental Ltd	3.2.0
InfoWorks ICM	Innovyze	2.5.2
ISIS 2D	Halcrow (a CH2M Hill company)	3.6
ISIS 2D GPU	Halcrow SINTEF (Norway)	1.17
ISIS Fast	Halcrow	
ISIS Fast Dynamic	Halcrow	3.6

JFLOW +	JBA Consulting	2.0
LISFLOOD FP	University of Bristol	5.5.2
MIKE FLOOD⁴	DHI	2012
RFSM (Direct) (2009)	HR Wallingford	3.5.4
Software Name	Developer	Version
RFSM EDA	HR Wallingford and Heriot-Watt University	1.2
SOBEK (2009)	Deltares	2.13
TUFLOW	BTM WBM	2012-05-AA
TUFLOW GPU	BTM WBM	2012-05-AA
TUFLOW FV	BTM WBM	2012.000b
UIM (2009)	University of Exeter	2009-2012 (2009-2010 in Test 8)
XPSTORM	Micro Drainage Ltd	2010-10-AB- iDP-w32

In the study 8 different tests were performed to assess the performance of each program over a variety of circumstances. River to floodplain linking was tested to evaluate capability to simulate flood volume transfer between rivers and floodplains using 1D to 2D model linking (Environment Agency, 2013). This study provided a good outline for the general process used to complete model comparison studies.

The first step in setting up a 2D model is data to create a digital elevation model (DEM). This is typically accomplished through aerial or ground surveying to gather the topographic information needed to provide a terrain for the model. After this is accomplished boundary and initial conditions are established. Boundary conditions in the river channel that were used were a hypothetical unsteady inflow hydrograph upstream and a rating curve (flow vs. head) was

applied downstream. A uniform water surface level was applied as an initial condition. In the floodplain the boundary conditions used were break lines along the riverbanks, a culvert, and a sluice gate. After the boundary conditions were defined, Miscellaneous parameter values were established.

The parameters values that were defined were Manning's n value, model grid resolution, and simulation run time. Manning's n values were 0.028 in the river and 0.04 in the floodplains. A grid resolution of 20m was with a total of 16,700 cells were created. A simulation time of 72 hours was used.

The results compared in this study were water depth levels and velocities in the river channel and floodplains. Points were also delineated on a 2D map to compare results at each point. The test identified a relatively high level of inconsistency between models reflect the physics of a flood event. It was found that accurate geometry of critical structures was needed to predict flood hazards. It was also found that some of the software's had trouble accurately representing the critical structures and the locations specified. Errors concerning these were often comparable with riverbank overtopping depths and therefore had very significant effects in the prediction of flood flow patterns. Flood wave timing throughout the model also had inconsistency up to 3 hours which also decreased the reliability of the prediction of flood flow patterns (Environment Agency, 2013). Similar procedures that were used in this benchmark study were followed throughout this thesis. After reviewing this benchmark 2D surface water model study other surface water model comparison studies are summarized.

2.1.2 FLOWE-3D vs HEC-RAS Steady State Over Broad Crested Weir

Jalil and Qasim (2016) performed a numerical model comparison of the flow over a single step broad crested weir using FLOW-3D, HEC-RAS, and a physical model. In this study, the (k- ϵ model) of FLOW-3D and the steady flow model of HEC-RAS was used. Results found that FLOW-3D provided more accurate results HEC-RAS for the flows before, over, and downstream of the weir location. A hydraulic jump was located downstream of the weir structure and both programs accurately predicted the location of the hydraulic jump (Quasim, October 2016).

2.1.3 HEC-RAS vs 2D FESWMS

Cook (2008) conducted a thesis comparing an 1D HEC-RAS model with a 2D FESWMS model for flood inundation mapping. Throughout the thesis the effect of digital elevation modes (DEM), and computational mesh were analyzed for model sensitivity. The results of the thesis showed that inundation extent increases as the resolution of the DEM decrease for both 1D and 2D models. Mesh resolution is shown to change the inundation extent less than changing the resolution of the DEM. FESWMS software predicted higher inundation extent than HEC-RAS software (Cook, 2008). This study provided good insight on the importance of producing an accurate DEM.

2.1.4 2D Modeling of the Red River Floodway

A master thesis by Goazalez (1999) used one-dimensional HEC-RAS and two-dimensional FESWMS programs. The two programs were coupled together to complete a model across a floodway channel on the Red River near the city of Winnipeg in Canada. HEC-RAS was used to analyze flow at bridge structures, while FESWMS was used to model the flow in the

channel between bridge structures. The interactive analysis performed was successful. Transfer of results from one program to the other was completed with little complications.

The differences found between the programs were that FESWMS is more sensitive and takes more computation effort than HEC-RAS. Model calibration showed that the HEC-RAS one-dimensional model had a maximum discrepancy of 3.8” from measured and computed data. The FESWMS did not have as good of calibration results as HEC-RAS with a discrepancy of \pm 0.5 ft. (Gonzalez, 1999)

2.1.5 Comparative study of HEC-RAS IBER, and FLOW 3D Across a Meander in Columbia

Vargas, and six others (2019) produced a study to compare 1D, 2D, and 3D results from HEC-RAS, IBER, and FLOW-3D software's, respectively. Results from the study showed that IBER underestimates the channel velocity and overestimates the channel depth. HEC-RAS and FLOW 3D showed similar results for channel depths. FLOW-3D showed higher velocities than both HEC-RAS and IBER and can be attributed to it being a 3D model. In the 3D model channel velocities are calculated in the z direction which tends to make the resultant velocity to be higher than the 1D and 2D models (Juliana Vargas, 2019).

These studies provided a good basis for learning typical processes and challenges faced with surface water model comparison studies. The studies also provide an emphasis that water modeling software performances do vary, and some can produce more accurate results than others depending on what scenario is trying to be modeled. With this background of surface water model comparison studies the governing equations behind the computations of HEC-RAS and FLOW-3D are presented.

2.2 HEC-RAS

HEC-RAS is an open-source computation fluid dynamic (CFD) software designed by the Army Core of Engineers to help engineers analyze river systems. The software has many capabilities that are discussed below.

2.2.1 Introduction

HEC-RAS allows the user to manually input river sections and input survey data to create geometries. This is where the user can input parameters such as Manning's n values, storage areas, 2D Flow areas, 2D flow area connections, boundary condition locations. Once a geometry is made modifications can be made to the river, or terrain. The modifications available in HEC-RAS are river junctions, cross section edits, bridges, culverts, weirs, and 2D flow area mesh sizing. Once modifications to the geometry are made the user can choose to run several different types of conditions.

Steady, unsteady, quasi unsteady flow, sediment transfer, and water quality data used for analysis is then input into the software. Once all this is input a simulation can be ran. HEC-RAS offers several different styles for viewing results. The RAS Mapper is a useful tool that graphs your results on top of your terrain to visually see the flood event. The RAS Mapper shows the terrain from bird's eye view and is shown two dimensionally.

Several different output results can be graphed such as depth and velocity. Output hydrographs are also available to view in graphical or tabular forms for each cross section. Now that the model creation has been described the governing equations behind HEC-RAS modeling will be introduced.

2.2.2 Governing Equations

The Navier Stokes equations compute fluid motion in three dimensions. HEC-RAS further simplifies these equations by making some fundamental assumptions. The fundamental assumptions are that the vertical length scale is significantly smaller than the horizontal length scale. As a consequence, the vertical velocity is small and pressure is hydrostatic leading to the differential form of the shallow water (SW) equations (Brunner, 2016). For incompressible flows, constant water density, and the Cartesian coordinate system, the continuity equation reduces to Equation 2.1.

$$\frac{\partial H}{\partial t} + \frac{\partial(hu)}{\partial x} + \frac{\partial(hv)}{\partial y} + q = 0 \quad \text{Equation 2.1}$$

Under these same fundamental assumptions, the simplified momentum conservation equations are simplified to Equation 2.2 and Equations 2.3.

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = -g \frac{\partial H}{\partial x} + \nu_t \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right) - c_f u + f v \quad \text{Equation 2.2}$$

$$\frac{\partial v}{\partial t} + u \frac{\partial v}{\partial x} + v \frac{\partial v}{\partial y} = -g \frac{\partial H}{\partial y} + \nu_t \left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} \right) - c_f v + f u \quad \text{Equation 2.3}$$

Where,

u and v = velocity in the corresponding x and y cartesian directions

p = pressure

g = gravitational acceleration

ν_t = horizontal eddy viscosity coefficient

f = coriolis parameter (effect of angular velocity of the earth and latitude)

2.3 FLOW-3D

FLOW-3D is a private computation fluid dynamic (CFD) software that is popular in the industry and has a wide variety of applications. Version 12.0 is the latest update of the software, and this was used during this study. The software has many capabilities and is introduced below.

2.3.1 Introduction

FLOW-3D has four different tabs while the program is open. These tabs are the simulation manager, model setup, analyze, and display tabs. A brief description of each tab will be discussed next.

The simulation manager tab allows the user to organize the simulations run in the program by saving them into different portfolios. Within the portfolio several simulations or simulation copies can be saved. This tab also has a queue window which shows the user which simulation is in queue to be run next and amount of computation time left in the simulation. Another window shows runtime plots which allow the user to visually see the convergence of the computations. Below this is the solver messages window which provides feedback on the performance of the simulation. Now that the simulation manager tab has been introduced the model setup will be discussed.

The model setup tab allows the user all the inputs needed to run a simulation. Within the model setup tab the user defines the global conditions which are where the governing unit system and the pressure type of the simulation is chosen. Model physics are then entered which control the physics that best represent the project at hand. Then different fluids can be imported the physical and hydraulic properties of the fluid used during the simulation. After this the user can upload or create the geometry of the project. Once a geometry is made a computation mesh can

be created to tell the program the extents and how coarse or fine of a mesh to use for the simulation. Different initial conditions and numerical operations can be selected within the model setup tab as well. Once the model has been setup the simulation can be ran. Now that the basics of the model setup tab are discussed the analyze tab will be introduced.

The analyze tab allows the user to view the various output results from Flow-3D. Within the analyze tab history probes 1-D, 2-D, 3-D, and text outputs can be viewed. History probe is a specific location defined by the user in which specific results will be saved at the specified location. Options for 1-D, 2-D, and 3-D results can be chosen such as pressure, velocity, fluid elevation, and several other parameters. Now that the analyze tab has been described the display tab will be summarized.

Finally, the display tab allows the user to view the various results rendered through the analyze tab. 3-D result plots can be rotated and oriented however the user would like to view the results. This feature provides nice visual representation to access how the flow in the simulation is behaving.

2.3.2 FLOW-3D Governing Equations

The governing equation for hydraulic modeling in FLOW-3D are the continuity equation and the Reynolds-Averaged Navier-Stokes equations (RANS). For incompressible flows, constant water density, and the Cartesian coordinate system, the continuity equation reduces to Equation 2.4.

$$\frac{\partial}{\partial x}(uA_x) + \frac{\partial}{\partial y}(vA_y) + \frac{\partial}{\partial z}(wA_z) = 0 \quad \text{Equation 2.4}$$

Similarly, the RANS momentum equations reduce to Equations 2.2, 2.3, and 2.4.

$$\frac{\partial u}{\partial t} + \frac{1}{V_F} \left\{ u A_x \frac{\partial u}{\partial x} + v A_y \frac{\partial u}{\partial y} + w A_z \frac{\partial u}{\partial z} \right\} = -\frac{1}{\rho} \frac{\partial p}{\partial x} + G_x + f_x \quad \text{Equation 2.5}$$

$$\frac{\partial v}{\partial t} + \frac{1}{V_F} \left\{ u A_x \frac{\partial v}{\partial x} + v A_y \frac{\partial v}{\partial y} + w A_z \frac{\partial v}{\partial z} \right\} = -\frac{1}{\rho} \frac{\partial p}{\partial y} + G_y + f_y \quad \text{Equation 2.6}$$

$$\frac{\partial w}{\partial t} + \frac{1}{V_F} \left\{ u A_x \frac{\partial w}{\partial x} + v A_y \frac{\partial w}{\partial y} + w A_z \frac{\partial w}{\partial z} \right\} = -\frac{1}{\rho} \frac{\partial p}{\partial z} + G_z + f_z \quad \text{Equation 2.7}$$

Where,

u , v , and w = velocity in the corresponding x , y , and z - directions

A_x , A_y , and A_z = fractional area open to flow in x , y , and z - directions respectively

p = pressure

G_x , G_y , and G_z are body accelerations

f_x , f_y , and f_z are viscous accelerations

2.3.3 Simplification of governing equations for 2D shallow water mesh

The shallow water approximation is based on the assumption that the horizontal extents of the fluid are much greater than the vertical extent, in which case the governing equations can be formulated into depth-averaged equations. Examples of shallow flows include flow in the ocean, estuaries, large lakes, seasonal floods, and water on automobile windshields.

The shallow water model in FLOW-3D assumes that the shallow direction is the z -direction and gravity is in the negative z -direction. The three-dimensional equations of motion are then reduced to two-dimensional equations in the horizontal plane, referred to as the shallow water equations or shallow water model as shown in Equations 2.8 and 2.9 (Flow Science, 2019).

$$\frac{\partial u}{\partial t} + \frac{1}{V_F} \left\{ u A_x \frac{\partial u}{\partial x} + v A_y \frac{\partial u}{\partial y} \right\} = -\frac{1}{\rho} \frac{\partial p}{\partial x} + G_x + \frac{\tau_{s,x} + \tau_{b,x}}{\rho d} + 2\Omega v \quad \text{Equation 2.8}$$

$$\frac{\partial v}{\partial t} + \frac{1}{V_F} \left\{ u A_x \frac{\partial v}{\partial x} + v A_y \frac{\partial v}{\partial y} \right\} = -\frac{1}{\rho} \frac{\partial p}{\partial y} + G_y + \frac{\tau_{s,y} + \tau_{b,y}}{\rho d} + 2\Omega u \quad \text{Equation 2.9}$$

Where,

u and v = velocity in the corresponding x and y -directions

A_x and A_y = fractional area open to flow in x and y -directions respectively

V_F is the volume fraction (fraction of open volume in cell)

p = pressure

G_x and G_y are body accelerations

$\tau_{s,x}, \tau_{s,y}$ are the wind shear stress on fluid surface in x and y directions, respectively

$\tau_{b,x}, \tau_{b,y}$ are the x and y components of the bottom shear stress, respectively

Ω is the vertical component of the earth's angular velocity

Chapter 3 - Methodology/ Model Calibration

This chapter explains the data used for the terrain in HEC-RAS. It also describes the channel modifications required to accurately represent the Portneuf river and floodplain modifications required. After this model calibration and accuracy is presented.

3.1 LIDAR Data

Light Detection and Ranging (Lidar) data was used as the base terrain for the model in HEC-RAS. Lidar data uses an aircraft equipped with Leica ALS70, which is a laser that scans the elevation of ground surface. Idaho has an entire website dedicated to sharing LIDAR data named the Idaho Lidar Consortium. The data compiled on this website is very extensive. The area of from the Idaho Lidar Consortium Lidar was named Blackfoot Portneuf 2017 D1 (LIDAR, 2020). This area contained lidar data extending from Downey Idaho to Blackfoot Idaho. The project area was the extracted from this data set.

The file type extracted from the Idaho Lidar Consortium was a geoTIFF file. This file type is a raster image file type that stores arial imagery and topographic information for a specific location on the earth. This file type is one of the file types that is supported by HEC-RAS and was imported to the RAS Mapper window in HEC-RAS.

Lidar data used for the model was taken between April 22, 2015 and June 2, 2015. The average vertical deviation of the data was 0.093 ft. Ground survey were conducted in parallel with the lidar survey to ensure accuracy of data. The density of the ground points are 0.21 points per square foot. The terrain produced from the lidar survey is shown in Figure 15.

One inaccuracy with lidar surveying is the lack of ability to survey beneath any water surface. Due to this lack of data a ground survey was needed to capture the river bathymetry.



Figure 15 – LIDAR terrain

3.2 Survey of Portneuf/ Excavated Connection Channel

To allow for accurate river cross section bathymetry, a ground survey was conducted within the project location. The survey was conducted on January 6th, 2020. Six different cross section locations were surveyed throughout the model area. This cross-section data was then used to modify the LIDAR terrain to account for cross section bathymetry. Along with the modification of Portneuf River bathymetry the excavated channel connection the two oxbows were added. The modified terrain is show in Figure 16.

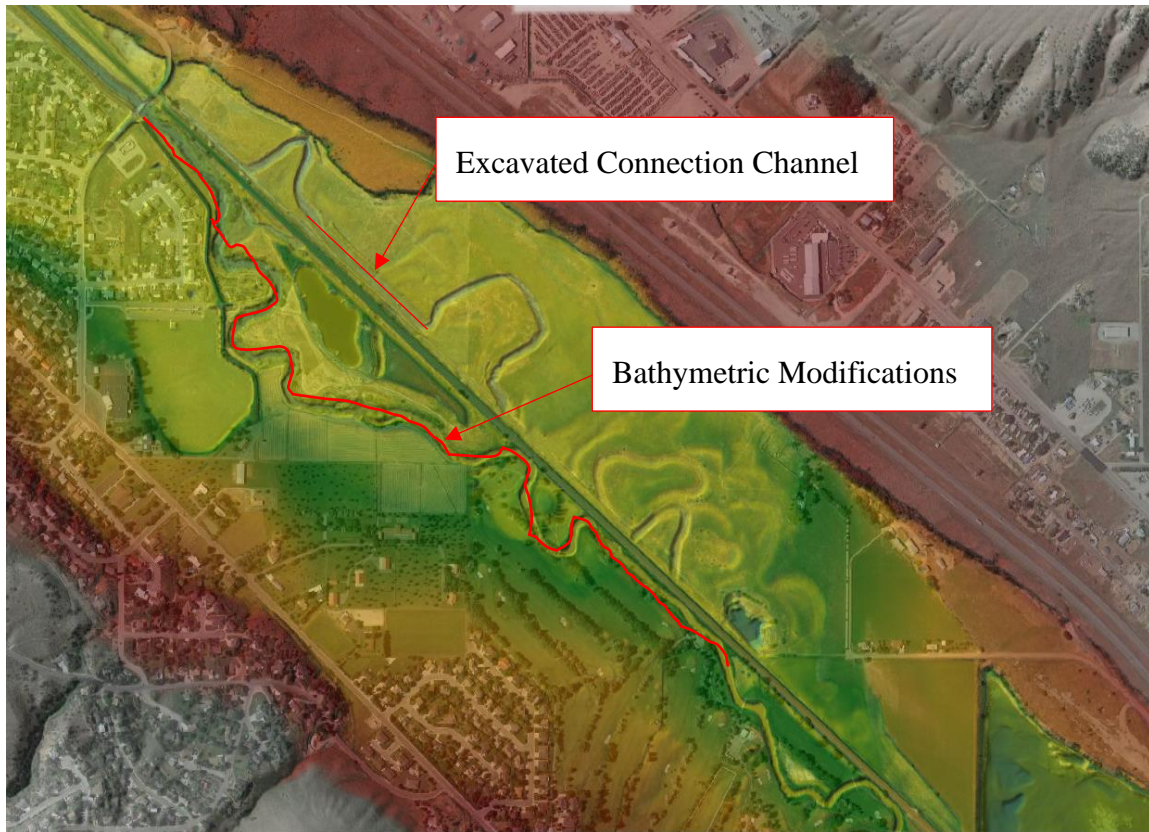


Figure 16 – LIDAR terrain with modifications

The channel was modeled with a slope of -0.018% slope to second oxbow and would require approximately 113300 yd³ of excavation.

3.3 Model Calibration

3.3.1 Calibration Setup

USGS stream flow data was used to calibrate the model with real world conditions. Figure 17 shows the location of the USGS flow monitoring station for the Portneuf river. Flow monitoring station is not located within the model area. To perform model calibration water surface elevations (WSE) from the LIDAR data were compared with model water surface elevation results from the same period the LIDAR survey was conducted. The discharge

hydrograph used for model calibration is presented in Figure 18 (USGS, National Water Information System, 2020). The discharge hydrograph used is also provided in Appendix A.



Figure 17 – USGS Flow Gage Location

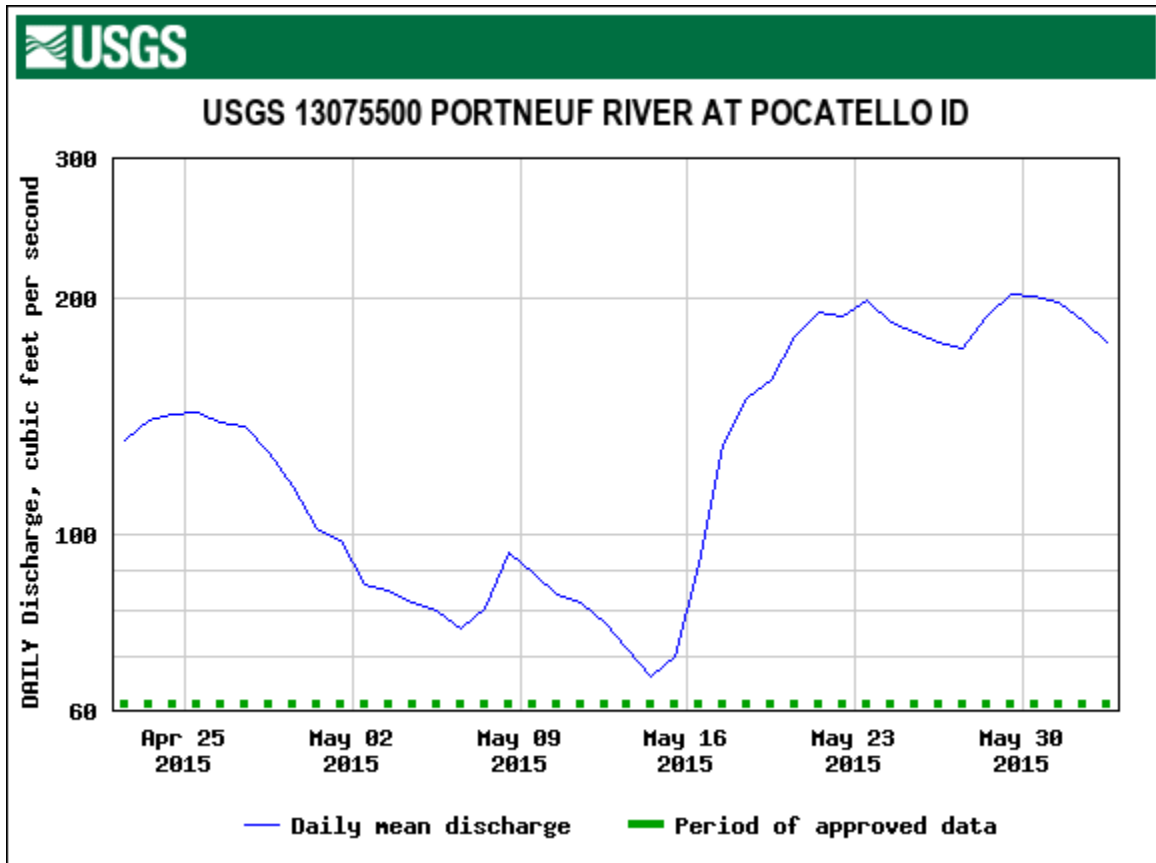


Figure 18 – Portneuf River discharge hydrograph (April 22, 2015 – June 2, 2015)

3.3.2 Model Accuracy

To check for HEC-RAS model accuracy ten different points along the model were checked to calibration with real world water surface elevations taken during the LIDAR survey. The locations of each point are shown in Figure 19. Each model was calibrated by making minor adjustments to the manning's n value of the channel to match the existing WSE from the LIDAR data. HEC-RAS showed incredible model accuracy and is summarized in Table 3. Figure 20 shows the WSEs from the calibration model results. Maximum deviation of WSE from the LIDAR data was 0.455 ft or about 5.5 inches with an average deviation of 0.75 inches. The depth was also recorded to find the percent error in WSE relative to the water depth at each location.



Figure 19 – Calibration depth comparison locations

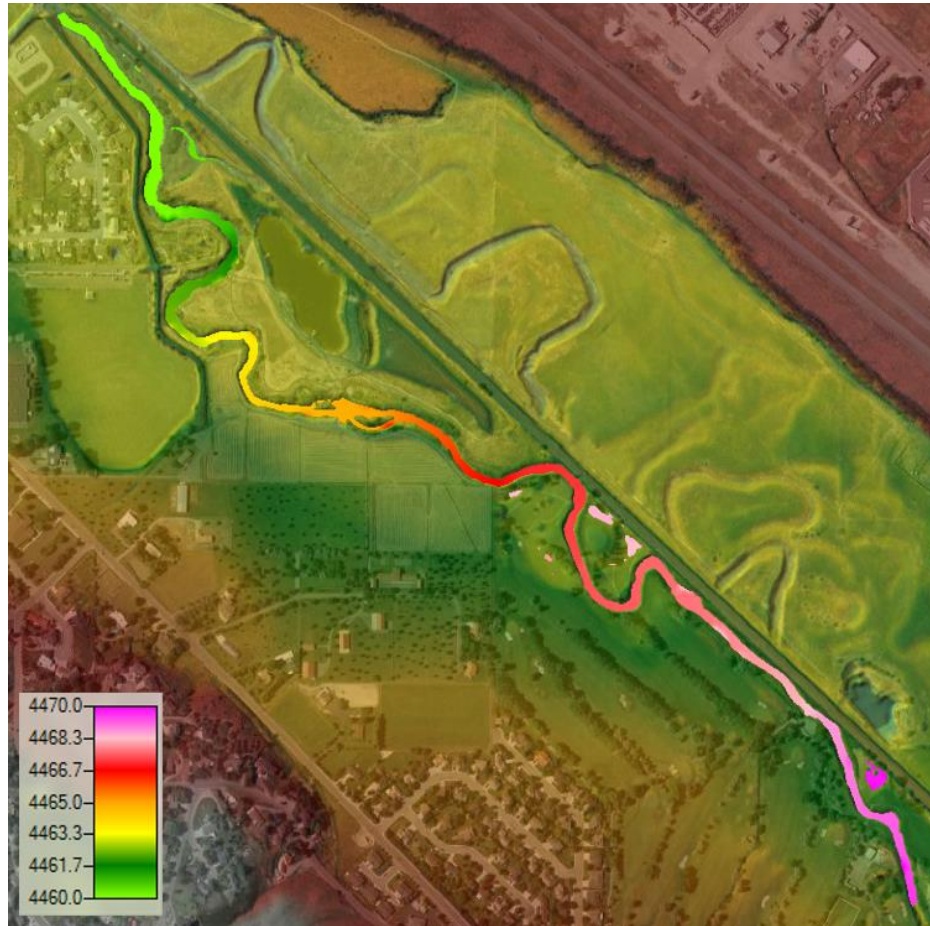


Figure 20 – HEC-RAS WSE from calibration model

Table 3 – HEC-RAS Model Calibration Summary

Point #	LIDAR WSE (ft)	HEC- RAS WSE (ft)	Difference (ft)	Depth (ft)	Error %
1	4469.92	4469.78	-0.14	4.33	-3.30%
2	4466.72	4466.69	-0.02	3.81	-0.58%
3	4465.56	4466.02	0.46	4.34	10.53%
4	4465.64	4465.50	-0.14	3.89	-3.73%
5	4464.90	4464.87	-0.03	4.06	-0.74%
6	4464.65	4464.94	0.29	4.19	7.02%
7	4462.20	4462.16	-0.04	4.79	-0.77%
8	4460.50	4460.69	0.19	4.90	3.82%
9	4458.24	4458.06	-0.18	5.44	-3.31%
10	4456.62	4456.84	0.22	4.60	4.76087%
Average					1.37%

Chapter 4 -HEC-RAS and FLOW-3D Model Setup

This chapter discusses the setup of the HEC-RAS and FLOW-3D model. Slope and Manning's roughness calculations are presented first. After this HEC-RAS model boundary conditions and 2-D flow areas will be described. The conversion of the base terrain file necessary to run the FLOW-3D model is summarized. Then grid size, boundary conditions, and culvert modifications completed in FLOW-3D are explained.

4.1 Portneuf River Slope

A profile line was exported from HEC-RAS along the entire model length. This profile line data was then imported into excel to calculate the slope of the Portneuf River throughout the area of the model. A regression trendline was fit to the profile data, and the equation of the line was produced as $y = -0.0013x + 4468.4$ with an R^2 trendline fit value of 0.9372 as show in Figure 21. The slope of the Portneuf River within the boundaries of this study is 0.0013 ft/ft. This slope value was used for boundary condition parameters.

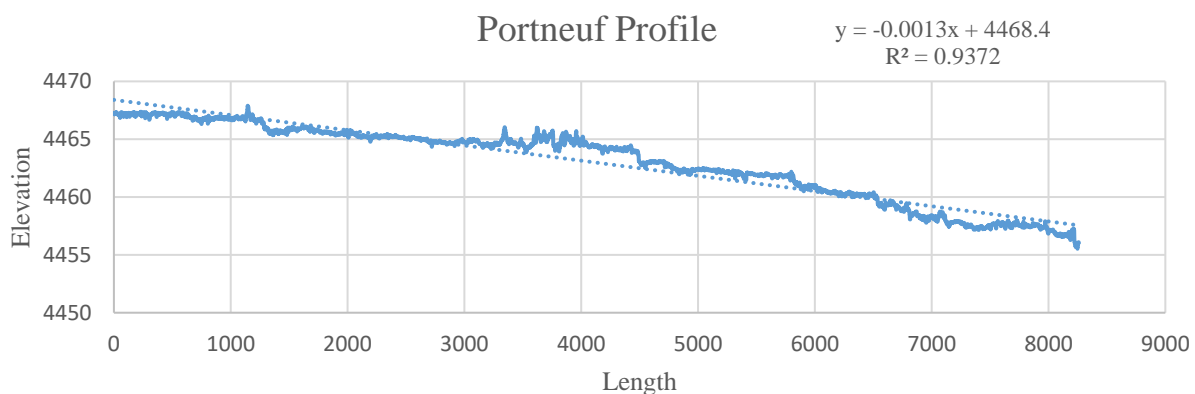


Figure 21 – Portneuf River Profile Plot

4.2 HEC-RAS Model Setup

4.2.1 Manning's n Selection

The Manning's channel roughness coefficient (n) represents the channel roughness and accounts for the headloss due to different channel characteristics. There are several different methodologies used to determine a roughness coefficient value. Cowan's method was used to provide an initial estimate of the roughness throughout the Portneuf River. This n value was then modified during model calibration to provide the most accurate result. Cowan's method accounts for six different channel characteristics which allows for a lower degree of variability as oppose to using the generic roughness value tables. With Cowan's method you can characterize your channel roughness value to what is observed in the field. A summary of the results of Cowan's method are provided in the Table 4 below (McCuen, 2004).

Table 4 – Summary of Cowan's Method

Cowan's Method			
		Characteristic	Reference
N	0.020	Earth	Table 3.5
n2	0.010	Fair Channel Erosion	Table 3.6
n3	0.010	Moderate Variation	Table 3.7
n4	0.025	Appreciable Obstructions	Table 3.8
n5	0.035	High Vegetation	Table 3.9
M	0.150	Minor Meandering	Table 3.10
N	0.015	Cowan's Calculation	
N_{calibration}	0.020	Calibrated	
N_{overbank}	0.060	Overbank	

After calibration, the resulting n value used for the model was 0.02 throughout the main channel, and 0.06 for the overbank roughness. Overbank roughness is defined as the roughness outside of the bank station of the cross sections in HEC-RAS.



Figure 22 – Manning's n Value Regions

4.2.2 HEC-RAS Projection

A projection is how you display the coordinate system and your data on a flat surface, such as a piece of paper or a digital screen. Mathematical calculations are used to convert the coordinate system used on the curved surface of earth to one for a flat surface (ArcGIS, n.d.). The projection used in HEC-RAS was the NAD83 Idaho East. This coordinate system uses the English system and the main unit of measurement is one foot. This was consistent with the bathymetric survey units. Now that the projection for the HEC-RAS terrain has been explained the boundary conditions are described next.

4.2.3 HEC-RAS Boundary Conditions

Boundary conditions in computational fluid dynamics are the set of constraints to the boundary of the problem that mimic real world conditions to predict accurate model results. These boundary conditions include inlet boundary conditions, outlet boundary conditions, wall boundary conditions, constant pressure boundary conditions, axisymmetric boundary conditions, symmetric boundary conditions, and periodic or cyclic boundary conditions. Figure 23 shows the boundary conditions chosen for the models in this study which were inlet and outlet boundary conditions discussed in the following sections.



Figure 23 – Boundary Conditions

4.2.4 HEC-RAS Inlet Conditions

The inlet conditions used for the unsteady flow model was a flow hydrograph. The development of the total flow hydrographs is discussed later in Section 5.4. The channel slope is required for inlet computations and the slope of 0.0013 ft/ft was used. The inlet of the model was placed 3000 feet upstream from the inlet culvert to the oxbows to provide adequate distance for model stability. Placing the inlet boundary condition closer to the culvert could produce inaccurate model results.

4.2.5 HEC-RAS Outlet Conditions

The outlet condition was assumed to be normal flow. Normal flow describes steady open-channel flow in which the flow depth, area, and velocity remain constant at every cross section along the channel (Akan, 2006). This outlet boundary condition was assumed as these are the real-world conditions that would occur. For normal depth boundary conditions, an input of the boundary friction slope is required to run computations. The Portneuf slope of 0.0013 ft/ft was used as the friction slope for the outlet boundary condition. Now that the inlet and outlet flow area boundary conditions have been introduced, the setup of the 2D flow area mesh and culvert connections will be described.

4.2.6 HEC-RAS 2-D Flow Area Setup

The computational flow domain in HEC-RAS is an area defined by the user to calculate two-dimensional flow. The flow area was created in HEC-RAS with a spacing of 25 feet in both the x and y directions. In areas where a break in flow is expected, a line can be added which will spit the flow mesh at the respective break line. Break lines were added at the railroad and the pathways adjacent to the Edson Fichter flow area as illustrated in Figure 24. Figure 24 also shows the mesh size and spacing.

The LIDAR survey data was accurately capturing the bridge elevations of the Cheyenne Bridge. The river is inaccessible to LIDAR scanning at this location therefore river bathymetry was unavailable. An attempt was made to remove a portion of the bridge. When the bridge section was removed the pathway and railroad were also removed during the cross section cut operation withing the GIS Tools tab. The flow area was stopped before the Cheyenne Bridge due this inaccurate representation of the bathymetry.

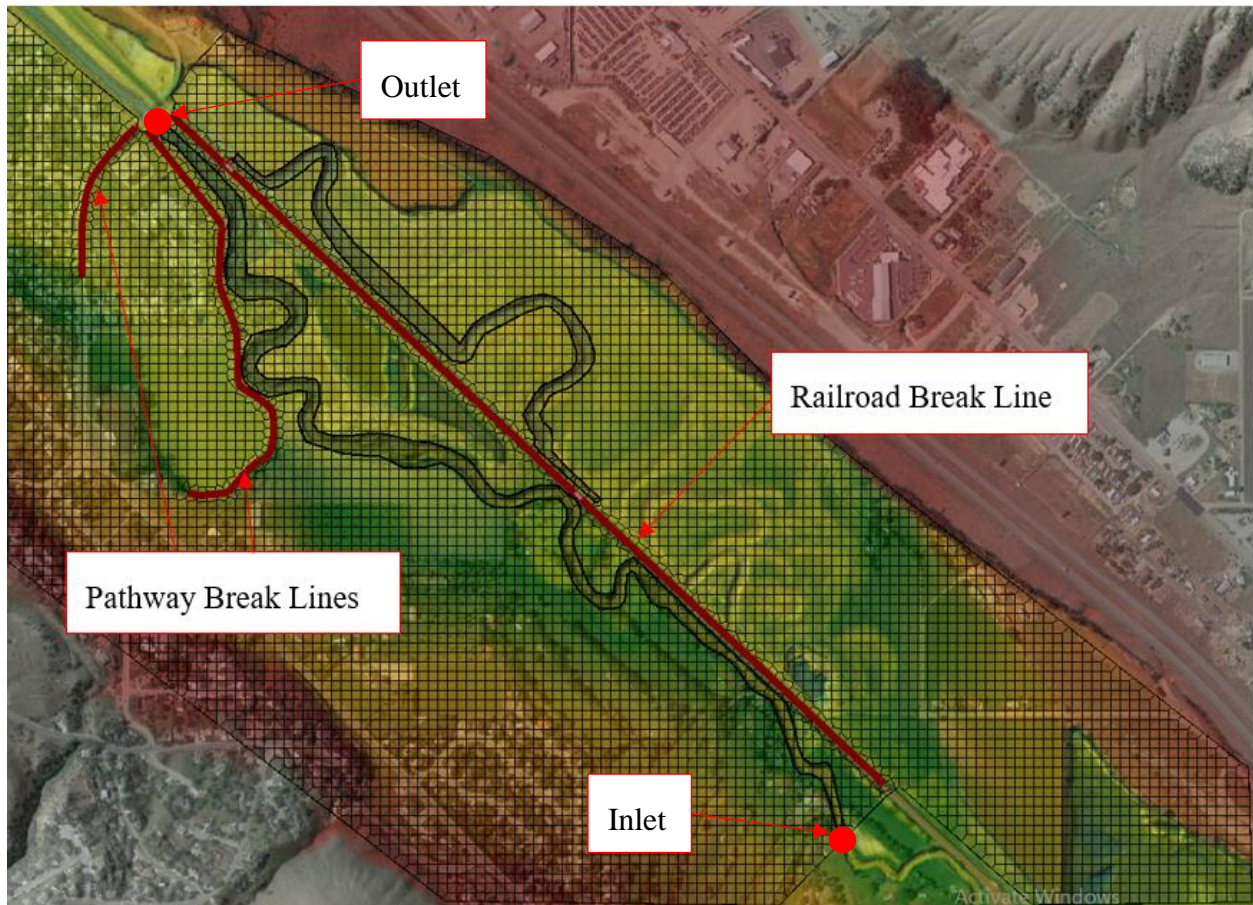


Figure 24 – 2D Flow Area Mesh and Break Lines

Culvert connections were added to connect the Portneuf River with the historical oxbows. The connections between the flow areas will be specified next.

4.2.7 HEC-RAS Flow Area Culvert Connections

A 4 ft diameter inlet culvert was used to divert flows from the Portneuf River into the floodplain and oxbows. Four 1 ft diameter outlet culverts were used to divert flows from the floodplain and oxbows back to the Portneuf River. The details of the process of sizing and positioning the inlet and outlet culvert are explained in Section 6.2. Now that the basic setup of the HEC-RAS model has been explained the process of developing the FLOW-3D model is discussed next.

4.3 FLOW-3D Model Setup

Once the HEC-RAS model was completed the following steps were used to setup the FLOW-3D model. The first step was to convert the edited terrain which is a geoTIFF file type from HEC-RAS and convert this to an STL file type which is the file type required by FLOW-3D. The next section will detail the process of converting the geoTIFF to an STL file type.

4.3.1 GeoTIFF to STL File Conversion

To convert the geoTIFF an open source geographic information system (GIS) program named QGIS was used (QGIS, n.d.). First the geoTIFF file was imported into QGIS. After this the projection system was required to be converted to the NADA83 Idaho East SI coordinate system. This system was required to run the plugin required to convert the geoTIFF to an STL. QGIS has multiple plugins which are tools you can add the program to perform a certain modification. The plugin that was used is named DEM to 3D. DEM stands for digital elevation model to a 3D object. This plugin converts the flat geoTIFF image file to a 3-Dimensional object. Figure 25 shows the geoTIFF file open in GIS before the file conversion. Figure 26 shows STL file after the conversion. Once the base STL file was created, methods to find and fix errors within the STL were used to increase model accuracy. These STL smoothing techniques are discussed next.

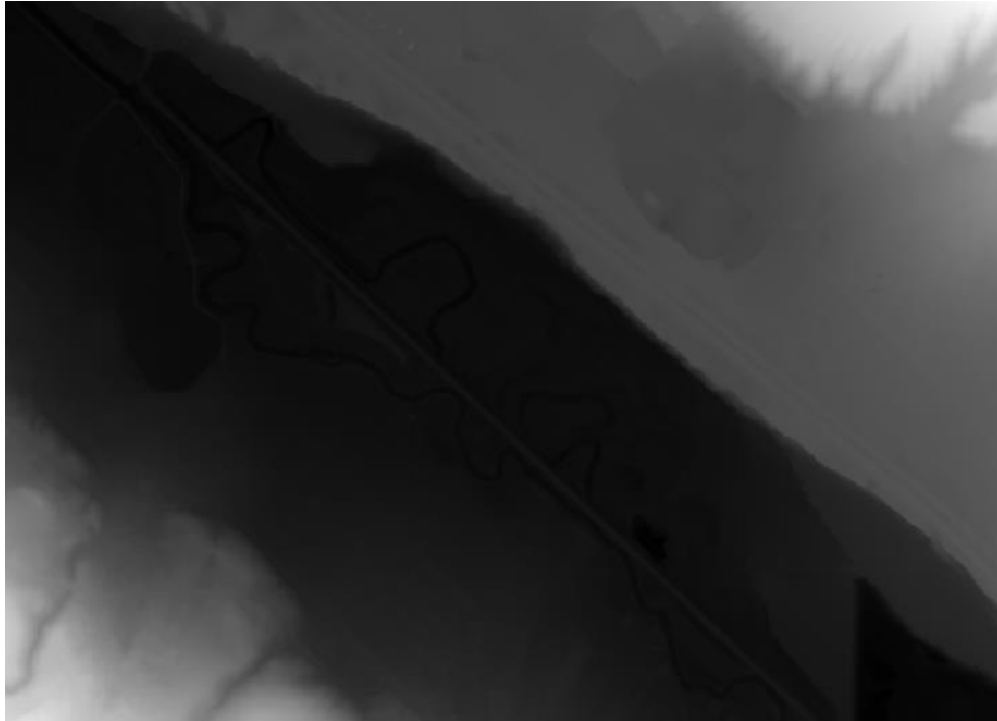


Figure 25 – GeoTIFF File

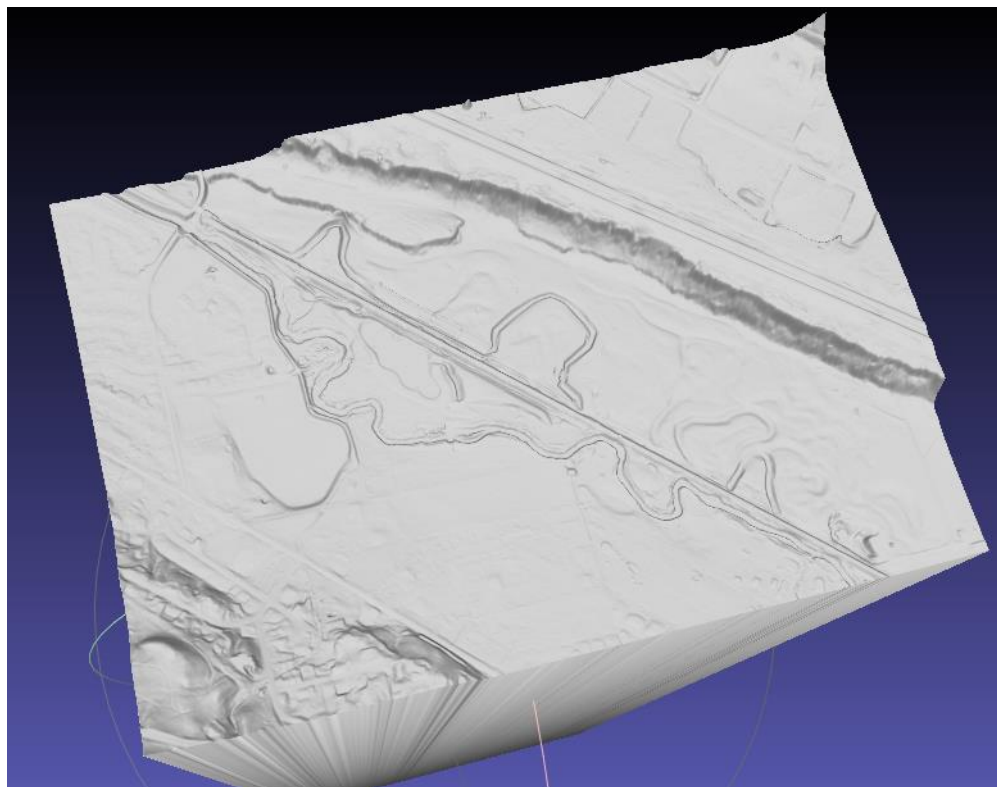


Figure 26 – STL File

4.3.2 STL Smoothing

Three different methods were used to fix potential errors within the STL terrain. Reduce volume errors within the simulation. The methods used were ADMesh, NetFabb from Autodesk, and FAVOR™ with FLOW-3D.

ADMesh is a program for processing triangulated solid meshes. Currently, ADMesh only reads the STL file format that is used for rapid prototyping applications, although it can write STL, VRML, OFF, and DXF files. ADMesh was used as the initial STL smoothing program. The program checks each facet of the mesh for its neighbors. There should be three neighboring facets for each facet in the mesh. There should be no unconnected facet edges in the mesh. When the program is run the three neighboring facets are searched for and, if found, the neighbors are the edges are matched. If the neighbors are not found holes can remain in the terrain (ADMesh, n.d.).

Once ADMesh operations were applied the STL the STL was imported to FLOW-3D. Once in FLOW-3D the STL terrain file was smoothed through Fractional Area-Volume Obstacle Representation FAVOR™ in FLOW-3D. This method computes the open area fractions (AFT, AFR, AFB) on the cell faces along with the open volume fraction (VF) and reconstructs the geometry based on these parameters. This approach offers a simple and accurate way to represent complex surfaces in the domain without requiring a body-fitted grid (Flow Science, 2019). A uniform mesh size of 1.5 ft was used during FAVOR™ operations. After the FAVOR™ operation was complete the STL file was exported from FLOW-3D and imported to NetFabb.

Netfabb is a software program within the Autodesk suite of programs. Netfabb is another program used to fabricate CAD objects. Netfabb has several tools to edit, repair, position and slice CAD data. The repair tool was applied four times until all the errors Netfabb found in the STL were repaired. After this the STL was exported and imported back into FLOW-3D. After this model physics and parameters were defined.

4.3.3 FLOW-3D Model Physics and Parameters

A uniform manning's n value of 0.06 was used for the terrain. Gravity was set to the negative Z direction with a value of 32.2 ft/s^2 . In FLOW-3D six different turbulence models are available. The renormalized group model (RNG) was selected. The RNG model describes low intensity turbulence flows and flows have strong shear regions and the turbulent mixing length is dynamically computed. The shallow water model was used for all meshes and is described in detail in Section 2.3.3. Water was set to 68°F with a water density of $1.94032 \text{ slugs/ft}^3$.

4.3.4 FLOW-3D Geometry

Six different geometry objects were added to the base terrain. The first two objects created were the bridge abutments on each side of the Cheyenne Bridge as shown in Figure 27 and Figure 28. These were the modifications that were unsuccessful at the Cheyenne Bridge in HEC-RAS discussed in Section 4.2.6. The solid geometry was removed making circular holes to model the inlet and outlet culverts at the given locations of the floodplain. Rectangular blocks were also placed at the Y minimum boundary to create walls to restrict inflow from entering the Y minimum boundary everywhere besides the river channel. Figure 27 illustrates each of these modifications.

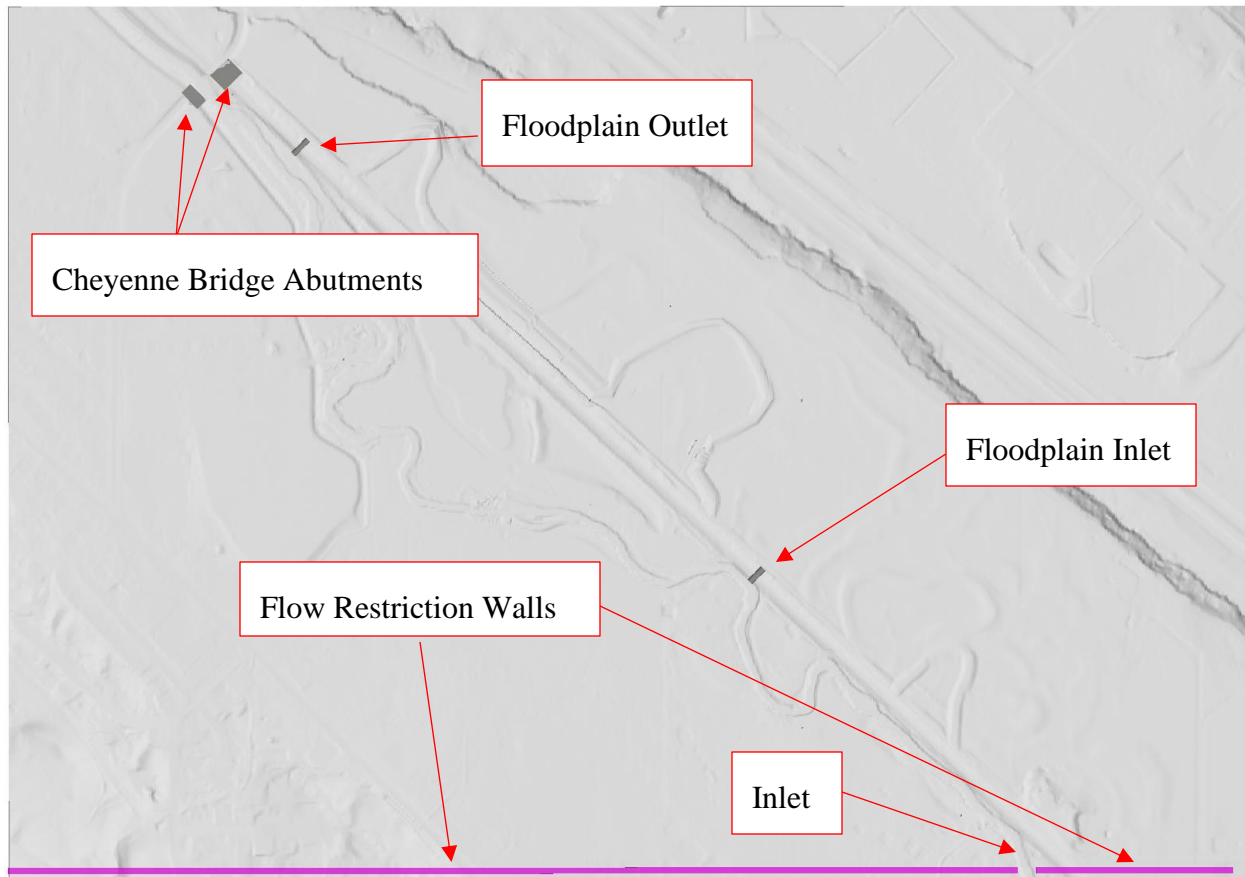


Figure 27 – Base Terrain Modifications

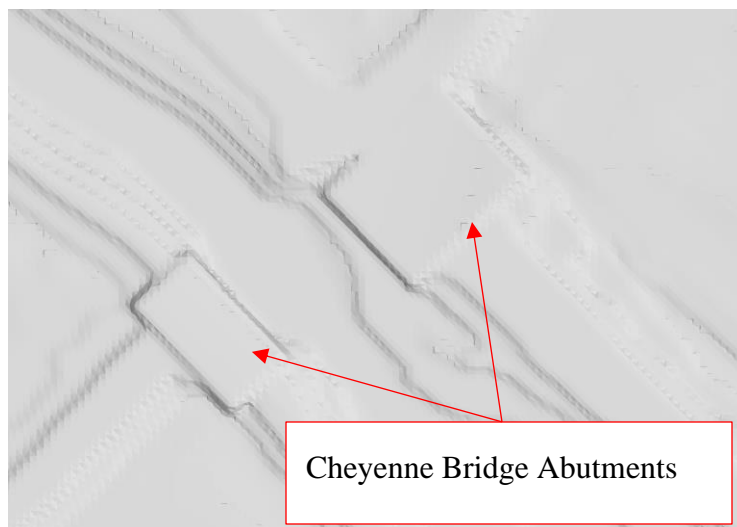


Figure 28 – Bridge Adbudment Modifications

The initial holes produced were a 4 ft radius cut through the railroad as shown in Figure 29. This was done to reduce computation time for the initial simulation. Issues occurred during the second trial to cut only culvert through the railroad. These errors are discussed later in Section 7.6.

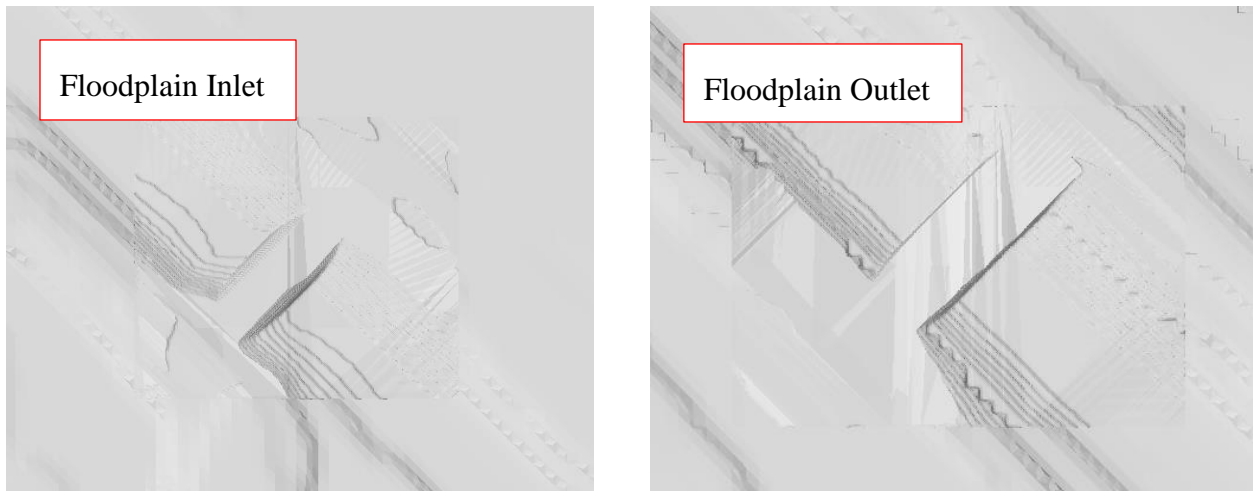


Figure 29 - Inlet and Outlet Terrain Modifications

4.3.5 FLOW-3D Boundary Conditions

Boundary condition are used at mesh boundaries to represent what occurs at these boundaries in the real world. Four out of the ten boundary conditions available in FLOW-3D were used in the simulation.

At the X minimum, X maximum, and Z minimum locations, boundaries walls were defined as the boundary conditions. In FLOW-3D a wall applies the no-slip condition at the boundary as well as a zero-velocity condition perpendicular to the boundary. These boundaries were chosen because no flow was anticipated to reach these boundaries.

The Y minimum boundary was set as a volume flow rate. This flow rate can be entered as either a constant or tabular flow rate. The 25-year total unit hydrograph that is discussed later in

Section 5.4 was entered as a tabular volume flow rate. Outflow conditions were used at the Y maximum boundary.

Finally, the Z maximum boundary condition was set as a stagnation pressure. Stagnation pressure is the pressure across the boundary that is continuous. Each of these boundary conditions are illustrated in Figure 30.

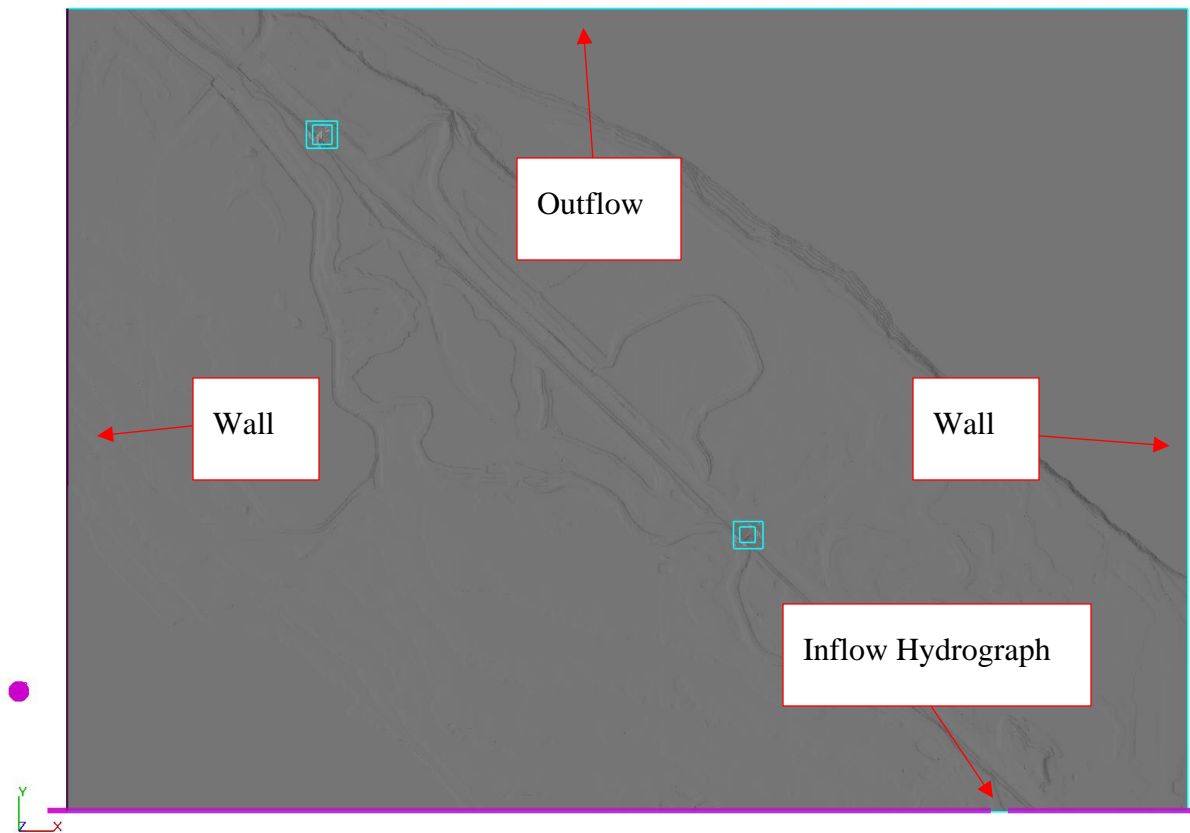


Figure 30 – FLOW 3D Boundary Conditions

4.3.6 FLOW-3D Mesh Setup

All meshes used were 2D shallow water models. One large mesh with a spacing of 10 ft. At both the inlet and outlet two mesh blocks were overlapped. The Larger of the two with a grid spacing of 5ft and the smaller with a grid spacing of 2.5ft. The larger mesh block's purpose was

to provide a smooth transition between mesh blocks during computation and the smaller grid is to provide adequate resolution to capture the flow dynamics around both the inlet and outlet. Inlet and outlet mesh blocks are shown in Figure 31. A 10 ft grid spacing was used rather than the HEC-RAS mesh spacing of 25 ft decrease the amount of mesh blocks needed to transition from 10 ft to 2.5 ft mesh spacing at the floodplain inlet and outlets. The mesh transition from a uniform 10 ft cell size to a uniform 2.5 ft cell size is illustrated in Figure 32.

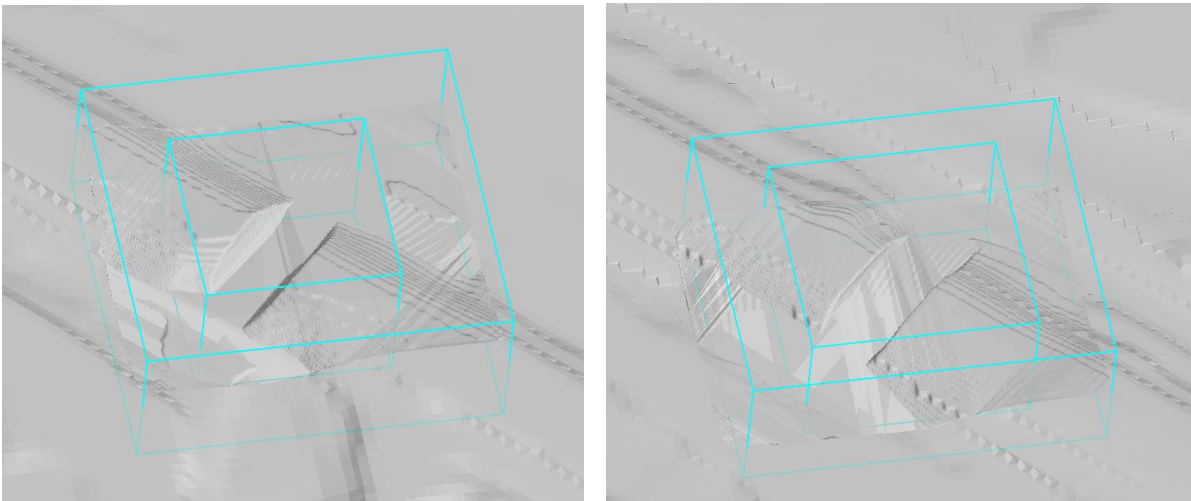


Figure 31 – Inlet and Outlet Mesh Setup

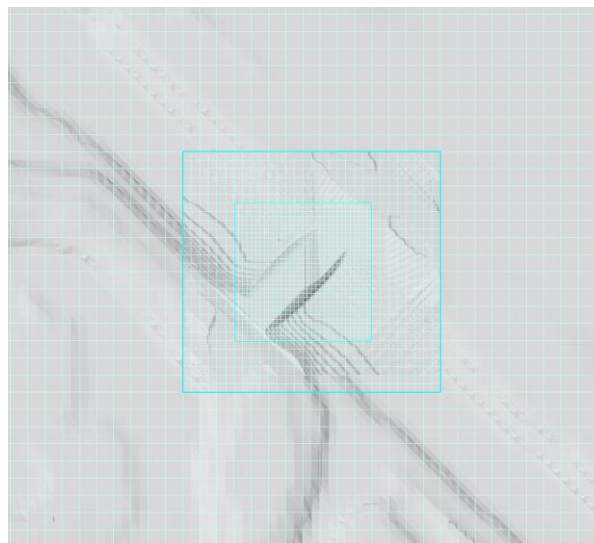


Figure 32 – Grid Sizing

Chapter 5 - Hydrologic Considerations

A total runoff hydrograph was created to simulate return period flood events for both HEC-RAS and FLOW-3D models. The following steps were used and repeated to develop total hydrographs for a 2, 10, and 25-year flood events.

1. Obtain return period peak discharges from USGS Streamstats (USGS, StreamStats, 2020).
2. Use Soil Conservation Service SCS unit hydrograph (UH) model
3. Convolve the rainfall-excess hyetograph with the UH to compute the direct runoff hydrograph
4. Add baseflow to the direct-runoff hydrograph to compute the total runoff hydrograph
5. Model total runoff hydrograph in HEC-RAS and Flow-3D

5.1 USGS Streamstats Peak Discharges

Streamstats is a web application developed by the USGS. It is an application that allows users to delineate watersheds for a river in their area of interest. Once the watershed is outlined, the user can select different scenarios and watershed characteristics that they want to know about the watershed. A report is produced summarizing all the information that the user wanted. For this study, the Portneuf River Watershed was delineated to find the selected return period peak discharge values, watershed length, and watershed slope. Table 5 lists values for various return periods for the Portneuf Watershed obtained from Streamstats. Peak flows of 860 cfs, 2220 cfs, 3240 cfs, 4020 cfs, and 4910 cfs were used to create the respective 2, 10, 25, 50 and 100-year flood hydrographs.

Table 5 – USGS Streamstats Return Period Peak Flood Values

Statistic	Value	Unit
1.25 Year Peak Flood	457	ft ³ /s
1.5 Year Peak Flood	623	ft ³ /s
2 Year Peak Flood	860	ft ³ /s
2 33 Year Peak Flood	988	ft ³ /s
5 Year Peak Flood	1610	ft ³ /s
10 Year Peak Flood	2220	ft ³ /s
25 Year Peak Flood	3240	ft ³ /s
50 Year Peak Flood	4020	ft ³ /s
100 Year Peak Flood	4910	ft ³ /s
200 Year Peak Flood	5870	ft ³ /s
500 Year Peak Flood	7370	ft ³ /s

5.2 SCS Unit Hydrograph Development

The SCS unit hydrograph is shown in Figure 33. This unit hydrograph is based on an extensive analysis of measured data. Many actual watersheds were evaluated and then made dimensionless. An average of these dimensionless UHs were computed to create the curvilinear unit hydrograph shown in Figure 33. A table with the ratios for the SCS dimensionless unit hydrograph and mass curve used in determining the hydrographs are provided in Appendix B.

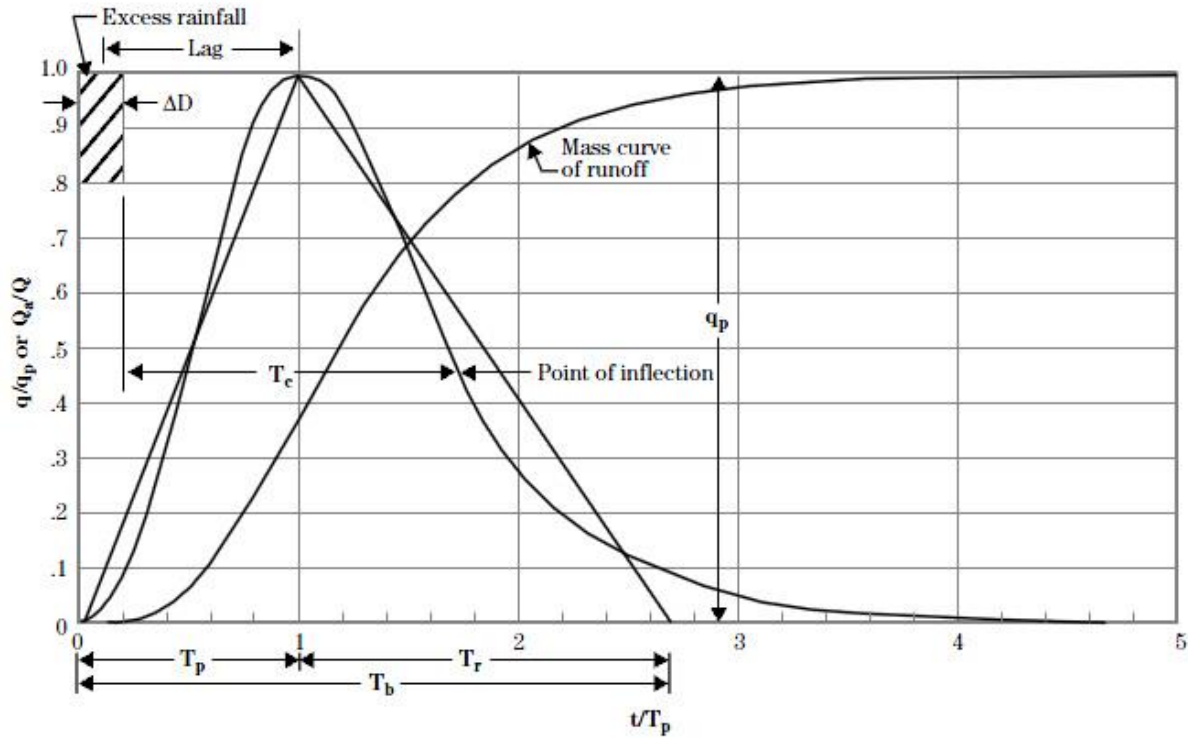


Figure 33 – SCS dimensionless curvilinear unit hydrograph

The area under the UH represents the depth of direct runoff Q , which is one inch for a UH (McCuen, 2004). To create a UH the time of concentration must be computed. The following section describes this process.

5.2.1 The SCS Lag Formula

The SCS provided an equation for estimating the watershed lag time. The watershed lag time is the time in hours from the center of mass of the excess rainfall to the peak discharge. The SCS also indicates that the time of concentration equals 1.67 times the lag. With this the concentration time in minutes is calculated using Equation 6.2 (McCuen, 2004).

$$t_c = 0.00526L^{0.8} \left(\frac{1000}{CN} - 9 \right)^{0.7} S^{-0.5} \quad \text{Equation 5.1}$$

Where,

L = Watershed length ft

S = Watershed slope ft/ft

CN = SCS runoff curve number

The hydrologic soil group of the project are is soil group B. From the SCS runoff CN table in Appendix D. The cover type primary in the area is Fair Pinyon-Juniper resulting in at CN of 58. The time of concentration resulted to 2120 minutes or 35.3 hours. With the time of concentration and peak flood discharge values known direct runoff hydrographs where developed. The development of the direct runoff hydrographs is described below.

5.3 Direct Runoff Hydrographs

Direct runoff hydrographs are a discharge hydrograph of flood flows above the base flow rate of the river. Using the peak flood values, the time of concentration, and the ratios for the SCS unit hydrograph in Appendix B direct runoff hydrographs were created. A total of 32 points were used to create each hydrograph curve. Directed runoff hydrographs for the 2, 10, 25, 50, and 100 year flood events are show in Figure 34. Now that direct runoff hydrographs are created the river baseflow can be added to develop the total runoff hydrographs for each event.

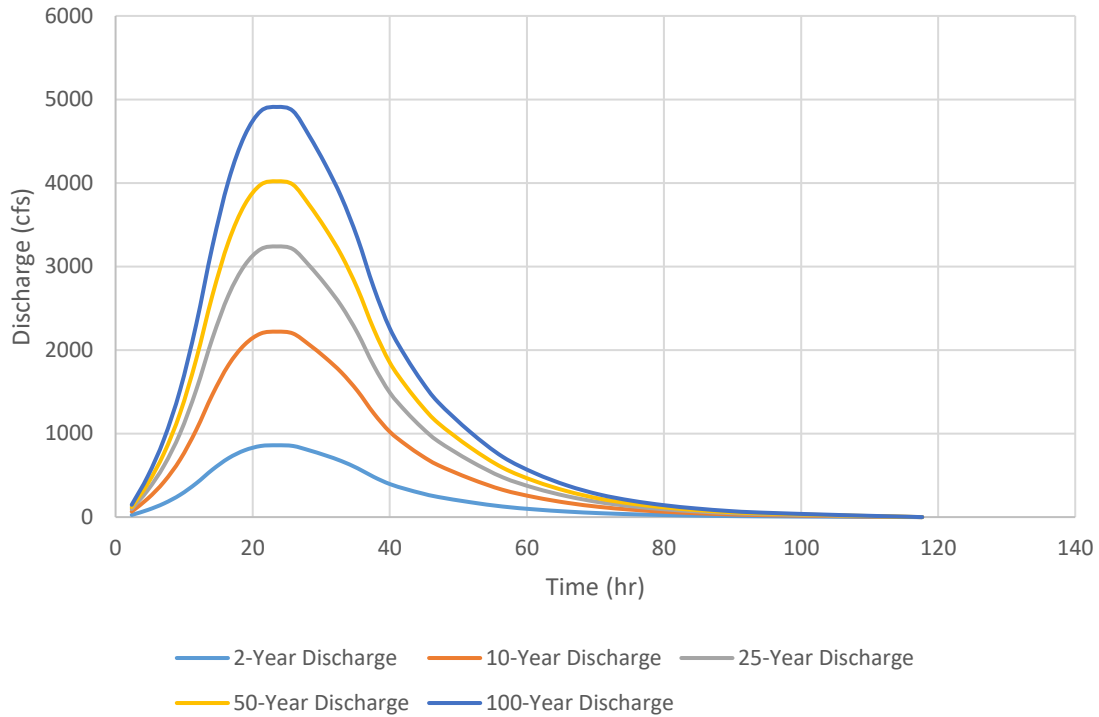


Figure 34 – Direct Runoff Hydrographs

5.4 Total Runoff Hydrographs

Total runoff hydrographs are the direct runoff hydrograph plus the base flow of the river. The average baseflow for the Portneuf river for the last ten years is 198.83 cfs. This was analyzed by ITD using the “PART” computer program (Harelson, 2019). This program calculates river baseflow with seepage estimates included. This baseflow was added to each direct runoff hydrograph to create each total runoff hydrograph. Each total runoff hydrograph was used as inlet boundary conditions for each respective model. Tables summarizing the total flow hydrograph data for each storm event are provided in Appendix E. Directed runoff hydrographs for the 2, 10, 25, 50, and 100 year flood events are show in Figure 35.

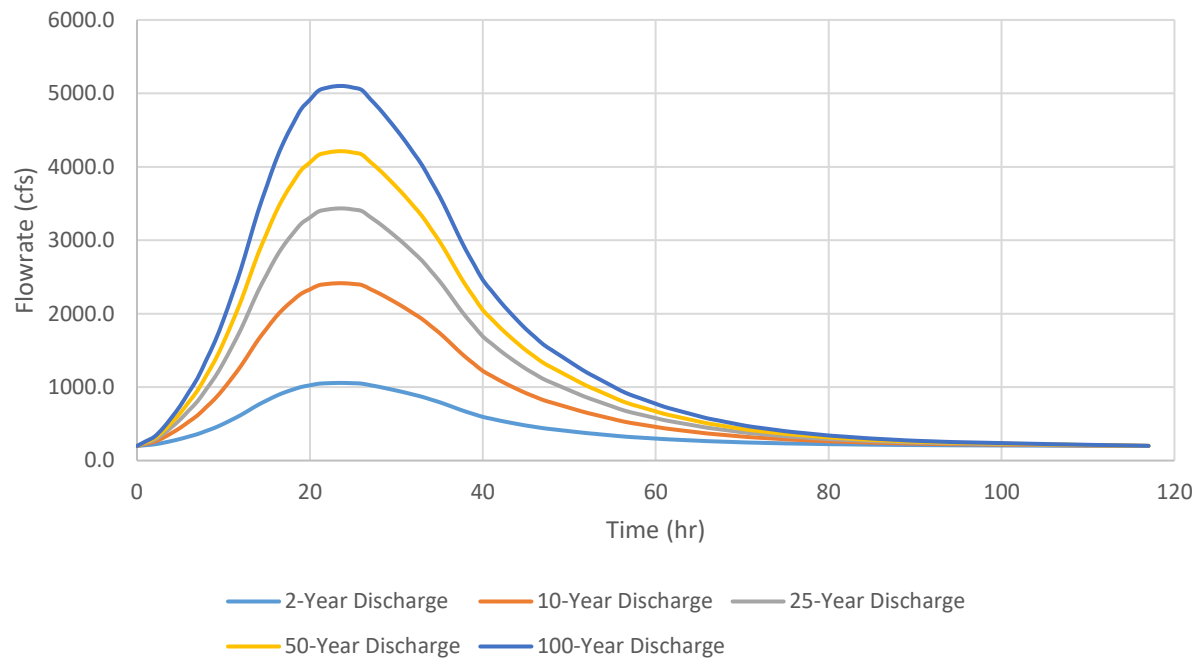


Figure 35 – Total Runoff Hydrographs

Chapter 6 - Hydraulic Considerations

The hydraulic consideration of the proposed modifications to the Portneuf river and diversion culverts are presented below. First an analysis of the available storage withing the floodplain area is presented. Then inlet and outlet culvert details are explained.

6.1 Floodplain Storage Analysis

Two feet of freeboard from the crest of the railroad was used as the maximum elevation allowed in the floodplain during a 25-year flood. A profile line of the terrain at the outlet culvert was taken to find the maximum water surface elevation. The maximum allowable water surface was found to be 4470.5 ft as shown in Figure 36.

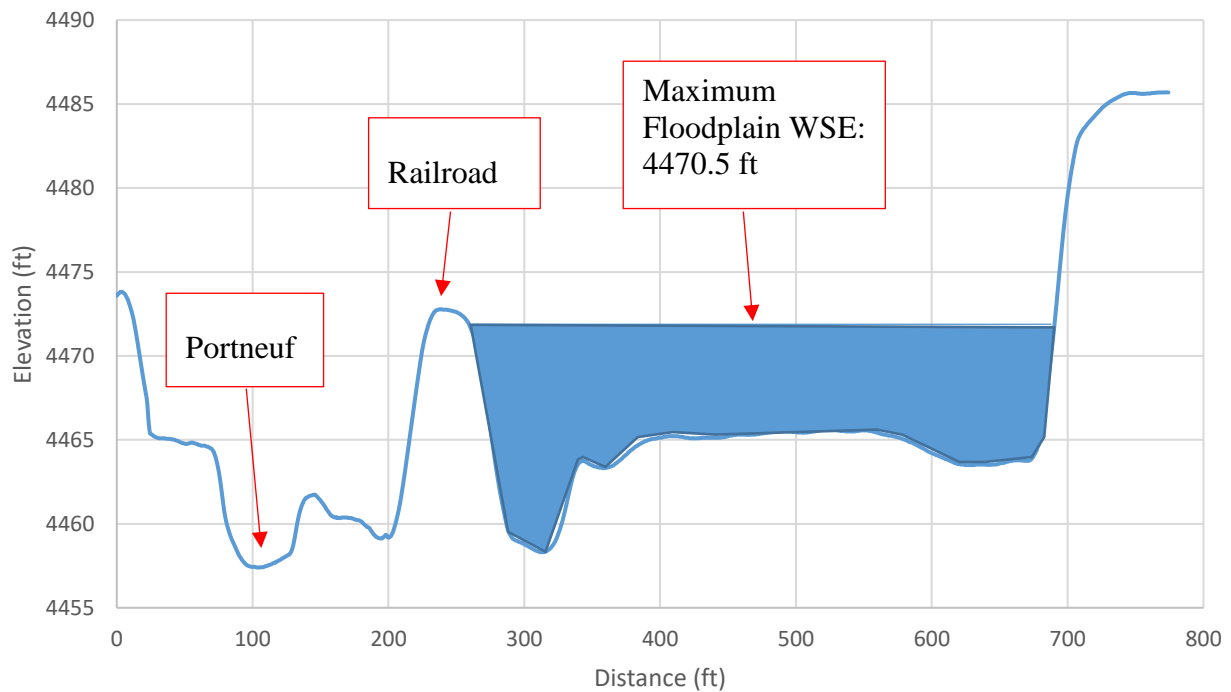


Figure 36 – Maximum Floodplain WSE

With the freeboard criteria and the terrain, the volume of the storage was found using HEC-RAS. The maximum storage of the floodplain was found to be 568.14 acre-ft. Figure 37 shows the floodplain volume in acre-ft based on the respective elevation of water in the floodplain.

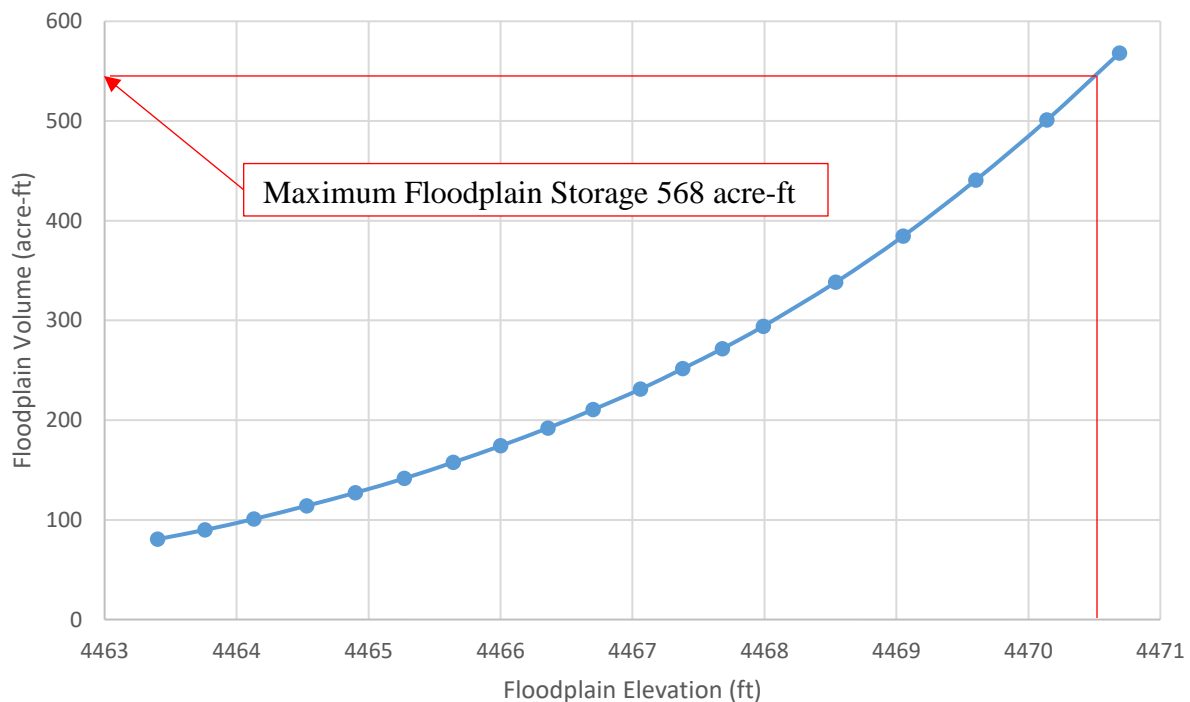


Figure 37 – Floodplain Volume vs. Elevation

After the floodplain volume was found the incremental volume for each hour of the 25-year total flood hydrograph was calculated. The maximum floodplain volume was subtracted from the peak hydrograph volume as shown in Figure 38. Floodplain storage is represented by the red hatched area.

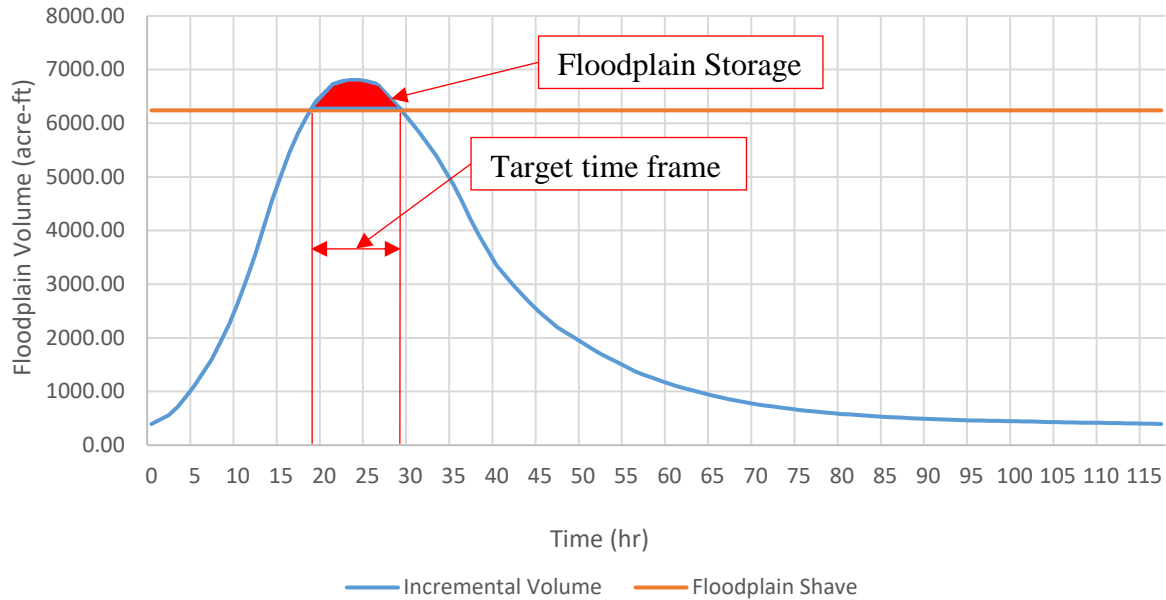


Figure 38 – Hydrograph Volume Minus Floodplain Storage

This was used to estimate the time frame that the floodplain can store the peak volume of the flood flows. The time frame from hour 19 to 28 was targeted. Now that the target time frame and maximum floodplain WSE is known the inlet and outlet culvert details were analyzed.

6.2 Inlet and Outlet Culvert Details

Finding the elevation needed for the inlet culvert to draw the peak flow of a 25-year flood is a function of floodplain WSE and the time to the peak of the flood. A four-foot inlet culvert was used to divert the flood flow from the Portneuf. This pipe size was chosen because it has the hydraulic ability to fill the floodplain storage within the target time frame. Four two-foot culverts are also within a realistic size range of culverts able to be bored within the project area.

An iterative process was used to find the appropriate invert elevation for the inlet culvert of the floodplain. The 25-year total flood hydrograph was used for the design criteria. 50-year and 100-year total flood hydrographs were also checked to analyze if the floodplain depth would

overtop the railroad. The invert of the culvert was placed at the maximum WSE of the Portneuf river without modifications during a 25-year flood at the limits of the target time frame. The culvert was then lowered from this elevation until the floodplain storage was able to fill with a 4 ft inlet, or four 2 ft inlets.

Three 1 ft emergency outlet culverts were placed at the maximum floodplain WSE of 4470.5 ft to provide secondary outflow in the event of the first outlet becoming clogged. The additional raised outlets will also provide additional drainage if the floodplain WSE exceeds the design WSE.

6.2.1 Inlet Culvert Conditions

In HEC-RAS the culvert invert was placed at the elevation that allows the floodplain storage to reach the maximum level during the target peak time frame of the flood hydrograph. The elevation for the invert of the inlet of the culvert was placed at an elevation of 4467 ft and the downstream invert was placed at 4466 ft. The required length of culvert to fully pass underneath the railroad was 90 ft. This resulted in a culvert slope of 0.011 ft/ft. Figure 39 shows the inlet culvert invert elevations.

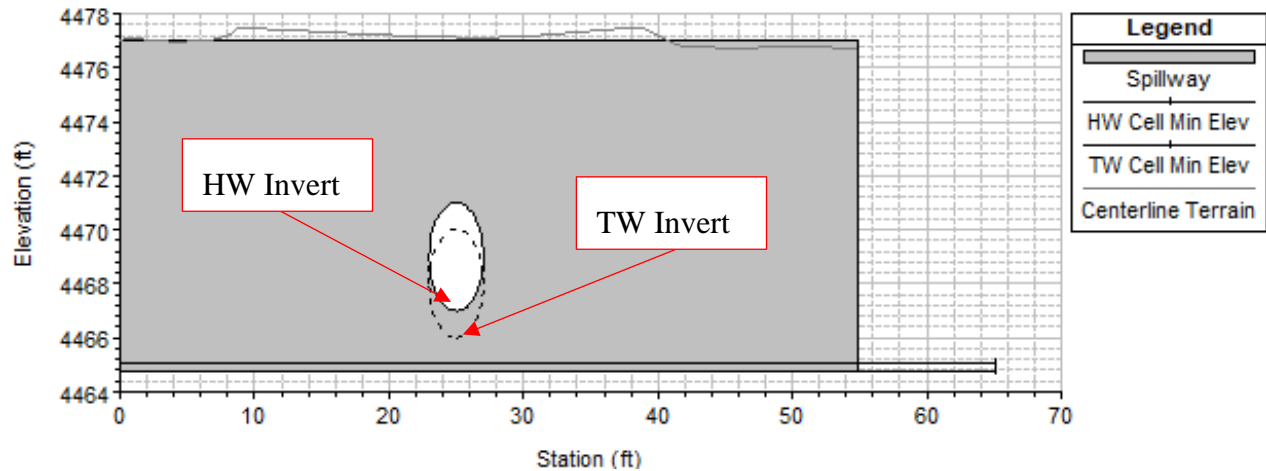


Figure 39 – Inlet Culvert Elevations

Typically, during a pipe boring operation, the casing used to bore the hole is a steel pipe which is periodically welded once the pipe has penetrated through the soil about 75 percent of the length. The manning's n value used for the pipe was 0.015. This was chosen as it is on the upper range of all concrete pipe and is in the range of steel pipe. The entrance loss was assumed to be 0.5 which is equivalent to a square end circular pipe. This was also chosen to stay on the conservative range of entrance loss coefficients. Table 6 summarizes the parameters used for the inlet culvert.

Table 6 – Inlet Culvert Characteristics

Culvert Length:	90		Depth to use Bottom n:	0
Entrance Loss Coeff:	0.5	?	Depth Blocked:	0
Exit Loss Coeff:	1		Upstream Invert Elev:	4467
Manning's n for Top:	0.015	?	Downstream Invert Elev:	4466
Manning's n for Bottom:	0.015			

The resulting maximum 25-year WSE for these conditions is shown in Figure 41. The maximum WSE on the floodplain side was 4470.5 which matched the design freeboard

elevation. Figure 41 also shows that the WSE at the headwater (HW) location of both the inlet and outlet culvert is higher than the tailwater (TW). This shows that due to the higher head on the inlet side of each culvert there must be positive flow through both culverts. The WSE also matches the emergency outlet culvert allowing additional outflow to be activated during the maximum WSE of the 25-year flood.

Four 2 ft inlet culverts can be used to achieve the same effect if they are placed at the same invert elevations of 4467 ft on the upstream side and 4466 ft on the downstream side. The culverts would need to be spaced horizontally as shown in Figure 40. Other options could also be analyzed such as multiple 2 ft barrels stacked vertically to activate the floodplain at multiple different flood stages. Additional modeling would need to be completed to access these options.

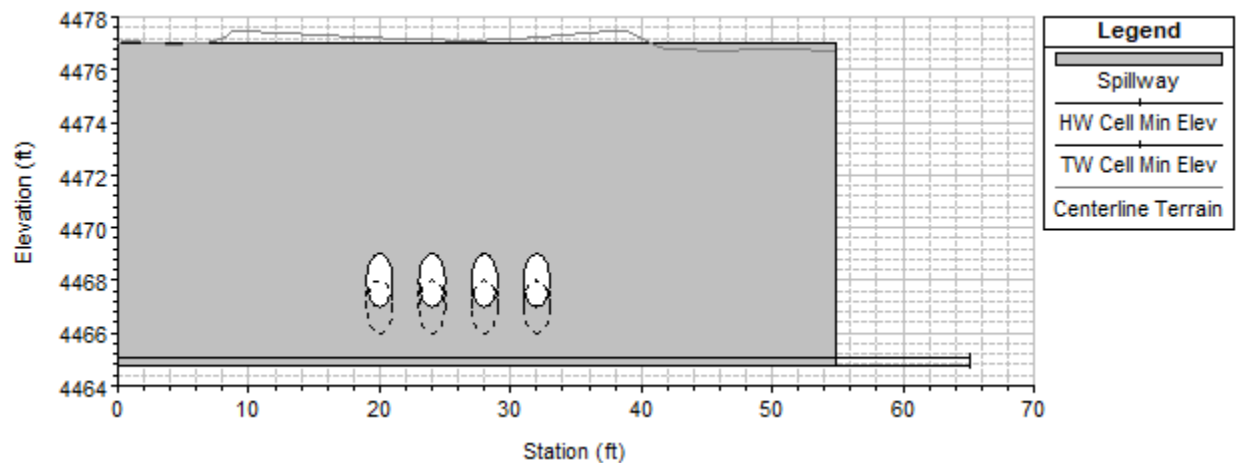


Figure 40 – Equivalent Inlet Option with Four 2 ft Culverts Spaced Horizontally

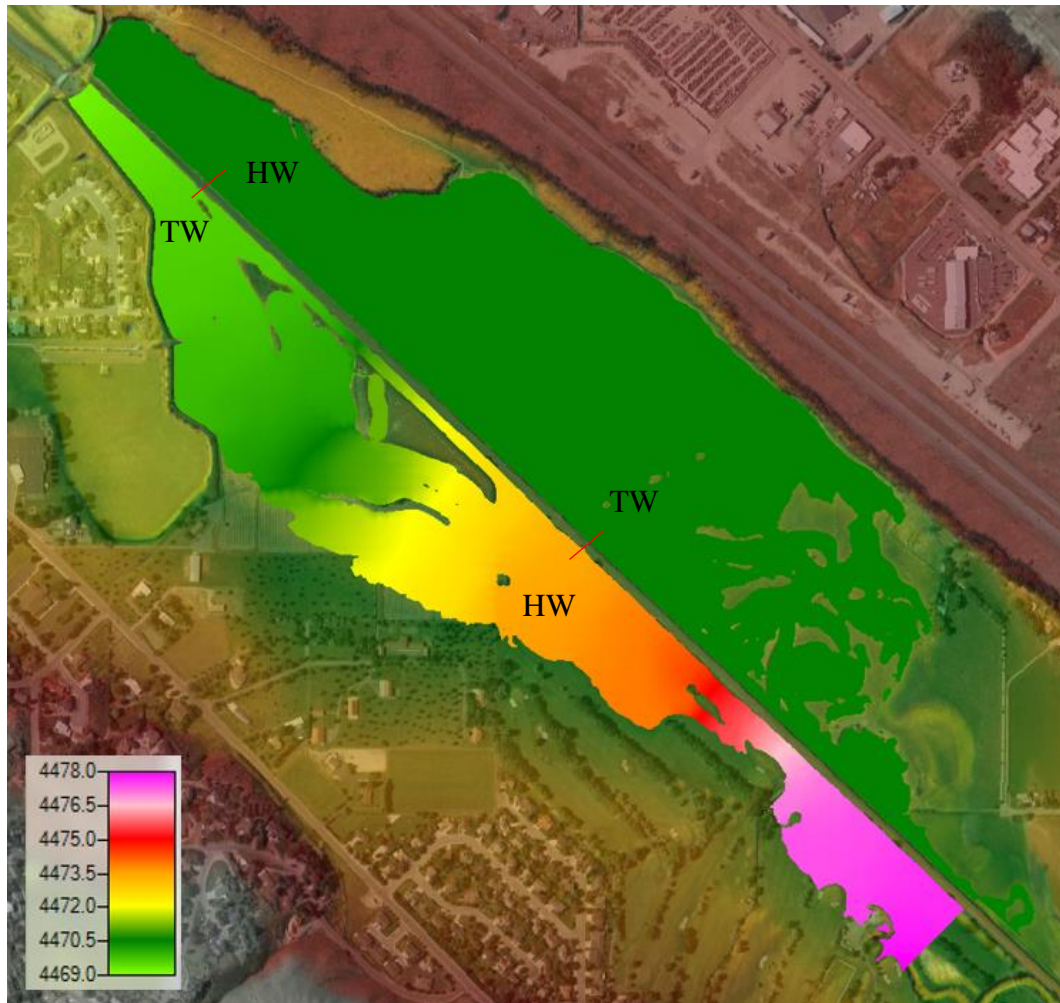


Figure 41 – Maximum 25-year WSE With Inlet Culvert Conditions

No backflow flap gates were modeled. The rational behind this is that a flap gate is likely to have more maintenance issues with clogging or become blocked by wind blown soil or debris. The inlet stage and flow hydrograph is presented in Figure 42. Negative flows in HEC-RAS are inflow through the HW end of the inlet. All positive flows are outflows from the inlet culvert. This figure indicates how the inlet culvert is performing in several ways.

First it shows that the “weir flow” is 0 cfs throughout the entire model. This means that the HW WSE did not exceed the top of the railroad. Secondly, It shows that the inlet culvert acts as an inlet during the initial 2.75 days and then reverses its role and provides drainage from the

floodplain for 3.75 days until the WSE of the floodplain falls below the the HW inlet invert elevation. Figure 42 also shows there is a larger area under the the inflow flow than the outflow. This show that the floodplain provides some storage of water. This will be discussed more in the outlet culvert conditions.

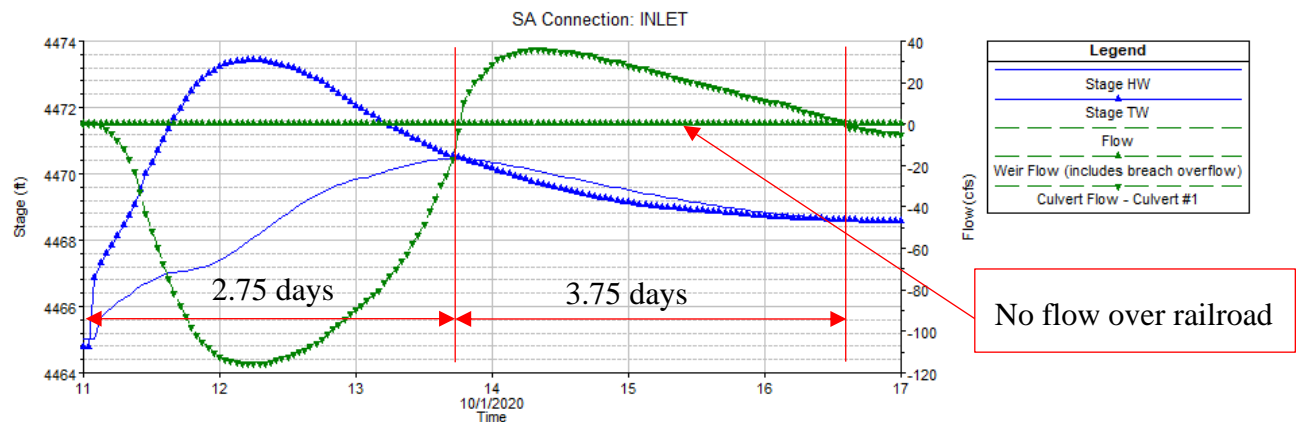


Figure 42 – Inlet Stage and Flow Hydrograph

6.2.2 Outlet Culverts' Conditions

Four 1 ft culverts were used at the outlet of the floodplain as discussed in previous sections. Figure 43 shows the orientation of these culverts. The three culverts at the maximum floodplain WSE of 4470.5 ft are the emergency outlet. The culvert at the lower elevation is the main outlet culvert. This culvert was placed at an elevation of 4461 ft which is 1.5 ft above the minimum floodplain elevation. This is to provide a small amount of groundwater recharge, and sediment storage before the main outlet begins to fill.

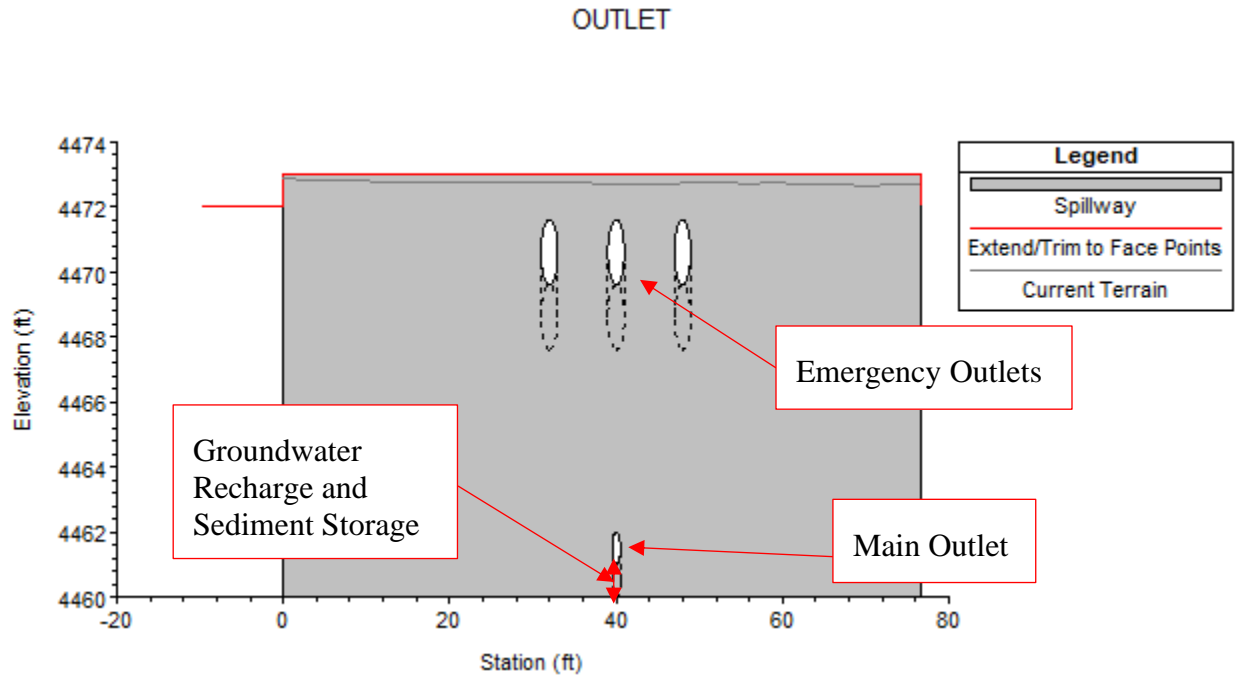


Figure 43 – Outlet Culverts' Elevations

Figure 44 shows the outlet culverts flow and stage hydrographs. The weir flow is 0 cfs which also indicates that there is no flow over the railroad at the outlet culvert location.

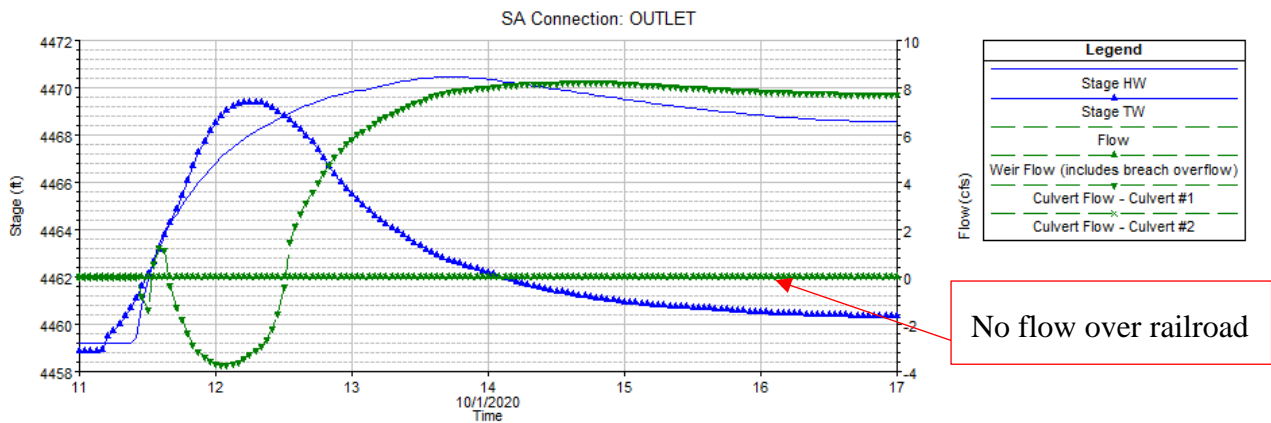


Figure 44 – Outlet Stage and Flow Hydrograph

Chapter 7 - Results and Model Comparisons

This chapter presents the results and comparison of all the models ran in HEC-RAS and Flow-3D. All total flood hydrographs were analyzed first without modifications. Then the flood hydrographs were modeled with the culvert modifications in HEC-RAS as discussed in proceeding sections. The results from the FLOW-3D model are explained in sections 7.6.1 through 7.6.4.

7.1 Base Model Results/Portneuf without Culvert additions

The base model results are discussed first to provide a basis for comparison of how the additions of diversion culverts affect the Portneuf. Water surface elevations for all total flood hydrographs are presented first. Later, channel velocities are depicted for each flood return period. Finally, all model depths without culvert modifications are shown.

The WSE within the model that were considered the failure points of the Portneuf River were the points that would allow residential areas and the railroad or Cheyenne Avenue to be overtopped. These specific locations include the pathway that borders the Indian Hills Soccer complex, the subdivision to the West of Edson Fichter Nature Area, and the Union Pacific Railroad. The elevations of the pathway, Cheyenne Avenue and the railroad mean elevation are 4473 ft, 4471 ft, and 4472 ft respectively. Locations commonly discussed in the following sections have been given numbers and are defined in Table 7.

Table 7 – Result Location Summary

Point #	Location
1	Inlet
2	North West of Juniper Hills
3	Edson Fitcher Nature Area
4	Residential Area
5	Floodplain

7.1.1 2-Year Flood WSE No Modifications

The two-year peak discharge maximum WSE without modifications are shown in Figure 45. The WSEs range from 4463 ft to 4475 ft during the 2-year total hydrograph. At the 2-year peak discharge, some overbank flows occur and minimal flooding is detected. Overbank flows are observed throughout the Edson Fichter Nature Area (3) and the Northwest Portion of the Juniper Hills Country Club (2).

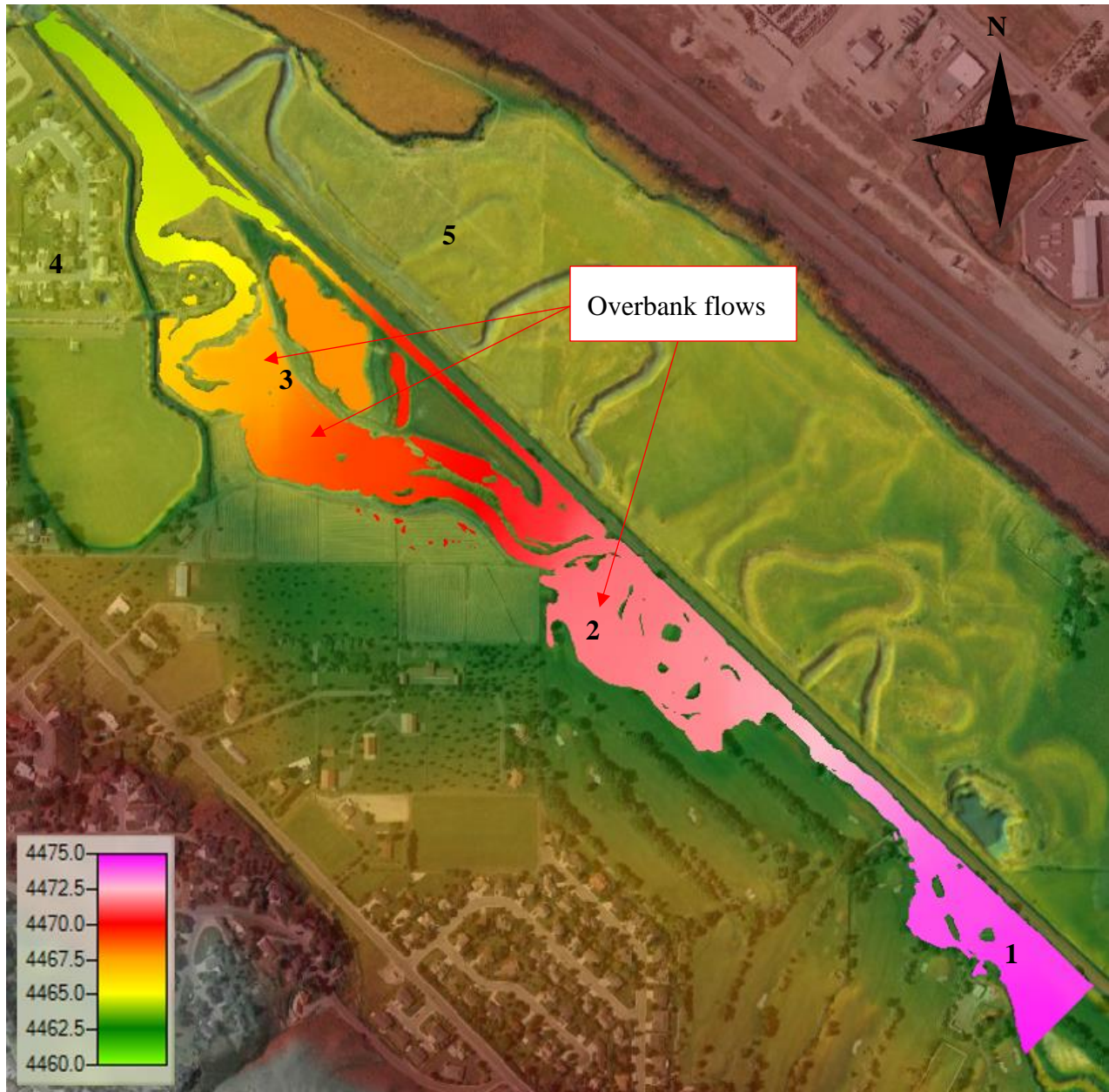


Figure 45 – 2-Year Maximum WSE without Modifications

7.1.2 10-Year Flood WSE No Modifications

Ten-year peak discharge maximum WSE without modifications are shown in Figure 46. The 10-year total hydrograph shows WSEs ranging from 4467 ft to 4477 ft. More significant

overbank flows and some flooding are detected in the fields northwest of the golf course (2).

Flooding is also observed throughout the Edson Fichter Nature Area (3).

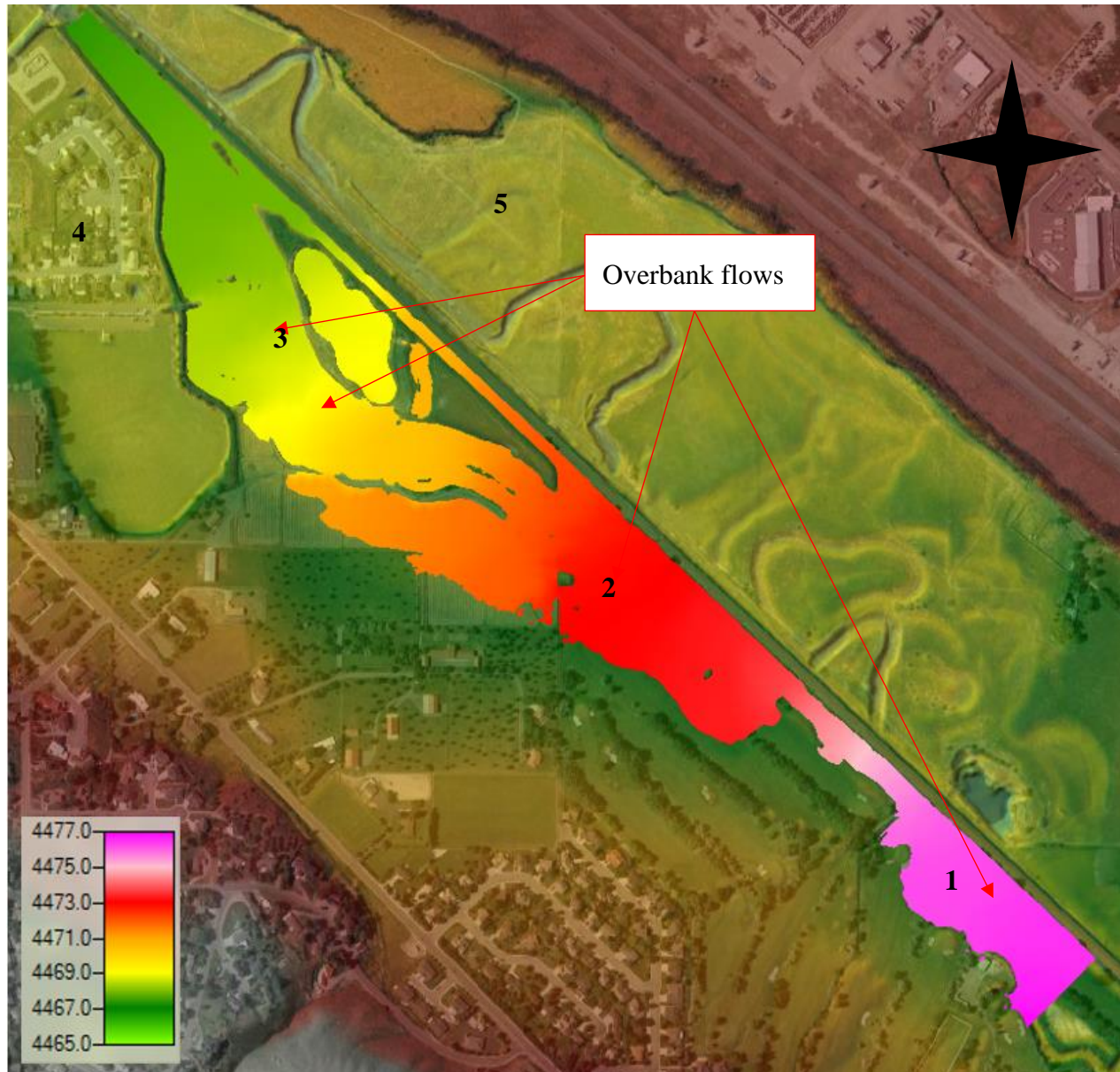


Figure 46 – 10-Year Maximum WSE without Modifications

7.1.3 25-Year Flood WSE No Modifications

Twenty five-year peak discharge maximum WSE without modifications are shown in Figure 47. WSEs ranging from 4469.5 ft to 4478 ft are observed. The 25-year total hydrograph

shows more significant flooding with additional flooding in the fields northwest of the golf course (2). Flooding is also observed throughout the Edson Fichter Nature Area connecting to the Edson Fichter Pond (3). The flooding in the northwest portion of the Juniper Hills Country Club (2) is similar to the 10-year hydrograph.

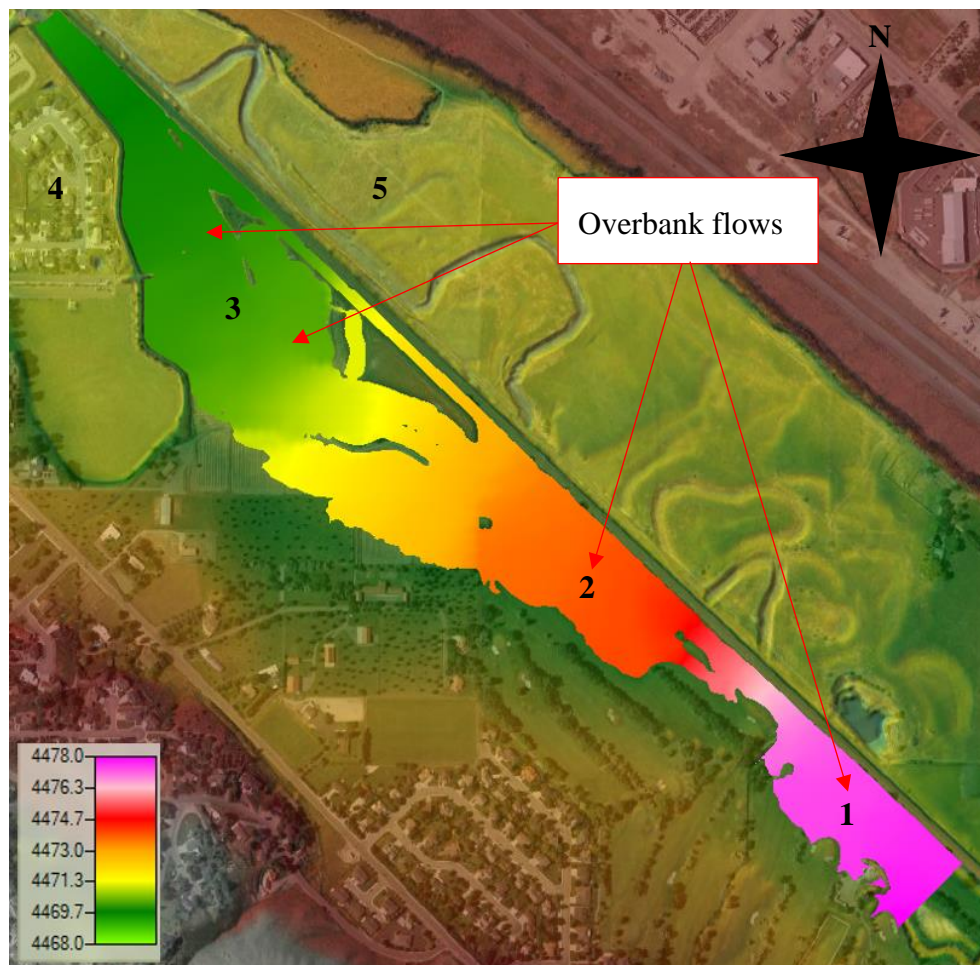


Figure 47 – 25-Year Maximum WSE without Modifications

7.1.4 50-Year Flood WSE No Modifications

The fifty-year peak discharge maximum WSE without modifications are shown in Figure 48. WSEs ranging from 4469 ft to 4478 ft are observed. The 50-year total hydrograph conditions are almost identical flooding to the 25-year flood. There is still no flow that overtops the railroad,

or breaches into any residential subdivisions. No structures are observed within the flood boundary.

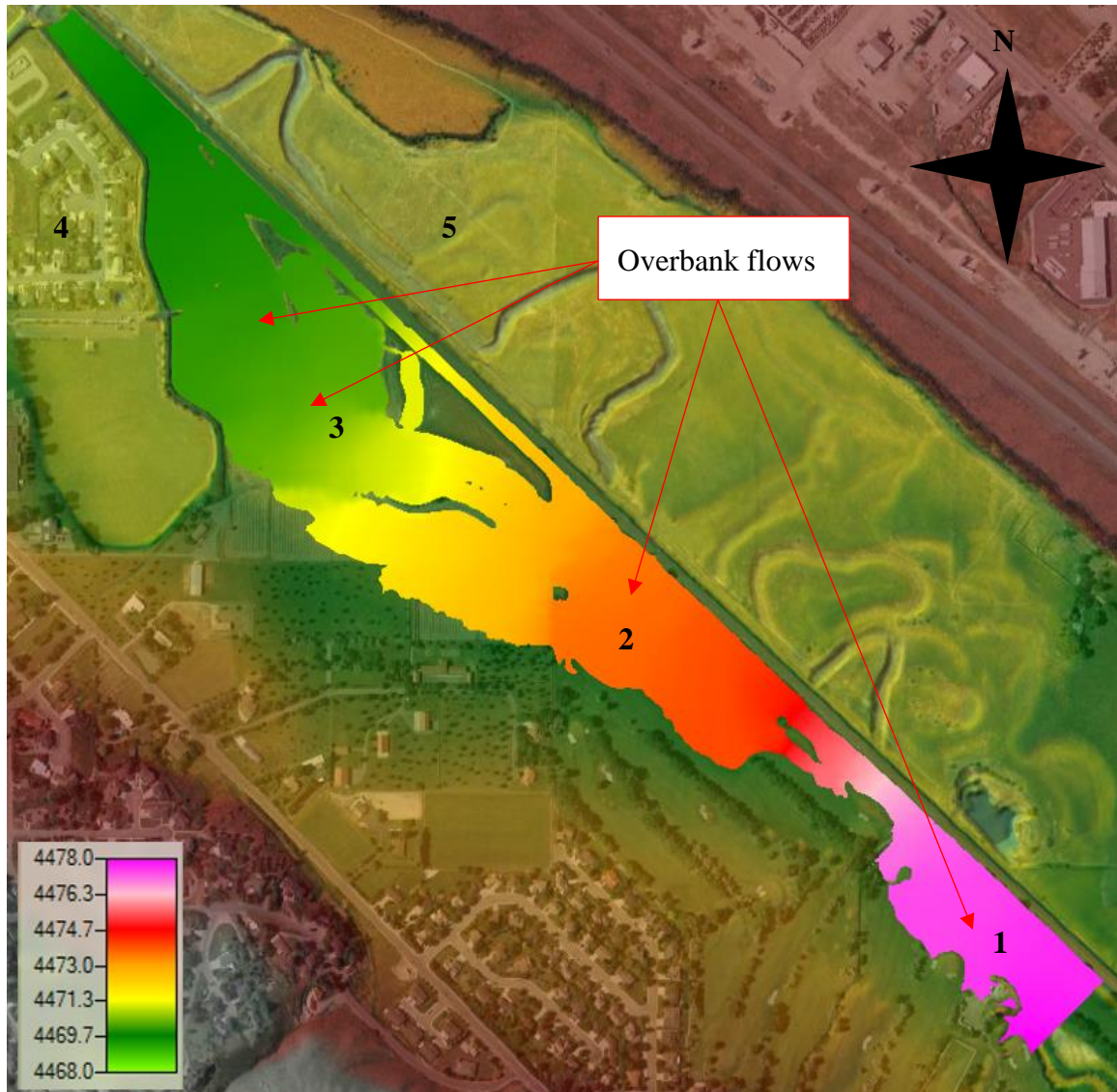


Figure 48 – 50-Year Maximum WSE without Modifications

7.1.5 100-Year Flood WSE No Modifications

One hundred-year peak discharge maximum WSE without modifications are shown in Figure 49. WSEs range from 4467 ft to 4480 ft and major flooding is observed. Flooding is detected in the subdivision to the west of the Edson Fichter area and in the subdivision north of

Cheyenne Ave (4). The 100-year flood storm also overtops the railroad and spills into the floodplain (5). Now that maximum WSEs from each flood event have been presented, the channel velocities will be discussed next.

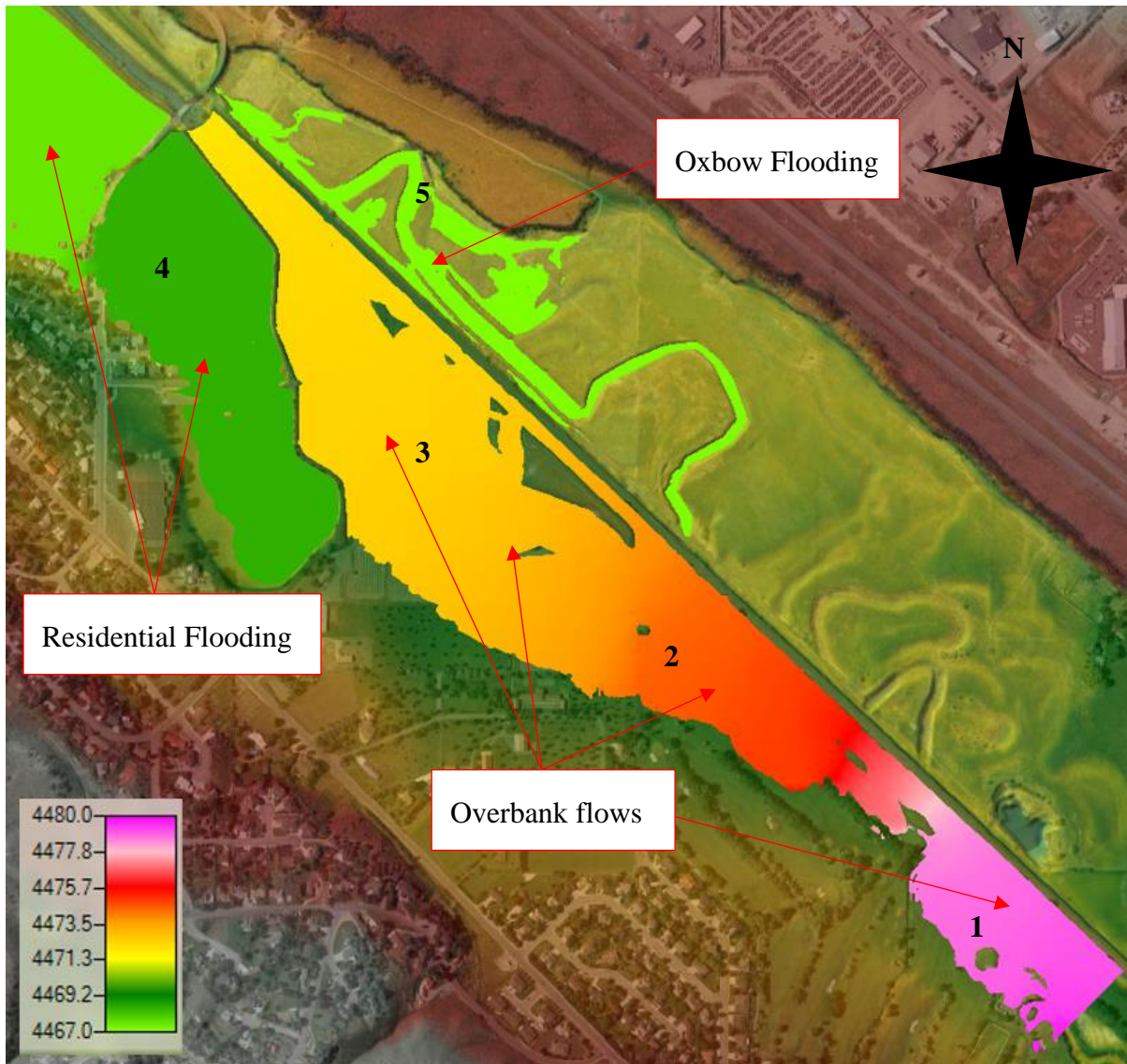


Figure 49 – 100-Year Maximum WSE without Modifications

7.1.6 Channel Velocities

Higher velocities produce an increased amount of bed shear on the soil. This action tends to scour and erode soil away from the channel banks and invert. On the other hand, areas that show low velocities are typically areas where soil deposition will occur. Many times, the high velocity portions of the model will indicate the location of the river thalweg. Velocities of all models were within the range of 0 ft/s to 7ft/s.

7.1.7 2-Year Flood Channel Velocity No Modifications

Two-year peak discharge maximum channel velocities without modifications are shown in Figure 50. Velocities ranging from 0 ft/s to 4 ft/s. Areas where the velocities are zero are sections that have experienced overbank flows and have ponded at a lower elevation on the outside of the riverbank.

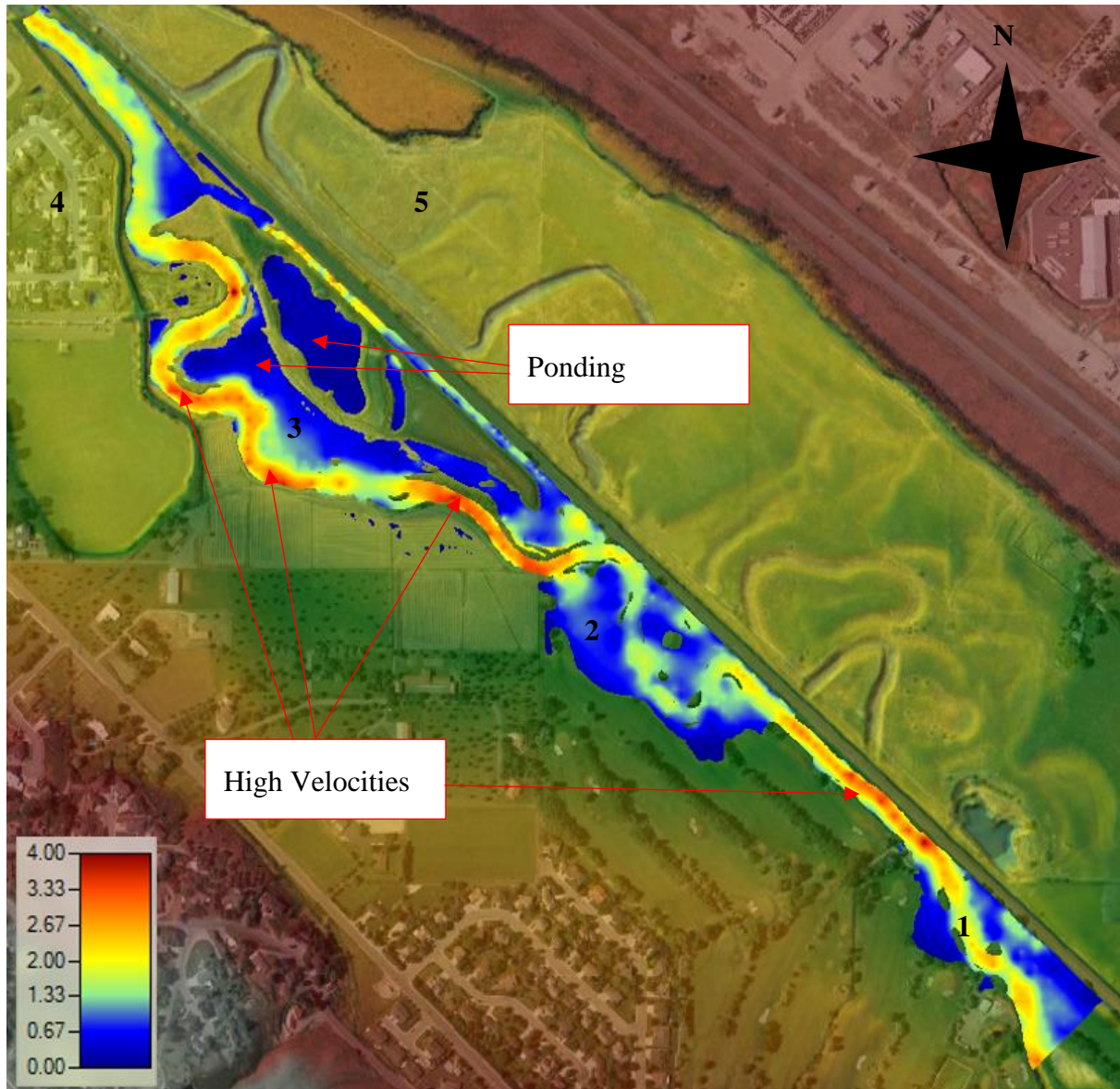


Figure 50 – 2-Year Maximum Channel Velocity without Modifications

7.1.8 10-Year Flood Channel Velocity No Modifications

Ten-year peak discharge maximum channel velocities without modifications are shown in Figure 51. Velocities range from 0 ft/s to 5 ft/s. Less ponding occurred within the Edson Fichter Nature Area (3) as the flood stage was able to breach back over the downstream banks. Ponding occurred in the fields to the South of the nature area.

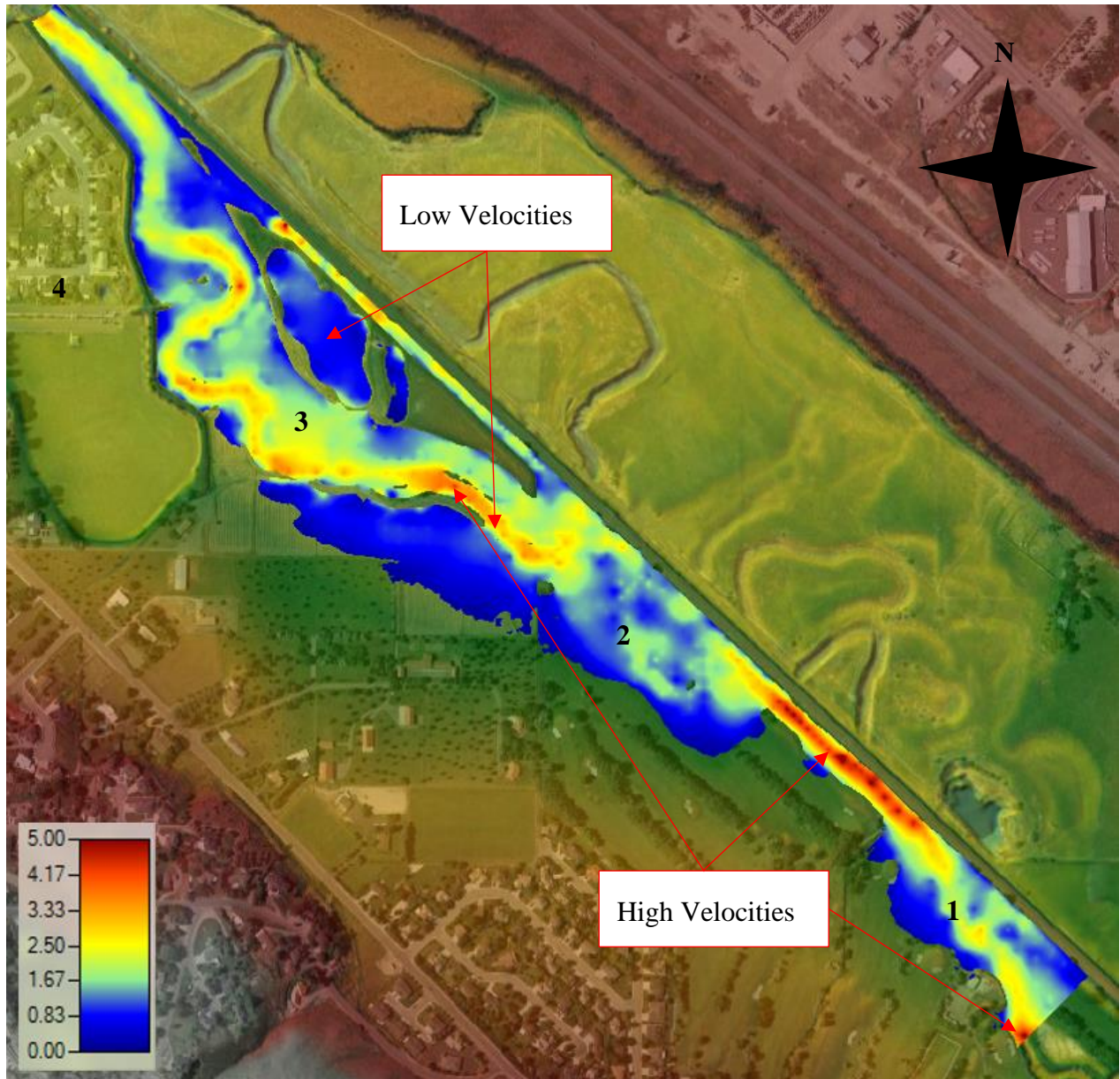


Figure 51 – 10-Year Maximum Channel Velocity without Modifications

7.1.9 25-Year Flood Channel Velocity No Modifications

Twenty five-year peak discharge maximum channel velocities without modifications are shown in Figure 52. Velocities range from 0 ft/s to 6 ft/s. Less ponding occurred within the Edson Fichter Nature Area (3) as the flood stage was able to breach back over the downstream

banks. Ponding still occurred in the fields to the south of the nature area, but have also reconnected.

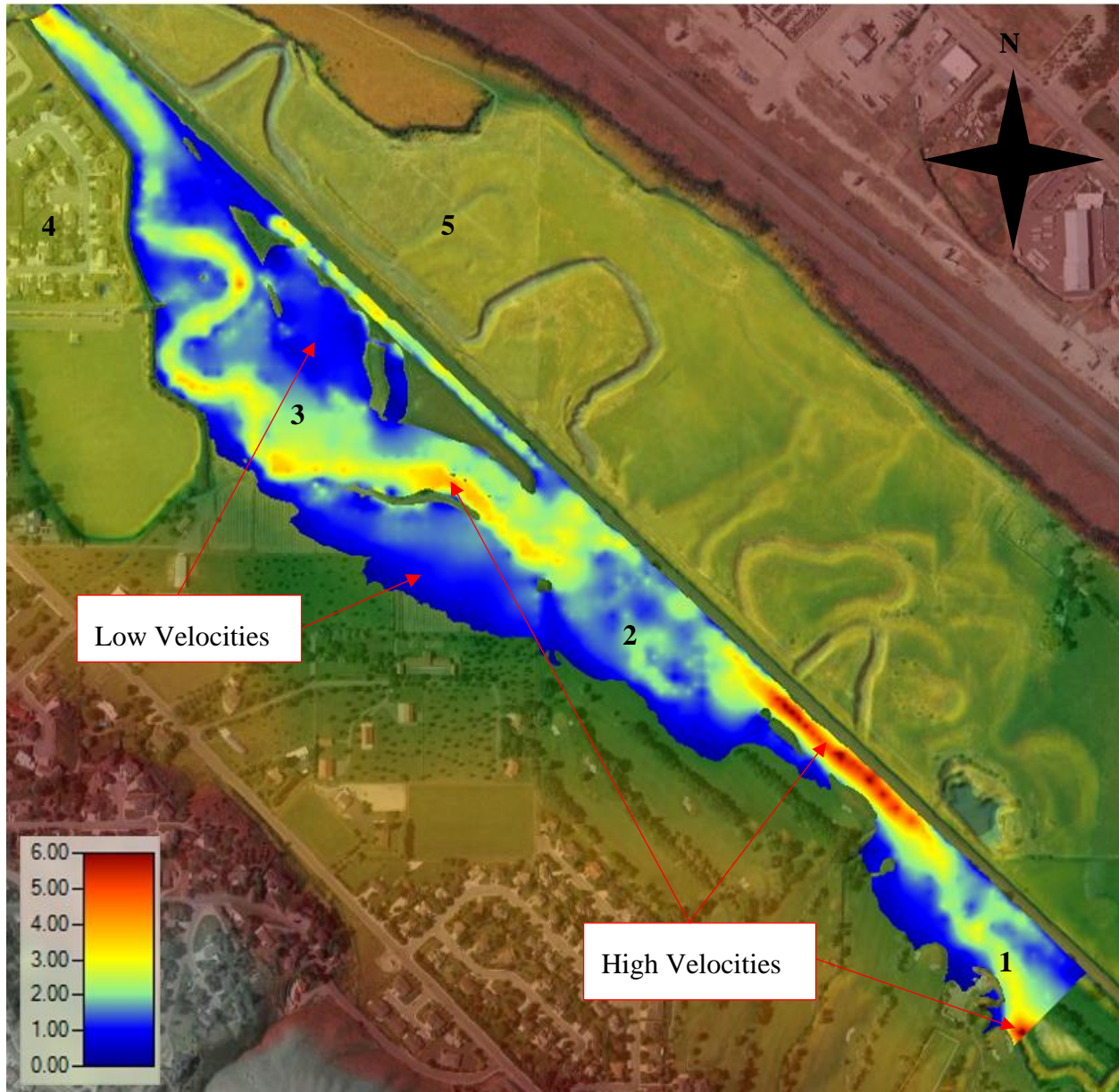


Figure 52 – 25-Year Maximum Channel Velocity without Modifications

7.1.10 50-Year Flood Channel Velocity No Modifications

Fifty-year peak discharge maximum channel velocities without modifications are shown in Figure 53. The 50-year total hydrograph shows velocities range from 0 ft/s to 6 ft/s. The flood

stage of the 50-year design storm was large enough that all overbank flows have reconnected to the main channel and minimal ponding have occurred.

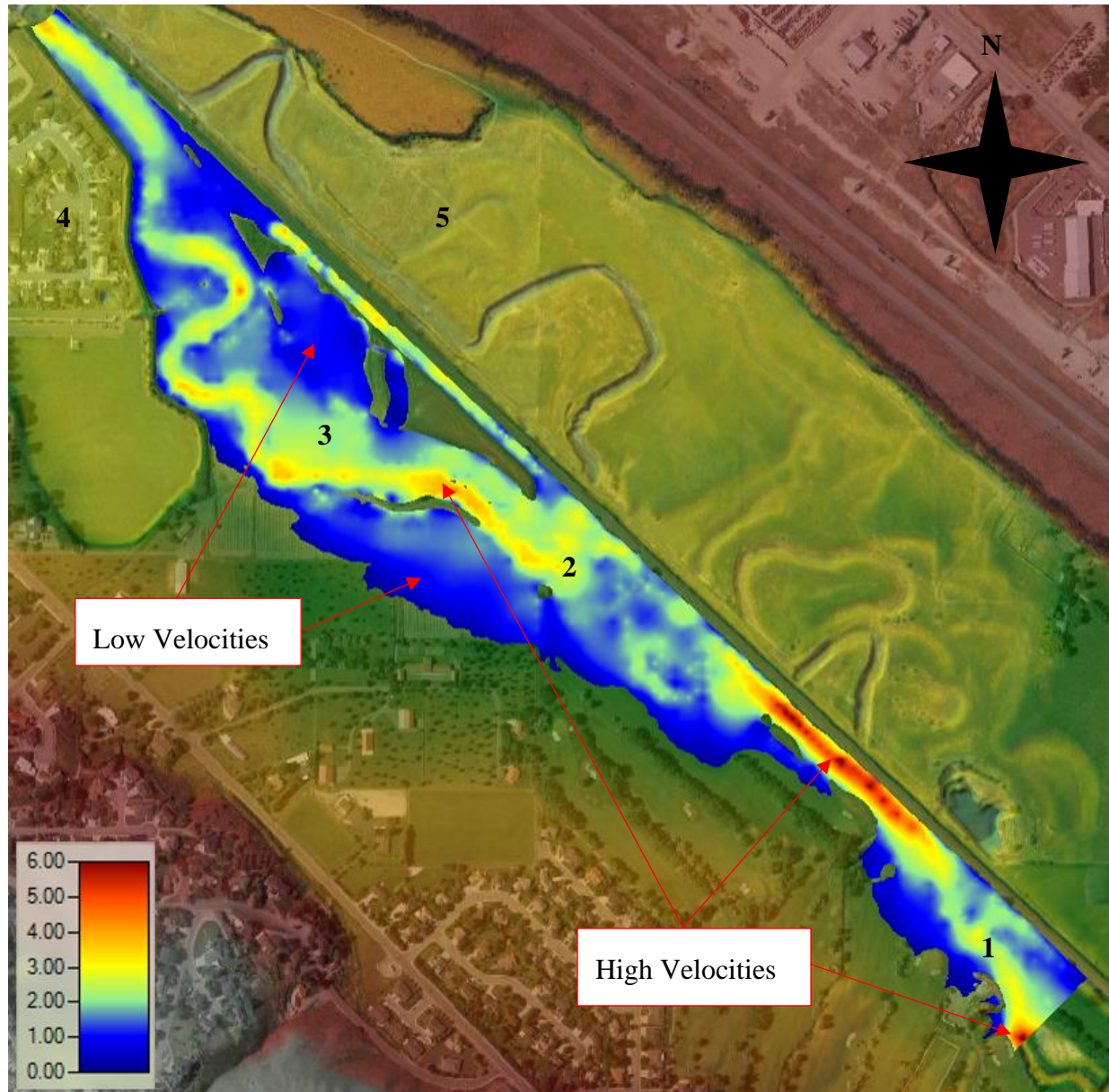


Figure 53 – 50-Year Maximum Channel Velocity without Modifications

7.1.11 100-Year Flood Channel Velocity No Modifications

One hundred-year peak discharge maximum channel velocities without modifications are shown in Figure 54. The 100-year total hydrograph shows velocities ranging from 0 ft/s to 7 ft/s.

The flood stage of the 100-year design storm was large enough that all overbank flows have reconnected to the main channel. The stage of the river exceeded the elevation of the railroad and pathway. This has caused ponding of water in the subdivisions and oxbows (4).

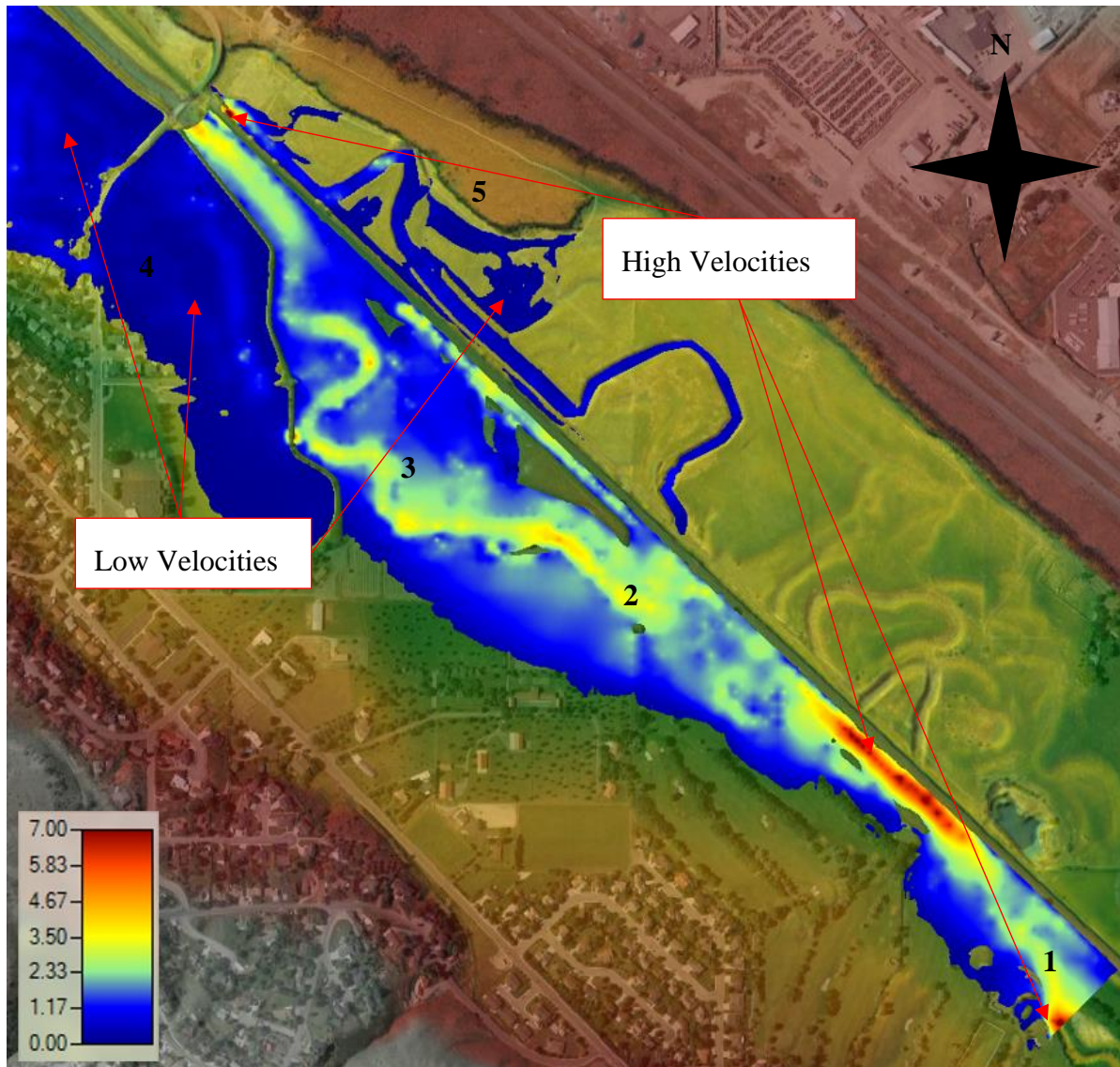


Figure 54– 100-Year Maximum Channel Velocity without Modifications

7.1.12 Water Depth

Now that a basis of the significance of each flood events channel velocities the maximum depths will be discussed next. Where high depths are observed this is also an indication of the thalweg as with high velocities. Analyzing depths is also a great indication of the amount of water stored in an area. It can also be used to access flood damage to structures. Water depths of all models were within the range of 0 ft to 15 ft.

7.1.13 2-Year Flood Depth No Modifications

Two-year peak discharge maximum water depths without modifications are shown in Figure 55. The 2-year total hydrograph shows water depths ranging from 0 ft to 8 ft. The 2-year total hydrograph also shows overbank depths up to 3 ft. At the 2-year peak discharge minimal flooding is detected. Overbank flows are observed throughout the Edson Fichter Nature Area (3) are 0.5 ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 2.5 ft of water.

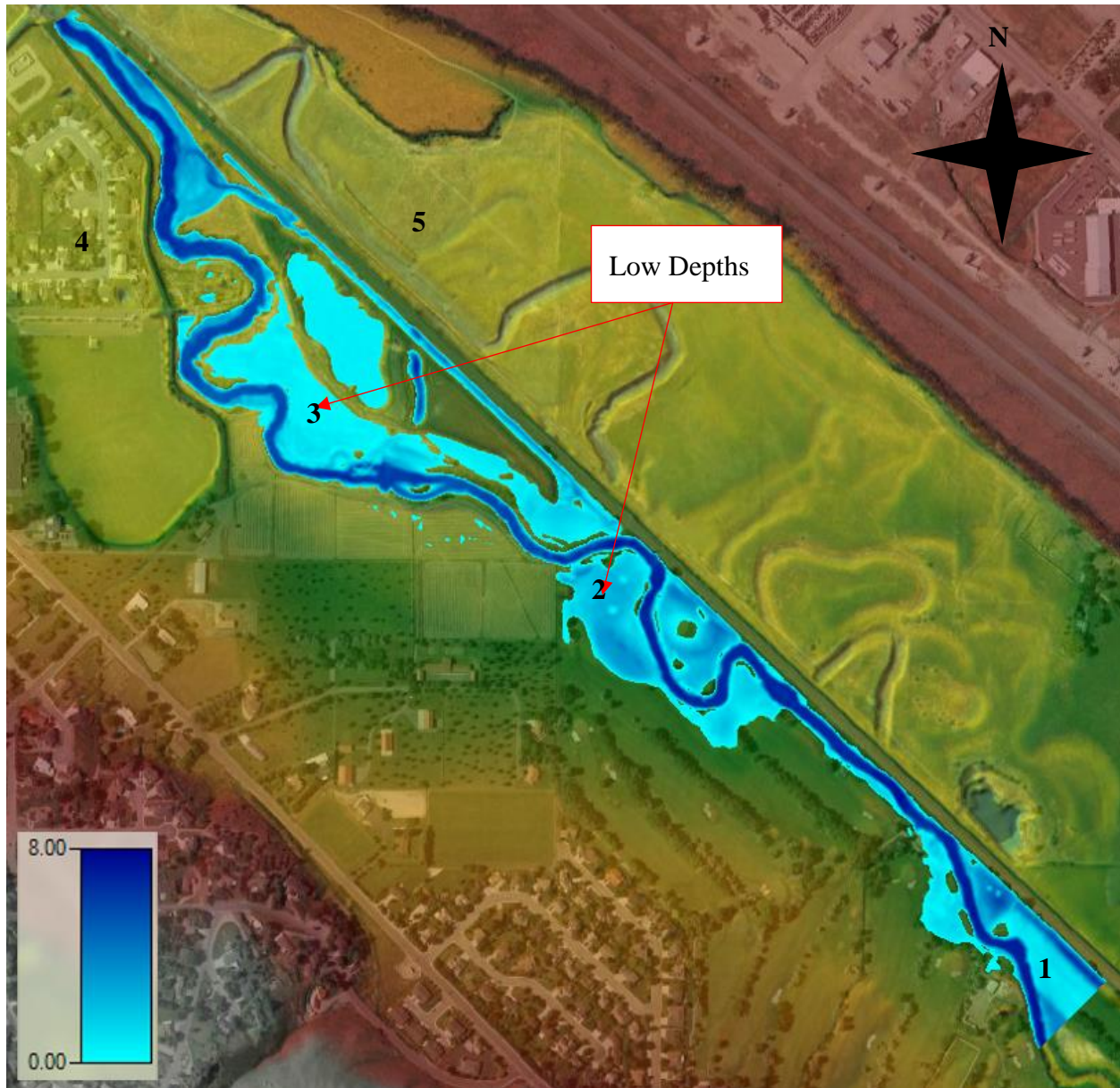


Figure 55 – 2-Year Maximum Depths without Modifications

7.1.14 10-Year Flood Depth No Modifications

Ten-year peak discharge maximum water depths without modifications are shown in Figure 56. The 10-year total hydrograph shows water depths ranging from 0 ft to 10 ft. The 10-year total hydrograph also shows overbank depths up to 5 ft. At the 10-year peak discharge significant flooding is detected. Overbank flows are observed throughout the Edson Fichter

Nature Area (3) range from 0 ft to 2 ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 4.5 ft of water.

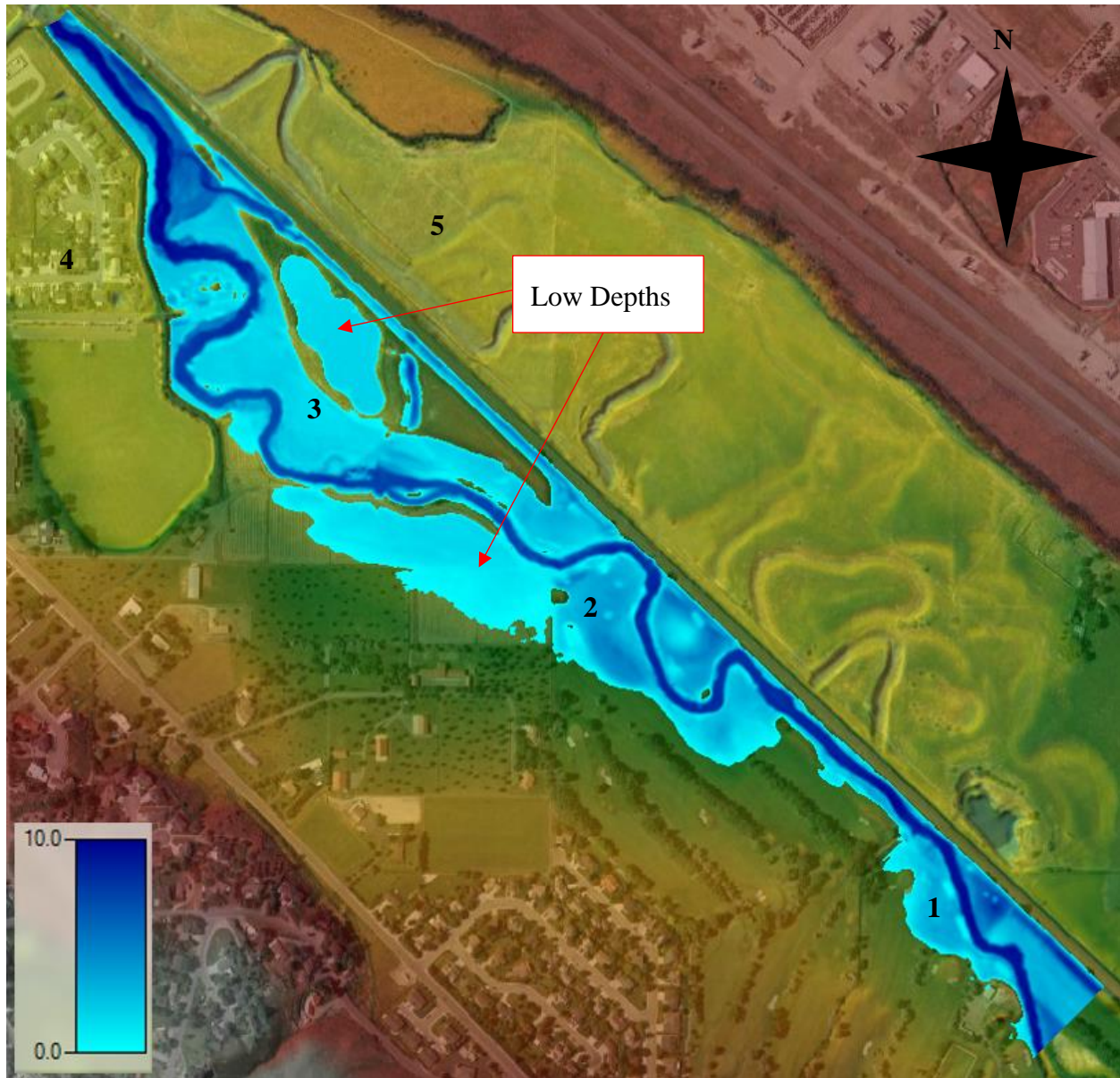


Figure 56 – 10-Year Maximum Depths without Modifications

7.1.15 25-Year Flood Depth No Modifications

Twenty five-year peak discharge maximum water depths without modifications are shown in Figure 57. The 25-year total hydrograph shows water depths ranging from 0 ft to 12 ft.

The 25-year total hydrograph also shows overbank depths up to 5.5 ft. At the 25-year peak discharge significant flooding is detected. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 3.5ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 5 ft of water.

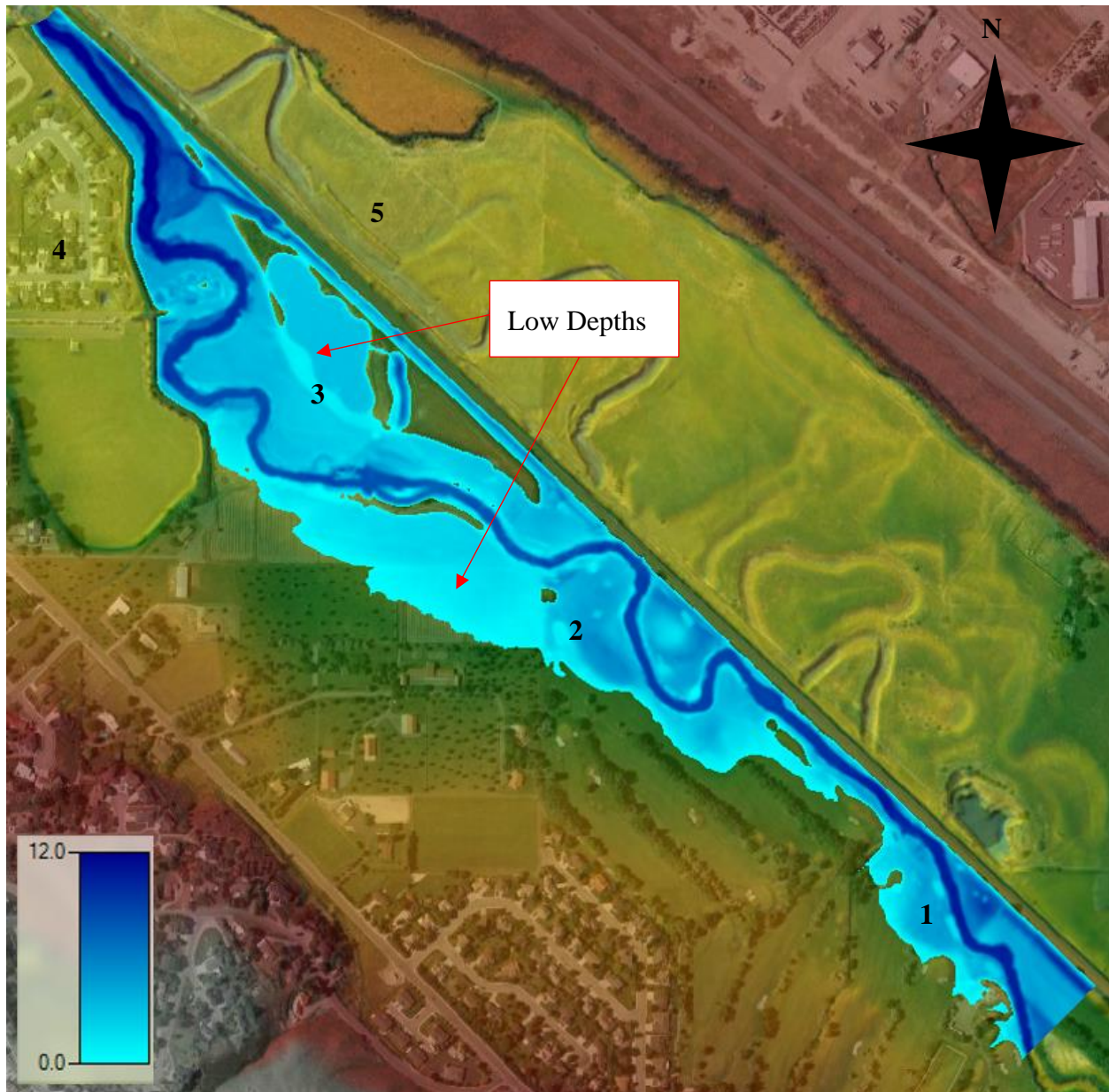


Figure 57 – 25-Year Maximum Depths without Modifications

7.1.16 50-Year Flood Depth No Modifications

Fifty-year peak discharge maximum water depths without modifications are shown in Figure 58. The 50-year total hydrograph shows water depths ranging from 0 ft to 15 ft. The 50-year total hydrograph also shows overbank depths up to 5.5 ft. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 3.5 ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 5 ft of water.

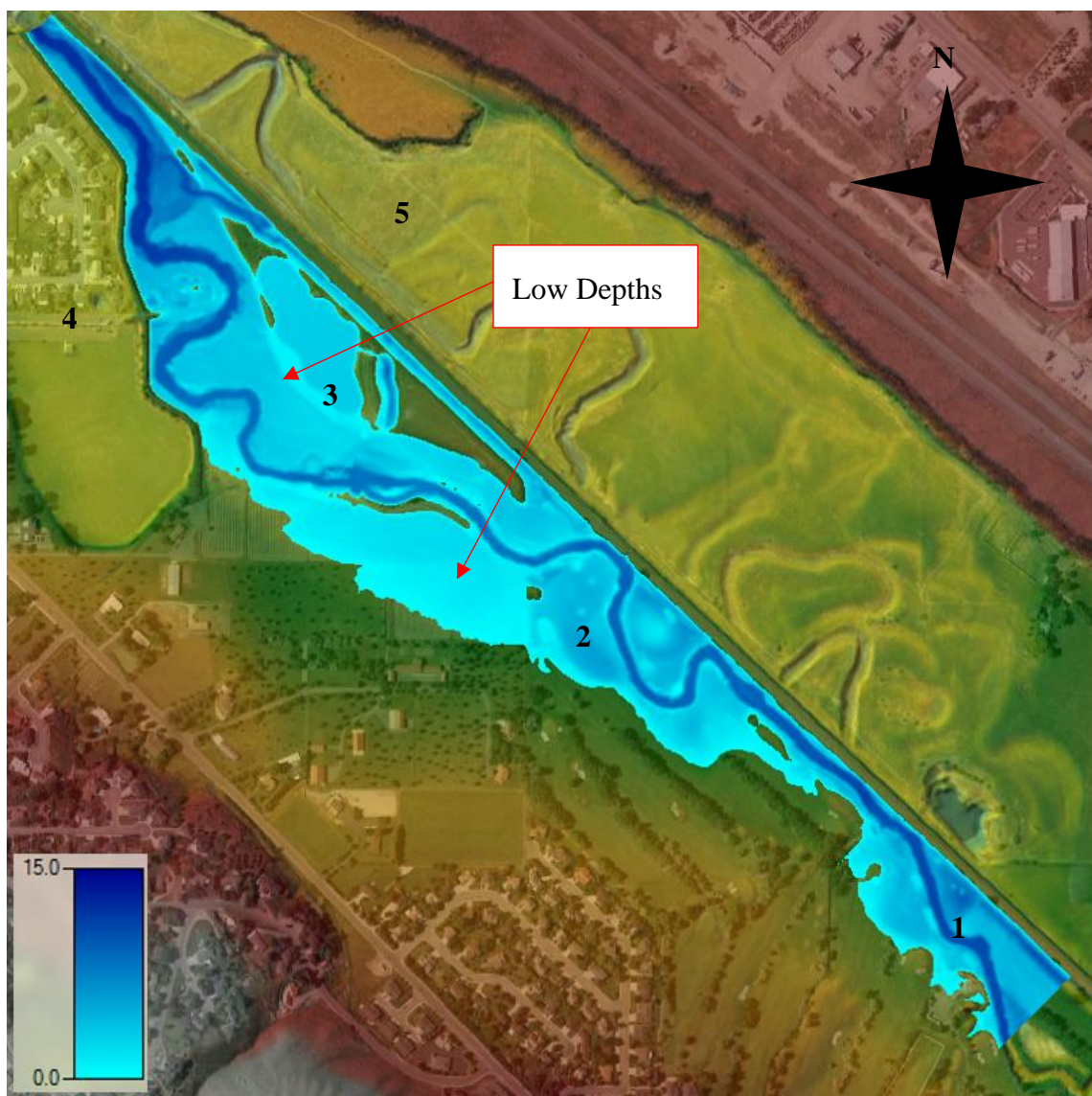


Figure 58 – 50-Year Maximum Depths without Modifications

7.1.17 100-Year Flood Depth No Modifications

One hundred-year peak discharge maximum water depths without modifications are shown in Figure 59. The 100-year total hydrograph shows water depths ranging from 0 ft to 15 ft. The 100-year total hydrograph also shows overbank depths up to 5.5 ft. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 9 ft deep.

The northwest portion of the Juniper Hills Country Club (2) has around 6 ft of water. The subdivision to the West of the Edson Fichter Nature (4) flood depths range from 0 ft to 3.5 ft. The subdivision to the North of the Edson Fichter Nature (4) flood depths range from 0 ft to 3 ft. This amount of flooding withing both subdivisions would cause significant damage these residences.

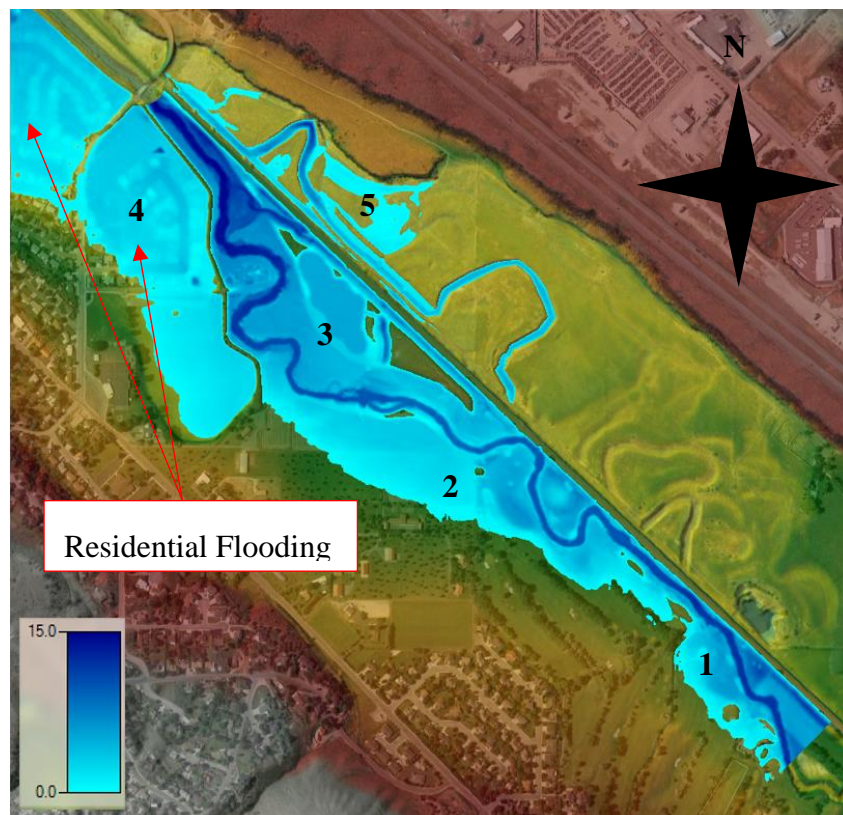


Figure 59 – 100-Year Maximum Depths without Modifications

7.2 HEC-RAS Model Results 4 ft Inlet with 1 ft Outlet

Now that flood inundation conditions of the Portneuf River without modifications has been developed, the culvert modification effectiveness can be accessed. First, the WSEs for all flood return periods with culvert modifications will be presented. After this, the channel velocities are discussed. Finally, maximum water depths will be examined. All results with culvert modifications will be compared to the results without modifications.

7.3 HEC-RAS WSE Comparisons

7.3.1 2-Year Flood WSE with 4 ft Inlet and 1 ft Outlet

The two-year peak discharge maximum WSE with culvert modifications are shown in Figure 60. The 2-year total hydrograph shows WSEs ranging from 4463 ft to 4475 ft. The 2-year total hydrograph also shows overbank flows. At the 2-year peak discharge minimal flooding is detected. Overbank flows are observed throughout the Edson Fichter Nature Area (3) and the northwest portion of the Juniper Hills Country Club (2).

The maximum floodplain (5) 2-year WSE is 4468.7 ft which provides a storage amount of 354 acre-ft of storage. During the 2-year maximum flood the floodplain storage is 1.8 ft away from the design freeboard elevation. At this condition, the floodplain is at 52% of its maximum storage capacity.

Differences in WSE are seen throughout the Edson Fichter Nature Area (3). The Edson Fichter pond does not receive any flooding and elevations throughout the area are lower. This indicates that the diversion culvert has removed some of the peak of the hydrograph and routed this water into the oxbows and floodplain.

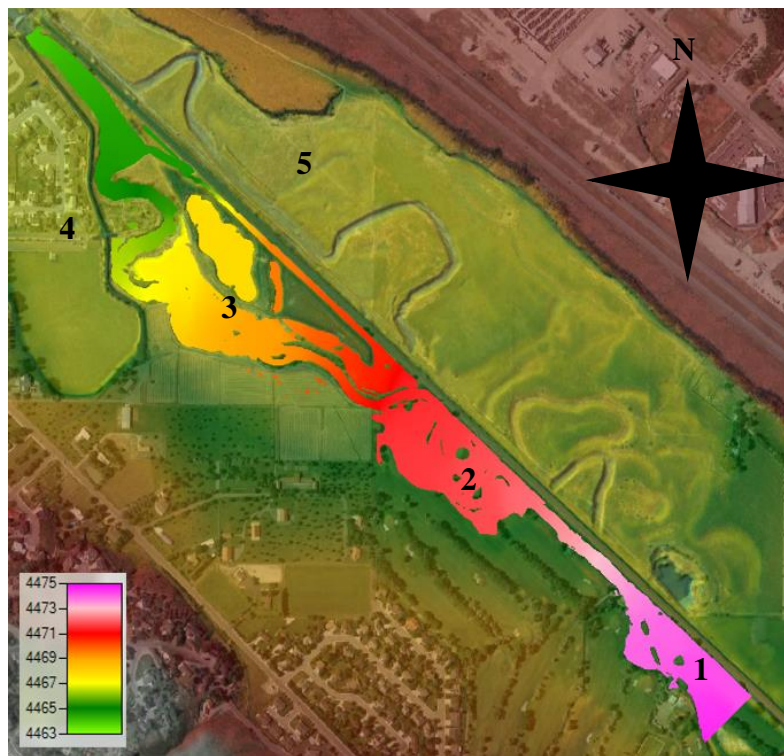
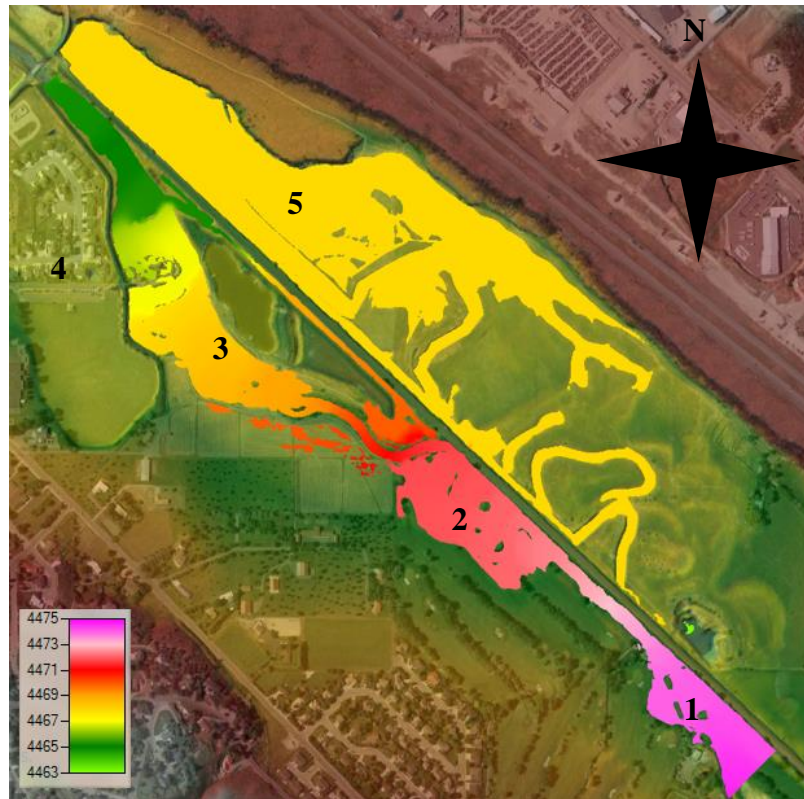


Figure 60 – 2-Year Maximum WSE with 4 ft Inlet and 1 ft Outlet

7.3.2 10-Year Flood WSE with 4 ft Inlet and 1 ft1 ft Outlet

Ten-year peak discharge maximum WSE with culvert modifications are shown in Figure 61. The 10-year total hydrograph shows WSEs ranging from 4467 ft to 4476 ft. The 10-year total hydrograph also shows overbank flows. At the 10-year peak discharge significant flooding is detected. Inundation flows are observed throughout much of the river reach. No flooding has occurred to the surround structures and residential areas.

The maximum floodplain 10-year WSE is 4469.97 ft which provides a storage amount of acre-ft of storage. During the 10-year maximum flood the floodplain storage is 0.53 ft away from the design freeboard elevation. At this condition, the floodplain is at 72% of its maximum storage capacity. Minimal differences in WSEs are observed during the 10-year total hydrographs in WSE are seen throughout the Edson Fitcher Nature Area (3).

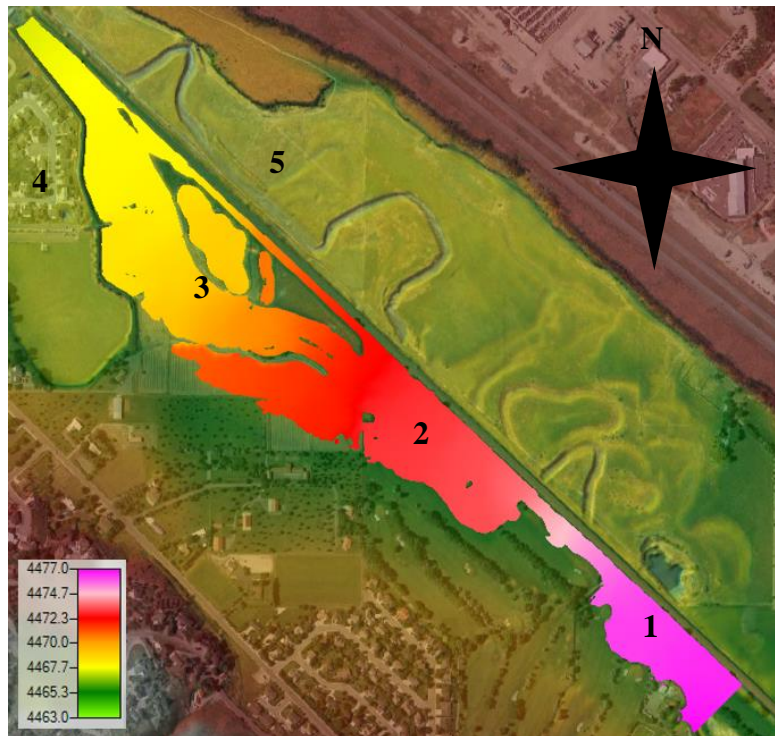
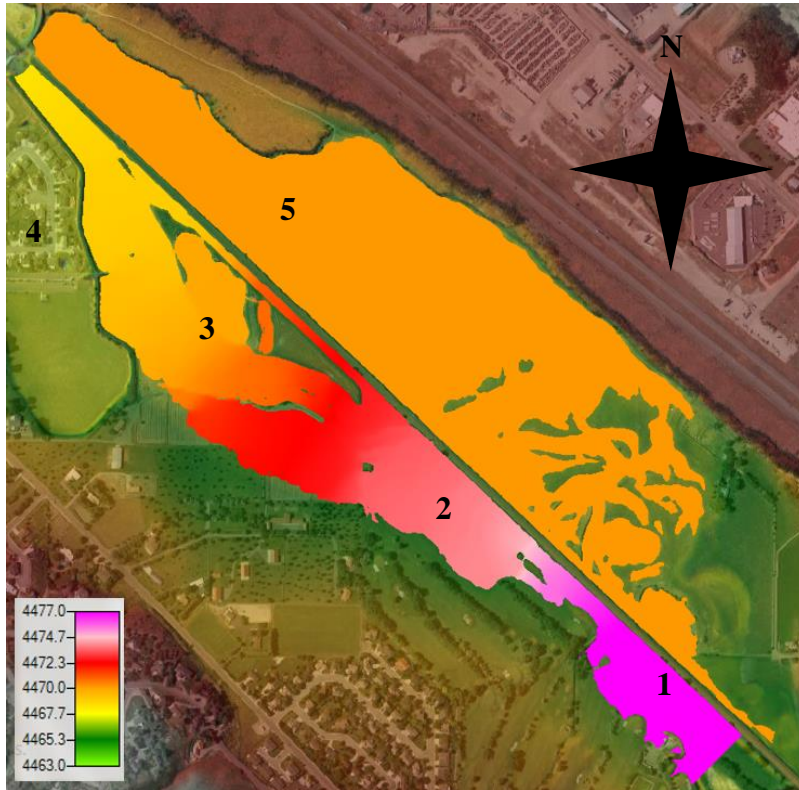


Figure 61 – 10-Year Maximum WSE with 4 ft Inlet and 1 ft Outlet

7.3.3 25-Year Flood WSE with 4 ft Inlet and 1 ft1 ft Outlet

Twenty five-year peak discharge maximum WSE with culvert modifications are shown in Figure 62. The 25-year total hydrograph shows WSEs ranging from 4468 ft to 4478 ft. The 25-year total hydrograph also shows overbank flows. At the 25-year peak discharge significant flooding is detected. Inundation flows are observed throughout much of the river reach. No flooding has occurred to the surround structures and residential areas.

The maximum floodplain 25-year WSE is 4470.47 ft which provides a storage amount of 645 acre-ft of storage. During the 25-year maximum flood the floodplain storage is 0.03 ft away from the design freeboard elevation. At this condition, the floodplain is at 95% of its maximum storage capacity. It is also observed that the WSE near the outlet of the model are lower by about 1 foot. This indicates that the culvert modifications are providing some flood storage and has dampened the peak of the 25-year flood hydrograph.

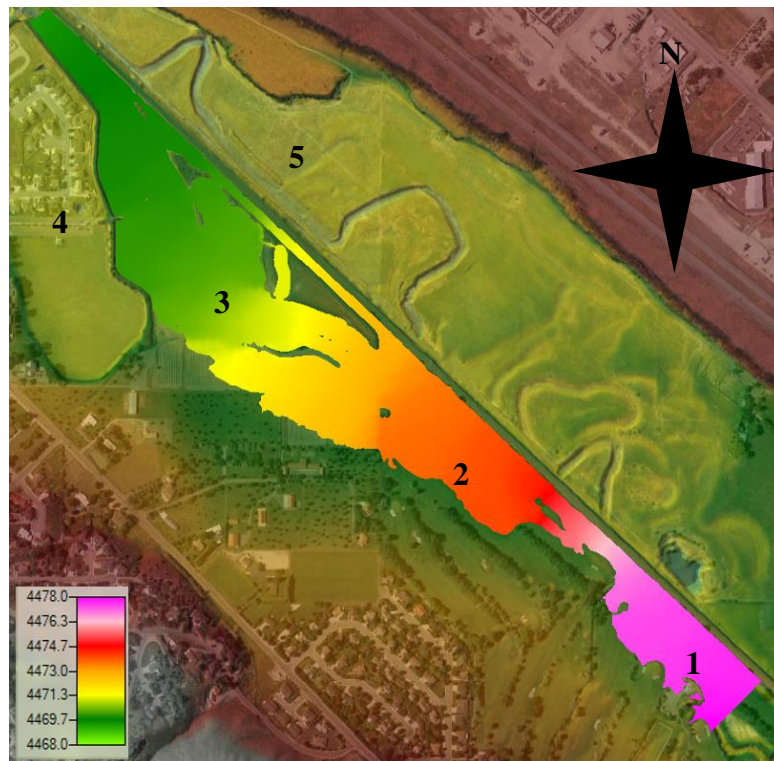
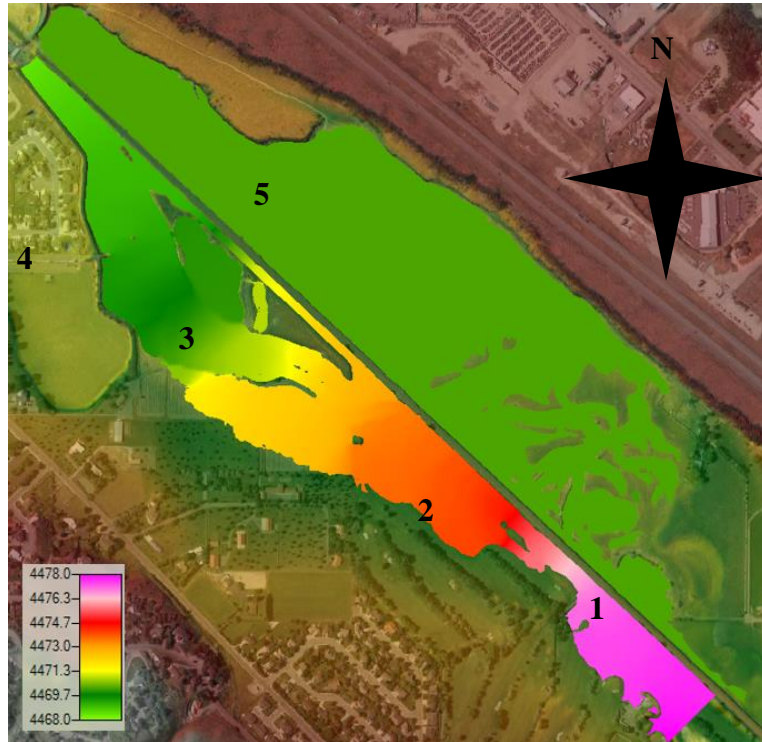


Figure 62 – 25-Year Maximum WSE with 4 ft Inlet and 1 ft Outlet

7.3.4 50-Year Flood WSE with 4 ft Inlet and 1 ft1 ft Outlet

Fifty-year peak discharge maximum WSE with culvert modifications are shown in Figure 63. The 50-year total hydrograph shows WSEs ranging from 4469 ft to 4478 ft. The 50-year total hydrograph also shows overbank flows. At the 250-year peak discharge significant flooding is detected. Inundation flows are observed throughout much of the river reach. No flooding has occurred to the surround structures and residential areas. The flooding from the 25- and 50-year return period does not change significantly.

The maximum floodplain 50-year WSE is also 4470.47 ft which provides a storage amount of 645 acre-ft of storage. During the 50-year maximum flood the floodplain storage is 0.03 ft away from the design freeboard elevation. At this condition, the floodplain is at 95% of its maximum storage capacity. It is also observed that the WSE near the outlet of the model are lower by about 1 foot. This indicates that the culvert modifications are providing some flood storage and has dampened the peak of the 50-year flood hydrograph.

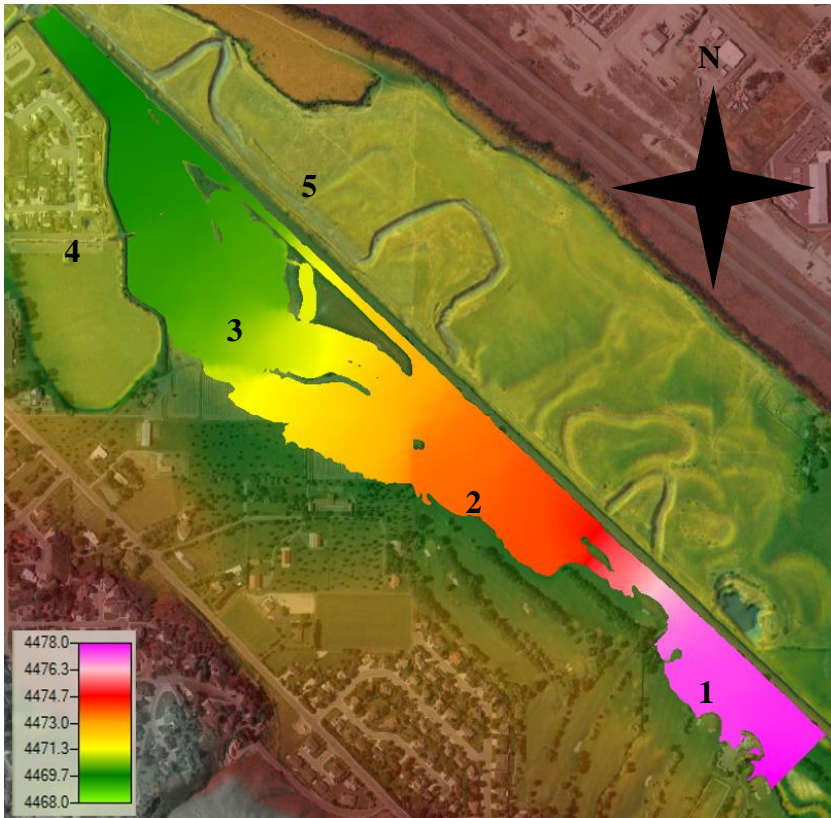
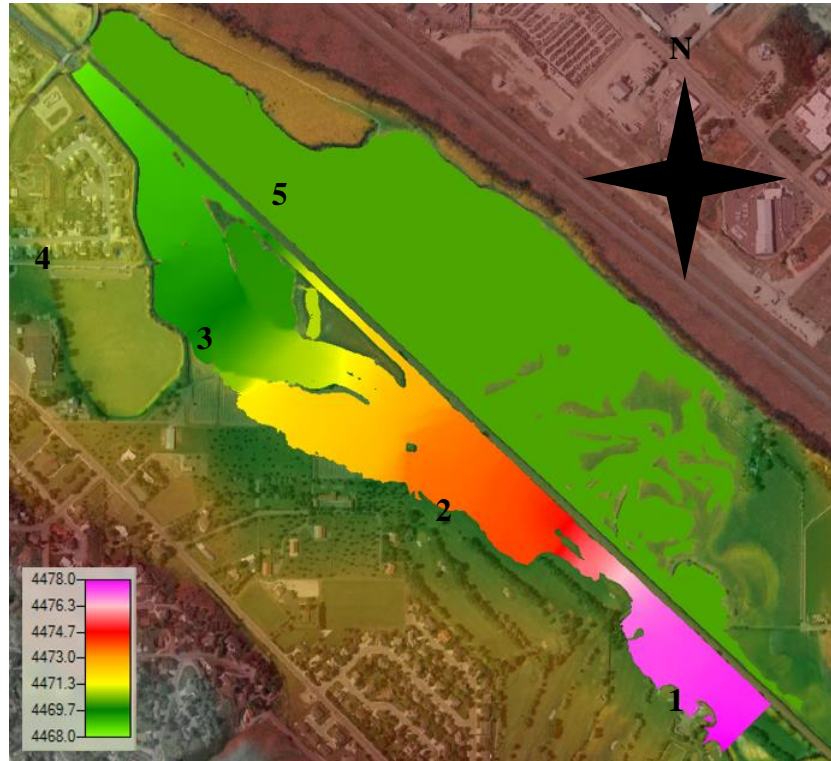


Figure 63 – 50-Year Maximum WSE with 4 ft Inlet and 1 ft Outlet

7.3.5 100-Year Flood WSE with 4 ft Inlet and 1 ft 1 ft Outlet

One-hundred-year peak discharge maximum WSE with culvert modifications are shown in Figure 64. The 100-year total hydrograph shows WSEs ranging from 4466 ft to 4480 ft. The 100-year total hydrograph also shows overbank flows. At the 100-year peak discharge major flooding is detected. Inundation flows are observed throughout much of residential areas.

The maximum floodplain 100-year WSE is 4471.03 ft which provides a storage amount of 677 acre-ft of storage. During the 100-year maximum flood the floodplain storage is exceeded. At this condition, the floodplain is at 101.5% of its maximum storage capacity.

The 100-year peak discharge shows major flooding of the Residential areas on the West side of the model near Indian Hills Elementary (4) and the subdivisions to the north of Cheyenne Road. With the modifications added flooding is significantly decreased in the locations. This shows that the oxbows and floodplain provide flood storage, and the floodplain has the ability to decrease flooding in residential areas near the project location.

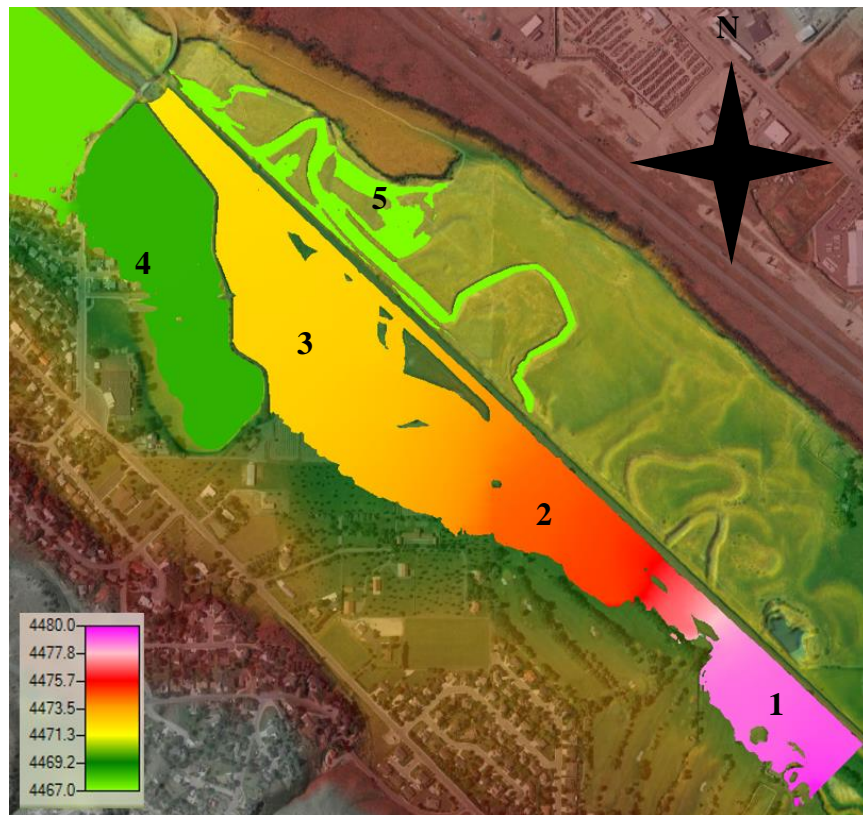
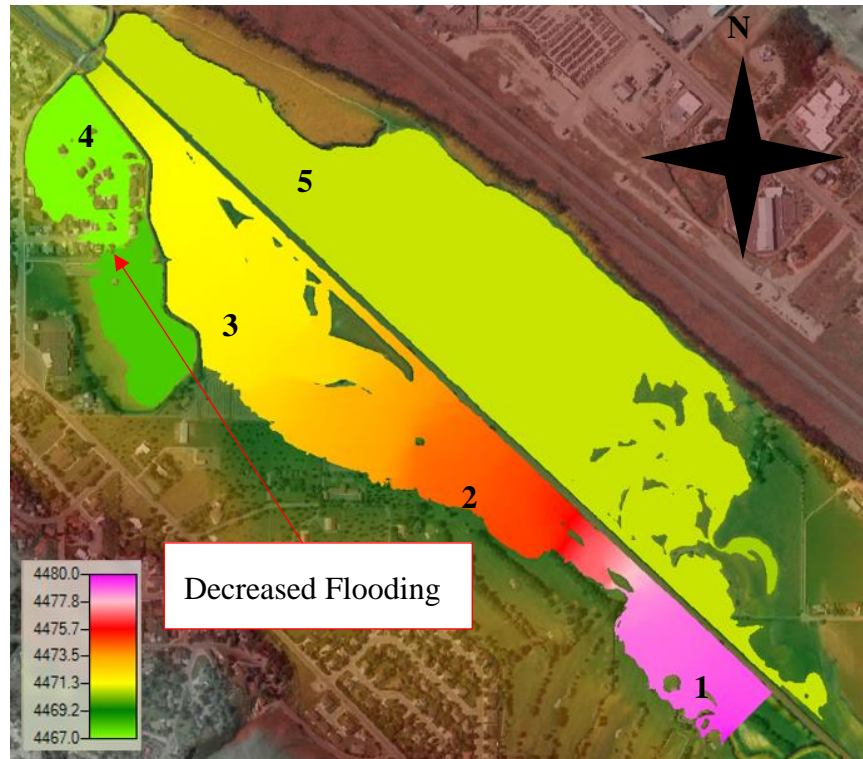


Figure 64 – 100-Year Maximum WSE with 4 ft Inlet and 1 ft Outlet

7.4 Channel Velocities

Areas where the velocities are zero are the sections that have experienced overbank flows, and have ponded at a lower elevation on the outside of the river bank. Velocities are close to zero throughout much of the floodplain. Sediment deposition will occur in these areas which will improve the quality of the water before it is diverted back to the Portneuf. The effect of the culvert modifications on water is noticed in zero velocities within the floodplain. Most of the floodplain is at very low velocities which indicate that soil deposition will occur in these areas. This soil deposition will improve the water quality. High velocity areas show the need for channel protection such as riprap or a splash pad to prevent erosion in these locations.

7.4.1 2-Year Flood Channel Velocity with 4 ft Inlet and 1 ft Outlet

Two-year peak discharge maximum channel velocities with modifications are shown in Figure 65. The 2-year total hydrograph shows velocities ranging from 0 ft/s to 4 ft/s. Velocities up to 3 fps are observed at both the inlet and outlet of all diversion culverts.

7.4.2 10-Year Flood Channel Velocity with 4 ft Inlet and 1 ft Outlet

Ten-year peak discharge maximum channel velocities with modifications are shown in Figure 66. The 10-year total hydrograph shows velocities ranging from 0 ft/s to 5 ft/s. Velocities are close to zero throughout most of the floodplain. Velocities up to 3.5 fps are observed at both the inlet and outlet of all diversion culverts.

7.4.3 25-Year Flood Channel Velocity with 4 ft Inlet and 1 ft Outlet

Twenty five-year peak discharge maximum channel velocities with modifications are shown in Figure 67. The 25-year total hydrograph shows velocities ranging from 0 ft/s to 6 ft/s.

Velocities are close to zero throughout most of the floodplain. Velocities up to 4.5 fps are observed at both the inlet and outlet of all diversion culverts.

7.4.4 50-Year Flood Channel Velocity with 4 ft Inlet and 1 ft Outlet

Fifty-year peak discharge maximum channel velocities with modifications are shown in Figure 68. The 50-year total hydrograph shows velocities ranging from 0 ft/s to 6 ft/s. Velocities from the 50-year hydrograph are very similar to the 25-year hydrograph. Velocities up to 5.5 fps are observed at both the inlet and outlet of all diversion culverts.

7.4.5 100-Year Flood Channel Velocity with 4 ft Inlet and 1 ft Outlet

One-hundred-year peak discharge maximum channel velocities with modifications are shown in Figure 69. The 100-year total hydrograph shows velocities ranging from 0 ft/s to 7 ft/s. Velocities up to 6.5 fps are observed at both the inlet and outlet of the upstream diversion culvert. Overtopping of the railroad is shown without modification. The addition of the culverts prevents the railroad from overflowing during the 100-year total hydrograph.

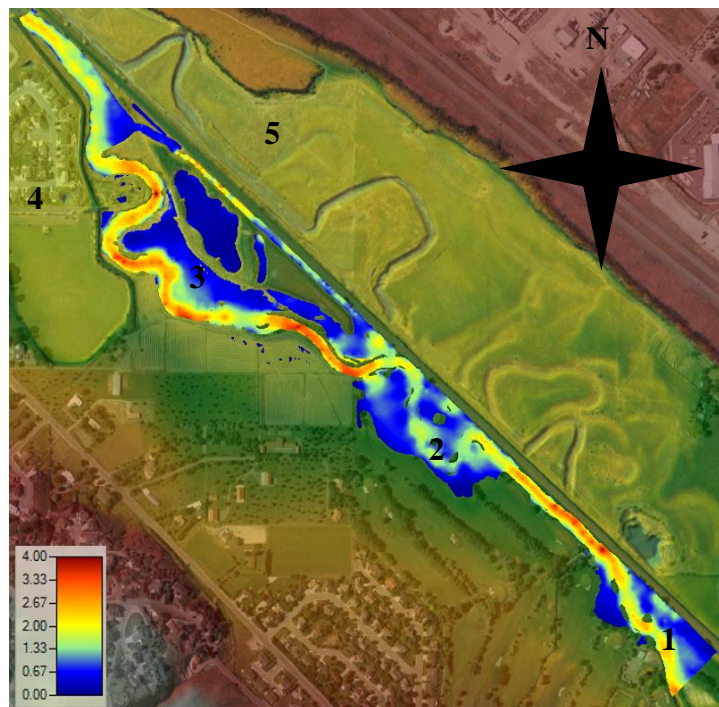
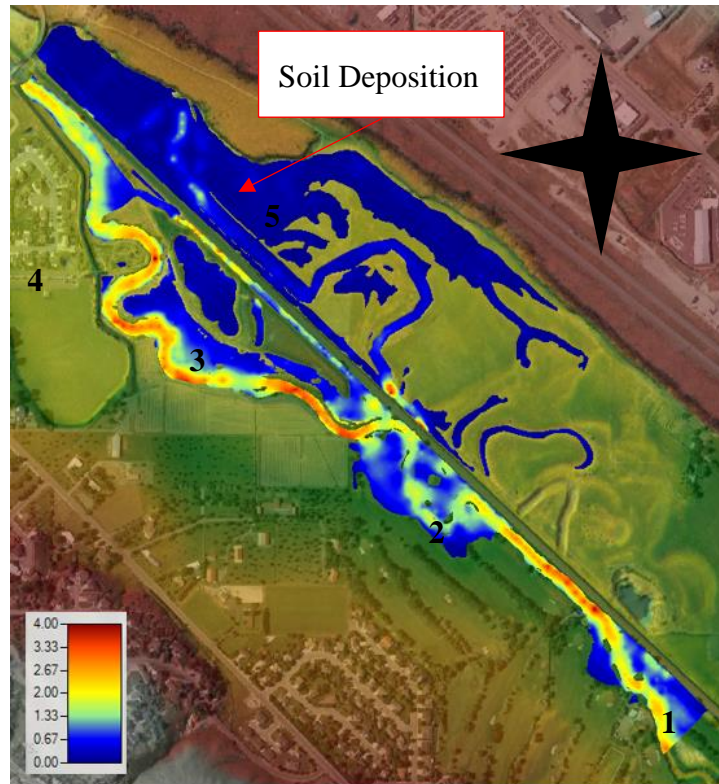


Figure 65 – 2-Year Maximum Channel Velocity with 4 ft Inlet and 1 ft Outlet

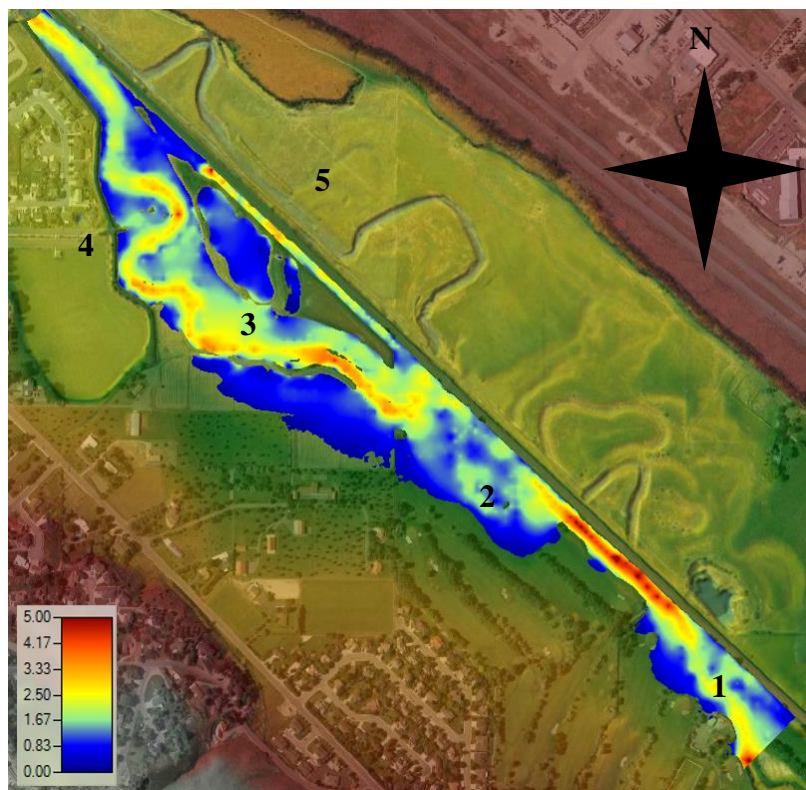
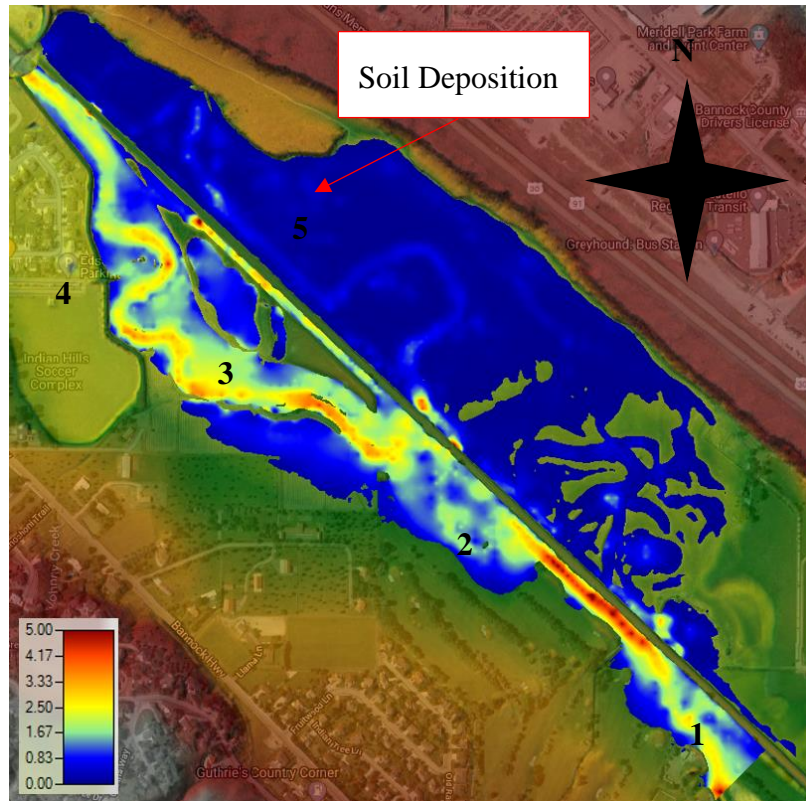


Figure 66 – 10-Year Maximum Channel Velocity with 4 ft Inlet and 1 ft Outlet

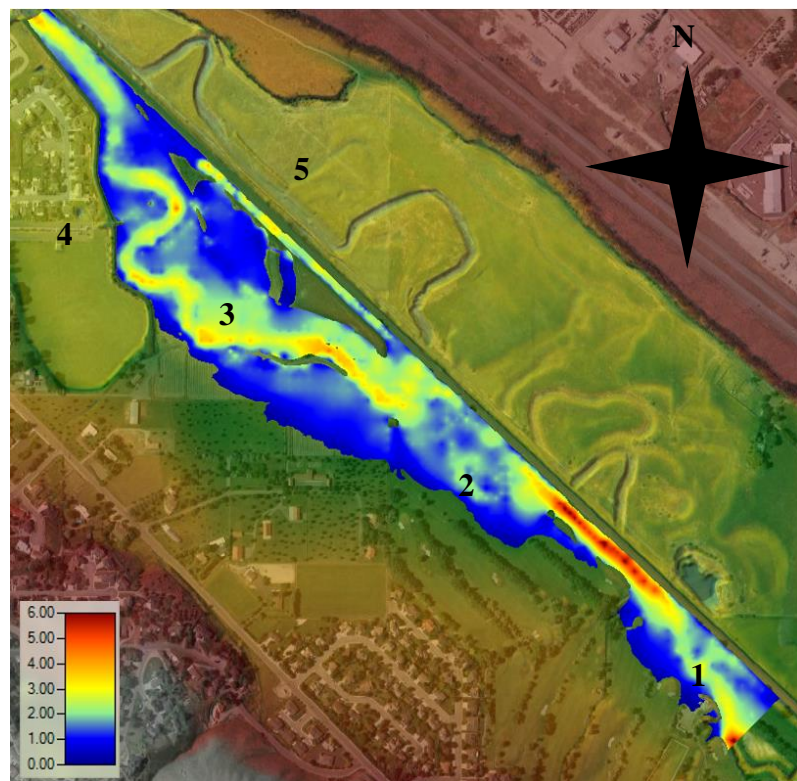
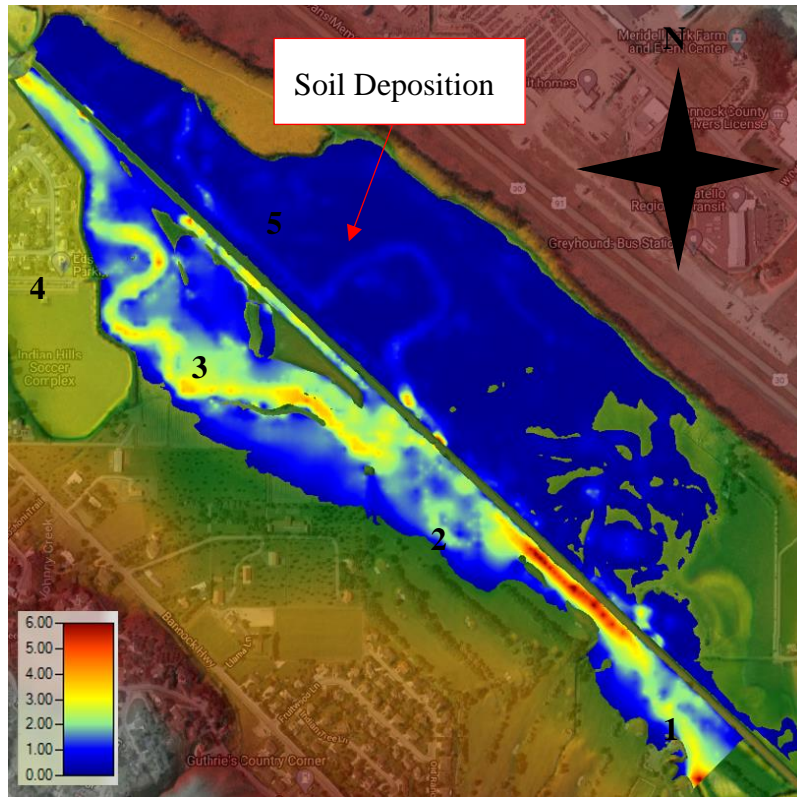


Figure 67 – 25-Year Maximum Channel Velocity with 4 ft Inlet and 1 ft Outlet

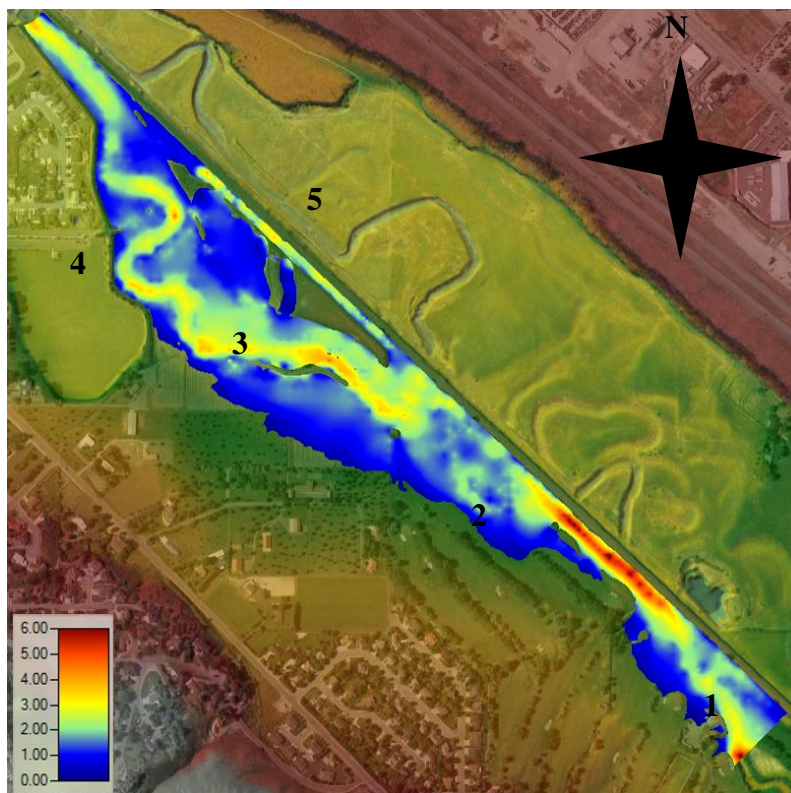
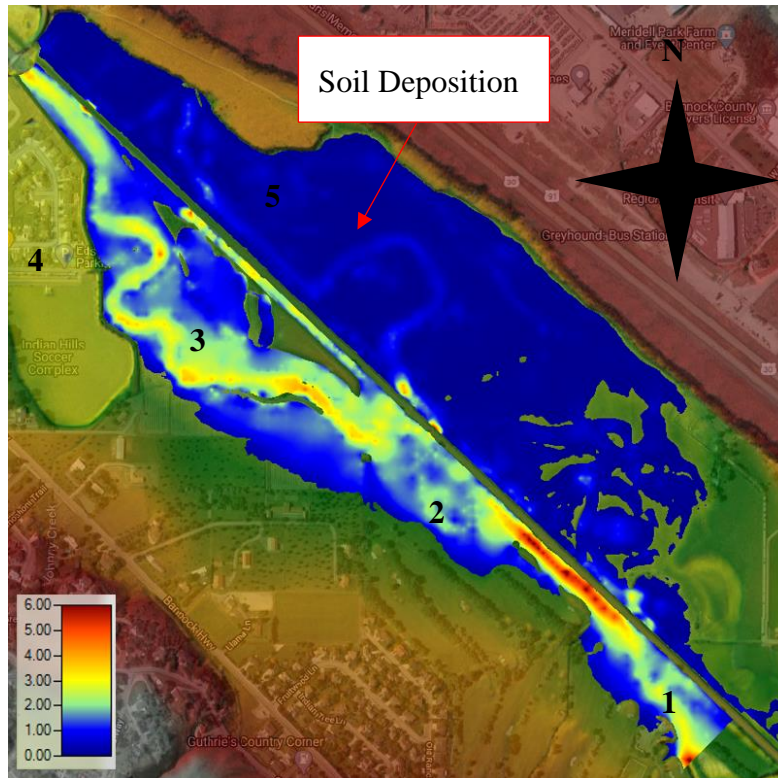


Figure 68 – 50-Year Maximum Channel Velocity with 4 ft Inlet and 1 ft Outlet

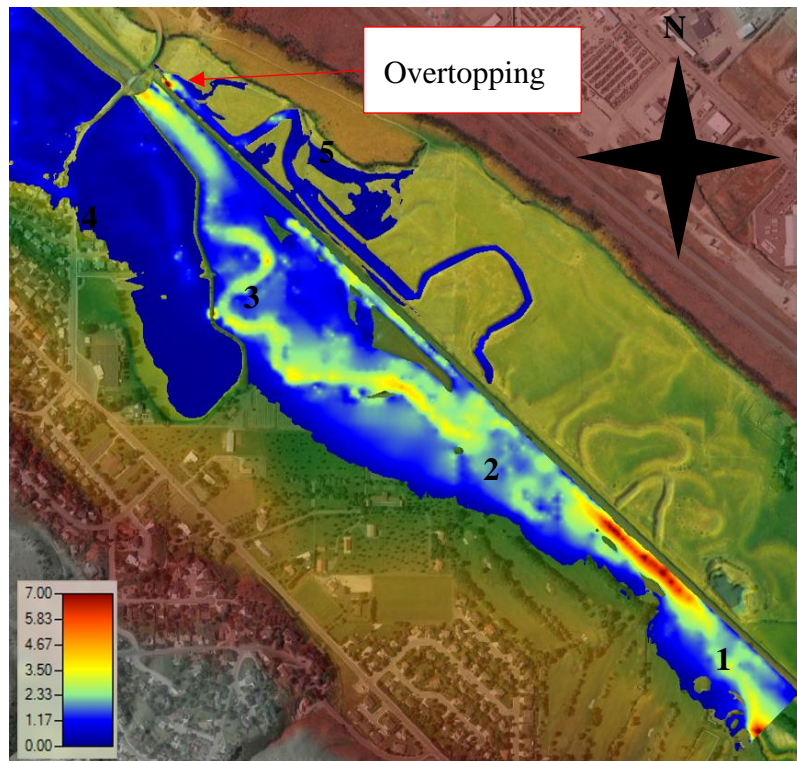
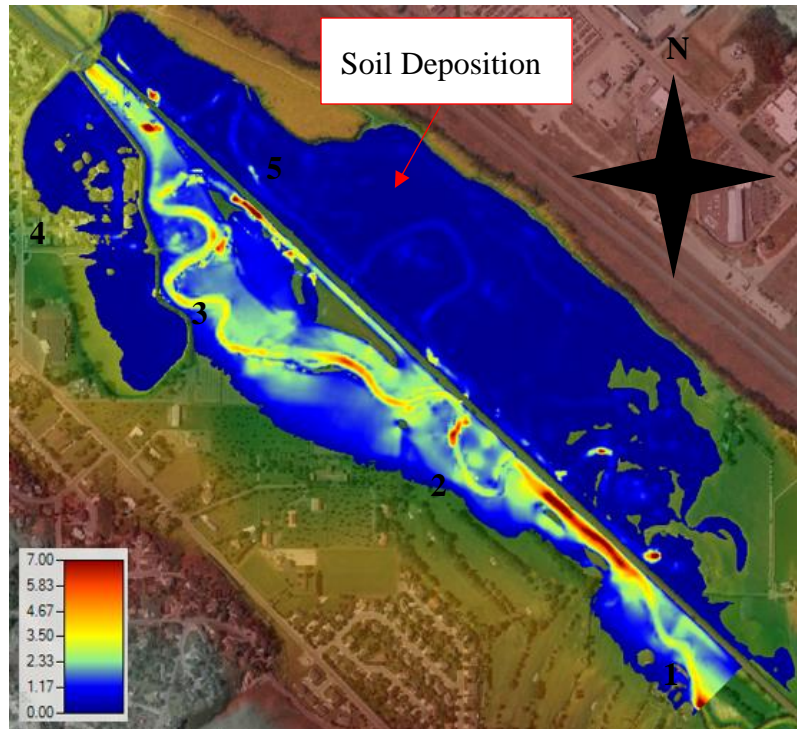


Figure 69 – 100-Year Maximum Channel Velocity with 4 ft Inlet and 1 ft Outlet

7.5 Water Depth

7.5.1 2-Year Flood Depth with 4 ft Inlet and 1 ft Outlet

Two-year peak discharge maximum water depths with modifications are shown in Figure 70. The 2-year total hydrograph shows water depths ranging from 0 ft to 15 ft throughout the modeled area. Also, 2-year total hydrograph shows overbank depths up to 3.5 ft on the Portneuf side of the railroad. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 0.5 ft deep. No ponding occurred in the Edson Fitcher Pond when culvert modifications are added. The Northwest Portion of the Juniper Hills Country Club (2) has around 3.6 ft of overbank flows.

Overbank depths throughout the floodplain (5) vary from 0 ft to 6 ft deep. Depths are greater on the downstream side of the floodplain which is expected. Maximum flow depths of 15 ft occur in the second oxbow. 2-year return period maximum overbank flood depths within five different areas are summarized in Table 8.

Table 8 – 2-Year Maximum Overbank Depths

Area #	Location	Depth without modifications (ft)	Depth with modificaitons (ft)	Difference (ft)
1	Inlet	1.10	1.15	0.05
2	Northwest of Juniper Hills	3.72	3.6	-0.12
3	Edson Fitcher	0.66	1.12	0.46
4	Residential Areas	0.00	0	0.00
5	Floodplain	0.00	4.55	4.55

7.5.2 10-Year Flood Depth with 4 ft Inlet and 1 ft Outlet

Ten-year peak discharge maximum water depths with modifications are shown in Figure 71. The 10-year total hydrograph shows water depths ranging from 0 ft to 18 ft. The 10-year total hydrograph also shows overbank depths up to 4.5 ft on the Portneuf side of the railroad.

Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 2.5 ft deep. The northwest portion of the Juniper Hills Country Club (2) has around 4.7 ft of water.

Overbank depths throughout the floodplain (5) vary from 0 ft to 6.75 ft deep. Maximum flow depths of 18 ft occur in the second oxbow. No significant flow depth changes were found throughout the Portneuf River side of the model.

7.5.3 25-Year Flood Depth with 4 ft Inlet and 1 ft Outlet

Twenty five-year peak discharge maximum water depths without modifications are shown in Figure 72. The 25-year total hydrograph shows water depths ranging from 0 ft to 19 ft. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 9ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 6 ft of water.

Overbank depths throughout the floodplain (5) vary from 0 ft to 7.25 ft deep. Maximum flow depths of 19 ft occur in the second oxbow. No significant flow depth changes were found throughout the Portneuf River side of the model. 25-year return period maximum overbank flood depths within five different areas are summarized in Table 9.

Table 9 - 25-Year Maximum Overbank Depths

Point #	Location	Depth without modifications (ft)	Depth with modificaitons (ft)	Difference (ft)
1	Inlet	4.58	4.31	-0.27
2	Northwest of Juniper Hills	5.24	5.72	0.48
3	Edson Fitcher	3.40	2.8	-0.60
4	Residential Areas	0.00	0	0.00
5	Floodplain	0.00	7.3	7.30

7.5.4 50-Year Flood Depth with 4 ft Inlet and 1 ft Outlet

Fifty-year peak discharge maximum water depths with modifications are shown in Figure 73. The 50-year total hydrograph shows water depths ranging from 0 ft to 20 ft. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 9ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 6 ft of water.

Overbank depths throughout the floodplain (5) vary from 0 ft to 7.25 ft deep. Maximum flow depths of 20 ft occur in the second oxbow. Flow depth conditions from the 50-year hydrograph are very similar to that of the 25-year hydrograph. No significant flow depth changes were found throughout the Portneuf River side of the model.

7.5.5 100-Year Flood Depth with 4 ft Inlet and 1 ft Outlet

One-hundred-year peak discharge maximum water depths without modifications are shown in Figure 74. The 100-year total hydrograph shows water depths ranging from 0 ft to 20 ft. Overbank flows are observed throughout the Edson Fichter Nature Area (3) range from 0 ft to 12 ft deep. The Northwest Portion of the Juniper Hills Country Club (2) has around 6 ft of water. The subdivision to the West of the Edson Fichter Nature (4) flood depths range from 0 ft to 2.25 ft which is a decrease of 1.25 ft or 44% to the depths without culvert modifications. Flooding in the Subdivision north of Cheyenne road is reduced by 100%.

Overbank depths throughout the floodplain (5) vary from 0 ft to 8 ft deep. Maximum flow depths of 19 ft occur in the second oxbow. The flood depths throughout the residential area north of the Cheyenne bridge is removed with the addition of the culverts. This reduces the amount of homes within the flood area and could prevent a significant amount of flooding damage in this area.

100-year return period maximum overbank flood depths within five different areas are summarized in Table 10.

Table 10 – 100-Year Maximum Overbank Depths

Point #	Location	Depth without modifications (ft)	Depth with modificaitons (ft)	Difference (ft)
1	Inlet	5.73	5.76	0.03
2	Northwest of Juniper Hills	5.49	5.3	-0.19
3	Edson Fitcher	5.72	4.79	-0.93
4	Residential Areas	4.17	2.34	-1.83
5	Floodplain	0.50	7.89	7.39
	Residential Structures Flooded	83.00	31	-52.00

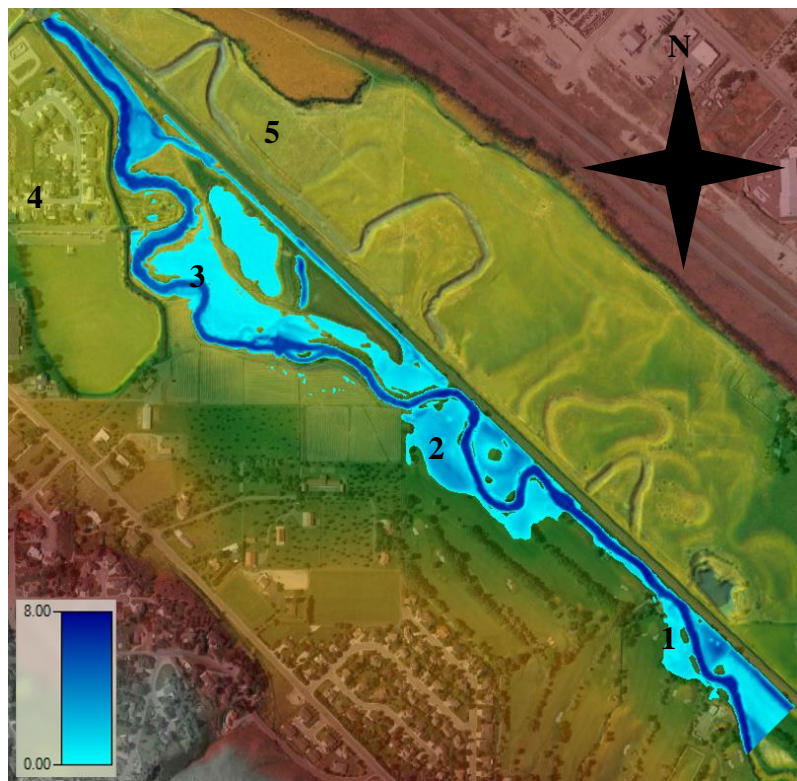
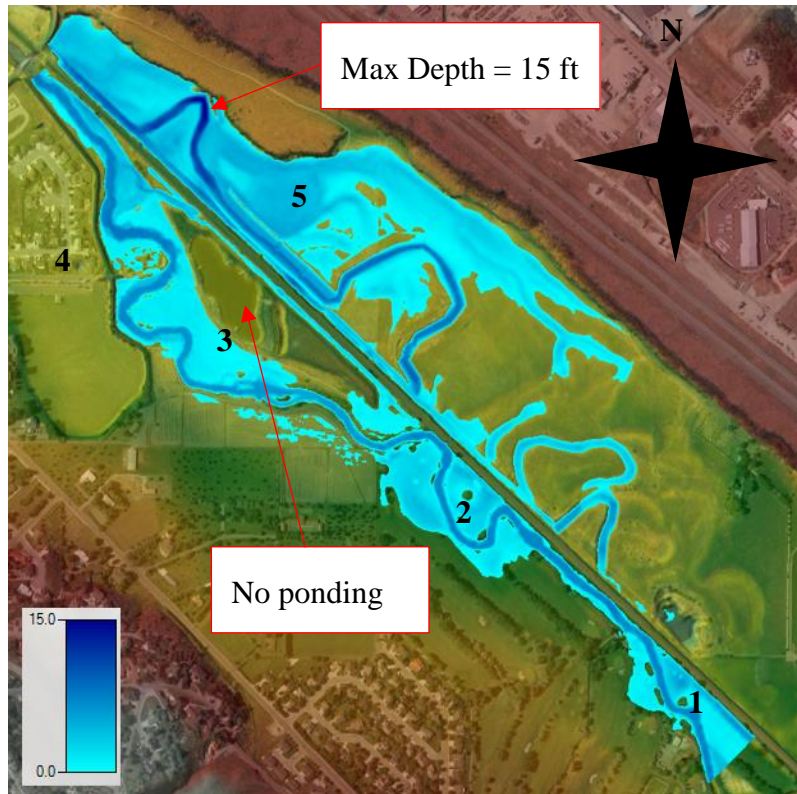


Figure 70 – 2-Year Maximum Depth with 4 ft Inlet and 1 ft Outlet

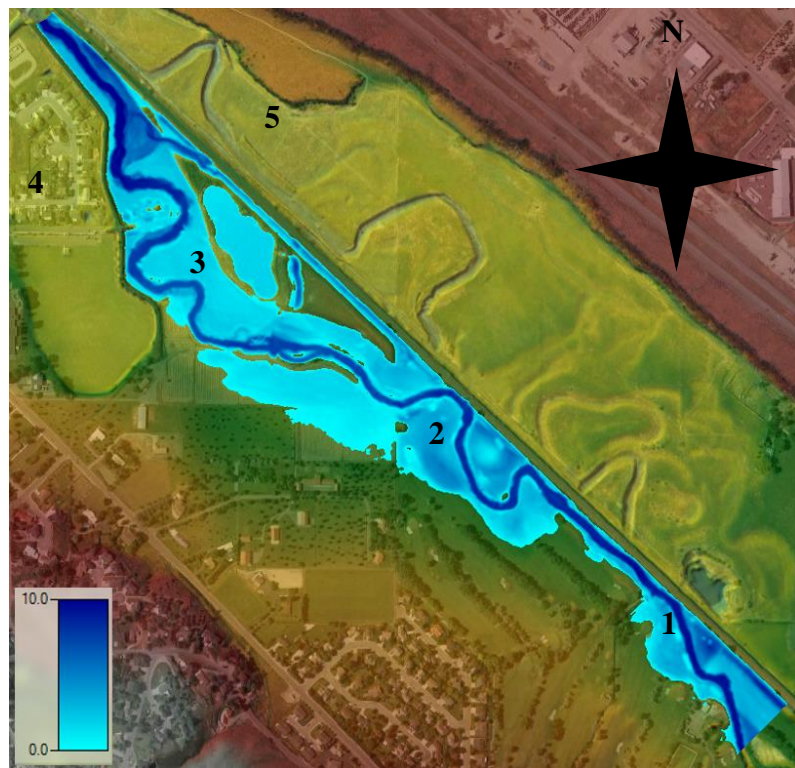
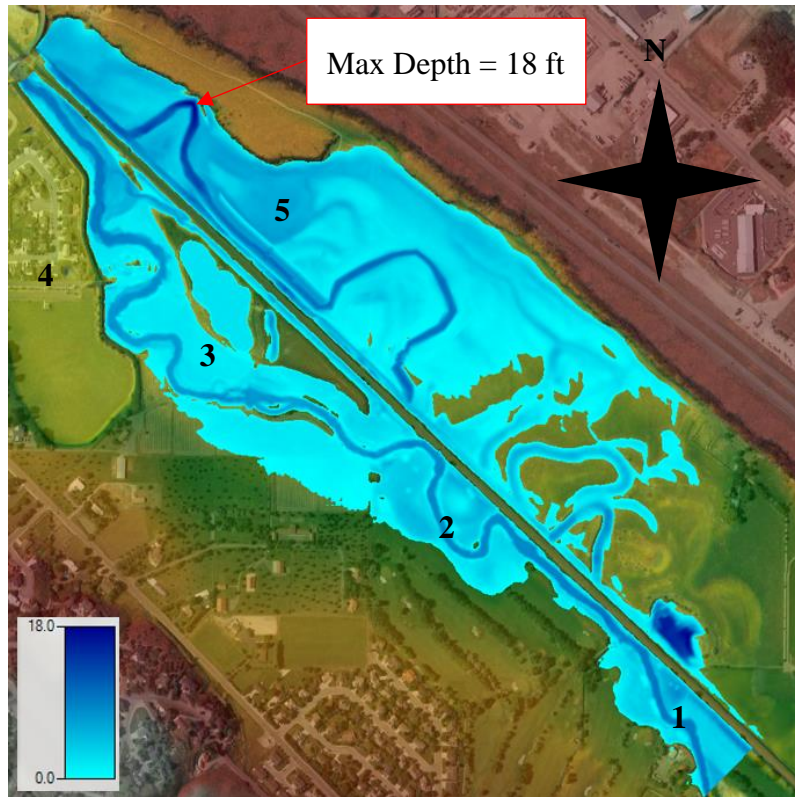


Figure 71 – 10-Year Maximum Depth with 4 ft Inlet and 1 ft Outlet

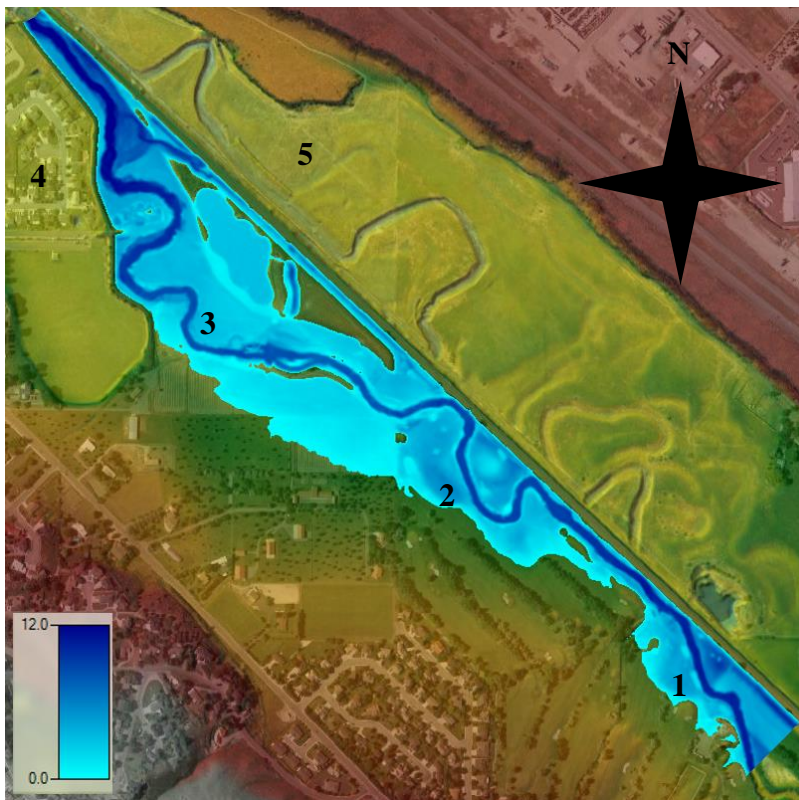
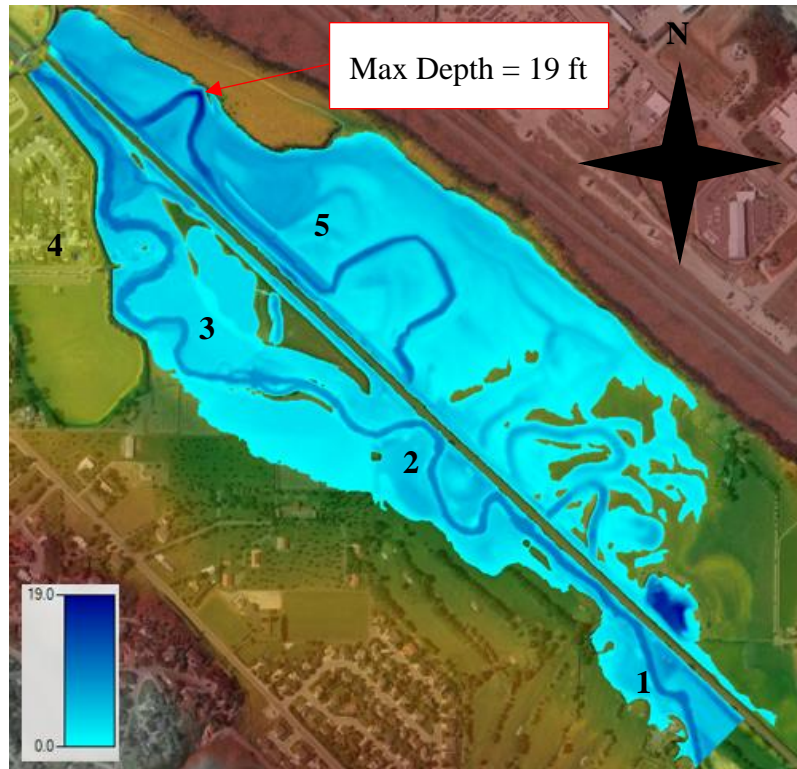


Figure 72 – 25-Year Maximum Depth with 4 ft Inlet and 1 ft Outlet

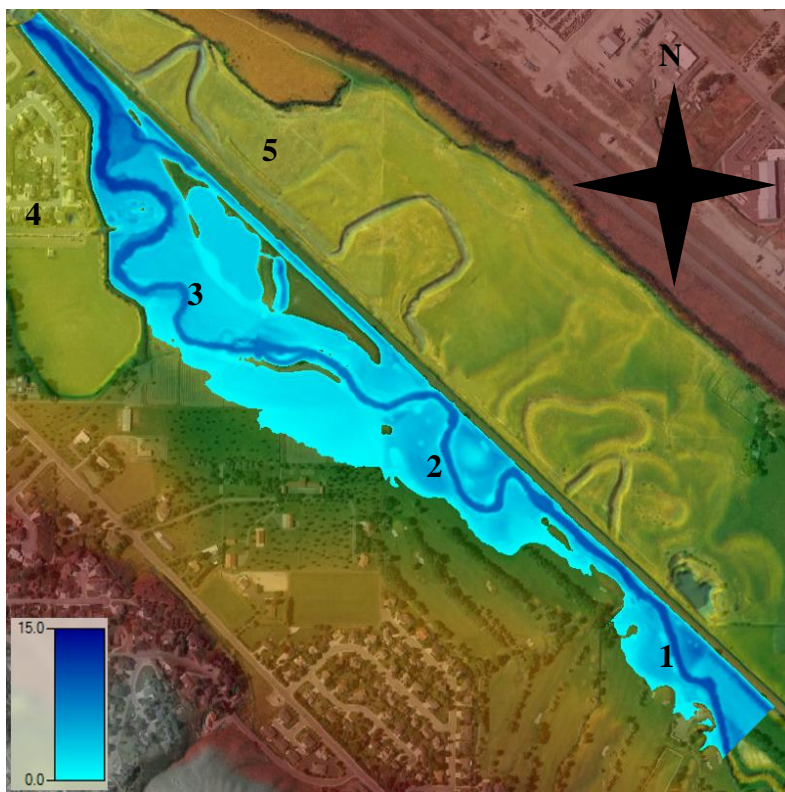
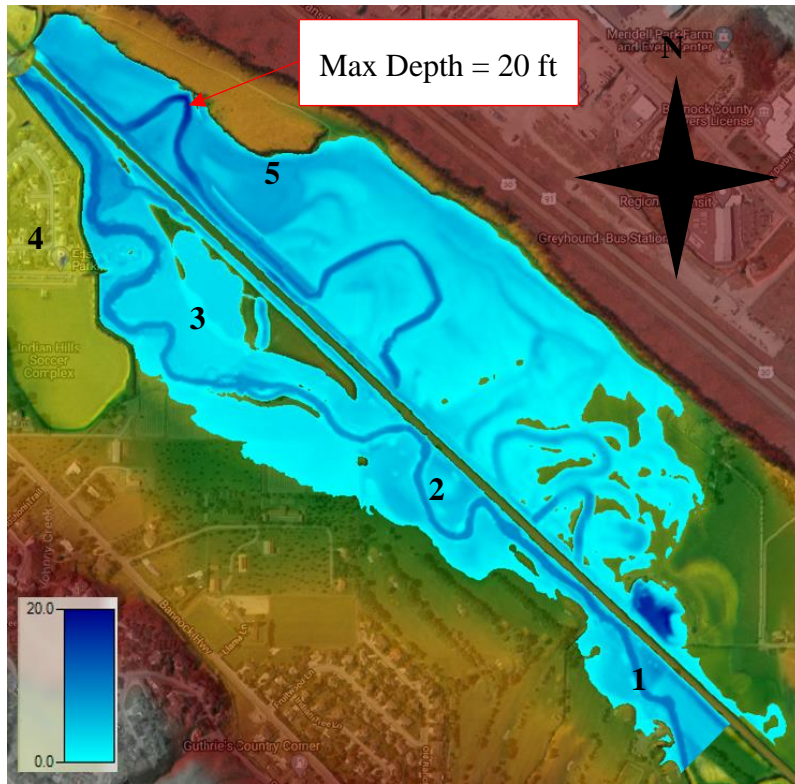


Figure 73 – 50-Year Maximum Depth with 4 ft Inlet and 1 ft Outlet

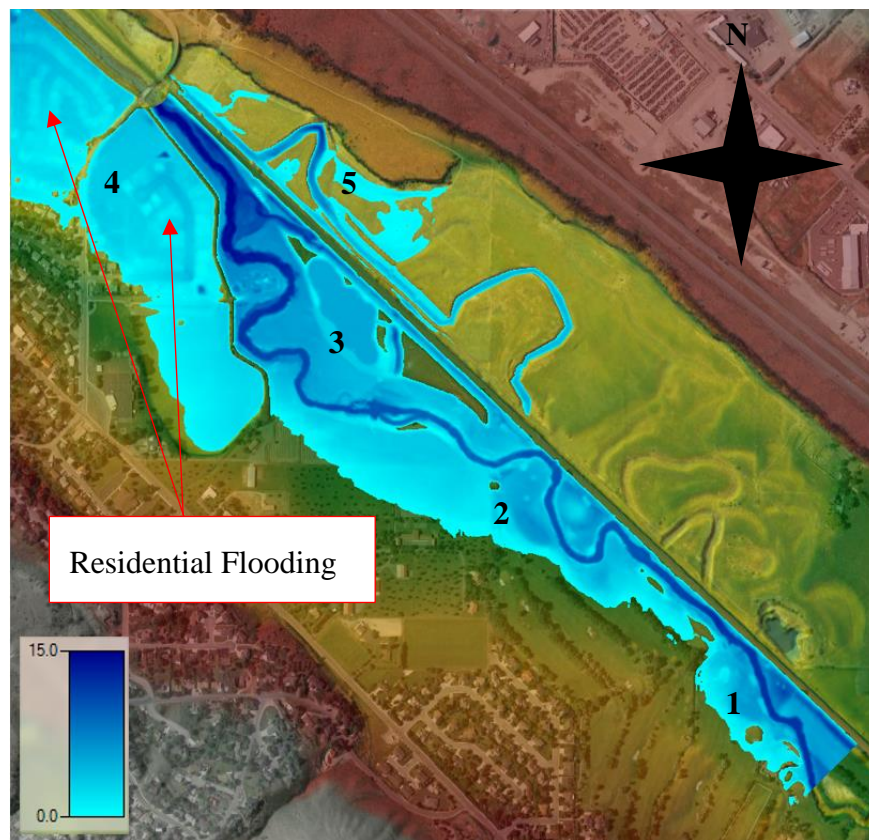
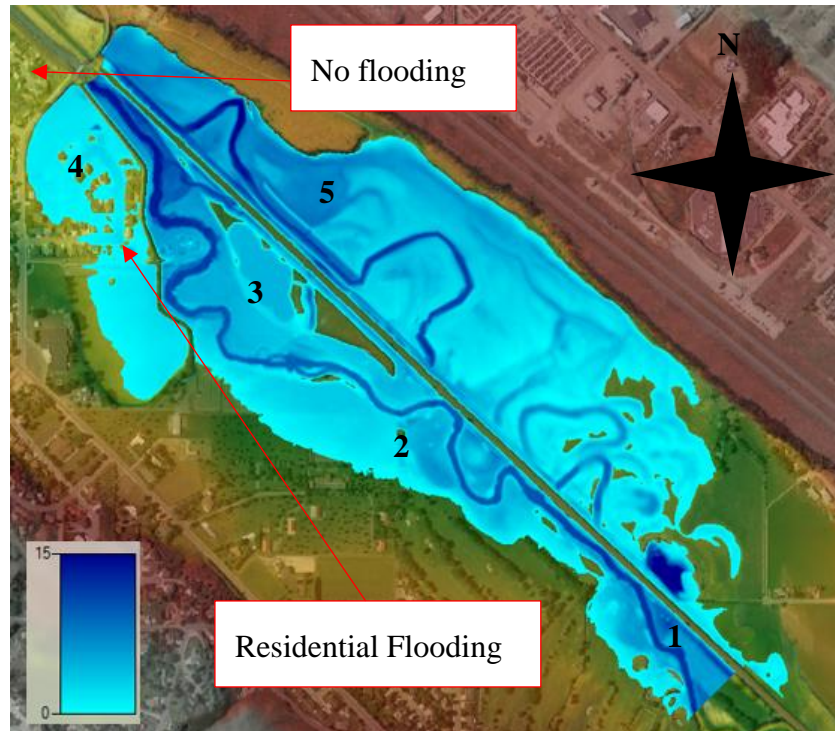


Figure 74 – 100-Year Maximum Depth with 4 ft Inlet and 1 ft Outlet

7.6 HEC-RAS and Flow 3-D Comparisons

Several issues were experienced when trying to run the simulation in FLOW-3D that were not encountered in HEC-RAS. These errors occurred when trying to create the culvert modifications within FLOW-3D, both within the results and runtime errors. Because of the problems with getting quality answers from FLOW-3D's 2D model, the discussion, comparison and simulation will focus on the 25-year hydrograph from FLOW-3D.

7.6.1 FLOW-3D Issues

The first issue encountered when trying to run the model within FLOW-3D was the STL file size. The file size of the STL used as the base terrain was about 1.5GB. The large size of the STL created issues with FLOW-3D being able to load and render the STL. This caused the program to have issue when adding the culverts to match the HEC-RAS setup. This caused a major concern with the applicability of the FLOW-3D model. Flow Science was contacted regarding these issues, but no suitable solution has been presented. To complete the study, the modifications to the inlet and outlet were completed as outlined previously in Section 4.3.4.

The significant error in the FLOW-3D simulation results occurred with the reported volume % losses. The values reported for multiple simulations were greater than 12% which is considered unacceptable. This percentage represents the cumulative fluid fraction error of the volume of fluid #1 (water) in the domain at the reported computation cycle (Flow Science, 2019). The volume % loss for the simulation is shown in Figure 75.

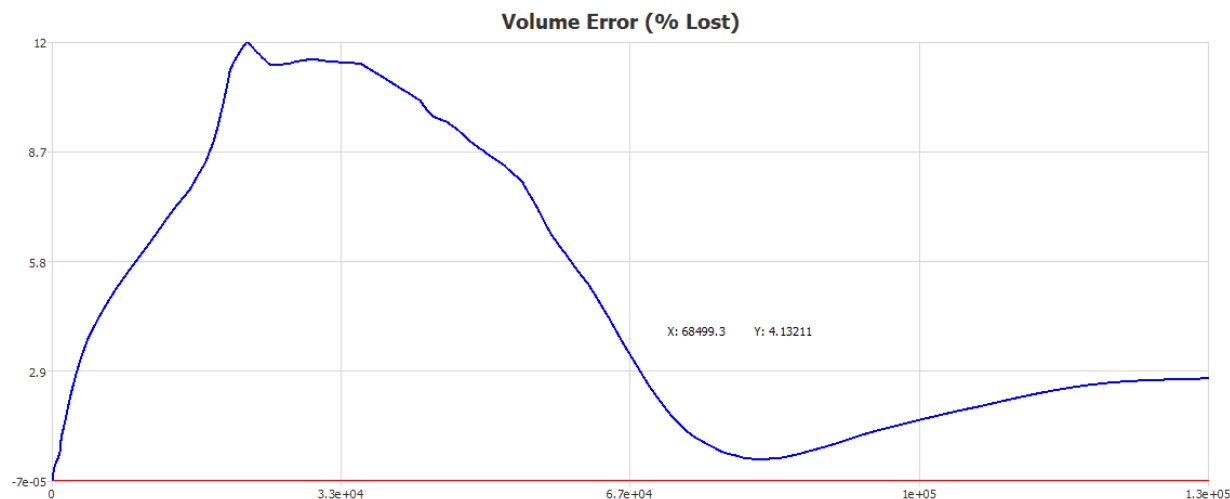


Figure 75 – FLOW-3D Volume % Loss

7.6.2 25-Year Flood WSE Comparison

The 25-year total hydrograph was used as the base hydrograph to compare in HEC-RAS and FLOW-3D. Six different locations were chose to compare results and are shown in Figure 76. The locations chosen were at the start (1), HW and TW side of the inlet culvert (2 and 3), Edson Fitch Area (4), and the HW and TW side of the outlet culvert (5 and 6). WSE within FLOW-3D were found to be lower than HEC-RAS by an average of 3.15 ft. The minimum and maximum difference in WSE were 2.37 ft and 4.20 ft respectively. Result comparisons are shown in Table 11.

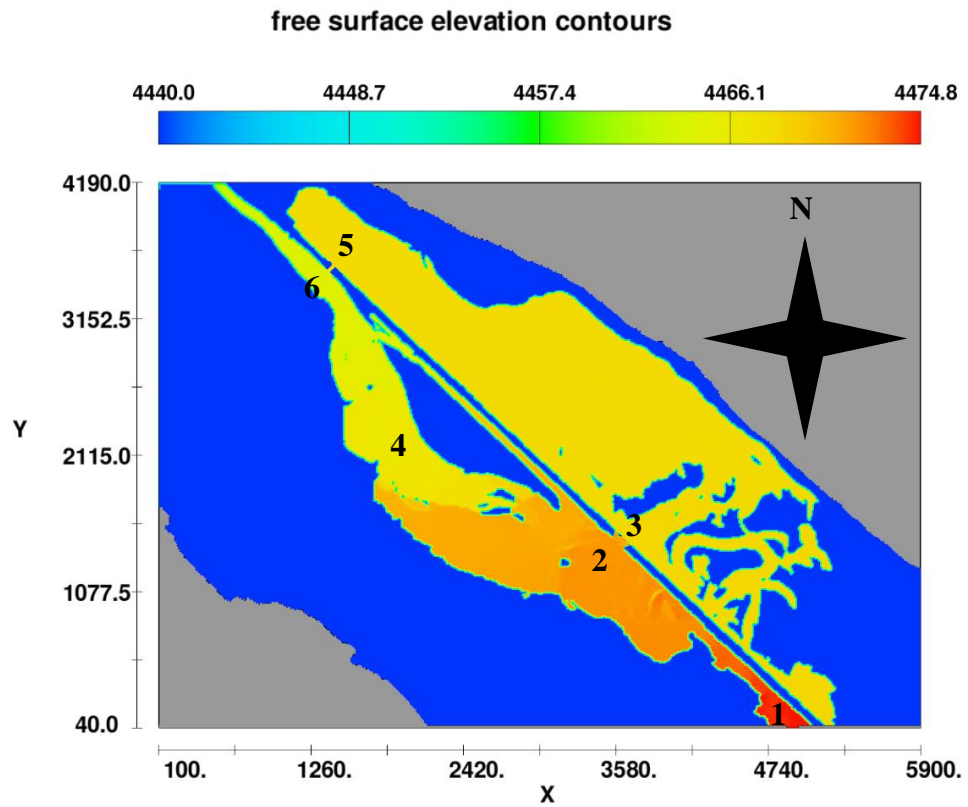


Figure 76 – FLOW-3D vs. HEC-RAS WSEs

Table 11 – FLOW-3D vs. HEC-RAS WSE

Point #	HEC-RAS WSE (ft)	FLOW-3D WSE (ft)	Difference (ft)
1	4477.50	4474.36	-3.14
2	4473.50	4469.3	-4.20
3	4470.17	4467.2	-2.97
4	4469.70	4466.5	-3.20
5	4470.17	4467.8	-2.37
6	4468.50	4465.5	-3.00

7.6.3 25-Year Flood Channel Velocity Comparison

Velocities within FLOW-3D were found to be higher than HEC-RAS by an average of 0.52 fps. The minimum and maximum difference in velocities were 0.14 fps and 2 fps respectively. Table 12 summarizes the results at each location. Two dimensional results from each program are provided in Figure 77.

Table 12 - FLOW-3D vs. HEC-RAS Velocity

Point #	HEC-RAS Velocity (fps)	FLOW-3D Velocity (fps)	Difference (fps)
1	4.55	4.75	0.20
2	3.15	3.82	0.67
3	4.17	6.17	2.00
4	3.22	3.36	0.14
5	0.50	0	-0.50
6	8.80	9.4	0.60

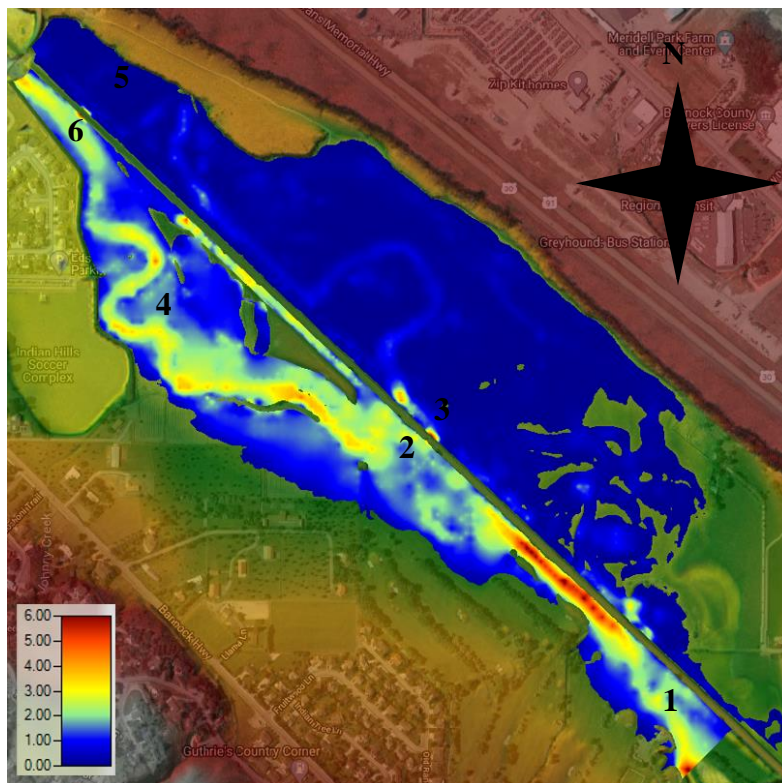
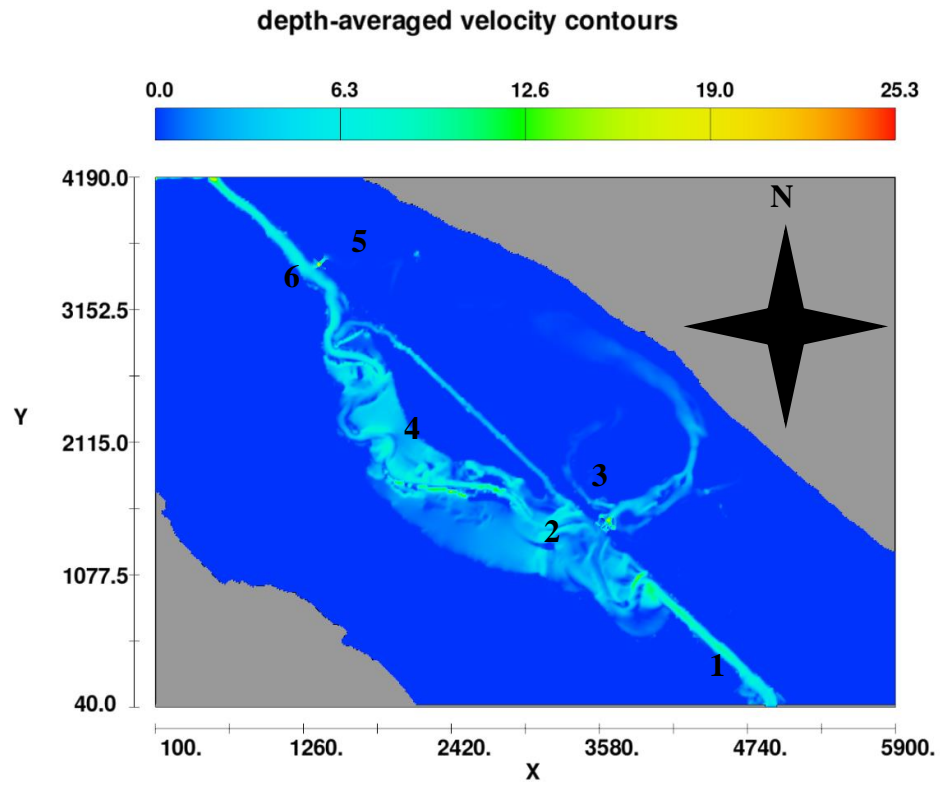


Figure 77 - FLOW-3D vs. HEC-RAS Velocities

7.6.4 25-Year Flood Depth Comparison

Depths within FLOW-3D were found to be lower than HEC-RAS by an average of 1.23 ft. The minimum and maximum difference in depths was 0.14 fps and 2 fps respectively. Table 13 summarizes the results at each location. Two dimensional results from each program are provided in Figure 78.

Table 13 – FLOW-3D vs. HEC-RAS Depth

Point #	HEC-RAS Depth (ft)	FLOW-3D Depth (ft)	Difference (ft)
1	10.82	10.3	-0.52
2	8.30	4.78	-3.52
3	3.37	1.91	-1.46
4	2.36	1.42	-0.94
5	11.70	12.1	0.40
6	10.66	9.3	-1.36

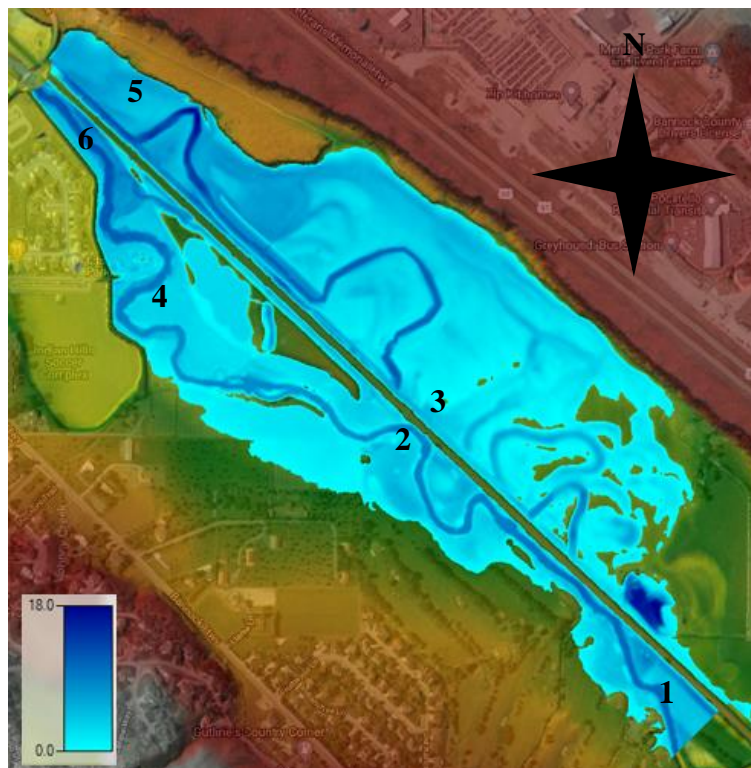
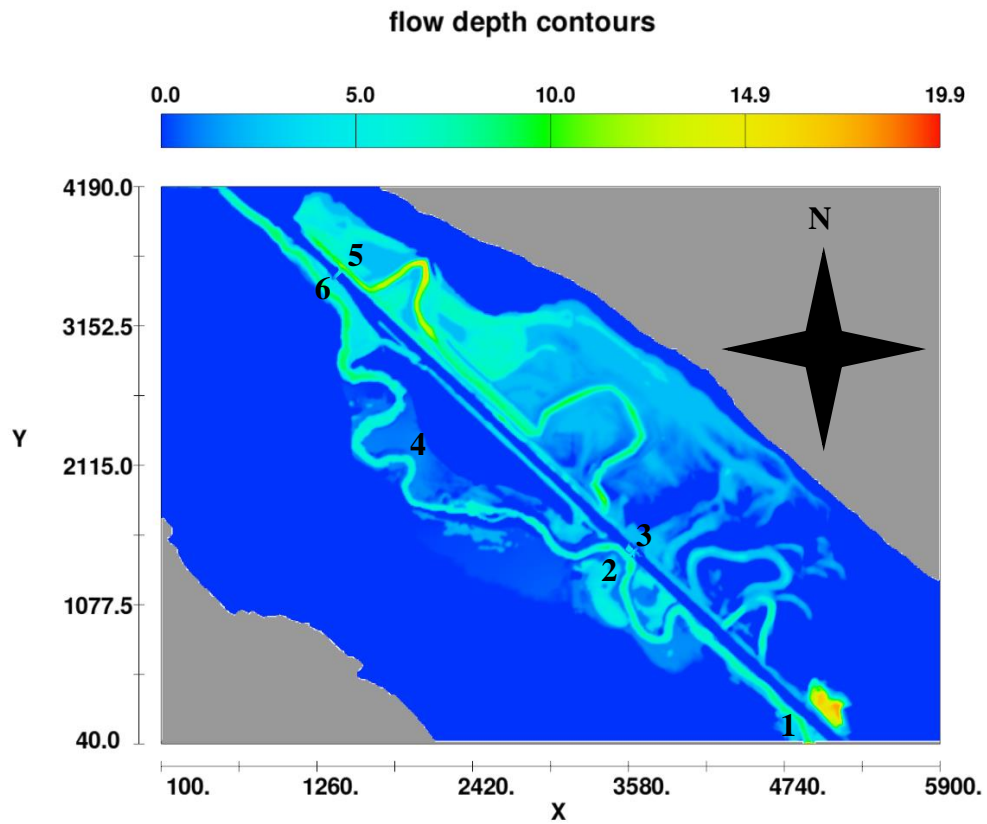


Figure 78 - FLOW-3D vs. HEC-RAS Depths

Chapter 8 -Discussion, Conclusions and Recommendations

8.1 Discussion

8.1.1 HEC-RAS

HEC-RAS is a very useful tool for 2-D surface water modeling at large scales. The program is time effective and produces reliable results when calibrated. It was found that geoTiff file types are smaller than STL file formats required by FLOW-3D. Also, creating a DEM from geoTiff files is also less time consuming and contain less errors than STL file types.

Computational time for the simulation was drastically less than FLOW-3D which provides an advantage of accessing more alternatives quickly. HEC-RAS was also found to be more user friendly for adding modifications and setting model parameters. Results from HEC-RAS are also found to be easier to analyze, because the surface of the water can be probed in real time.

8.1.2 FLOW-3D

FLOW-3D is useful for modeling a variety of flow conditions. At smaller model scales FLOW-3D is a very effective to for modeling fluid flow with free surfaces with the ability to model flow in three-dimensions. However, it was found that the larger the 3D model gets the computational time increases exponentially and there computational limitation with the mass flow error in 2D makes it less reliable. It is also found that FLOW-3D does not produce geometry objects effectively when using a 2D mesh. More effort is also needed at large model scales to clean errors and imperfections out of and STL file, and may require additional software to perform the repairs.

8.2 Conclusions

In conclusion, it was found that HEC-RAS is a more effective 2D water modeling program than FLOW-3D. Model WSE calibration results for HEC-RAS were within 5.5" of the LIDAR water surface elevations.

WSE within FLOW-3D were found to be lower than HEC-RAS by an average of 3.6 ft. The minimum and maximum difference in WSE were 2.37 ft and 4.20 ft respectively. Velocities within FLOW-3D were found to be higher than HEC-RAS by an average of 0.52 fps. The minimum and maximum difference in velocities were 0.14 fps and 2 fps respectively. Depths within FLOW-3D were found to be lower than HEC-RAS by an average of 1.23 ft. The minimum and maximum difference in depths was 0.14 fps and 2 fps respectively.

Results produced from HEC-RAS were also much more reliable than those of FLOW-3D. Due to the volume loss of 12% the FLOW-3D results were considered unreliable and unsuccessful.

8.3 Inlet and Outlet Culvert Recommendations

A 4 ft inlet culvert is recommended at the elevation that allows the floodplain storage to reach the maximum level during the target peak time frame of the flood hydrograph. The elevation for the invert of the inlet of the culvert was placed at an elevation of 4467 ft and the downstream invert was placed at 4466 ft. The required length of culvert to fully pass underneath the railroad was 90 ft. This resulted in a culvert slope of 0.011 ft/ft.

Four 2 ft inlet culverts can be used to achieve the same effect if they are placed at the same invert elevations of 4467 ft on the upstream side and 4466 ft on the downstream side. Other options could also be analyzed such as multiple 2 ft barrels stacked vertically to activate the

floodplain at multiple different flood stages. Additional modeling would need to be completed to assess these options.

Four 1 ft culverts are recommended at the outlet of the floodplain as discussed in previous sections. The culverts at the maximum floodplain WSE is the emergency outlet at 4470.5 ft. The culvert at the lower elevation is the main outlet culvert. This culvert was placed at an elevation of 4461 ft which is 1.5 ft from the minimum floodplain elevation. This is to provide a small amount of groundwater recharge, and sediment storage before the main outlet begins to fill.

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Appendix A – USGS Flow Data (April 22,2020 – June 20, 2020)

Source	Gauge Station	Date	Flow Rate (cfs)
USGS	13075500	4/22/2015	132
USGS	13075500	4/23/2015	140
USGS	13075500	4/24/2015	142
USGS	13075500	4/25/2015	143
USGS	13075500	4/26/2015	139
USGS	13075500	4/27/2015	137
USGS	13075500	4/28/2015	127
USGS	13075500	4/29/2015	115
USGS	13075500	4/30/2015	102
USGS	13075500	5/1/2015	98.4
USGS	13075500	5/2/2015	86.7
USGS	13075500	5/3/2015	84.9
USGS	13075500	5/4/2015	82
USGS	13075500	5/5/2015	80.3
USGS	13075500	5/6/2015	76.2
USGS	13075500	5/7/2015	80.5
USGS	13075500	5/8/2015	94.9
USGS	13075500	5/9/2015	89.6
USGS	13075500	5/10/2015	84
USGS	13075500	5/11/2015	82
USGS	13075500	5/12/2015	77.3
USGS	13075500	5/13/2015	71.9
USGS	13075500	5/14/2015	66.1
USGS	13075500	5/15/2015	69.9
USGS	13075500	5/16/2015	91.9
USGS	13075500	5/17/2015	130
USGS	13075500	5/18/2015	149
USGS	13075500	5/19/2015	157
USGS	13075500	5/20/2015	179
USGS	13075500	5/21/2015	192
USGS	13075500	5/22/2015	189
USGS	13075500	5/23/2015	199
USGS	13075500	5/24/2015	186
USGS	13075500	5/25/2015	181
USGS	13075500	5/26/2015	176

USGS	13075500	5/27/2015	173
USGS	13075500	5/28/2015	189
USGS	13075500	5/29/2015	202
USGS	13075500	5/30/2015	201
USGS	13075500	5/31/2015	197
USGS	13075500	6/1/2015	187
USGS	13075500	6/2/2015	176

Appendix B – Ratios for the Unit Hydrograph and Mass Curve

Time Ratios t/T_p	Discharge Ratios q/q_p	Mass Curve Ratios Q_a/Q
0.1	0.030	0.001
0.2	0.100	0.006
0.3	0.190	0.017
0.4	0.310	0.035
0.5	0.470	0.065
0.6	0.660	0.107
0.7	0.820	0.163
0.8	0.930	0.228
0.9	0.990	0.300
1	1.000	0.375
1.1	0.990	0.450
1.2	0.930	0.522
1.3	0.860	0.589
1.4	0.780	0.650
1.5	0.680	0.705
1.6	0.560	0.751
1.7	0.460	0.790
1.8	0.390	0.822
1.9	0.330	0.849
2	0.280	0.871
2.2	0.207	0.908
2.4	0.147	0.934
2.6	0.107	0.953
2.8	0.077	0.967
3	0.055	0.977
3.2	0.040	0.984
3.4	0.029	0.989
3.6	0.021	0.993
3.8	0.015	0.995
4	0.011	0.997
4.5	0.005	0.999
5	0.000	1.000

Appendix C – USGS Streamstats Report

10/12/2020

StreamStats

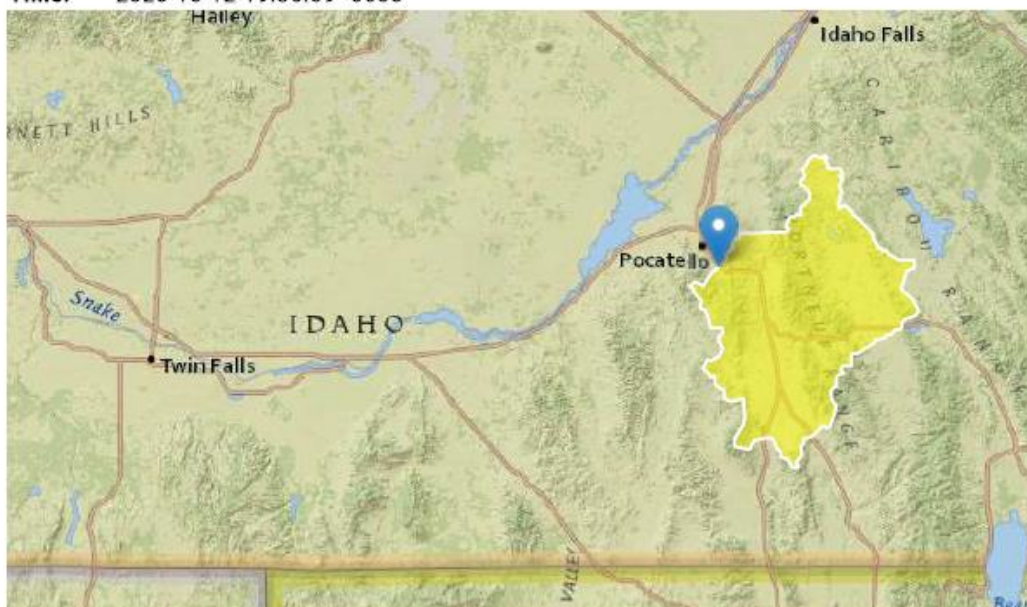
StreamStats Report

Region ID: ID

Workspace ID: ID20201013013550004000

Clicked Point (Latitude, Longitude): 42.81092, -112.38866

Time: 2020-10-12 19:36:09 -0600



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1213.85	square miles
MINBELEV	Minimum basin elevation	4470	feet
SLOP50	Slopes Greater Than 50 Percent as percent of drainage area	5.03	percent
FOREST	Percentage of area covered by forest	13	percent
SLOP30_30M	Percent area with slopes greater than 30 percent from 30-meter DEM.	23.2	percent

<https://streamstats.usgs.gov/ss/>

1/4

Parameter Code	Parameter Description	Value	Unit
BSLDEM30M	Mean basin slope computed from 30 m DEM	19.2	percent
BSLDEM10M	Mean basin slope computed from 10 m DEM	21	percent
ELEV	Mean Basin Elevation	5860	feet
ELEVMAX	Maximum basin elevation	9290	feet
PRECIP	Mean Annual Precipitation	17.3	inches

Peak-Flow Statistics Parameters[100 Percent (1210 square miles) Peak Flow Region 7 2016 5083]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1213.85	square miles	0.15	1400
MINBELEV	Minimum Basin Elevation	4470	feet	2230	7020

Peak-Flow Statistics Flow Report[100 Percent (1210 square miles) Peak Flow Region 7 2016 5083]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SEp
1.25 Year Peak Flood	457	ft ³ /s	139	1500	66.9
1.5 Year Peak Flood	623	ft ³ /s	200	1940	63.7
2 Year Peak Flood	860	ft ³ /s	290	2550	61.3
2 33 Year Peak Flood	988	ft ³ /s	335	2910	61.1
5 Year Peak Flood	1610	ft ³ /s	551	4700	61.7
10 Year Peak Flood	2220	ft ³ /s	746	6610	63.8
25 Year Peak Flood	3240	ft ³ /s	1040	10100	68.1
50 Year Peak Flood	4020	ft ³ /s	1240	13100	71.5
100 Year Peak Flood	4910	ft ³ /s	1440	16700	75.1
200 Year Peak Flood	5870	ft ³ /s	1650	20900	78.8
500 Year Peak Flood	7370	ft ³ /s	1940	27900	84

Peak-Flow Statistics Citations

Wood, M.S., Fosness, R.L., Skinner, K.D., and Veilleux, A.G., 2016, Estimating peak-flow frequency statistics for selected gaged and ungaged sites in naturally flowing streams and

rivers in Idaho: U.S. Geological Survey Scientific Investigations Report 2016–5083, 56 p.
(<http://dx.doi.org/10.3133/sir20165083>)

Low-Flow Statistics Parameters[100 Percent (1210 square miles) Low Flow Region 7 2006 5053]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1213.85	square miles	7.4	535.3
SLOP50	Slopes Greater Than 50 Percent	5.03	percent	0.189	28.5

Low-Flow Statistics Disclaimers[100 Percent (1210 square miles) Low Flow Region 7 2006 5053]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report[100 Percent (1210 square miles) Low Flow Region 7 2006 5053]

Statistic	Value	Unit
1 Day 10 Year Low Flow	6.37	ft ³ /s
7 Day 2 Year Low Flow	17	ft ³ /s
7 Day 10 Year Low Flow	7.99	ft ³ /s
30 Day 5 Year Low Flow	12.5	ft ³ /s

Low-Flow Statistics Citations

Hortness, J.E., 2006, Estimating Low-Flow Frequency Statistics for Unregulated Streams in Idaho: U.S. Geological Survey Scientific Investigations Report 2006–5035, 31 p.
(<http://pubs.usgs.gov/sir/2006/5035/pdf/sir20065035.pdf>)

Annual Flow Statistics Parameters[100 Percent (1210 square miles) Monthly Annual Region 7 2001 4093]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1213.85	square miles	7.4	535.3
FOREST	Percent Forest	13	percent	0	38.9
SLOP30_30M	Slopes gt 30pct from 30m DEM	23.2	percent	0	55.2

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
BSLDEM30M	Mean Basin Slope from 30m DEM	19.2	percent	1.7	35.3

Annual Flow Statistics Disclaimers[100 Percent (1210 square miles) Monthly Annual Region 7 2001 4093]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report[100 Percent (1210 square miles) Monthly Annual Region 7 2001 4093]

Statistic	Value	Unit
Mean Annual Flow	508	ft ³ /s

Annual Flow Statistics Citations

Hortness, J.E., and Berenbrock, Charles, 2001, Estimating Monthly and Annual Streamflow Statistics at Ungaged Sites in Idaho: U.S. Geological Survey Water-Resources Investigations Report 01-4093, 36 p. (<https://pubs.er.usgs.gov/publication/wri014093>)

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Application Version: 4.4.0

Appendix D – NRCS Runoff Curve Numbers

Cover Type And Hydrologic Condition	Hydrologic Soil Group			
	A	B	C	D
Open Space (lawns, parks, golf courses, cemeteries, landscaping, etc.): ¹				
Poor condition (grass cover <50% of the area)	68	79	86	89
Fair condition (grass cover on 50% to 75% of the area)	49	69	79	84
Good condition (grass cover on >75% of the area)	39	61	74	80
Impervious Areas:				
Open water bodies: lakes, wetlands, ponds, etc.	100	100	100	100
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Streets and Roads:				
Paved: curbs and storm sewers (excluding right-of-way)	98	98	98	98
Paved: open ditches/swales (including right-of-way)	83	89	92	93
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Porous Pavers and Permeable Interlocking Concrete (assume 85% impervious and 15% fair condition lawn):	91	94	95	96
Urban Districts:				
Commercial and Business (average 85% impervious)	89	92	94	95
Industrial (average 72% impervious)	81	88	91	93
Residential Districts By Average Lot Size:				
1/8 acre or less or townhouses (average 65% impervious)	77	85	90	92
1/4 acre (average 38% impervious)	61	75	83	87
1/3 acre (average 30 % impervious)	57	72	81	86
1/2 acre (average 25% impervious)	54	70	80	85
1 acre (average 20% impervious)	51	68	79	84
2 acres (average 12% impervious)	46	65	77	82
Newly graded areas (pervious areas only, no vegetation)	77	86	91	94
Farmsteads – buildings, lanes, driveways, and surrounding lots	59	74	82	86
Pasture, Grassland, or Range-Continuous Forage for Grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch)	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Meadow (continuous grass, protected from grazing and generally mowed for hay)	30	58	71	78
Cultivated Agricultural Lands:				
Row Crops (good) e.g. corn, sugar beets, soy beans	64	75	82	85
Small Grain (good) e.g. wheat, barley, flax	60	72	80	84

Cover Type And Hydrologic Condition	Hydrologic Soil Group			
	A	B	C	D
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning)	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Brush-Weed-Grass Mixture (with brush the major element):				
Poor (<50% ground cover)	48	67	77	83
Fair (50% to 75% ground cover)	35	56	70	77
Good (>75% ground cover) ²	30	48	65	73
Herbaceous (mixture of grass, weeds, and low-growing brush, with brush the minor element) ³ :				
Poor (<30% ground cover)		80	87	93
Fair (30% to 70% ground cover)		71	81	89
Good (>70% ground cover)		62	74	85
Pinyon-Juniper (pinyon, juniper, or both; grass understory) ³ :				
Poor (<30% ground cover)		75	85	89
Fair (30% to 70% ground cover)		58	73	80
Good (>70% ground cover)		41	61	71
Sagebrush With Grass Understory ³ :				
Poor (<30% ground cover)		67	80	85
Fair (30% to 70% ground cover)		51	63	70
Good (>70% ground cover)		35	47	55

¹ Composite CNs may be computed for other combinations of open space cover type.

² Actual curve number is less than 30; use CN = 30 for runoff computations.

³ Curve numbers have not been developed for group A soils.

Appendix E – 2, 10, 25, 50, 100-year total flow hydrograph tables

time (hr)	2-year Discharge q (cfs)	10-year Discharge q (cfs)	25-year Discharge q (cfs)	50-year Discharge q (cfs)	100-year Discharge q (cfs)
0	198.8	198.8	198.8	199	199
1	209.8	227.1	240.1	250	261
2	220.8	255.4	281.4	301	324
3	241.2	308.1	358.3	397	441
4	266.7	374.2	454.7	516	587
5	294.5	445.7	559.1	646	745
6	327.4	530.6	683.0	800	933
7	360.2	615.5	807.0	953	1120
8	403.4	727.0	969.7	1155	1367
9	447.3	840.2	1134.9	1360	1617
10	499.7	975.5	1332.4	1605	1917
11	558.2	1126.4	1552.6	1879	2250
12	619.2	1283.9	1782.5	2164	2599
13	688.6	1463.2	2044.1	2488	2995
14	758.0	1642.4	2305.7	2813	3392
15	817.8	1796.7	2530.9	3092	3733
16	876.3	1947.7	2751.2	3366	4067
17	925.2	2073.8	2935.3	3594	4346
18	965.4	2177.6	3086.7	3782	4575
19	1002.4	2273.2	3226.3	3955	4787
20	1024.3	2329.8	3308.9	4058	4912
21	1046.3	2386.4	3391.5	4160	5037
22	1053.2	2404.4	3417.7	4193	5077
23	1056.9	2413.8	3431.5	4210	5098
24	1057.1	2414.4	3432.4	4211	5099
25	1053.5	2405.0	3418.7	4194	5078
26	1047.8	2390.3	3397.2	4167	5046
27	1025.8	2333.7	3314.6	4065	4921
28	1003.9	2277.1	3232.0	3962	4795
29	979.2	2213.3	3138.9	3847	4654
30	953.6	2147.3	3042.6	3727	4508
31	926.6	2077.5	2940.6	3601	4354
32	897.4	2002.0	2830.5	3464	4187
33	867.7	1925.6	2718.9	3326	4018
34	831.2	1831.2	2581.2	3155	3809

time (hr)	2-year Discharge q (cfs)	10-year Discharge q (cfs)	25-year Discharge q (cfs)	50-year Discharge q (cfs)	100-year Discharge q (cfs)
35	794.7	1736.9	2443.6	2984	3601
36	753.0	1629.4	2286.7	2789	3363
37	709.2	1516.2	2121.5	2584	3112
38	667.8	1409.5	1965.8	2391	2876
39	631.3	1315.2	1828.1	2220	2668
40	594.7	1220.8	1690.4	2050	2459
41	569.1	1154.6	1593.7	1929	2313
42	543.5	1088.5	1497.3	1810	2167
43	520.2	1028.5	1409.7	1701	2034
44	498.3	971.9	1327.1	1599	1909
45	477.4	918.0	1248.5	1501	1789
46	459.2	870.9	1179.6	1416	1685
47	440.9	823.7	1110.8	1330	1581
48	427.2	788.4	1059.2	1266	1503
49	413.9	753.9	1009.0	1204	1427
50	400.5	719.5	958.7	1142	1350
51	387.2	685.1	908.5	1079	1274
52	374.4	652.0	860.3	1019	1201
53	363.4	623.7	819.0	968	1139
54	352.5	595.4	777.7	917	1076
55	341.5	567.1	736.4	866	1013
56	330.5	538.8	695.1	815	951
57	321.5	515.4	660.9	772	899
58	314.2	496.5	633.3	738	857
59	306.9	477.7	605.8	704	816
60	299.5	458.8	578.3	670	774
61	292.2	439.9	550.7	635	732
62	286.4	424.9	528.8	608	699
63	280.9	410.8	508.1	583	668
64	275.4	396.6	487.5	557	636
65	270.0	382.5	466.8	531	605
66	264.6	368.7	446.7	506	575
67	260.6	358.3	431.6	488	552
68	256.6	347.9	416.5	469	529
69	252.6	337.6	401.3	450	506
70	248.6	327.2	386.2	431	483
71	245.0	318.1	372.9	415	463
72	242.3	311.1	362.6	402	447

time (hr)	2-year Discharge q (cfs)	10-year Discharge q (cfs)	25-year Discharge q (cfs)	50-year Discharge q (cfs)	100-year Discharge q (cfs)
73	239.6	304.0	352.3	389	431
74	236.8	296.9	342.0	376	416
75	234.1	289.8	331.6	364	400
76	231.8	284.1	323.2	353	387
77	229.8	278.9	315.6	344	376
78	227.8	273.7	308.1	334	364
79	225.8	268.5	300.5	325	353
80	223.8	263.3	292.9	316	341
81	222.3	259.5	287.4	309	333
82	220.9	255.7	281.9	302	325
83	219.4	252.0	276.4	295	316
84	217.9	248.2	270.9	288	308
85	216.6	244.7	265.7	282	300
86	215.5	241.8	261.6	277	294
87	214.4	239.0	257.5	272	288
88	213.3	236.2	253.3	266	281
89	212.2	233.4	249.2	261	275
90	211.3	231.1	245.9	257	270
91	210.6	229.2	243.1	254	266
92	209.9	227.3	240.4	250	262
93	209.1	225.4	237.6	247	258
94	208.4	223.5	234.9	244	253
95	207.9	222.3	233.0	241	251
96	207.5	221.1	231.4	239	248
97	207.0	220.0	229.7	237	246
98	206.6	218.9	228.1	235	243
99	206.2	217.7	226.4	233	241
100	205.7	216.6	224.8	231	238
101	205.3	215.5	223.1	229	236
102	204.8	214.4	221.5	227	233
103	204.4	213.2	219.8	225	231
104	204.0	212.1	218.2	223	228
105	203.5	211.0	216.5	221	226
106	203.1	209.8	214.9	219	223
107	202.7	208.9	213.5	217	221
108	202.4	208.0	212.1	215	219
109	202.0	207.0	210.8	214	217
110	201.6	206.1	209.4	212	215

time (hr)	2-year Discharge q (cfs)	10-year Discharge q (cfs)	25-year Discharge q (cfs)	50-year Discharge q (cfs)	100-year Discharge q (cfs)
111	201.3	205.1	208.0	210	213
112	200.9	204.2	206.6	209	211
113	200.5	203.2	205.3	207	209
114	200.2	202.3	203.9	205	206
115	199.8	201.4	202.5	203	204
116	199.4	200.4	201.1	202	202
117	199.1	199.5	199.8	200	200

Appendix F –Flow 3-D OUTPUT FILES

```
Preprocessor Starting
processing options and properties
processing mesh

*****
warning
irating(2) for block # 1 is reset to 0
*****

*****
** warning **
** turbulence models are not used **
** with shallow water model: **
** ifvis reset to zero **
*****

processing geometry components
processing non-moving component      4 in mesh block    1
  processing subcomponent    17
  processing subcomponent    18
processing non-moving component      5 in mesh block    1
processing non-moving component      4 in mesh block    2
  processing subcomponent    17
  processing subcomponent    18
processing non-moving component      5 in mesh block    2
processing non-moving component      4 in mesh block    3
  processing subcomponent    17
  processing subcomponent    18
processing non-moving component      5 in mesh block    3
processing non-moving component      4 in mesh block    4
  processing subcomponent    17
  processing subcomponent    18
processing non-moving component      5 in mesh block    4
processing non-moving component      4 in mesh block    5
  processing subcomponent    17
  processing subcomponent    18
processing non-moving component      5 in mesh block    5
  total, fluid and solid sub-domain cell counts:    1240860    710354    181251
converting stl data to internal storage
processing initial conditions
  processing fluid initialization regions
processing baffles
setting up remaining array data
evaluating mesh boundary conditions for block    1
evaluating mesh boundary conditions for block    2
evaluating mesh boundary conditions for block    3
evaluating mesh boundary conditions for block    4
evaluating mesh boundary conditions for block    5
initializing fluid boundary conditions
processing graphics and output requests
processing particle data
processing user-defined plot requests
producing preprocessor plot data
successful completion of preprocessor

Preprocessor Done

Solver starting

trying to check out a parallel token
```



```

License token checked out for simulation: hydr3dp
Number of core license tokens checked out: 0

program title : FLOW-3D
program version : hydr3d version 12.0.1.08 win64 10/15/2019
version id : double
DOUBLE precision version
process identification number for this job= 1

job name: alqr
problem date: 03/04/2021
problem time: 17:18:59

Portneuf and Oxbows original terrain

*** estimated uncompressed solver output file size (flsgrf): 1 gb ***

*** running solver on 32 cores ***

processing restart data:
processing data from restart source file: D:\Portneuf_and_Oxbows\Portneuf_and_Oxbows_original_terrain_DR__SAVAGE_STL_FINAL_2-D_SIM_TRY_6/
D_SIM_TRY_6
restart time: 1.14910E+04
restart data created by: hydr3d version 12.0.1.08 win64 10/15/2019
finished processing restart data

***
restart and spatial data available at t= 0.00000E+00
***
-----
progress          time step          pressure          fluid #1          performance
sim_time    cycle    delt    dt_stbl/code    iter    res/epsi    volume    %loss    frac    el_time    %PE    clk_time    est_rem_time
-----
0.00000E+00    0    2.37E-02    6.02E-02/cy    0    0.00E+00    1.3559E+06    +0.00E+00    0.00    00:00:53    26    17:19:21    ...
Spatial Data Request Signaled
***
restart and spatial data available at t= 4.27054E+01
***
4.27054E+01    481    1.39E-01    1.39E-01/cy    3    7.69E-01    1.3518E+06    +4.43E-03    0.00    00:02:17    96    17:20:44    4:22:09:05
Spatial Data Request Signaled
***
restart and spatial data available at t= 1.06804E+02
***
1.06804E+02    880    1.72E-01    1.72E-01/cx    4    7.54E-01    1.3483E+06    +1.03E-01    0.00    00:03:17    100    17:21:44    2:19:58:29
Spatial Data Request Signaled
***
restart and spatial data available at t= 1.39027E+02
***
1.39027E+02    1115    1.10E-01    1.10E-01/cy    3    4.03E-01    1.3475E+06    +1.55E-01    0.00    00:03:53    97    17:22:20    2:13:46:50
Spatial Data Request Signaled
***
restart and spatial data available at t= 2.48538E+02
***
2.48538E+02    2049    1.20E-01    1.20E-01/cy    3    5.89E-01    1.3424E+06    +2.98E-01    0.00    00:06:11    96    17:24:38    2:07:03:12
Spatial Data Request Signaled
***
restart and spatial data available at t= 3.38797E+02
***
3.38797E+02    2784    1.25E-01    1.25E-01/cy    3    4.17E-01    1.3378E+06    +3.88E-01    0.00    00:08:05    100    17:26:32    2:04:46:16
4.83010E+02    3896    1.33E-01    1.33E-01/cy    3    9.26E-01    1.3307E+06    +4.82E-01    0.00    00:10:53    98    17:29:21    2:01:51:25
Spatial Data Request Signaled
***

```

```

restart and spatial data available at t= 6.77099E+02
***
6.77099E+02      5359      1.33E-01      1.33E-01/cy      4      9.69E-01      1.3228E+06      +5.82E-01      0.00      00:14:29      100      17:32:56      1:23:12:60
1.01293E+03      7883      1.34E-01      1.34E-01/cy      4      8.92E-01      1.3052E+06      +9.70E-01      0.00      00:20:53      96      17:39:21      1:21:25:55
1.54346E+03      11933      1.24E-01      1.24E-01/cy      5      8.70E-01      1.2699E+06      +1.59E+00      0.00      00:30:53      99      17:49:21      1:19:54:47
2.06081E+03      15905      1.31E-01      1.31E-01/cy      6      9.43E-01      1.2315E+06      +2.14E+00      0.00      00:40:54      98      17:59:21      1:19:22:05
2.57171E+03      19852      1.33E-01      1.33E-01/cy      7      8.66E-01      1.1946E+06      +2.62E+00      0.00      00:50:54      100      18:09:21      1:19:04:59
3.09491E+03      23795      1.33E-01      1.33E-01/cy      7      9.76E-01      1.1618E+06      +3.04E+00      0.00      01:00:54      100      18:19:21      1:18:39:48
3.61185E+03      27689      1.34E-01      1.34E-01/cy      8      8.84E-01      1.1379E+06      +3.40E+00      0.00      01:10:54      100      18:29:21      1:18:23:33
4.13192E+03      31563      1.35E-01      1.35E-01/cy      7      9.90E-01      1.1202E+06      +3.72E+00      0.00      01:20:54      97      18:39:21      1:18:06:54
4.63330E+03      35364      1.32E-01      1.32E-01/cy      9      9.31E-01      1.1079E+06      +3.96E+00      0.00      01:30:54      99      18:49:21      1:18:02:15
5.11678E+03      39140      1.23E-01      1.23E-01/cy      9      9.34E-01      1.0984E+06      +4.17E+00      0.00      01:40:54      95      18:59:22      1:18:05:42
5.59028E+03      42961      1.24E-01      1.24E-01/cy      10      9.12E-01      1.0915E+06      +4.37E+00      0.00      01:50:54      98      19:09:22      1:18:11:33
6.05765E+03      46778      1.20E-01      1.20E-01/cy      10      9.06E-01      1.0868E+06      +4.56E+00      0.00      02:00:54      100      19:19:22      1:18:17:35
6.51281E+03      50642      1.10E-01      1.10E-01/cy      8      9.79E-01      1.0834E+06      +4.73E+00      0.00      02:10:54      99      19:29:22      1:18:26:22
7.00089E+03      54479      1.09E-01      1.09E-01/cy      8      9.38E-01      1.0814E+06      +4.91E+00      0.00      02:20:55      100      19:39:22      1:18:20:00
7.46842E+03      58349      1.33E-01      1.33E-01/cx      7      9.41E-01      1.0803E+06      +5.07E+00      0.00      02:30:55      99      19:49:22      1:18:20:33
7.93546E+03      62246      1.32E-01      1.32E-01/cx      10      9.25E-01      1.0816E+06      +5.23E+00      0.00      02:40:55      100      19:59:22      1:18:20:00
-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
8.43225E+03      66088      1.32E-01      1.32E-01/cx      6      8.50E-01      1.0843E+06      +5.39E+00      0.00      02:50:55      98      20:09:22      1:18:08:53
8.92286E+03      69957      1.10E-01      1.10E-01/cy      8      9.05E-01      1.0897E+06      +5.54E+00      0.00      03:00:55      100      20:19:22      1:17:59:43
9.38739E+03      73840      1.32E-01      1.32E-01/cx      10      9.03E-01      1.0952E+06      +5.69E+00      0.00      03:10:55      96      20:29:22      1:17:57:59
9.86062E+03      77700      1.11E-01      1.11E-01/cy      8      8.92E-01      1.1053E+06      +5.83E+00      0.00      03:20:55      100      20:39:22      1:17:53:04
1.03004E+04      81575      1.11E-01      1.11E-01/cy      9      9.11E-01      1.1163E+06      +5.97E+00      0.00      03:30:55      97      20:49:22      1:17:48:36
1.08006E+04      85447      1.11E-01      1.11E-01/cy      8      9.73E-01      1.1251E+06      +6.12E+00      0.00      03:40:55      100      20:59:22      1:17:43:32
1.12337E+04      89365      1.11E-01      1.11E-01/cy      9      9.21E-01      1.1336E+06      +6.25E+00      0.00      03:50:55      96      21:09:23      1:17:47:05
1.16688E+04      93302      1.10E-01      1.10E-01/cy      8      9.34E-01      1.1427E+06      +6.39E+00      0.00      04:00:55      98      21:19:23      1:17:49:09
1.21021E+04      97225      1.10E-01      1.10E-01/cy      8      9.56E-01      1.1526E+06      +6.52E+00      0.00      04:10:55      97      21:29:23      1:17:50:45
1.25373E+04      101133      1.10E-01      1.10E-01/cy      8      9.74E-01      1.1638E+06      +6.66E+00      0.00      04:20:55      97      21:39:23      1:17:51:08
1.29703E+04      105047      1.13E-01      1.13E-01/cy      7      9.98E-01      1.1753E+06      +6.81E+00      0.00      04:30:55      98      21:49:23      1:17:51:18
-----
restart and spatial data available at t= 1.33200E+04
***
1.33200E+04      108160      1.12E-01      1.12E-01/cy      7      9.38E-01      1.1836E+06      +6.92E+00      0.00      04:38:51      99      21:57:18      1:17:49:37
1.34098E+04      108961      1.12E-01      1.12E-01/cy      8      9.31E-01      1.1858E+06      +6.95E+00      0.00      04:40:55      100      21:59:23      1:17:49:28
1.38466E+04      112872      1.11E-01      1.11E-01/cy      8      9.81E-01      1.1968E+06      +7.09E+00      0.00      04:50:55      100      22:09:23      1:17:47:39
1.42867E+04      116800      1.13E-01      1.13E-01/cy      4      7.13E-01      1.2081E+06      +7.22E+00      0.00      05:00:56      100      22:19:23      1:17:44:42
1.47346E+04      120691      1.18E-01      1.18E-01/cy      8      9.95E-01      1.2192E+06      +7.34E+00      0.00      05:10:56      96      22:29:23      1:17:39:50
1.52078E+04      124558      1.27E-01      1.27E-01/cy      10      9.25E-01      1.2308E+06      +7.47E+00      0.00      05:20:56      100      22:39:23      1:17:29:58
1.57044E+04      128407      1.32E-01      1.32E-01/cx      10      9.25E-01      1.2440E+06      +7.60E+00      0.00      05:30:56      100      22:49:23      1:17:15:54
1.62052E+04      132228      1.32E-01      1.32E-01/cx      9      9.68E-01      1.2565E+06      +7.78E+00      0.00      05:40:56      96      22:59:23      1:17:01:21
1.67045E+04      136051      1.23E-01      1.30E-01/cy      10      9.64E-01      1.2665E+06      +7.99E+00      0.00      05:50:56      99      23:09:23      1:16:47:21
1.71995E+04      139868      1.27E-01      1.27E-01/cy      9      9.99E-01      1.2771E+06      +8.18E+00      0.00      06:00:56      100      23:19:23      1:16:34:17
1.76989E+04      143697      1.31E-01      1.31E-01/cx      10      9.83E-01      1.2892E+06      +8.39E+00      0.00      06:10:56      99      23:29:24      1:16:20:39
1.81971E+04      147506      1.25E-01      1.31E-01/cx      10      9.48E-01      1.2987E+06      +8.68E+00      0.00      06:20:56      100      23:39:24      1:16:07:27
-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
1.86936E+04      151314      1.32E-01      1.32E-01/cx      10      9.36E-01      1.3087E+06      +8.98E+00      0.00      06:30:56      100      23:49:24      1:15:54:38
1.91910E+04      155143      1.31E-01      1.31E-01/cy      10      9.42E-01      1.3172E+06      +9.39E+00      0.00      06:40:56      100      23:59:24      1:15:41:51
1.96898E+04      158960      1.25E-01      1.25E-01/cy      9      9.27E-01      1.3245E+06      +9.87E+00      0.00      06:50:56      100      00:09:24      1:15:29:00
2.01898E+04      162795      1.31E-01      1.31E-01/cx      10      9.71E-01      1.3335E+06      +1.04E+01      0.00      07:00:56      100      00:19:24      1:15:16:09
2.06750E+04      166630      1.32E-01      1.32E-01/cx      10      9.64E-01      1.3411E+06      +1.09E+01      0.00      07:10:56      100      00:29:24      1:15:05:25
2.11579E+04      170472      1.27E-01      1.27E-01/cy      9      9.81E-01      1.3525E+06      +1.11E+01      0.00      07:20:56      96      00:39:24      1:14:55:00
2.16488E+04      174286      1.13E-01      1.13E-01/cy      9      9.15E-01      1.3658E+06      +1.13E+01      0.00      07:30:57      96      00:49:24      1:14:43:36
2.21267E+04      178009      1.31E-01      1.31E-01/cx      10      9.61E-01      1.3843E+06      +1.14E+01      0.00      07:40:57      94      00:59:24      1:14:33:52
2.26167E+04      181831      1.22E-01      1.22E-01/cy      10      9.41E-01      1.4032E+06      +1.15E+01      0.00      07:50:57      94      01:09:24      1:14:22:39
2.31015E+04      185667      1.32E-01      1.32E-01/cx      9      9.57E-01      1.4271E+06      +1.14E+01      0.00      08:00:57      99      01:19:24      1:14:12:07
2.35907E+04      189515      1.17E-01      1.17E-01/cy      9      9.10E-01      1.4549E+06      +1.13E+01      0.00      08:10:57      100      01:29:24      1:14:01:05
2.40665E+04      193345      1.15E-01      1.15E-01/cy      9      9.11E-01      1.4788E+06      +1.12E+01      0.00      08:20:57      100      01:39:25      1:13:51:38
2.45176E+04      197236      1.18E-01      1.18E-01/cy      9      9.67E-01      1.5007E+06      +1.11E+01      0.00      08:30:57      100      01:49:25      1:13:44:57
2.49900E+04      201086      1.29E-01      1.29E-01/cy      10      9.21E-01      1.5215E+06      +1.10E+01      0.00      08:40:57      100      01:59:25      1:13:35:48
2.54927E+04      204914      1.25E-01      1.31E-01/cx      10      9.49E-01      1.5403E+06      +1.09E+01      0.00      08:50:57      100      02:09:25      1:13:23:18
2.59960E+04      208741      1.32E-01      1.32E-01/cx      10      9.39E-01      1.5534E+06      +1.09E+01      0.00      09:00:58      100      02:19:25      1:13:10:50
2.64978E+04      212566      1.31E-01      1.31E-01/cx      10      9.84E-01      1.5632E+06      +1.10E+01      0.00      09:10:58      100      02:29:25      1:12:58:37
-----
***

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```

restart and spatial data available at t= 2.66401E+04
***
2.66401E+04 213652 1.31E-01 1.31E-01/cx 10 9.93E-01 1.5656E+06 +1.10E+01 0.00 09:13:49 100 02:32:16 1:12:55:14
2.69919E+04 216354 1.31E-01 1.31E-01/cx 11 9.25E-01 1.5706E+06 +1.10E+01 0.00 09:20:58 100 02:39:25 1:12:47:16
2.74828E+04 220166 1.24E-01 1.31E-01/cx 10 9.76E-01 1.5762E+06 +1.10E+01 0.00 09:30:58 99 02:49:25 1:12:36:17
2.79718E+04 223975 1.31E-01 1.31E-01/cx 10 9.72E-01 1.5801E+06 +1.10E+01 0.00 09:40:58 100 02:59:25 1:12:25:32
2.84609E+04 227786 1.31E-01 1.31E-01/cx 10 9.75E-01 1.5834E+06 +1.10E+01 0.00 09:50:58 100 03:09:25 1:12:14:48
2.89529E+04 231591 1.32E-01 1.32E-01/cx 10 9.81E-01 1.5858E+06 +1.11E+01 0.00 10:00:58 99 03:19:25 1:12:03:48
-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
2.94460E+04 235406 1.30E-01 1.31E-01/cx 10 9.99E-01 1.5901E+06 +1.11E+01 0.00 10:10:58 100 03:29:25 1:11:52:45
2.99367E+04 239199 1.31E-01 1.31E-01/cx 10 9.06E-01 1.5970E+06 +1.11E+01 0.00 10:20:58 99 03:39:26 1:11:41:57
3.04283E+04 243006 1.23E-01 1.31E-01/cx 10 9.97E-01 1.6080E+06 +1.11E+01 0.00 10:30:58 100 03:49:26 1:11:31:06
3.09199E+04 246817 1.32E-01 1.32E-01/cx 10 9.58E-01 1.6245E+06 +1.11E+01 0.00 10:40:58 99 03:59:26 1:11:20:16
3.14112E+04 250625 1.31E-01 1.31E-01/cx 10 9.19E-01 1.6447E+06 +1.10E+01 0.00 10:50:58 98 04:09:26 1:11:09:28
3.19013E+04 254435 1.31E-01 1.31E-01/cx 10 9.18E-01 1.6667E+06 +1.10E+01 0.00 11:00:58 100 04:19:26 1:10:58:50
3.23903E+04 258246 1.15E-01 1.30E-01/cx 10 9.88E-01 1.6885E+06 +1.10E+01 0.00 11:10:58 98 04:29:26 1:10:48:17
3.28745E+04 262031 1.31E-01 1.31E-01/cx 10 9.51E-01 1.7069E+06 +1.10E+01 0.00 11:20:58 100 04:39:26 1:10:38:10
3.33597E+04 265833 1.33E-01 1.33E-01/cx 10 9.79E-01 1.7232E+06 +1.10E+01 0.00 11:30:58 98 04:49:26 1:10:27:58
3.37836E+04 269677 1.01E-01 1.01E-01/cx 9 8.99E-01 1.7359E+06 +1.10E+01 0.00 11:40:59 100 04:59:26 1:10:22:47
3.42143E+04 273571 1.16E-01 1.16E-01/cx 9 9.99E-01 1.7500E+06 +1.10E+01 0.00 11:50:59 99 05:09:26 1:10:16:56
3.46523E+04 277313 1.13E-01 1.13E-01/cx 8 9.02E-01 1.7655E+06 +1.10E+01 0.00 12:00:59 96 05:19:26 1:10:10:23
3.50472E+04 280970 1.03E-01 1.03E-01/cx 8 9.35E-01 1.7786E+06 +1.10E+01 0.00 12:10:59 96 05:29:26 1:10:07:10
3.54451E+04 284862 1.01E-01 1.01E-01/cx 7 9.05E-01 1.7916E+06 +1.10E+01 0.00 12:20:59 100 05:39:26 1:10:03:34
3.58389E+04 288778 1.00E-01 1.00E-01/cx 8 9.82E-01 1.8067E+06 +1.09E+01 0.00 12:30:59 96 05:49:26 1:10:00:08
3.62319E+04 292688 1.00E-01 1.00E-01/cx 8 9.24E-01 1.8226E+06 +1.09E+01 0.00 12:40:59 95 05:59:26 1:09:56:37
3.66249E+04 296599 1.00E-01 1.00E-01/cx 9 8.97E-01 1.8407E+06 +1.08E+01 0.00 12:50:59 100 06:09:26 1:09:52:58
3.70172E+04 300503 1.01E-01 1.01E-01/cx 9 9.29E-01 1.8608E+06 +1.08E+01 0.00 13:00:59 100 06:19:27 1:09:49:15
3.74056E+04 304368 1.00E-01 1.00E-01/cx 8 9.82E-01 1.8820E+06 +1.07E+01 0.00 13:10:59 100 06:29:27 1:09:45:41
3.77951E+04 308240 1.01E-01 1.01E-01/cx 8 9.70E-01 1.9048E+06 +1.07E+01 0.00 13:20:59 100 06:39:27 1:09:41:54
3.81871E+04 312125 1.01E-01 1.01E-01/cx 8 9.79E-01 1.9293E+06 +1.06E+01 0.00 13:30:59 100 06:49:27 1:09:37:49
3.85796E+04 315998 1.01E-01 1.01E-01/cx 8 9.77E-01 1.9553E+06 +1.06E+01 0.00 13:40:59 100 06:59:27 1:09:33:33
3.89732E+04 319864 1.02E-01 1.02E-01/cx 10 9.20E-01 1.9815E+06 +1.05E+01 0.00 13:50:60 100 07:09:27 1:09:29:07
-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
3.93683E+04 323719 1.03E-01 1.03E-01/cx 8 9.78E-01 2.0087E+06 +1.04E+01 0.00 14:00:60 99 07:19:27 1:09:24:27
3.97777E+04 327700 1.03E-01 1.03E-01/cx 6 9.07E-01 2.0395E+06 +1.04E+01 0.00 14:10:60 100 07:29:27 1:09:18:39
***
restart and spatial data available at t= 3.99600E+04
***
3.99600E+04 329466 1.04E-01 1.04E-01/cx 6 9.18E-01 2.0534E+06 +1.04E+01 0.00 14:15:24 100 07:33:51 1:09:15:54
4.01910E+04 331693 1.03E-01 1.03E-01/cx 6 9.07E-01 2.0707E+06 +1.03E+01 0.00 14:20:60 98 07:39:27 1:09:12:30
4.06414E+04 335675 1.53E-01 1.53E-01/cx 10 9.89E-01 2.1043E+06 +1.03E+01 0.00 14:30:60 100 07:49:27 1:09:03:39
4.12059E+04 339454 1.26E-01 1.26E-01/cx 8 9.77E-01 2.1510E+06 +1.02E+01 0.00 14:40:60 100 07:59:27 1:08:46:52
4.16746E+04 343304 1.23E-01 1.23E-01/cx 8 9.25E-01 2.1953E+06 +1.01E+01 0.00 14:51:00 100 08:09:27 1:08:36:48
4.21651E+04 347202 1.30E-01 1.30E-01/cx 8 9.35E-01 2.2445E+06 +1.00E+01 0.00 15:01:00 100 08:19:28 1:08:25:16
4.26986E+04 351153 1.34E-01 1.34E-01/cx 4 5.86E-01 2.3084E+06 +9.91E+00 0.00 15:11:00 100 08:29:28 1:08:10:54
4.32557E+04 355259 1.35E-01 1.35E-01/cy 4 6.56E-01 2.3866E+06 +9.74E+00 0.00 15:21:00 95 08:39:28 1:07:55:06
4.38122E+04 359406 1.34E-01 1.34E-01/cy 4 7.04E-01 2.4613E+06 +9.62E+00 0.00 15:31:00 96 08:49:28 1:07:39:28
4.42784E+04 363609 8.69E-02 8.69E-02/cx 3 3.73E-01 2.5185E+06 +9.55E+00 0.00 15:41:00 98 08:59:28 1:07:29:45
4.46503E+04 367820 8.95E-02 8.95E-02/cx 3 3.98E-01 2.5608E+06 +9.51E+00 0.00 15:51:00 96 09:09:28 1:07:26:01
4.50306E+04 372026 9.15E-02 9.15E-02/cx 3 4.49E-01 2.6032E+06 +9.48E+00 0.00 16:01:00 100 09:19:28 1:07:21:38
4.54449E+04 376233 1.01E-01 1.01E-01/cx 3 5.86E-01 2.6476E+06 +9.45E+00 0.00 16:11:00 100 09:29:28 1:07:15:02
4.58660E+04 380417 1.01E-01 1.01E-01/cx 3 6.08E-01 2.6957E+06 +9.38E+00 0.00 16:21:01 99 09:39:28 1:07:07:57
4.62887E+04 384619 1.01E-01 1.01E-01/cx 3 6.20E-01 2.7452E+06 +9.31E+00 0.00 16:31:01 100 09:49:28 1:07:00:43
4.67138E+04 388819 1.01E-01 1.01E-01/cx 3 5.84E-01 2.7933E+06 +9.24E+00 0.00 16:41:01 99 09:59:28 1:06:53:17
4.71356E+04 393013 1.00E-01 1.00E-01/cx 3 6.24E-01 2.8446E+06 +9.15E+00 0.00 16:51:01 98 10:09:28 1:06:45:60
4.75541E+04 397173 1.01E-01 1.01E-01/cx 3 7.07E-01 2.9003E+06 +9.06E+00 0.00 17:01:01 94 10:19:28 1:06:38:52
Spatial Data Request Signaled
***

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restart and spatial data available at t= 4.76870E+04
***
4.76870E+04    398504    1.00E-01    1.00E-01/cx    3    7.21E-01    2.9185E+06    +9.03E+00    0.00    17:04:17    100    10:22:44    1:06:36:45
4.79555E+04    401273    9.50E-02    9.50E-02/cy    3    6.96E-01    2.9575E+06    +8.98E+00    0.00    17:11:01    100    10:29:28    1:06:32:42
4.83272E+04    405260    1.02E-01    1.02E-01/cx    3    8.78E-01    3.0105E+06    +8.91E+00    0.00    17:21:01    98    10:39:28    1:06:28:15
-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
4.87492E+04    409448    1.01E-01    1.01E-01/cx    3    9.46E-01    3.0731E+06    +8.83E+00    0.00    17:31:01    100    10:49:29    1:06:20:44
4.91700E+04    413612    1.01E-01    1.01E-01/cx    4    7.78E-01    3.1385E+06    +8.76E+00    0.00    17:41:01    98    10:59:29    1:06:13:15
4.95878E+04    417748    1.04E-01    1.04E-01/cx    4    7.92E-01    3.1986E+06    +8.70E+00    0.00    17:51:01    100    11:09:29    1:06:05:53
5.00193E+04    421859    1.07E-01    1.07E-01/cx    4    9.10E-01    3.2599E+06    +8.62E+00    0.00    18:01:01    98    11:19:29    1:05:57:42
5.04374E+04    425961    1.03E-01    1.03E-01/cx    4    9.28E-01    3.3221E+06    +8.56E+00    0.00    18:11:01    100    11:29:29    1:05:50:15
5.08592E+04    430047    1.03E-01    1.03E-01/cx    4    9.81E-01    3.3878E+06    +8.49E+00    0.00    18:21:01    96    11:39:29    1:05:42:33
5.12844E+04    434121    1.06E-01    1.06E-01/cx    5    7.66E-01    3.4585E+06    +8.42E+00    0.00    18:31:01    100    11:49:29    1:05:34:37
5.17106E+04    438155    1.05E-01    1.05E-01/cx    5    8.07E-01    3.5337E+06    +8.36E+00    0.00    18:41:02    100    11:59:29    1:05:26:36
5.21517E+04    442177    1.13E-01    1.13E-01/cx    5    9.92E-01    3.6202E+06    +8.28E+00    0.00    18:51:02    100    12:09:29    1:05:17:43
5.26056E+04    446142    1.17E-01    1.17E-01/cy    6    9.81E-01    3.7191E+06    +8.18E+00    0.00    19:01:02    100    12:19:29    1:05:08:07
5.30576E+04    450032    1.17E-01    1.17E-01/cy    7    9.18E-01    3.8212E+06    +8.09E+00    0.00    19:11:02    100    12:29:29    1:04:58:36
***
restart and spatial data available at t= 5.32800E+04
***
5.32800E+04    451950    1.15E-01    1.15E-01/cy    7    9.68E-01    3.8725E+06    +8.05E+00    0.00    19:16:01    100    12:34:28    1:04:54:01
5.34636E+04    453940    5.70E-02    5.70E-02/cx    3    7.78E-01    3.9166E+06    +8.02E+00    0.00    19:21:02    98    12:39:29    1:04:51:35

===== mentor tip =====
multi-block fluid volume error exceeds 5%.

maximum volume error is between mesh blocks 1 and 4:
fluid volume flow rate mismatch = 9.18594E+05
% error = 6.09752E+00

1. reduce the number of mesh blocks.
2. reduce grid size variation at inter-block boundaries.
3. align nested block boundaries with mesh planes in the containing blocks.
4. shift inter-block boundaries to where there is less flow variation.
5. increase inter-block interpolation factor alphamb to 0.5 or higher
6. is there excessive fluid break up?
=====

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=====

```

5.38454E+04	457896	1.02E-01	1.02E-01/cx	7	9.21E-01	4.0063E+06	+7.94E+00	0.00	19:31:02	100	12:49:29	1:04:45:48
5.42363E+04	461762	1.01E-01	1.01E-01/cx	7	8.76E-01	4.1010E+06	+7.84E+00	0.00	19:41:02	100	12:59:29	1:04:39:29
5.46241E+04	465616	1.01E-01	1.01E-01/cx	7	9.44E-01	4.2007E+06	+7.68E+00	0.00	19:51:02	100	13:09:30	1:04:33:17
5.50113E+04	469476	9.93E-02	9.93E-02/cy	7	8.95E-01	4.3098E+06	+7.53E+00	0.00	20:01:02	100	13:19:30	1:04:27:03
5.53857E+04	473328	8.43E-02	8.43E-02/cx	6	9.44E-01	4.4222E+06	+7.39E+00	0.00	20:11:02	98	13:29:30	1:04:21:27
5.57073E+04	477205	7.33E-02	7.33E-02/cx	6	8.71E-01	4.5195E+06	+7.26E+00	0.00	20:21:02	98	13:39:30	1:04:18:33
5.59911E+04	481091	8.70E-02	8.84E-02/cy	11	9.68E-01	4.6048E+06	+7.14E+00	0.00	20:31:02	100	13:49:30	1:04:17:32
5.63254E+04	484719	9.73E-02	9.73E-02/cy	9	9.82E-01	4.7056E+06	+6.99E+00	0.00	20:41:02	100	13:59:30	1:04:13:48
5.66849E+04	488434	9.64E-02	9.64E-02/cy	8	9.70E-01	4.8177E+06	+6.83E+00	0.00	20:51:03	100	14:09:30	1:04:08:42
5.70422E+04	492147	9.61E-02	9.61E-02/cy	9	8.72E-01	4.9320E+06	+6.67E+00	0.00	21:01:03	95	14:19:30	1:04:03:38

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
5.73945E+04	495820	9.53E-02	9.53E-02/cy	7	9.53E-01	5.0462E+06	+6.53E+00	0.00	21:11:03	98	14:29:30	1:03:58:46
5.77342E+04	499583	8.55E-02	8.55E-02/cy	6	9.85E-01	5.1588E+06	+6.41E+00	0.00	21:21:03	95	14:39:30	1:03:54:29
5.80533E+04	503379	9.73E-02	9.73E-02/cy	8	8.92E-01	5.2635E+06	+6.31E+00	0.00	21:31:03	100	14:49:30	1:03:51:11
5.83619E+04	507178	7.76E-02	7.76E-02/cy	6	9.39E-01	5.3660E+06	+6.21E+00	0.00	21:41:03	100	14:59:31	1:03:48:21
5.86790E+04	510941	9.04E-02	9.04E-02/cy	8	9.38E-01	5.4709E+06	+6.11E+00	0.00	21:51:03	100	15:09:31	1:03:45:00
5.90132E+04	514674	8.84E-02	8.84E-02/cy	6	9.84E-01	5.5835E+06	+6.01E+00	0.00	22:01:03	100	15:19:31	1:03:40:43
5.93648E+04	518622	9.46E-02	9.46E-02/cy	4	9.16E-01	5.7080E+06	+5.91E+00	0.00	22:11:03	98	15:29:31	1:03:35:30
5.97160E+04	522593	9.55E-02	9.55E-02/cy	4	6.44E-01	5.8375E+06	+5.79E+00	0.00	22:21:03	100	15:39:31	1:03:30:15
6.00740E+04	526579	9.63E-02	9.63E-02/cy	4	6.90E-01	5.9714E+06	+5.68E+00	0.00	22:31:04	100	15:49:31	1:03:24:36
6.04339E+04	530570	8.14E-02	9.35E-02/cy	3	6.93E-01	6.1086E+06	+5.57E+00	0.00	22:41:04	100	15:59:31	1:03:18:48
6.07931E+04	534562	9.42E-02	9.42E-02/cy	4	7.39E-01	6.2482E+06	+5.46E+00	0.00	22:51:04	100	16:09:31	1:03:12:59
6.11506E+04	538552	9.33E-02	9.33E-02/cy	4	8.79E-01	6.3887E+06	+5.35E+00	0.00	23:01:04	100	16:19:31	1:03:07:13
6.15061E+04	542535	9.34E-02	9.34E-02/cy	4	9.81E-01	6.5259E+06	+5.25E+00	0.00	23:11:04	98	16:29:31	1:03:01:29
6.18606E+04	546504	9.35E-02	9.35E-02/cy	4	7.19E-01	6.6641E+06	+5.15E+00	0.00	23:21:04	100	16:39:31	1:02:55:45
6.22196E+04	550491	8.82E-02	9.25E-02/cy	4	8.68E-01	6.8055E+06	+5.02E+00	0.00	23:31:04	100	16:49:32	1:02:49:45
6.25754E+04	554485	9.45E-02	9.45E-02/cy	4	7.30E-01	6.9458E+06	+4.89E+00	0.00	23:41:04	98	16:59:32	1:02:43:52
6.29294E+04	558458	9.21E-02	9.21E-02/cy	3	9.81E-01	7.0868E+06	+4.75E+00	0.00	23:51:04	98	17:09:32	1:02:38:01
6.32815E+04	562433	9.18E-02	9.18E-02/cy	3	9.16E-01	7.2261E+06	+4.61E+00	0.00	1:00:01:04	100	17:19:32	1:02:32:13
6.36356E+04	566424	8.38E-02	8.38E-02/cy	3	9.87E-01	7.3699E+06	+4.48E+00	0.00	1:00:11:04	98	17:29:32	1:02:26:16
6.39946E+04	570348	9.06E-02	9.06E-02/cy	3	9.34E-01	7.5187E+06	+4.35E+00	0.00	1:00:21:04	100	17:39:32	1:02:20:31
6.43316E+04	574284	8.93E-02	8.93E-02/cy	4	8.94E-01	7.6648E+06	+4.22E+00	0.01	1:00:31:05	98	17:49:32	1:02:14:49
6.46738E+04	578213	9.32E-02	9.32E-02/cy	15	9.43E-01	7.8095E+06	+4.07E+00	0.01	1:00:41:05	100	17:59:32	1:02:09:18
6.50122E+04	582135	7.85E-02	9.30E-02/cy	3	7.93E-01	7.9513E+06	+3.94E+00	0.01	1:00:51:05	100	18:09:32	1:02:03:55

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
6.53459E+04	586064	8.86E-02	8.86E-02/cy	3	9.95E-01	8.0859E+06	+3.80E+00	0.01	1:01:01:05	100	18:19:32	1:01:58:42
6.56815E+04	590027	8.11E-02	8.11E-02/cy	3	8.19E-01	8.2205E+06	+3.67E+00	0.01	1:01:11:05	98	18:29:32	1:01:53:21
6.60177E+04	593948	9.12E-02	9.12E-02/cy	4	8.78E-01	8.3560E+06	+3.54E+00	0.01	1:01:21:05	100	18:39:32	1:01:47:55
6.63565E+04	597898	8.74E-02	8.74E-02/cy	3	9.93E-01	8.4974E+06	+3.41E+00	0.01	1:01:31:05	93	18:49:33	1:01:42:19

restart and spatial data available at t= 6.66000E+04												

6.66000E+04	600764	8.03E-02	8.03E-02/cy	3	9.05E-01	8.6001E+06	+3.32E+00	0.01	1:01:38:25	98	18:56:52	1:01:38:25
6.66895E+04	601798	9.23E-02	9.23E-02/cy	3	9.65E-01	8.6380E+06	+3.28E+00	0.01	1:01:41:05	95	18:59:33	1:01:36:57
6.70233E+04	605721	8.14E-02	8.14E-02/cy	4	9.20E-01	8.7768E+06	+3.16E+00	0.01	1:01:51:05	98	19:09:33	1:01:31:29
6.73653E+04	609688	7.78E-02	7.78E-02/cy	3	9.05E-01	8.9151E+06	+3.03E+00	0.01	1:02:01:05	100	19:19:33	1:01:25:37
6.77046E+04	613640	8.02E-02	8.02E-02/cy	4	9.16E-01	9.0489E+06	+2.91E+00	0.01	1:02:11:05	100	19:29:33	1:01:19:50
6.80454E+04	617591	8.97E-02	8.97E-02/cy	3	9.65E-01	9.1753E+06	+2.78E+00	0.01	1:02:21:06	95	19:39:33	1:01:13:55
6.83911E+04	621556	9.10E-02	9.10E-02/cy	3	9.83E-01	9.3016E+06	+2.65E+00	0.01	1:02:31:06	100	19:49:33	1:01:07:45
6.87379E+04	625502	8.99E-02	8.99E-02/cy	3	9.18E-01	9.4276E+06	+2.52E+00	0.01	1:02:41:06	95	19:59:33	1:01:01:30
6.90825E+04	629444	8.39E-02	8.39E-02/cx	3	9.26E-01	9.5513E+06	+2.41E+00	0.01	1:02:51:06	98	20:09:33	1:00:55:18
6.94240E+04	633328	9.08E-02	9.08E-02/cy	5	9.47E-01	9.6745E+06	+2.29E+00	0.01	1:03:01:06	100	20:19:33	1:00:49:13
6.97673E+04	637228	8.84E-02	8.84E-02/cy	4	8.87E-01	9.7962E+06	+2.18E+00	0.01	1:03:11:06	100	20:29:33	1:00:42:60
7.01088E+04	641112	8.80E-02	8.80E-02/cy	3	9.57E-01	9.9172E+06	+2.08E+00	0.01	1:03:21:06	98	20:39:33	1:00:36:50
7.04504E+04	645014	8.76E-02	8.76E-02/cy	4	9.30E-01	1.0035E+07	+1.98E+00	0.01	1:03:31:06	100	20:49:34	1:00:30:37
7.07920E+04	648933	8.69E-02	8.69E-02/cy	3	9.38E-01	1.0157E+07	+1.88E+00	0.01	1:03:41:06	100	20:59:34	1:00:24:22
7.11340E+04	652873	8.35E-02	8.35E-02/cx	3	8.73E-01	1.0280E+07	+1.78E+00	0.01	1:03:51:06	100	21:09:34	1:00:18:04
7.14743E+04	656803	8.73E-02	8.73E-02/cy	3	9.57E-01	1.0404E+07	+1.69E+00	0.01	1:04:01:06	98	21:19:34	1:00:11:49
7.18140E+04	660726	8.49E-02	8.49E-02/cx	3	9.28E-01	1.0526E+07	+1.60E+00	0.01	1:04:11:06	98	21:29:34	1:00:05:32
7.21478E+04	664602	8.66E-02	8.66E-02/cy	4	7.43E-01	1.0642E+07	+1.52E+00	0.01	1:04:21:06	100	21:39:34	23:59:29
7.24807E+04	668477	8.71E-02	8.71E-02/cy	4	8.31E-01	1.0757E+07	+1.44E+00	0.01	1:04:31:06	100	21:49:34	23:53:27

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
7.28191E+04	672399	8.70E-02	8.70E-02/cy	3	9.85E-01	1.0876E+07	+1.37E+00	0.01	1:04:41:06	98	21:59:34	23:47:07
7.31554E+04	676303	8.64E-02	8.64E-02/cy	5	9.71E-01	1.0992E+07	+1.31E+00	0.01	1:04:51:07	100	22:09:34	23:40:52
7.34885E+04	680228	8.03E-02	8.03E-02/cx	3	9.14E-01	1.1107E+07	+1.24E+00	0.01	1:05:01:07	100	22:19:34	23:34:42
7.38034E+04	684142	8.31E-02	8.31E-02/cx	4	9.38E-01	1.1215E+07	+1.19E+00	0.01	1:05:11:07	100	22:29:34	23:29:17
7.41254E+04	687928	8.52E-02	8.52E-02/cy	4	8.94E-01	1.1323E+07	+1.14E+00	0.01	1:05:21:07	100	22:39:34	23:23:32
7.44500E+04	691737	8.56E-02	8.56E-02/cy	4	9.81E-01	1.1429E+07	+1.10E+00	0.01	1:05:31:07	100	22:49:34	23:17:37
7.47683E+04	695483	8.53E-02	8.53E-02/cy	4	8.16E-01	1.1533E+07	+1.06E+00	0.01	1:05:41:07	98	22:59:34	23:11:57
7.50950E+04	699334	8.49E-02	8.49E-02/cy	4	7.40E-01	1.1637E+07	+1.02E+00	0.01	1:05:51:07	98	23:09:35	23:05:53
7.54209E+04	703180	8.43E-02	8.43E-02/cy	5	9.97E-01	1.1740E+07	+9.74E-01	0.01	1:06:01:07	98	23:19:35	22:59:49
7.57309E+04	706854	8.44E-02	8.44E-02/cy	6	9.35E-01	1.1831E+07	+9.41E-01	0.01	1:06:11:07	100	23:29:35	22:54:23
7.60446E+04	710577	8.44E-02	8.44E-02/cy	10	9.50E-01	1.1923E+07	+9.06E-01	0.01	1:06:21:07	100	23:39:35	22:48:46
7.63697E+04	714448	8.41E-02	8.41E-02/cx	4	7.35E-01	1.2022E+07	+8.64E-01	0.01	1:06:31:08	100	23:49:35	22:42:38
7.66934E+04	718320	8.39E-02	8.39E-02/cx	3	9.95E-01	1.2122E+07	+8.23E-01	0.01	1:06:41:08	98	23:59:35	22:36:31
7.70111E+04	722131	8.36E-02	8.36E-02/cx	3	9.99E-01	1.2218E+07	+7.86E-01	0.01	1:06:51:08	98	00:09:35	22:30:37
7.73294E+04	725957	8.34E-02	8.34E-02/cx	4	9.04E-01	1.2313E+07	+7.56E-01	0.01	1:07:01:08	95	00:19:35	22:24:40
7.76464E+04	729802	8.42E-02	8.42E-02/cy	5	8.94E-01	1.2406E+07	+7.29E-01	0.01	1:07:11:08	98	00:29:35	22:18:44
7.79419E+04	733550	8.39E-02	8.39E-02/cy	6	8.65E-01	1.2488E+07	+7.11E-01	0.01	1:07:21:08	100	00:39:36	22:13:39
7.82231E+04	737186	6.55E-02	6.55E-02/cx	4	9.58E-01	1.2565E+07	+6.96E-01	0.01	1:07:31:08	100	00:49:36	22:09:08
7.85096E+04	740971	8.32E-02	8.32E-02/cx	5	9.18E-01	1.2641E+07	+6.81E-01	0.01	1:07:41:08	100	00:59:36	22:04:21
7.87971E+04	744777	8.31E-02	8.31E-02/cx	5	9.97E-01	1.2718E+07	+6.67E-01	0.01	1:07:51:08	100	01:09:36	21:59:29
7.90791E+04	748575	7.03E-02	7.03E-02/cx	4	9.76E-01	1.2799E+07	+6.50E-01	0.01	1:08:01:08	100	01:19:36	21:54:48
7.93567E+04	752385	7.18E-02	7.18E-02/cx	4	7.79E-01	1.2888E+07	+6.28E-01	0.01	1:08:11:09	100	01:29:36	21:50:16
7.96430E+04	756211	6.80E-02	6.80E-02/cx	3	9.64E-01	1.2971E+07	+6.11E-01	0.01	1:08:21:09	100	01:39:36	21:45:21

restart and spatial data available at t= 7.99200E+04

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
7.99200E+04	759912	8.12E-02	8.12E-02/cy	5	8.12E-01	1.3052E+07	+6.00E-01	0.01	1:08:30:43	95	01:49:11	21:40:29
7.99319E+04	760063	6.92E-02	6.92E-02/cx	3	9.48E-01	1.3055E+07	+6.00E-01	0.01	1:08:31:09	98	01:49:36	21:40:17
8.02205E+04	763901	8.22E-02	8.22E-02/cx	4	9.93E-01	1.3140E+07	+5.91E-01	0.01	1:08:41:09	100	01:59:36	21:35:11
8.05101E+04	767744	8.26E-02	8.26E-02/cx	4	9.58E-01	1.3221E+07	+5.85E-01	0.01	1:08:51:09	100	02:09:36	21:30:01
8.07980E+04	771566	6.76E-02	6.76E-02/cx	3	9.93E-01	1.3295E+07	+5.80E-01	0.01	1:09:01:09	100	02:19:36	21:24:53
8.10894E+04	775406	7.41E-02	7.41E-02/cx	3	9.86E-01	1.3372E+07	+5.78E-01	0.01	1:09:11:09	100	02:29:36	21:19:34
8.13802E+04	779201	8.43E-02	8.43E-02/cx	5	9.39E-01	1.3450E+07	+5.79E-01	0.01	1:09:21:09	98	02:39:37	21:14:15
8.16693E+04	783018	7.60E-02	7.60E-02/cy	4	8.67E-01	1.3526E+07	+5.79E-01	0.01	1:09:31:09	100	02:49:37	21:08:58
8.19589E+04	786832	7.53E-02	7.53E-02/cy	4	9.25E-01	1.3600E+07	+5.80E-01	0.01	1:09:41:09	100	02:59:37	21:03:38
8.22421E+04	790563	7.52E-02	7.52E-02/cy	4	8.98E-01	1.3672E+07	+5.81E-01	0.01	1:09:51:09	100	03:09:37	20:58:31
8.25332E+04	794371	7.70E-02	7.70E-02/cy	4	9.63E-01	1.3747E+07	+5.83E-01	0.01	1:10:01:09	100	03:19:37	20:53:03
8.28248E+04	798174	7.70E-02	7.70E-02/cy	4	9.03E-01	1.3822E+07	+5.86E-01	0.01	1:10:11:09	100	03:29:37	20:47:33
8.31177E+04	801953	7.52E-02	7.52E-02/cy	4	8.91E-01	1.3896E+07	+5.89E-01	0.01	1:10:21:09	98	03:39:37	20:41:56
8.34121E+04	805746	8.23E-02	8.23E-02/cy	5	8.69E-01	1.3971E+07	+5.93E-01	0.01	1:10:31:10	100	03:49:37	20:36:15
8.37057E+04	809491	7.97E-02	7.97E-02/cy	6	9.35E-01	1.4046E+07	+6.00E-01	0.01	1:10:41:10	100	03:59:37	20:30:34
8.39989E+04	813224	8.27E-02	8.27E-02/cx	6	9.90E-01	1.4117E+07	+6.12E-01	0.01	1:10:51:10	100	04:09:37	20:24:52
8.42943E+04	816967	7.12E-02	7.53E-02/cy	11	9.29E-01	1.4187E+07	+6.23E-01	0.01	1:11:01:10	98	04:19:37	20:19:03
8.45870E+04	820693	8.17E-02	8.17E-02/cx	5	9.75E-01	1.4257E+07	+6.36E-01	0.01	1:11:11:10	100	04:29:37	20:13:18
8.48769E+04	824408	7.96E-02	7.96E-02/cy	4	9.65E-01	1.4333E+07	+6.48E-01	0.01	1:11:21:10	100	04:39:38	20:07:39
8.51667E+04	828115	7.40E-02	8.17E-02/cx	14	9.19E-01	1.4410E+07	+6.64E-01	0.01	1:11:31:10	100	04:49:38	20:01:58
8.54577E+04	831782	8.16E-02	8.16E-02/cx	6	9.85E-01	1.4486E+07	+6.80E-01	0.01	1:11:41:10	100	04:59:38	19:56:12
8.57473E+04	835393	8.16E-02	8.16E-02/cx	7	9.36E-01	1.4560E+07	+6.97E-01	0.01	1:11:51:10	100	05:09:38	19:50:28
8.60382E+04	839009	8.08E-02	8.08E-02/cy	7	9.33E-01	1.4630E+07	+7.13E-01	0.01	1:12:01:10	100	05:19:38	19:44:39

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
8.63127E+04	842626	6.20E-02	6.20E-02/cy	7	9.78E-01	1.4697E+07	+7.29E-01	0.01	1:12:11:11	98	05:29:38	19:39:26
8.65518E+04	846238	6.63E-02	6.63E-02/cy	6	8.53E-01	1.4746E+07	+7.43E-01	0.01	1:12:21:11	100	05:39:38	19:35:34
8.67971E+04	849894	6.70E-02	6.70E-02/cy	6	9.45E-01	1.4800E+07	+7.58E-01	0.01	1:12:31:11	98	05:49:38	19:31:26
8.70340E+04	853504	6.50E-02	6.50E-02/cy	7	8.14E-01	1.4850E+07	+7.74E-01	0.01	1:12:41:11	100	05:59:38	19:27:35
8.72737E+04	857121	6.99E-02	6.99E-02/cy	6	8.75E-01	1.4897E+07	+7.87E-01	0.01	1:12:51:11	100	06:09:38	19:23:36
8.75101E+04	860719	5.98E-02	5.98E-02/cy	8	9.17E-01	1.4943E+07	+8.01E-01	0.01	1:13:01:11	98	06:19:38	19:19:42
8.77346E+04	864213	6.83E-02	6.83E-02/cy	6	9.36E-01	1.4986E+07	+8.15E-01	0.01	1:13:11:11	100	06:29:38	19:16:14
8.79619E+04	867711	6.55E-02	6.55E-02/cy	8	9.56E-01	1.5027E+07	+8.30E-01	0.01	1:13:21:11	100	06:39:38	19:12:37
8.81881E+04	871213	6.76E-02	6.76E-02/cy	6	9.61E-01	1.5068E+07	+8.44E-01	0.01	1:13:31:11	98	06:49:39	19:09:01
8.84011E+04	874630	6.34E-02	6.34E-02/cy	9	9.48E-01	1.5106E+07	+8.57E-01	0.01	1:13:41:11	100	06:59:39	19:05:54
8.86293E+04	878144	6.06E-02	6.06E-02/cy	10	9.92E-01	1.5148E+07	+8.72E-01	0.01	1:13:51:11	100	07:09:39	19:02:09
8.88440E+04	881555	5.96E-02	6.03E-02/cy	11	9.59E-01	1.5181E+07	+8.86E-01	0.01	1:14:01:11	98	07:19:39	18:58:54
8.90547E+04	884945	6.23E-02	6.23E-02/cy	9	9.47E-01	1.5217E+07	+9.00E-01	0.01	1:14:11:12	100	07:29:39	18:55:46
8.92704E+04	888381	6.56E-02	6.56E-02/cy	9	9.02E-01	1.5254E+07	+9.14E-01	0.01	1:14:21:12	100	07:39:39	18:52:24
8.94820E+04	891827	6.15E-02	6.15E-02/cy	9	9.18E-01	1.5294E+07	+9.28E-01	0.01	1:14:31:12	100	07:49:39	18:49:10
8.96914E+04	895236	6.26E-02	6.26E-02/cy	9	9.73E-01	1.5332E+07	+9.41E-01	0.01	1:14:41:12	100	07:59:39	18:45:60
8.98944E+04	898555	6.07E-02	6.07E-02/cy	10	9.87E-01	1.5365E+07	+9.56E-01	0.01	1:14:51:12	100	08:09:39	18:43:02
9.00988E+04	901913	5.40E-02	5.95E-02/cy	10	9.69E-01	1.5402E+07	+9.71E-01	0.01	1:15:01:12	93	08:19:39	18:39:58
9.02945E+04	905206	5.62E-02	5.97E-02/cy	10	9.90E-01	1.5433E+07	+9.85E-01	0.01	1:15:11:12	98	08:29:40	18:37:14
9.05000E+04	908543	6.49E-02	6.49E-02/cy	9	9.60E-01	1.5466E+07	+1.00E+00	0.01	1:15:21:12	100	08:39:40	18:34:04
9.06923E+04	911848	6.04E-02	6.04E-02/cy	10	9.33E-01	1.5494E+07	+1.01E+00	0.01	1:15:31:12	100	08:49:40	18:31:23
9.08845E+04	915169	6.28E-02	6.28E-02/cy	10	9.25E-01	1.5522E+07	+1.03E+00	0.01	1:15:41:12	98	08:59:40	18:28:41
9.10875E+04	918523	6.00E-02	6.00E-02/cy	9	1.00E+00	1.5555E+07	+1.05E+00	0.01	1:15:51:13	100	09:09:40	18:25:32

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
9.12827E+04	921845	5.37E-02	6.21E-02/cy	10	9.64E-01	1.5583E+07	+1.06E+00	0.01	1:16:01:13	100	09:19:40	18:22:39
9.14745E+04	925155	5.92E-02	5.92E-02/cy	10	9.49E-01	1.5610E+07	+1.07E+00	0.01	1:16:11:13	98	09:29:40	18:19:51
9.16721E+04	928474	5.59E-02	5.59E-02/cy	10	9.37E-01	1.5637E+07	+1.09E+00	0.01	1:16:21:13	93	09:39:40	18:16:49
9.18608E+04	931762	6.05E-02	6.14E-02/cy	11	9.71E-01	1.5664E+07	+1.10E+00	0.01	1:16:31:13	98	09:49:40	18:14:06
9.20533E+04	935069	5.77E-02	6.08E-02/cy	10	9.91E-01	1.5690E+07	+1.12E+00	0.01	1:16:41:13	98	09:59:40	18:11:12
9.22415E+04	938356	5.99E-02	6.02E-02/cy	10	9.99E-01	1.5718E+07	+1.13E+00	0.01	1:16:51:13	98	10:09:41	18:08:26
9.24328E+04	941655	5.87E-02	5.87E-02/cy	11	9.49E-01	1.5744E+07	+1.15E+00	0.01	1:17:01:13	100	10:19:41	18:05:31
9.26205E+04	944940	5.47E-02	6.01E-02/cy	10	9.90E-01	1.5771E+07	+1.16E+00	0.01	1:17:11:13	98	10:29:41	18:02:42
9.28121E+04	948214	5.34E-02	6.03E-02/cy	10	9.72E-01	1.5797E+07	+1.17E+00	0.01	1:17:21:13	98	10:39:41	17:59:43
9.29982E+04	951496	6.02E-02	6.06E-02/cy	11	9.75E-01	1.5824E+07	+1.19E+00	0.01	1:17:31:14	98	10:49:41	17:56:55
9.31867E+04	954783	5.66E-02	5.77E-02/cy	11	9.68E-01	1.5848E+07	+1.20E+00	0.01	1:17:41:14	100	10:59:41	17:53:60

restart and spatial data available at t= 9.32400E+04												

9.32400E+04	955730	5.72E-02	6.00E-02/cy	11	9.60E-01	1.5856E+07	+1.21E+00	0.01	1:17:44:06	98	11:02:34	17:53:11
9.33703E+04	958056	5.69E-02	6.04E-02/cy	11	9.75E-01	1.5875E+07	+1.21E+00	0.01	1:17:51:14	98	11:09:41	17:51:14
9.35571E+04	961341	5.50E-02	6.03E-02/cy	10	9.74E-01	1.5902E+07	+1.23E+00	0.01	1:18:01:14	100	11:19:41	17:48:19
9.37441E+04	964619	5.44E-02	6.10E-02/cy	10	9.65E-01	1.5926E+07	+1.24E+00	0.01	1:18:11:14	100	11:29:41	17:45:22
9.39274E+04	967881	5.38E-02	6.02E-02/cy	10	9.69E-01	1.5951E+07	+1.25E+00	0.01	1:18:21:14	98	11:39:41	17:42:32
9.41118E+04	971159	5.53E-02	6.00E-02/cy	11	9.79E-01	1.5974E+07	+1.27E+00	0.01	1:18:31:14	100	11:49:41	17:39:37
9.42969E+04	974444	5.63E-02	5.98E-02/cy	11	9.63E-01	1.5997E+07	+1.28E+00	0.01	1:18:41:14	98	11:59:42	17:36:40
9.44852E+04	977730	5.97E-02	6.14E-02/cy	11	9.80E-01	1.6023E+07	+1.29E+00	0.01	1:18:51:14	98	12:09:42	17:33:33
9.46698E+04	981013	5.57E-02	5.99E-02/cy	10	9.92E-01	1.6047E+07	+1.30E+00	0.01	1:19:01:14	100	12:19:42	17:30:33
9.48552E+04	984294	5.12E-02	6.03E-02/cy	9	9.69E-01	1.6072E+07	+1.31E+00	0.01	1:19:11:14	100	12:29:42	17:27:30
9.50400E+04	987551	5.45E-02	5.92E-02/cy	10	9.83E-01	1.6097E+07	+1.32E+00	0.01	1:19:21:14	98	12:39:42	17:24:26
9.52253E+04	990831	5.84E-02	6.15E-02/cy	11	9.66E-01	1.6120E+07	+1.34E+00	0.01	1:19:31:15	100	12:49:42	17:21:20

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
9.54096E+04	994114	5.98E-02	6.03E-02/cy	11	9.89E-01	1.6146E+07	+1.35E+00	0.01	1:19:41:15	100	12:59:42	17:18:14
9.55928E+04	997385	5.54E-02	6.07E-02/cy	11	9.62E-01	1.6172E+07	+1.36E+00	0.01	1:19:51:15	98	13:09:42	17:15:09
9.57775E+04	1000668	5.86E-02	6.09E-02/cy	11	9.83E-01	1.6197E+07	+1.37E+00	0.01	1:20:01:15	98	13:19:42	17:11:60
9.59619E+04	1003947	5.85E-02	6.15E-02/cy	11	9.70E-01	1.6222E+07	+1.38E+00	0.01	1:20:11:15	100	13:29:42	17:08:49
9.61459E+04	1007209	5.99E-02	6.05E-02/cy	10	9.91E-01	1.6248E+07	+1.39E+00	0.01	1:20:21:15	98	13:39:42	17:05:38
9.63322E+04	1010491	5.98E-02	6.16E-02/cy	11	9.80E-01	1.6272E+07	+1.40E+00	0.01	1:20:31:15	94	13:49:42	17:02:20
9.65137E+04	1013774	5.35E-02	6.08E-02/cy	10	9.65E-01	1.6298E+07	+1.41E+00	0.01	1:20:41:15	98	13:59:43	16:59:11
9.67006E+04	1017058	5.57E-02	6.14E-02/cy	10	9.88E-01	1.6323E+07	+1.42E+00	0.01	1:20:51:15	100	14:09:43	16:55:48
9.68828E+04	1020338	5.33E-02	6.06E-02/cy	11	9.74E-01	1.6350E+07	+1.43E+00	0.01	1:21:01:15	100	14:19:43	16:52:35
9.70645E+04	1023615	5.89E-02	6.11E-02/cy	11	9.69E-01	1.6377E+07	+1.44E+00	0.01	1:21:11:15	100	14:29:43	16:49:21
9.72429E+04	1026870	5.64E-02	6.23E-02/cy	10	9.75E-01	1.6399E+07	+1.45E+00	0.01	1:21:21:16	98	14:39:43	16:46:14
9.74206E+04	1030147	5.83E-02	6.15E-02/cy	11	9.79E-01	1.6423E+07	+1.46E+00	0.01	1:21:31:16	100	14:49:43	16:43:06
9.76053E+04	1033427	5.82E-02	6.16E-02/cy	10	9.98E-01	1.6446E+07	+1.47E+00	0.01	1:21:41:16	93	14:59:43	16:39:41
9.77916E+04	1036707	5.66E-02	6.14E-02/cy	10	9.90E-01	1.6468E+07	+1.48E+00	0.01	1:21:51:16	100	15:09:43	16:36:11
9.79722E+04	1039986	5.62E-02	6.21E-02/cy	10	9.91E-01	1.6491E+07	+1.49E+00	0.01	1:22:01:16	98	15:19:43	16:32:52
9.81559E+04	1043266	5.55E-02	6.02E-02/cy	10	9.90E-01	1.6513E+07	+1.50E+00	0.01	1:22:11:16	98	15:29:44	16:29:25
9.83412E+04	1046525	5.93E-02	6.27E-02/cy	11	9.70E-01	1.6535E+07	+1.52E+00	0.01	1:22:21:16	98	15:39:44	16:25:52
9.85248E+04	1049799	5.91E-02	6.21E-02/cy	11	9.77E-01	1.6556E+07	+1.53E+00	0.01	1:22:31:16	98	15:49:44	16:22:22
9.87109E+04	1053076	5.47E-02	6.13E-02/cy	10	9.77E-01	1.6576E+07	+1.54E+00	0.01	1:22:41:16	98	15:59:44	16:18:45
9.88959E+04	1056356	5.45E-02	6.26E-02/cy	10	9.73E-01	1.6598E+07	+1.55E+00	0.01	1:22:51:16	100	16:09:44	16:15:09
9.90803E+04	1059634	5.43E-02	6.04E-02/cy	10	9.94E-01	1.6619E+07	+1.56E+00	0.01	1:23:01:16	100	16:19:44	16:11:33
9.92606E+04	1062913	5.31E-02	6.13E-02/cy	10	9.87E-01	1.6640E+07	+1.57E+00	0.01	1:23:11:17	100	16:29:44	16:08:05
9.94427E+04	1066174	5.35E-02	6.06E-02/cy	10	9.77E-01	1.6662E+07	+1.58E+00	0.01	1:23:21:17	100	16:39:44	16:04:31
progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
9.96268E+04	1069449	5.67E-02	6.00E-02/cy	11	9.65E-01	1.6684E+07	+1.59E+00	0.01	1:23:31:17	98	16:49:44	16:00:51
9.98083E+04	1072724	4.83E-02	6.03E-02/cy	10	9.77E-01	1.6703E+07	+1.60E+00	0.01	1:23:41:17	100	16:59:44	15:57:16
9.99897E+04	1076003	5.29E-02	6.08E-02/cy	10	9.95E-01	1.6724E+07	+1.61E+00	0.01	1:23:51:17	100	17:09:44	15:53:40
1.00172E+05	1079267	5.57E-02	6.15E-02/cy	10	9.74E-01	1.6745E+07	+1.62E+00	0.01	2:00:01:17	98	17:19:45	15:49:60
1.00355E+05	1082545	5.73E-02	6.09E-02/cy	11	9.60E-01	1.6766E+07	+1.63E+00	0.01	2:00:11:17	100	17:29:45	15:46:16
1.00537E+05	1085792	5.93E-02	6.11E-02/cy	11	9.80E-01	1.6786E+07	+1.64E+00	0.01	2:00:21:17	100	17:39:45	15:42:36
1.00716E+05	1089065	5.93E-02	6.09E-02/cy	11	9.82E-01	1.6806E+07	+1.65E+00	0.01	2:00:31:17	98	17:49:45	15:38:58
1.00899E+05	1092319	5.61E-02	6.14E-02/cy	10	9.86E-01	1.6825E+07	+1.66E+00	0.01	2:00:41:17	98	17:59:45	15:35:12
1.01081E+05	1095599	5.24E-02	6.01E-02/cy	11	9.76E-01	1.6847E+07	+1.67E+00	0.01	2:00:51:17	98	18:09:45	15:31:26
1.01262E+05	1098876	5.92E-02	6.20E-02/cy	11	9.91E-01	1.6866E+07	+1.68E+00	0.01	2:01:01:18	98	18:19:45	15:27:41
1.01446E+05	1102139	5.48E-02	6.08E-02/cy	10	9.98E-01	1.6888E+07	+1.69E+00	0.01	2:01:11:18	98	18:29:45	15:23:47
1.01625E+05	1105395	5.84E-02	6.13E-02/cy	11	9.86E-01	1.6907E+07	+1.70E+00	0.01	2:01:21:18	98	18:39:45	15:20:03
1.01803E+05	1108655	5.30E-02	6.20E-02/cy	10	9.70E-01	1.6925E+07	+1.71E+00	0.01	2:01:31:18	93	18:49:45	15:16:24
1.01983E+05	1111932	6.02E-02	6.06E-02/cy	11	9.89E-01	1.6946E+07	+1.72E+00	0.01	2:01:41:18	98	18:59:45	15:12:35
1.02161E+05	1115170	5.65E-02	5.95E-02/cy	12	9.97E-01	1.6965E+07	+1.73E+00	0.01	2:01:51:18	98	19:09:45	15:08:50
1.02336E+05	1118428	5.00E-02	5.92E-02/cy	11	9.71E-01	1.6982E+07	+1.74E+00	0.01	2:02:01:18	98	19:19:45	15:05:11
1.02510E+05	1121705	5.75E-02	6.06E-02/cy	11	9.84E-01	1.6997E+07	+1.74E+00	0.01	2:02:11:18	98	19:29:46	15:01:33
1.02689E+05	1124963	5.54E-02	6.15E-02/cy	11	9.70E-01	1.7013E+07	+1.75E+00	0.01	2:02:21:18	98	19:39:46	14:57:41
1.02867E+05	1128218	4.81E-02	6.05E-02/cy	10	9.86E-01	1.7034E+07	+1.76E+00	0.01	2:02:31:18	100	19:49:46	14:53:52
1.03043E+05	1131492	5.32E-02	6.09E-02/cy	10	9.97E-01	1.7051E+07	+1.77E+00	0.01	2:02:41:18	100	19:59:46	14:50:06
1.03213E+05	1134769	5.07E-02	6.16E-02/cy	9	9.92E-01	1.7067E+07	+1.78E+00	0.01	2:02:51:18	100	20:09:46	14:46:30
1.03383E+05	1138028	5.46E-02	6.24E-02/cy	10	9.98E-01	1.7085E+07	+1.79E+00	0.01	2:03:01:19	98	20:19:46	14:42:54
1.03558E+05	1141250	5.58E-02	6.22E-02/cy	11	9.64E-01	1.7104E+07	+1.80E+00	0.01	2:03:11:19	94	20:29:46	14:39:07

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.03726E+05	1144396	5.83E-02	6.18E-02/cy	11	9.77E-01	1.7121E+07	+1.81E+00	0.01	2:03:21:19	100	20:39:46	14:35:33
1.03895E+05	1147669	5.01E-02	5.99E-02/cy	10	9.79E-01	1.7138E+07	+1.82E+00	0.01	2:03:31:19	100	20:49:46	14:31:58
1.04069E+05	1150929	5.67E-02	6.16E-02/cy	11	9.78E-01	1.7156E+07	+1.83E+00	0.01	2:03:41:19	98	20:59:47	14:28:06
1.04242E+05	1154190	5.45E-02	6.30E-02/cy	10	9.84E-01	1.7171E+07	+1.84E+00	0.01	2:03:51:19	100	21:09:47	14:24:18
1.04415E+05	1157459	5.25E-02	6.23E-02/cy	10	9.74E-01	1.7190E+07	+1.85E+00	0.01	2:04:01:19	98	21:19:47	14:20:28
1.04588E+05	1160719	4.83E-02	6.00E-02/cy	10	9.76E-01	1.7210E+07	+1.85E+00	0.01	2:04:11:20	100	21:29:47	14:16:39
1.04757E+05	1163962	5.31E-02	5.91E-02/cy	11	9.89E-01	1.7227E+07	+1.86E+00	0.01	2:04:21:20	98	21:39:47	14:12:55
1.04931E+05	1167220	5.45E-02	6.02E-02/cy	11	9.81E-01	1.7247E+07	+1.87E+00	0.01	2:04:31:20	98	21:49:47	14:08:59
1.05103E+05	1170472	5.10E-02	6.14E-02/cy	10	9.92E-01	1.7268E+07	+1.88E+00	0.01	2:04:41:20	100	21:59:47	14:05:08
1.05269E+05	1173744	5.14E-02	6.12E-02/cy	11	9.79E-01	1.7284E+07	+1.89E+00	0.01	2:04:51:20	98	22:09:47	14:01:27
1.05441E+05	1177016	5.18E-02	5.93E-02/cy	11	9.79E-01	1.7299E+07	+1.90E+00	0.01	2:05:01:20	98	22:19:48	13:57:32
1.05608E+05	1180275	5.05E-02	6.05E-02/cy	10	9.83E-01	1.7314E+07	+1.90E+00	0.01	2:05:11:20	98	22:29:48	13:53:48
1.05776E+05	1183531	5.20E-02	6.00E-02/cy	11	9.90E-01	1.7324E+07	+1.91E+00	0.01	2:05:21:20	100	22:39:48	13:49:59
1.05943E+05	1186789	5.33E-02	6.08E-02/cy	11	9.91E-01	1.7337E+07	+1.92E+00	0.01	2:05:31:21	98	22:49:48	13:46:14
1.06111E+05	1190059	5.39E-02	6.09E-02/cy	11	9.82E-01	1.7347E+07	+1.93E+00	0.01	2:05:41:21	98	22:59:48	13:42:21
1.06279E+05	1193317	5.00E-02	5.96E-02/cy	10	9.76E-01	1.7358E+07	+1.93E+00	0.01	2:05:51:21	98	23:09:48	13:38:32
1.06448E+05	1196570	4.91E-02	6.06E-02/cy	11	9.70E-01	1.7370E+07	+1.94E+00	0.01	2:06:01:21	98	23:19:48	13:34:37

restart and spatial data available at t= 1.06560E+05												

1.06560E+05	1198760	5.23E-02	5.98E-02/cy	11	9.84E-01	1.7378E+07	+1.95E+00	0.01	2:06:08:02	100	23:26:30	13:32:01
1.06613E+05	1199834	5.01E-02	5.95E-02/cy	10	9.97E-01	1.7380E+07	+1.95E+00	0.01	2:06:11:21	93	23:29:48	13:30:49
1.06779E+05	1203090	5.15E-02	5.98E-02/cy	11	9.77E-01	1.7390E+07	+1.96E+00	0.01	2:06:21:21	100	23:39:48	13:26:59
1.06947E+05	1206341	5.07E-02	6.05E-02/cy	11	9.67E-01	1.7401E+07	+1.97E+00	0.01	2:06:31:21	100	23:49:48	13:23:03
1.07114E+05	1209611	5.13E-02	6.14E-02/cy	10	9.97E-01	1.7413E+07	+1.97E+00	0.01	2:06:41:21	100	23:59:49	13:19:08
1.07281E+05	1212886	4.90E-02	6.01E-02/cy	10	9.74E-01	1.7424E+07	+1.98E+00	0.01	2:06:51:21	100	00:09:49	13:15:11

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.07448E+05	1216143	4.79E-02	5.94E-02/cy	10	9.88E-01	1.7434E+07	+1.99E+00	0.01	2:07:01:21	98	00:19:49	13:11:15
1.07616E+05	1219419	4.80E-02	6.01E-02/cy	10	9.74E-01	1.7444E+07	+2.00E+00	0.01	2:07:11:22	94	00:29:49	13:07:14
1.07782E+05	1222674	5.20E-02	6.06E-02/cy	11	9.77E-01	1.7455E+07	+2.01E+00	0.01	2:07:21:22	98	00:39:49	13:03:17
1.07947E+05	1225928	4.85E-02	5.97E-02/cy	10	9.79E-01	1.7466E+07	+2.02E+00	0.01	2:07:31:22	100	00:49:49	12:59:19
1.08114E+05	1229191	5.20E-02	6.07E-02/cy	10	9.98E-01	1.7476E+07	+2.03E+00	0.01	2:07:41:22	100	00:59:49	12:55:18
1.08281E+05	1232449	5.34E-02	6.26E-02/cy	11	9.70E-01	1.7488E+07	+2.04E+00	0.01	2:07:51:22	94	01:09:49	12:51:15
1.08449E+05	1235721	4.87E-02	6.05E-02/cy	10	9.78E-01	1.7500E+07	+2.05E+00	0.01	2:08:01:22	98	01:19:49	12:47:10
1.08615E+05	1238977	5.54E-02	6.11E-02/cy	11	9.93E-01	1.7510E+07	+2.05E+00	0.01	2:08:11:22	98	01:29:50	12:43:08
1.08783E+05	1242232	4.91E-02	6.09E-02/cy	11	9.79E-01	1.7522E+07	+2.06E+00	0.01	2:08:21:22	100	01:39:50	12:38:58
1.08951E+05	1245503	5.21E-02	5.95E-02/cy	11	9.91E-01	1.7533E+07	+2.07E+00	0.01	2:08:31:22	100	01:49:50	12:34:50
1.09114E+05	1248758	5.10E-02	6.03E-02/cy	10	9.99E-01	1.7544E+07	+2.08E+00	0.01	2:08:41:22	98	01:59:50	12:30:50
1.09281E+05	1252034	5.12E-02	6.09E-02/cx	11	9.78E-01	1.7555E+07	+2.09E+00	0.01	2:08:51:23	100	02:09:50	12:26:40
1.09448E+05	1255306	5.16E-02	5.98E-02/cy	11	9.87E-01	1.7566E+07	+2.10E+00	0.01	2:09:01:23	98	02:19:50	12:22:30
1.09614E+05	1258580	5.19E-02	5.94E-02/cy	11	9.84E-01	1.7578E+07	+2.11E+00	0.01	2:09:11:23	98	02:29:50	12:18:21
1.09780E+05	1261831	5.11E-02	6.10E-02/cx	10	9.89E-01	1.7590E+07	+2.12E+00	0.01	2:09:21:23	98	02:39:50	12:14:11
1.09945E+05	1265102	4.91E-02	6.04E-02/cy	10	9.73E-01	1.7602E+07	+2.12E+00	0.01	2:09:31:23	98	02:49:50	12:10:01
1.10113E+05	1268373	5.21E-02	5.99E-02/cy	11	9.67E-01	1.7613E+07	+2.13E+00	0.01	2:09:41:23	98	02:59:50	12:05:43
1.10279E+05	1271648	4.98E-02	6.12E-02/cy	10	9.84E-01	1.7626E+07	+2.14E+00	0.01	2:09:51:23	100	03:09:50	12:01:32
1.10442E+05	1274918	5.03E-02	6.04E-02/cy	11	9.70E-01	1.7637E+07	+2.15E+00	0.01	2:10:01:23	98	03:19:51	11:57:23
1.10609E+05	1278191	5.33E-02	5.94E-02/cy	11	9.85E-01	1.7646E+07	+2.16E+00	0.01	2:10:11:23	100	03:29:51	11:53:06
1.10775E+05	1281446	5.22E-02	6.12E-02/cy	10	9.97E-01	1.7659E+07	+2.17E+00	0.01	2:10:21:23	98	03:39:51	11:48:49
1.10940E+05	1284713	5.04E-02	6.01E-02/cy	10	9.91E-01	1.7669E+07	+2.18E+00	0.01	2:10:31:24	100	03:49:51	11:44:33
1.11107E+05	1287981	5.11E-02	5.97E-02/cy	11	9.78E-01	1.7680E+07	+2.18E+00	0.01	2:10:41:24	100	03:59:51	11:40:12

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.11269E+05	1291193	5.02E-02	6.01E-02/cy	11	9.74E-01	1.7689E+07	+2.19E+00	0.01	2:10:51:24	100	04:09:51	11:36:02
1.11435E+05	1294464	5.33E-02	6.02E-02/cy	11	9.70E-01	1.7701E+07	+2.20E+00	0.01	2:11:01:24	98	04:19:51	11:31:41
1.11600E+05	1297737	5.11E-02	6.01E-02/cy	11	9.91E-01	1.7713E+07	+2.21E+00	0.01	2:11:11:24	100	04:29:52	11:27:23
1.11761E+05	1300974	5.12E-02	6.02E-02/cy	11	9.85E-01	1.7722E+07	+2.22E+00	0.01	2:11:21:24	100	04:39:52	11:23:10
1.11926E+05	1304244	5.17E-02	5.92E-02/cy	11	9.93E-01	1.7732E+07	+2.22E+00	0.01	2:11:31:24	100	04:49:52	11:18:49
1.12092E+05	1307515	5.49E-02	6.13E-02/cy	11	9.90E-01	1.7743E+07	+2.23E+00	0.01	2:11:41:25	100	04:59:52	11:14:26
1.12255E+05	1310790	4.75E-02	5.95E-02/cy	10	9.74E-01	1.7755E+07	+2.24E+00	0.01	2:11:51:25	100	05:09:52	11:10:07
1.12418E+05	1314059	5.05E-02	5.99E-02/cy	11	9.69E-01	1.7765E+07	+2.25E+00	0.01	2:12:01:25	98	05:19:52	11:05:46
1.12583E+05	1317331	5.09E-02	6.07E-02/cy	11	9.69E-01	1.7775E+07	+2.26E+00	0.01	2:12:11:25	98	05:29:52	11:01:21
1.12747E+05	1320584	5.00E-02	6.06E-02/cy	10	9.80E-01	1.7785E+07	+2.26E+00	0.01	2:12:21:25	94	05:39:52	10:56:56
1.12908E+05	1323851	5.34E-02	6.10E-02/cy	11	9.79E-01	1.7795E+07	+2.27E+00	0.01	2:12:31:25	98	05:49:52	10:52:39
1.13071E+05	1327122	5.13E-02	5.99E-02/cy	11	9.84E-01	1.7806E+07	+2.28E+00	0.01	2:12:41:25	98	05:59:53	10:48:14
1.13235E+05	1330388	4.71E-02	5.88E-02/cy	10	9.76E-01	1.7816E+07	+2.29E+00	0.01	2:12:51:25	93	06:09:53	10:43:49
1.13399E+05	1333658	4.76E-02	6.07E-02/cy	10	9.78E-01	1.7828E+07	+2.29E+00	0.01	2:13:01:25	98	06:19:53	10:39:22
1.13562E+05	1336930	4.80E-02	5.97E-02/cy	10	9.85E-01	1.7839E+07	+2.30E+00	0.01	2:13:11:25	98	06:29:53	10:34:54
1.13724E+05	1340180	4.98E-02	5.99E-02/cy	11	9.74E-01	1.7846E+07	+2.31E+00	0.01	2:13:21:25	100	06:39:53	10:30:29
1.13888E+05	1343449	4.79E-02	5.99E-02/cy	10	9.95E-01	1.7855E+07	+2.32E+00	0.01	2:13:31:26	98	06:49:53	10:25:58
1.14052E+05	1346719	5.35E-02	5.98E-02/cy	11	9.88E-01	1.7865E+07	+2.32E+00	0.01	2:13:41:26	100	06:59:53	10:21:26
1.14213E+05	1349992	5.13E-02	6.06E-02/cy	11	9.66E-01	1.7875E+07	+2.33E+00	0.01	2:13:51:26	98	07:09:53	10:16:59
1.14378E+05	1353262	4.69E-02	5.94E-02/cy	10	9.73E-01	1.7885E+07	+2.34E+00	0.01	2:14:01:26	98	07:19:53	10:12:23
1.14541E+05	1356532	5.24E-02	6.02E-02/cy	11	9.89E-01	1.7895E+07	+2.34E+00	0.01	2:14:11:26	98	07:29:53	10:07:51
1.14705E+05	1359781	5.17E-02	6.09E-02/cy	11	9.85E-01	1.7907E+07	+2.35E+00	0.01	2:14:21:26	98	07:39:53	10:03:16
1.14868E+05	1363048	4.99E-02	5.81E-02/cy	11	9.83E-01	1.7916E+07	+2.36E+00	0.01	2:14:31:26	100	07:49:54	09:58:41
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.15032E+05	1366317	4.81E-02	6.01E-02/cy	10	9.85E-01	1.7926E+07	+2.37E+00	0.01	2:14:41:26	98	07:59:54	09:54:05
1.15193E+05	1369551	5.08E-02	5.94E-02/cy	11	9.92E-01	1.7935E+07	+2.37E+00	0.01	2:14:51:26	100	08:09:54	09:49:32
1.15356E+05	1372818	4.91E-02	5.95E-02/cy	11	9.73E-01	1.7945E+07	+2.38E+00	0.01	2:15:01:26	98	08:19:54	09:44:57
1.15518E+05	1376091	5.19E-02	6.05E-02/cy	11	9.84E-01	1.7955E+07	+2.39E+00	0.01	2:15:11:27	98	08:29:54	09:40:21
1.15678E+05	1379344	5.10E-02	6.06E-02/cy	11	9.76E-01	1.7964E+07	+2.39E+00	0.01	2:15:21:27	100	08:39:54	09:35:48
1.15841E+05	1382613	4.91E-02	6.10E-02/cy	10	9.87E-01	1.7972E+07	+2.40E+00	0.01	2:15:31:27	100	08:49:54	09:31:09
1.16006E+05	1385881	4.98E-02	5.94E-02/cy	11	9.70E-01	1.7982E+07	+2.41E+00	0.01	2:15:41:27	98	08:59:54	09:26:25
1.16168E+05	1389149	5.04E-02	6.02E-02/cy	11	9.76E-01	1.7990E+07	+2.41E+00	0.01	2:15:51:27	100	09:09:54	09:21:44
1.16331E+05	1392422	5.34E-02	5.97E-02/cy	11	9.72E-01	1.7999E+07	+2.42E+00	0.01	2:16:01:27	94	09:19:55	09:17:02
1.16493E+05	1395689	5.15E-02	5.99E-02/cy	11	9.87E-01	1.8008E+07	+2.42E+00	0.01	2:16:11:27	98	09:29:55	09:12:21
1.16657E+05	1398940	5.07E-02	5.99E-02/cy	11	9.93E-01	1.8018E+07	+2.43E+00	0.01	2:16:21:27	98	09:39:55	09:07:35
1.16818E+05	1402208	4.65E-02	5.97E-02/cy	9	9.79E-01	1.8027E+07	+2.44E+00	0.01	2:16:31:27	100	09:49:55	09:02:54
1.16982E+05	1405474	5.22E-02	6.06E-02/cy	11	9.89E-01	1.8035E+07	+2.44E+00	0.01	2:16:41:27	98	09:59:55	08:58:08
1.17146E+05	1408740	4.80E-02	6.01E-02/cy	10	9.97E-01	1.8044E+07	+2.45E+00	0.01	2:16:51:28	98	10:09:55	08:53:18
1.17309E+05	1412002	4.90E-02	5.97E-02/cy	10	9.62E-01	1.8052E+07	+2.45E+00	0.01	2:17:01:28	100	10:19:55	08:48:30
1.17470E+05	1415259	4.79E-02	6.04E-02/cy	10	9.93E-01	1.8060E+07	+2.46E+00	0.01	2:17:11:28	100	10:29:55	08:43:46
1.17630E+05	1418450	5.09E-02	6.01E-02/cy	10	9.93E-01	1.8068E+07	+2.47E+00	0.01	2:17:21:28	98	10:39:55	08:39:04
1.17793E+05	1421721	5.40E-02	6.06E-02/cy	11	9.91E-01	1.8078E+07	+2.47E+00	0.01	2:17:31:28	100	10:49:55	08:34:13
1.17956E+05	1424991	4.94E-02	5.91E-02/cy	11	9.78E-01	1.8086E+07	+2.48E+00	0.01	2:17:41:28	98	10:59:55	08:29:23
1.18119E+05	1428266	4.72E-02	6.01E-02/cy	9	9.78E-01	1.8095E+07	+2.48E+00	0.01	2:17:51:28	98	11:09:55	08:24:30
1.18283E+05	1431541	4.98E-02	6.10E-02/cy	10	9.74E-01	1.8102E+07	+2.49E+00	0.01	2:18:01:28	98	11:19:56	08:19:36
1.18448E+05	1434813	5.02E-02	5.91E-02/cy	11	9.72E-01	1.8112E+07	+2.49E+00	0.01	2:18:11:28	98	11:29:56	08:14:37
1.18609E+05	1438062	4.96E-02	6.13E-02/cy	10	9.86E-01	1.8121E+07	+2.50E+00	0.01	2:18:21:28	93	11:39:56	08:09:46

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.18775E+05	1441331	5.28E-02	6.20E-02/cy	10	9.92E-01	1.8128E+07	+2.50E+00	0.01	2:18:31:28	98	11:49:56	08:04:45
1.18937E+05	1444599	5.35E-02	6.05E-02/cy	11	9.74E-01	1.8139E+07	+2.51E+00	0.01	2:18:41:29	98	11:59:56	07:59:52
1.19101E+05	1447872	4.63E-02	6.00E-02/cy	10	9.74E-01	1.8146E+07	+2.51E+00	0.01	2:18:51:29	98	12:09:56	07:54:53
1.19266E+05	1451145	5.42E-02	6.08E-02/cy	11	9.73E-01	1.8153E+07	+2.52E+00	0.01	2:19:01:29	100	12:19:56	07:49:50
1.19426E+05	1454418	5.20E-02	6.06E-02/cy	11	9.65E-01	1.8161E+07	+2.52E+00	0.01	2:19:11:29	100	12:29:56	07:44:57
1.19593E+05	1457673	5.63E-02	6.23E-02/cy	11	9.75E-01	1.8168E+07	+2.53E+00	0.01	2:19:21:29	98	12:39:56	07:39:50
1.19757E+05	1460945	5.13E-02	5.91E-02/cy	11	9.70E-01	1.8176E+07	+2.53E+00	0.01	2:19:31:29	98	12:49:56	07:34:47

restart and spatial data available at t= 1.19880E+05												

1.19880E+05	1463361	5.02E-02	6.05E-02/cy	10	9.73E-01	1.8181E+07	+2.54E+00	0.01	2:19:38:53	98	12:57:20	07:30:59
1.19922E+05	1464205	4.75E-02	5.93E-02/cy	11	9.65E-01	1.8184E+07	+2.54E+00	0.01	2:19:41:29	98	12:59:56	07:29:41
1.20086E+05	1467464	5.12E-02	6.07E-02/cy	10	9.88E-01	1.8193E+07	+2.54E+00	0.01	2:19:51:29	98	13:09:56	07:24:38
1.20249E+05	1470739	5.41E-02	6.14E-02/cy	10	9.99E-01	1.8202E+07	+2.55E+00	0.01	2:20:01:29	98	13:19:56	07:19:34
1.20414E+05	1474012	4.69E-02	5.99E-02/cy	10	9.86E-01	1.8209E+07	+2.55E+00	0.01	2:20:11:29	100	13:29:57	07:14:28
1.20580E+05	1477269	5.06E-02	6.16E-02/cy	10	9.88E-01	1.8217E+07	+2.56E+00	0.01	2:20:21:29	100	13:39:57	07:09:15
1.20749E+05	1480542	4.85E-02	5.96E-02/cy	10	9.83E-01	1.8226E+07	+2.56E+00	0.01	2:20:31:29	98	13:49:57	07:03:58
1.20911E+05	1483814	4.89E-02	6.02E-02/cy	10	9.87E-01	1.8234E+07	+2.56E+00	0.01	2:20:41:30	98	13:59:57	06:58:54
1.21077E+05	1487088	4.92E-02	6.19E-02/cy	10	9.79E-01	1.8242E+07	+2.57E+00	0.01	2:20:51:30	100	14:09:57	06:53:40
1.21244E+05	1490361	4.71E-02	5.91E-02/cy	10	9.73E-01	1.8251E+07	+2.57E+00	0.01	2:21:01:30	98	14:19:57	06:48:24
Spatial Data Request Signaled												

restart and spatial data available at t= 1.21376E+05												

1.21376E+05	1492974	5.12E-02	5.98E-02/cy	11	9.70E-01	1.8258E+07	+2.57E+00	0.01	2:21:09:41	98	14:28:08	06:44:14
1.21404E+05	1493556	4.98E-02	6.03E-02/cy	11	9.68E-01	1.8259E+07	+2.57E+00	0.01	2:21:11:30	100	14:29:57	06:43:22
1.21566E+05	1496807	5.42E-02	6.10E-02/cy	11	9.63E-01	1.8268E+07	+2.58E+00	0.01	2:21:21:30	100	14:39:58	06:38:17
1.21731E+05	1500076	4.72E-02	5.93E-02/cy	10	9.89E-01	1.8274E+07	+2.58E+00	0.01	2:21:31:30	98	14:49:58	06:33:01
1.21896E+05	1503346	5.27E-02	6.08E-02/cy	11	9.91E-01	1.8281E+07	+2.59E+00	0.01	2:21:41:30	100	14:59:58	06:27:45
1.22065E+05	1506619	5.05E-02	6.03E-02/cy	10	9.97E-01	1.8290E+07	+2.59E+00	0.01	2:21:51:31	100	15:09:58	06:22:21

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.22228E+05	1509895	5.07E-02	5.89E-02/cy	11	9.88E-01	1.8299E+07	+2.59E+00	0.01	2:22:01:31	98	15:19:58	06:17:10
1.22392E+05	1513164	5.39E-02	6.11E-02/cy	11	9.66E-01	1.8307E+07	+2.60E+00	0.01	2:22:11:31	98	15:29:58	06:11:55
1.22557E+05	1516414	4.57E-02	5.84E-02/cy	10	9.91E-01	1.8314E+07	+2.60E+00	0.01	2:22:21:31	93	15:39:58	06:06:36
1.22720E+05	1519693	4.87E-02	5.87E-02/cy	11	9.65E-01	1.8323E+07	+2.60E+00	0.01	2:22:31:31	100	15:49:58	06:01:21
1.22885E+05	1522953	4.92E-02	5.94E-02/cy	11	9.77E-01	1.8328E+07	+2.61E+00	0.01	2:22:41:31	100	15:59:59	05:56:01
1.23053E+05	1526224	5.22E-02	6.24E-02/cy	10	9.91E-01	1.8336E+07	+2.61E+00	0.01	2:22:51:31	100	16:09:59	05:50:34
1.23221E+05	1529497	5.00E-02	5.92E-02/cy	10	9.98E-01	1.8344E+07	+2.61E+00	0.01	2:23:01:32	98	16:19:59	05:45:08
1.23386E+05	1532761	5.09E-02	6.07E-02/cy	10	9.69E-01	1.8349E+07	+2.61E+00	0.01	2:23:11:32	98	16:29:59	05:39:45
1.23549E+05	1536015	5.25E-02	6.11E-02/cy	11	9.71E-01	1.8354E+07	+2.62E+00	0.01	2:23:21:32	100	16:39:59	05:34:26
1.23716E+05	1539285	4.81E-02	5.88E-02/cy	10	9.82E-01	1.8359E+07	+2.62E+00	0.01	2:23:31:32	98	16:49:59	05:29:00
1.23883E+05	1542553	5.38E-02	6.13E-02/cy	11	9.72E-01	1.8363E+07	+2.62E+00	0.01	2:23:41:32	98	16:59:59	05:23:30
1.24054E+05	1545824	4.68E-02	5.73E-02/cy	11	9.69E-01	1.8369E+07	+2.62E+00	0.01	2:23:51:32	98	17:09:59	05:17:52
1.24220E+05	1549077	5.61E-02	6.12E-02/cy	11	9.79E-01	1.8372E+07	+2.63E+00	0.01	3:00:01:32	100	17:19:59	05:12:25
1.24392E+05	1552348	5.39E-02	6.09E-02/cy	11	9.75E-01	1.8376E+07	+2.63E+00	0.01	3:00:11:32	98	17:29:59	05:06:42
1.24562E+05	1555586	5.67E-02	6.15E-02/cy	11	9.95E-01	1.8381E+07	+2.63E+00	0.01	3:00:21:32	94	17:40:00	05:01:03
1.24721E+05	1558774	5.20E-02	5.98E-02/cy	11	9.70E-01	1.8384E+07	+2.63E+00	0.01	3:00:31:32	98	17:50:00	04:55:49
1.24887E+05	1561971	5.48E-02	6.06E-02/cy	11	9.82E-01	1.8387E+07	+2.63E+00	0.01	3:00:41:32	98	18:00:00	04:50:20
1.25059E+05	1565242	5.26E-02	6.16E-02/cy	10	9.84E-01	1.8390E+07	+2.64E+00	0.01	3:00:51:32	100	18:10:00	04:44:34
1.25227E+05	1568497	5.70E-02	6.08E-02/cy	11	9.88E-01	1.8395E+07	+2.64E+00	0.01	3:01:01:32	100	18:20:00	04:38:59
1.25398E+05	1571765	5.22E-02	6.04E-02/cy	10	9.72E-01	1.8396E+07	+2.64E+00	0.01	3:01:11:33	98	18:30:00	04:33:14
1.25561E+05	1574968	5.46E-02	6.10E-02/cy	11	9.69E-01	1.8401E+07	+2.64E+00	0.01	3:01:21:33	100	18:40:00	04:27:47
1.25731E+05	1578179	5.11E-02	6.08E-02/cy	10	9.78E-01	1.8402E+07	+2.64E+00	0.01	3:01:31:33	100	18:50:00	04:22:04
1.25900E+05	1581433	5.27E-02	5.98E-02/cy	11	9.65E-01	1.8406E+07	+2.65E+00	0.01	3:01:41:33	100	19:00:00	04:16:22

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.26068E+05	1584686	5.18E-02	6.01E-02/cy	10	9.90E-01	1.8409E+07	+2.65E+00	0.01	3:01:51:33	93	19:10:00	04:10:43
1.26238E+05	1587943	5.06E-02	5.92E-02/cy	11	9.69E-01	1.8411E+07	+2.65E+00	0.01	3:02:01:33	98	19:20:01	04:04:56
1.26410E+05	1591215	5.10E-02	6.00E-02/cy	10	9.91E-01	1.8415E+07	+2.65E+00	0.01	3:02:11:33	100	19:30:01	03:59:06
1.26580E+05	1594450	5.13E-02	6.06E-02/cy	10	9.91E-01	1.8417E+07	+2.65E+00	0.01	3:02:21:33	100	19:40:01	03:53:20
1.26751E+05	1597719	4.94E-02	6.02E-02/cy	10	9.84E-01	1.8419E+07	+2.65E+00	0.01	3:02:31:33	100	19:50:01	03:47:30
1.26922E+05	1600971	5.10E-02	6.17E-02/cy	10	9.76E-01	1.8422E+07	+2.65E+00	0.01	3:02:41:34	98	20:00:01	03:41:41
1.27093E+05	1604243	5.15E-02	5.98E-02/cy	10	9.76E-01	1.8424E+07	+2.66E+00	0.01	3:02:51:34	98	20:10:01	03:35:50
1.27264E+05	1607517	5.18E-02	5.98E-02/cy	11	9.57E-01	1.8425E+07	+2.66E+00	0.01	3:03:01:34	98	20:20:01	03:29:58
1.27434E+05	1610772	5.07E-02	5.92E-02/cy	10	9.79E-01	1.8428E+07	+2.66E+00	0.01	3:03:11:34	100	20:30:01	03:24:08
1.27603E+05	1614008	5.35E-02	6.06E-02/cy	10	9.92E-01	1.8431E+07	+2.66E+00	0.01	3:03:21:34	98	20:40:01	03:18:19
1.27774E+05	1617262	4.99E-02	5.92E-02/cy	10	9.85E-01	1.8434E+07	+2.66E+00	0.01	3:03:31:34	90	20:50:01	03:12:26
1.27945E+05	1620534	5.03E-02	5.99E-02/cy	10	9.93E-01	1.8435E+07	+2.66E+00	0.01	3:03:41:34	98	21:00:01	03:06:32
1.28116E+05	1623789	5.45E-02	6.08E-02/cy	11	9.71E-01	1.8436E+07	+2.66E+00	0.01	3:03:51:34	98	21:10:02	03:00:37
1.28287E+05	1627062	5.22E-02	5.97E-02/cy	11	9.73E-01	1.8437E+07	+2.67E+00	0.01	3:04:01:34	90	21:20:02	02:54:42
1.28457E+05	1630316	5.39E-02	5.98E-02/cy	11	9.55E-01	1.8437E+07	+2.67E+00	0.01	3:04:11:35	100	21:30:02	02:48:49
1.28629E+05	1633571	5.28E-02	6.01E-02/cy	10	9.73E-01	1.8438E+07	+2.67E+00	0.01	3:04:21:35	100	21:40:02	02:42:49
1.28801E+05	1636841	5.33E-02	5.94E-02/cy	11	9.53E-01	1.8441E+07	+2.67E+00	0.01	3:04:31:35	98	21:50:02	02:36:49
1.28972E+05	1640092	5.25E-02	6.02E-02/cy	10	9.81E-01	1.8442E+07	+2.67E+00	0.01	3:04:41:35	100	22:00:02	02:30:50
1.29143E+05	1643345	5.16E-02	6.06E-02/cy	10	9.69E-01	1.8443E+07	+2.67E+00	0.01	3:04:51:35	100	22:10:02	02:24:51
1.29315E+05	1646618	5.46E-02	6.05E-02/cy	11	9.57E-01	1.8444E+07	+2.67E+00	0.01	3:05:01:35	100	22:20:03	02:18:51
1.29488E+05	1649861	5.43E-02	6.04E-02/cy	11	9.50E-01	1.8445E+07	+2.68E+00	0.01	3:05:11:35	100	22:30:03	02:12:47
1.29657E+05	1653088	5.51E-02	6.01E-02/cy	11	9.83E-01	1.8448E+07	+2.68E+00	0.01	3:05:21:35	98	22:40:03	02:06:51
1.29828E+05	1656357	5.30E-02	6.03E-02/cy	11	9.55E-01	1.8450E+07	+2.68E+00	0.01	3:05:31:36	100	22:50:03	02:00:49

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.30003E+05	1659596	5.30E-02	5.97E-02/cy	11	9.57E-01	1.8450E+07	+2.68E+00	0.01	3:05:41:36	98	23:00:03	01:54:38
1.30175E+05	1662850	5.46E-02	6.10E-02/cy	11	9.55E-01	1.8452E+07	+2.68E+00	0.01	3:05:51:36	98	23:10:03	01:48:34
1.30349E+05	1666104	5.06E-02	5.96E-02/cy	10	9.87E-01	1.8451E+07	+2.68E+00	0.01	3:06:01:36	90	23:20:03	01:42:24
1.30521E+05	1669372	5.13E-02	5.99E-02/cy	10	9.99E-01	1.8448E+07	+2.68E+00	0.01	3:06:11:36	100	23:30:03	01:36:18
1.30693E+05	1672606	5.23E-02	5.98E-02/cy	11	9.55E-01	1.8448E+07	+2.68E+00	0.01	3:06:21:36	100	23:40:04	01:30:11
1.30862E+05	1675855	5.17E-02	5.99E-02/cy	10	9.70E-01	1.8444E+07	+2.68E+00	0.01	3:06:31:36	98	23:50:04	01:24:11
1.31037E+05	1679124	5.19E-02	5.85E-02/cy	11	9.58E-01	1.8444E+07	+2.69E+00	0.01	3:06:41:36	98	00:00:04	01:17:56
1.31211E+05	1682389	5.02E-02	5.98E-02/cy	10	9.77E-01	1.8440E+07	+2.69E+00	0.01	3:06:51:36	90	00:10:04	01:11:43
1.31386E+05	1685643	5.41E-02	5.89E-02/cy	11	9.80E-01	1.8439E+07	+2.69E+00	0.01	3:07:01:36	100	00:20:04	01:05:29
1.31560E+05	1688911	5.36E-02	5.93E-02/cy	10	9.98E-01	1.8437E+07	+2.69E+00	0.01	3:07:11:37	98	00:30:04	00:59:14
1.31730E+05	1692142	5.41E-02	6.02E-02/cy	11	9.54E-01	1.8435E+07	+2.69E+00	0.01	3:07:21:37	100	00:40:04	00:53:08
1.31907E+05	1695409	5.65E-02	6.15E-02/cy	10	9.82E-01	1.8435E+07	+2.69E+00	0.01	3:07:31:37	98	00:50:04	00:46:47
1.32079E+05	1698660	5.55E-02	5.99E-02/cy	11	9.69E-01	1.8432E+07	+2.69E+00	0.01	3:07:41:37	90	01:00:04	00:40:34
1.32255E+05	1701927	5.36E-02	5.99E-02/cy	10	9.63E-01	1.8431E+07	+2.69E+00	0.01	3:07:51:37	98	01:10:04	00:34:15
1.32430E+05	1705180	5.19E-02	5.91E-02/cy	11	9.55E-01	1.8431E+07	+2.69E+00	0.01	3:08:01:37	90	01:20:05	00:27:55
1.32607E+05	1708449	5.17E-02	6.09E-02/cy	10	9.78E-01	1.8429E+07	+2.69E+00	0.01	3:08:11:37	98	01:30:05	00:21:31
1.32779E+05	1711685	5.54E-02	6.04E-02/cy	10	9.92E-01	1.8428E+07	+2.70E+00	0.01	3:08:21:37	98	01:40:05	00:15:16
1.32960E+05	1714955	5.07E-02	6.00E-02/cy	10	9.56E-01	1.8432E+07	+2.70E+00	0.01	3:08:31:37	100	01:50:05	00:08:42
1.33141E+05	1718209	5.33E-02	5.98E-02/cy	11	9.60E-01	1.8432E+07	+2.70E+00	0.01	3:08:41:37	98	02:00:05	00:02:08

restart and spatial data available at t= 1.33200E+05

1.33200E+05	1719251	5.33E-02	6.05E-02/cy	10	9.68E-01	1.8432E+07	+2.70E+00	0.01	3:08:44:48	100	02:03:16	00:00:00
-------------	---------	----------	-------------	----	----------	------------	-----------	------	------------	-----	----------	----------

end of calculation at t = 1.33200E+05, cycle = 1719251
normal completion

flsgrf.Copy_of_Portneuf_and_Oxbows_original_terrain_DR_SAVAGE_STL_FINAL_2-D_SIM_TRY_6_Restart_2 file size: 2 gb

elapsed time = 2.90691E+05 seconds, or
3 days : 8 hours : 44 minutes : 51 seconds

cpu time = 9.25244E+06 seconds

date of completion = 03/08/2021
time = 02:03:19

Solver Done

Postprocessor Done

Preprocessor Starting

```
processing options and properties
processing mesh
processing geometry components
processing non-moving component      4 in mesh block    1
processing subcomponent 17
processing subcomponent 18
processing non-moving component      5 in mesh block    1
processing non-moving component      4 in mesh block    2
processing subcomponent 17
processing subcomponent 18
processing non-moving component      5 in mesh block    2
processing non-moving component      4 in mesh block    3
processing subcomponent 17
processing subcomponent 18
processing non-moving component      5 in mesh block    3
processing non-moving component      4 in mesh block    4
processing subcomponent 17
processing subcomponent 18
processing non-moving component      5 in mesh block    4
processing non-moving component      4 in mesh block    5
processing subcomponent 17
processing subcomponent 18
processing non-moving component      5 in mesh block    5
total, fluid and solid sub-domain cell counts: 1240860   710354   181251
converting stl data to internal storage
processing initial conditions
processing fluid initialization regions
processing baffles
setting up remaining array data
evaluating mesh boundary conditions for block 1
evaluating mesh boundary conditions for block 2
evaluating mesh boundary conditions for block 3
evaluating mesh boundary conditions for block 4
evaluating mesh boundary conditions for block 5
initializing fluid boundary conditions
processing graphics and output requests
processing particle data
processing user-defined plot requests
producing preprocessor plot data
successful completion of preprocessor
```

Preprocessor Done

Solver starting

trying to check out a parallel token

```
License token checked out for simulation: hydr3dp
Number of core license tokens checked out: 0

program title : FLOW-3D
program version : hydr3d version 12.0.1.08 win64 10/15/2019
version id : double
DOUBLE precision version
process identification number for this job= 1
```

```
job name: alqr
problem date: 03/04/2021
problem time: 17:18:59
```

Portneuf and Oxbows original terrain

```

*** estimated uncompressed solver output file size (flsgrf): 1 gb ***

*** running solver on 32 cores ***

processing restart data:
processing data from restart source file: D:\Portneuf_and_Oxbows\Portneuf_and_Oxbows_original_terrain_DR__SAVAGE_STL_FINAL_2-D_SIM_TRY_6/fl:
D_SIM_TRY_6
restart time: 1.14910E+04
restart data created by: hydr3d version 12.0.1.08 win64 10/15/2019
finished processing restart data

***
restart and spatial data available at t= 0.00000E+00
***
-----
progress      time step      pressure      fluid #1      performance
sim_time     cycle      delt  dt_stbl/code  iter  res/epsi  volume  %loss  frac  el_time  %PE  clk_time  est_rem_time
-----
0.00000E+00      0  2.37E-02  6.02E-02/cy      0  0.00E+00  1.3559E+06  +0.00E+00  0.00  00:00:53  26  17:19:21  ...

Spatial Data Request Signaled

***
restart and spatial data available at t= 4.27054E+01
***
4.27054E+01      481  1.39E-01  1.39E-01/cy      3  7.69E-01  1.3518E+06  +4.43E-03  0.00  00:02:17  96  17:20:44  4:22:09:05

Spatial Data Request Signaled

***
restart and spatial data available at t= 1.06804E+02
***
1.06804E+02      880  1.72E-01  1.72E-01/cx      4  7.54E-01  1.3483E+06  +1.03E-01  0.00  00:03:17  100  17:21:44  2:19:58:29

Spatial Data Request Signaled

***
restart and spatial data available at t= 1.39027E+02
***
1.39027E+02     1115  1.10E-01  1.10E-01/cy      3  4.03E-01  1.3475E+06  +1.55E-01  0.00  00:03:53  97  17:22:20  2:13:46:50

Spatial Data Request Signaled

***
restart and spatial data available at t= 2.48538E+02
***
2.48538E+02     2049  1.20E-01  1.20E-01/cy      3  5.89E-01  1.3424E+06  +2.98E-01  0.00  00:06:11  96  17:24:38  2:07:03:12

Spatial Data Request Signaled

***
restart and spatial data available at t= 3.38797E+02
***
3.38797E+02     2784  1.25E-01  1.25E-01/cy      3  4.17E-01  1.3378E+06  +3.88E-01  0.00  00:08:05  100  17:26:32  2:04:46:16
4.83010E+02     3896  1.33E-01  1.33E-01/cy      3  9.26E-01  1.3307E+06  +4.82E-01  0.00  00:10:53  98  17:29:21  2:01:51:25

Spatial Data Request Signaled

```

```

***
restart and spatial data available at t= 6.77099E+02
***
6.77099E+02      5359      1.33E-01      1.33E-01/cy      4      9.69E-01      1.3228E+06      +5.82E-01      0.00      00:14:29      100      17:32:56      1:23:12:60
1.01293E+03      7883      1.34E-01      1.34E-01/cy      4      8.92E-01      1.3052E+06      +9.70E-01      0.00      00:20:53      96      17:39:21      1:21:25:55
1.54346E+03      11933      1.24E-01      1.24E-01/cy      5      8.70E-01      1.2699E+06      +1.59E+00      0.00      00:30:53      99      17:49:21      1:19:54:47
2.06081E+03      15905      1.31E-01      1.31E-01/cy      6      9.43E-01      1.2315E+06      +2.14E+00      0.00      00:40:54      98      17:59:21      1:19:22:05
2.57171E+03      19852      1.33E-01      1.33E-01/cy      7      8.66E-01      1.1946E+06      +2.62E+00      0.00      00:50:54      100      18:09:21      1:19:04:59
3.09491E+03      23795      1.33E-01      1.33E-01/cy      7      9.76E-01      1.1618E+06      +3.04E+00      0.00      01:00:54      100      18:19:21      1:18:39:48
3.61185E+03      27689      1.34E-01      1.34E-01/cy      8      8.84E-01      1.1379E+06      +3.40E+00      0.00      01:10:54      100      18:29:21      1:18:23:33
4.13192E+03      31563      1.35E-01      1.35E-01/cy      7      9.90E-01      1.1202E+06      +3.72E+00      0.00      01:20:54      97      18:39:21      1:18:06:54
4.63330E+03      35364      1.32E-01      1.32E-01/cy      9      9.31E-01      1.1079E+06      +3.96E+00      0.00      01:30:54      99      18:49:21      1:18:02:15
5.11678E+03      39140      1.23E-01      1.23E-01/cy      9      9.34E-01      1.0984E+06      +4.17E+00      0.00      01:40:54      95      18:59:22      1:18:05:42
5.59028E+03      42961      1.24E-01      1.24E-01/cy      10      9.12E-01      1.0915E+06      +4.37E+00      0.00      01:50:54      98      19:09:22      1:18:11:33
6.05765E+03      46778      1.20E-01      1.20E-01/cy      10      9.06E-01      1.0868E+06      +4.56E+00      0.00      02:00:54      100      19:19:22      1:18:17:35
6.51281E+03      50642      1.10E-01      1.10E-01/cy      8      9.79E-01      1.0834E+06      +4.73E+00      0.00      02:10:54      99      19:29:22      1:18:26:22
7.00080E+03      54479      1.09E-01      1.09E-01/cy      8      9.38E-01      1.0814E+06      +4.91E+00      0.00      02:20:55      100      19:39:22      1:18:20:00
7.46842E+03      58349      1.33E-01      1.33E-01/cx      7      9.41E-01      1.0803E+06      +5.07E+00      0.00      02:30:55      99      19:49:22      1:18:20:33
7.93546E+03      62246      1.32E-01      1.32E-01/cx      10      9.25E-01      1.0816E+06      +5.23E+00      0.00      02:40:55      100      19:59:22      1:18:20:00

-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
8.43225E+03      66088      1.32E-01      1.32E-01/cx      6      8.50E-01      1.0843E+06      +5.39E+00      0.00      02:50:55      98      20:09:22      1:18:08:53
8.92286E+03      69957      1.10E-01      1.10E-01/cy      8      9.05E-01      1.0897E+06      +5.54E+00      0.00      03:00:55      100      20:19:22      1:17:59:43
9.38739E+03      73840      1.32E-01      1.32E-01/cx      10      9.03E-01      1.0952E+06      +5.69E+00      0.00      03:10:55      96      20:29:22      1:17:57:59
9.86062E+03      77700      1.11E-01      1.11E-01/cy      8      8.92E-01      1.1053E+06      +5.83E+00      0.00      03:20:55      100      20:39:22      1:17:53:04
1.03304E+04      81575      1.11E-01      1.11E-01/cy      9      9.11E-01      1.1163E+06      +5.97E+00      0.00      03:30:55      97      20:49:22      1:17:48:36
1.08006E+04      85447      1.11E-01      1.11E-01/cy      8      9.73E-01      1.1251E+06      +6.12E+00      0.00      03:40:55      100      20:59:22      1:17:43:32
1.12337E+04      89365      1.11E-01      1.11E-01/cy      9      9.21E-01      1.1336E+06      +6.25E+00      0.00      03:50:55      96      21:09:23      1:17:44:42
1.16688E+04      93302      1.10E-01      1.10E-01/cy      8      9.34E-01      1.1427E+06      +6.39E+00      0.00      04:00:55      98      21:19:23      1:17:49:09
1.21021E+04      97225      1.10E-01      1.10E-01/cy      8      9.56E-01      1.1526E+06      +6.52E+00      0.00      04:10:55      97      21:29:23      1:17:50:45
1.25373E+04      101133      1.10E-01      1.10E-01/cy      8      9.74E-01      1.1638E+06      +6.66E+00      0.00      04:20:55      97      21:39:23      1:17:51:08
1.29703E+04      105047      1.13E-01      1.13E-01/cy      7      9.98E-01      1.1753E+06      +6.81E+00      0.00      04:30:55      98      21:49:23      1:17:51:18

***
restart and spatial data available at t= 1.33200E+04
***
1.33200E+04      108160      1.12E-01      1.12E-01/cy      7      9.38E-01      1.1836E+06      +6.92E+00      0.00      04:38:51      99      21:57:18      1:17:49:37
1.34098E+04      108961      1.12E-01      1.12E-01/cy      8      9.31E-01      1.1858E+06      +6.95E+00      0.00      04:40:55      100      21:59:23      1:17:49:28
1.38466E+04      112872      1.11E-01      1.11E-01/cy      8      9.81E-01      1.1968E+06      +7.09E+00      0.00      04:50:55      100      22:09:23      1:17:47:39
1.42867E+04      116800      1.13E-01      1.13E-01/cy      4      7.13E-01      1.2081E+06      +7.22E+00      0.00      05:00:56      100      22:19:23      1:17:44:42
1.47346E+04      120691      1.18E-01      1.18E-01/cy      8      9.95E-01      1.2192E+06      +7.34E+00      0.00      05:10:56      96      22:29:23      1:17:39:50
1.52078E+04      124558      1.27E-01      1.27E-01/cy      10      9.25E-01      1.2308E+06      +7.47E+00      0.00      05:20:56      100      22:39:23      1:17:29:58
1.57044E+04      128407      1.32E-01      1.32E-01/cx      10      9.25E-01      1.2440E+06      +7.60E+00      0.00      05:30:56      100      22:49:23      1:17:15:54
1.62052E+04      132228      1.32E-01      1.32E-01/cx      9      9.68E-01      1.2565E+06      +7.78E+00      0.00      05:40:56      96      22:59:23      1:17:01:21
1.67045E+04      136051      1.23E-01      1.30E-01/cy      10      9.64E-01      1.2665E+06      +7.99E+00      0.00      05:50:56      99      23:09:23      1:16:47:21
1.71995E+04      139868      1.27E-01      1.27E-01/cy      9      9.99E-01      1.2771E+06      +8.18E+00      0.00      06:00:56      100      23:19:23      1:16:34:17
1.76989E+04      143697      1.31E-01      1.31E-01/cx      10      9.83E-01      1.2892E+06      +8.39E+00      0.00      06:10:56      99      23:29:24      1:16:20:39
1.81971E+04      147506      1.25E-01      1.31E-01/cx      10      9.48E-01      1.2987E+06      +8.68E+00      0.00      06:20:56      100      23:39:24      1:16:07:27

-----
progress      time step      pressure      fluid #1      performance
sim_time      cycle      delt      dt_stbl/code      iter      res/epsi      volume      %loss      frac      el_time      %PE      clk_time      est_rem_time
-----
1.86936E+04      151314      1.32E-01      1.32E-01/cx      10      9.36E-01      1.3087E+06      +8.98E+00      0.00      06:30:56      100      23:49:24      1:15:54:38
1.91910E+04      155143      1.31E-01      1.31E-01/cy      10      9.42E-01      1.3172E+06      +9.39E+00      0.00      06:40:56      100      23:59:24      1:15:41:51
1.96898E+04      158960      1.25E-01      1.25E-01/cy      9      9.27E-01      1.3245E+06      +9.87E+00      0.00      06:50:56      100      00:09:24      1:15:29:00
2.01898E+04      162795      1.31E-01      1.31E-01/cx      10      9.71E-01      1.3335E+06      +1.04E+01      0.00      07:00:56      100      00:19:24      1:15:16:09
2.06750E+04      166630      1.32E-01      1.32E-01/cx      10      9.64E-01      1.3411E+06      +1.09E+01      0.00      07:10:56      100      00:29:24      1:15:05:25
2.11579E+04      170472      1.27E-01      1.27E-01/cy      9      9.81E-01      1.3525E+06      +1.11E+01      0.00      07:20:56      96      00:39:24      1:14:55:00
2.16488E+04      174286      1.13E-01      1.13E-01/cy      9      9.15E-01      1.3658E+06      +1.13E+01      0.00      07:30:57      96      00:49:24      1:14:43:36
2.21267E+04      178009      1.31E-01      1.31E-01/cx      10      9.61E-01      1.3843E+06      +1.14E+01      0.00      07:40:57      94      00:59:24      1:14:33:52
2.26167E+04      181831      1.22E-01      1.22E-01/cy      10      9.41E-01      1.4032E+06      +1.15E+01      0.00      07:50:57      94      01:09:24      1:14:22:39
2.31015E+04      185667      1.32E-01      1.32E-01/cx      9      9.57E-01      1.4271E+06      +1.14E+01      0.00      08:00:57      99      01:19:24      1:14:12:07
2.35907E+04      189515      1.17E-01      1.17E-01/cy      9      9.10E-01      1.4549E+06      +1.13E+01      0.00      08:10:57      100      01:29:24      1:14:01:05
2.40665E+04      193345      1.15E-01      1.15E-01/cy      9      9.11E-01      1.4788E+06      +1.12E+01      0.00      08:20:57      100      01:39:25      1:13:51:38
2.45176E+04      197236      1.18E-01      1.18E-01/cy      9      9.67E-01      1.5007E+06      +1.11E+01      0.00      08:30:57      100      01:49:25      1:13:44:57
2.49900E+04      201086      1.29E-01      1.29E-01/cy      10      9.21E-01      1.5215E+06      +1.10E+01      0.00      08:40:57      100      01:59:25      1:13:35:48
2.54927E+04      204914      1.25E-01      1.31E-01/cx      10      9.49E-01      1.5403E+06      +1.09E+01      0.00      08:50:57      100      02:09:25      1:13:23:18
2.59960E+04      208741      1.32E-01      1.32E-01/cx      10      9.39E-01      1.5534E+06      +1.09E+01      0.00      09:00:58      100      02:19:25      1:13:10:50
2.64978E+04      212566      1.31E-01      1.31E-01/cx      10      9.84E-01      1.5632E+06      +1.10E+01      0.00      09:10:58      100      02:29:25      1:12:58:37

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restart and spatial data available at t= 2.66401E+04
***
2.66401E+04    213652    1.31E-01    1.31E-01/cx    10    9.93E-01    1.5656E+06    +1.10E+01    0.00    09:13:49    100    02:32:16    1:12:55:14
2.69919E+04    216354    1.31E-01    1.31E-01/cx    11    9.25E-01    1.5706E+06    +1.10E+01    0.00    09:20:58    100    02:39:25    1:12:47:16
2.74828E+04    220166    1.24E-01    1.31E-01/cx    10    9.76E-01    1.5762E+06    +1.10E+01    0.00    09:30:58    99    02:49:25    1:12:36:17
2.79718E+04    223975    1.31E-01    1.31E-01/cx    10    9.72E-01    1.5801E+06    +1.10E+01    0.00    09:40:58    100    02:59:25    1:12:25:32
2.84609E+04    227786    1.31E-01    1.31E-01/cx    10    9.75E-01    1.5834E+06    +1.10E+01    0.00    09:50:58    100    03:09:25    1:12:14:48
2.89529E+04    231591    1.32E-01    1.32E-01/cx    10    9.81E-01    1.5858E+06    +1.11E+01    0.00    10:00:58    99    03:19:25    1:12:03:48

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progress      time step      pressure      fluid #1      performance
sim_time     cycle      delt    dt_stbl/code  iter  res/epsi  volume    %loss    frac    el_time    %PE    clk_time    est_rem_time
-----
2.94460E+04    235406    1.30E-01    1.31E-01/cx    10    9.99E-01    1.5901E+06    +1.11E+01    0.00    10:10:58    100    03:29:25    1:11:52:45
2.99367E+04    239199    1.31E-01    1.31E-01/cx    10    9.06E-01    1.5970E+06    +1.11E+01    0.00    10:20:58    99    03:39:26    1:11:41:57
3.04283E+04    243006    1.23E-01    1.31E-01/cx    10    9.97E-01    1.6080E+06    +1.11E+01    0.00    10:30:58    100    03:49:26    1:11:31:06
3.09199E+04    246817    1.32E-01    1.32E-01/cx    10    9.58E-01    1.6245E+06    +1.11E+01    0.00    10:40:58    99    03:59:26    1:11:20:16
3.14112E+04    250625    1.31E-01    1.31E-01/cx    10    9.19E-01    1.6447E+06    +1.10E+01    0.00    10:50:58    98    04:09:26    1:11:09:28
3.19013E+04    254435    1.31E-01    1.31E-01/cx    10    9.19E-01    1.6667E+06    +1.10E+01    0.00    11:00:58    100    04:19:26    1:10:58:50
3.23903E+04    258246    1.15E-01    1.30E-01/cx    10    9.88E-01    1.6895E+06    +1.10E+01    0.00    11:10:58    98    04:29:26    1:10:48:17
3.28745E+04    262031    1.31E-01    1.31E-01/cx    10    9.51E-01    1.7069E+06    +1.10E+01    0.00    11:20:58    100    04:39:26    1:10:38:10
3.33597E+04    265833    1.33E-01    1.33E-01/cx    10    9.79E-01    1.7232E+06    +1.10E+01    0.00    11:30:58    98    04:49:26    1:10:27:58
3.37836E+04    269677    1.01E-01    1.01E-01/cx    9    8.99E-01    1.7359E+06    +1.10E+01    0.00    11:40:59    100    04:59:26    1:10:22:47
3.42143E+04    273571    1.16E-01    1.16E-01/cx    9    9.99E-01    1.7500E+06    +1.10E+01    0.00    11:50:59    99    05:09:26    1:10:16:56
3.46523E+04    277313    1.13E-01    1.13E-01/cx    8    9.02E-01    1.7655E+06    +1.10E+01    0.00    12:00:59    96    05:19:26    1:10:10:23
3.50472E+04    280970    1.03E-01    1.03E-01/cx    8    9.35E-01    1.7786E+06    +1.10E+01    0.00    12:10:59    96    05:29:26    1:10:07:10
3.54451E+04    284862    1.01E-01    1.01E-01/cx    7    9.05E-01    1.7916E+06    +1.10E+01    0.00    12:20:59    100    05:39:26    1:10:03:34
3.58389E+04    288778    1.00E-01    1.00E-01/cx    8    9.82E-01    1.8067E+06    +1.09E+01    0.00    12:30:59    96    05:49:26    1:10:00:08
3.62319E+04    292688    1.00E-01    1.00E-01/cx    8    9.24E-01    1.8226E+06    +1.09E+01    0.00    12:40:59    95    05:59:26    1:09:56:37
3.66249E+04    296599    1.00E-01    1.00E-01/cx    9    8.97E-01    1.8407E+06    +1.08E+01    0.00    12:50:59    100    06:09:26    1:09:52:58
3.70172E+04    300503    1.01E-01    1.01E-01/cx    9    9.29E-01    1.8608E+06    +1.08E+01    0.00    13:00:59    100    06:19:27    1:09:49:15
3.74056E+04    304368    1.00E-01    1.00E-01/cx    8    9.82E-01    1.8820E+06    +1.07E+01    0.00    13:10:59    100    06:29:27    1:09:45:41
3.77951E+04    308240    1.01E-01    1.01E-01/cx    8    9.70E-01    1.9048E+06    +1.07E+01    0.00    13:20:59    100    06:39:27    1:09:41:54
3.81871E+04    312125    1.01E-01    1.01E-01/cx    8    9.79E-01    1.9293E+06    +1.06E+01    0.00    13:30:59    100    06:49:27    1:09:37:49
3.85796E+04    315998    1.01E-01    1.01E-01/cx    8    9.77E-01    1.9553E+06    +1.06E+01    0.00    13:40:59    100    06:59:27    1:09:33:33
3.89732E+04    319864    1.02E-01    1.02E-01/cx    10    9.20E-01    1.9815E+06    +1.05E+01    0.00    13:50:60    100    07:09:27    1:09:29:07

-----
progress      time step      pressure      fluid #1      performance
sim_time     cycle      delt    dt_stbl/code  iter  res/epsi  volume    %loss    frac    el_time    %PE    clk_time    est_rem_time
-----
3.93683E+04    323719    1.03E-01    1.03E-01/cx    8    9.78E-01    2.0087E+06    +1.04E+01    0.00    14:00:60    99    07:19:27    1:09:24:27
3.97777E+04    327700    1.03E-01    1.03E-01/cx    6    9.07E-01    2.0395E+06    +1.04E+01    0.00    14:10:60    100    07:29:27    1:09:18:39

***
restart and spatial data available at t= 3.99600E+04
***
3.99600E+04    329466    1.04E-01    1.04E-01/cx    6    9.18E-01    2.0534E+06    +1.04E+01    0.00    14:15:24    100    07:33:51    1:09:15:54
4.01910E+04    331693    1.03E-01    1.03E-01/cx    6    9.07E-01    2.0707E+06    +1.03E+01    0.00    14:20:60    98    07:39:27    1:09:12:30
4.06414E+04    335675    1.53E-01    1.53E-01/cx    10    9.89E-01    2.1043E+06    +1.03E+01    0.00    14:30:60    100    07:49:27    1:09:03:39
4.12059E+04    339454    1.26E-01    1.26E-01/cx    8    9.77E-01    2.1510E+06    +1.02E+01    0.00    14:40:60    100    07:59:27    1:08:46:52
4.16746E+04    343304    1.23E-01    1.23E-01/cx    8    9.25E-01    2.1953E+06    +1.01E+01    0.00    14:51:00    100    08:09:27    1:08:36:48
4.21651E+04    347202    1.30E-01    1.30E-01/cx    8    9.35E-01    2.2445E+06    +1.00E+01    0.00    15:01:00    100    08:19:28    1:08:25:16
4.26986E+04    351153    1.34E-01    1.34E-01/cx    4    5.86E-01    2.3084E+06    +9.91E+00    0.00    15:11:00    100    08:29:28    1:08:10:54
4.32557E+04    355259    1.35E-01    1.35E-01/cy    4    6.56E-01    2.3866E+06    +9.74E+00    0.00    15:21:00    95    08:39:28    1:07:55:06
4.38122E+04    359406    1.34E-01    1.34E-01/cy    4    7.04E-01    2.4613E+06    +9.62E+00    0.00    15:31:00    96    08:49:28    1:07:39:28
4.42784E+04    363609    8.69E-02    8.69E-02/cx    3    3.73E-01    2.5185E+06    +9.55E+00    0.00    15:41:00    98    08:59:28    1:07:29:45
4.46503E+04    367820    8.95E-02    8.95E-02/cx    3    3.98E-01    2.5608E+06    +9.51E+00    0.00    15:51:00    96    09:09:28    1:07:26:01
4.50306E+04    372026    9.15E-02    9.15E-02/cx    3    4.49E-01    2.6032E+06    +9.48E+00    0.00    16:01:00    100    09:19:28    1:07:21:38
4.54449E+04    376233    1.01E-01    1.01E-01/cx    3    5.86E-01    2.6476E+06    +9.45E+00    0.00    16:11:00    100    09:29:28    1:07:15:02
4.58660E+04    380417    1.01E-01    1.01E-01/cx    3    6.08E-01    2.6957E+06    +9.38E+00    0.00    16:21:01    99    09:39:28    1:07:07:57
4.62887E+04    384619    1.01E-01    1.01E-01/cx    3    6.20E-01    2.7452E+06    +9.31E+00    0.00    16:31:01    100    09:49:28    1:07:00:43
4.67138E+04    388819    1.01E-01    1.01E-01/cx    3    5.84E-01    2.7933E+06    +9.24E+00    0.00    16:41:01    99    09:59:28    1:06:53:17
4.71356E+04    393013    1.00E-01    1.00E-01/cx    3    6.24E-01    2.8446E+06    +9.15E+00    0.00    16:51:01    98    10:09:28    1:06:45:60
4.75541E+04    397173    1.01E-01    1.01E-01/cx    3    7.07E-01    2.9003E+06    +9.06E+00    0.00    17:01:01    94    10:19:28    1:06:38:52

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Spatial Data Request Signaled

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***
restart and spatial data available at t= 4.76870E+04
***
4.76870E+04    398504    1.00E-01    1.00E-01/cx    3    7.21E-01    2.9185E+06    +9.03E+00    0.00    17:04:17    100    10:22:44    1:06:36:45
4.79555E+04    401273    9.50E-02    9.50E-02/cy    3    6.96E-01    2.9575E+06    +8.98E+00    0.00    17:11:01    100    10:29:28    1:06:32:42
4.83272E+04    405260    1.02E-01    1.02E-01/cx    3    8.78E-01    3.0105E+06    +8.91E+00    0.00    17:21:01    98    10:39:28    1:06:28:15

-----
progress                time step                pressure                fluid #1                performance
sim_time    cycle    delt    dt_stbl/code    iter    res/epsi    volume    %loss    frac    el_time    %PE    clk_time    est_rem_time
-----
4.87492E+04    409448    1.01E-01    1.01E-01/cx    3    9.46E-01    3.0731E+06    +8.83E+00    0.00    17:31:01    100    10:49:29    1:06:20:44
4.91700E+04    413612    1.01E-01    1.01E-01/cx    4    7.78E-01    3.1385E+06    +8.76E+00    0.00    17:41:01    98    10:59:29    1:06:13:15
4.95878E+04    417748    1.04E-01    1.04E-01/cx    4    7.92E-01    3.1986E+06    +8.70E+00    0.00    17:51:01    100    11:09:29    1:06:05:53
5.00193E+04    421859    1.07E-01    1.07E-01/cx    4    9.10E-01    3.2599E+06    +8.62E+00    0.00    18:01:01    98    11:19:29    1:05:57:42
5.04374E+04    425961    1.03E-01    1.03E-01/cx    4    9.28E-01    3.3221E+06    +8.56E+00    0.00    18:11:01    100    11:29:29    1:05:50:15
5.08592E+04    430047    1.03E-01    1.03E-01/cx    4    9.81E-01    3.3878E+06    +8.49E+00    0.00    18:21:01    96    11:39:29    1:05:42:33
5.12844E+04    434121    1.06E-01    1.06E-01/cx    5    7.66E-01    3.4585E+06    +8.42E+00    0.00    18:31:01    100    11:49:29    1:05:34:37
5.17106E+04    438155    1.05E-01    1.05E-01/cx    5    8.07E-01    3.5337E+06    +8.36E+00    0.00    18:41:02    100    11:59:29    1:05:26:36
5.21517E+04    442177    1.13E-01    1.13E-01/cx    5    9.92E-01    3.6202E+06    +8.28E+00    0.00    18:51:02    100    12:09:29    1:05:17:43
5.26056E+04    446142    1.17E-01    1.17E-01/cy    6    9.81E-01    3.7191E+06    +8.18E+00    0.00    19:01:02    100    12:19:29    1:05:08:07
5.30576E+04    450032    1.17E-01    1.17E-01/cy    7    9.18E-01    3.8212E+06    +8.09E+00    0.00    19:11:02    100    12:29:29    1:04:58:36

***
restart and spatial data available at t= 5.32800E+04
***
5.32800E+04    451950    1.15E-01    1.15E-01/cy    7    9.68E-01    3.8725E+06    +8.05E+00    0.00    19:16:01    100    12:34:28    1:04:54:01
5.34636E+04    453940    5.70E-02    5.70E-02/cx    3    7.78E-01    3.9166E+06    +8.02E+00    0.00    19:21:02    98    12:39:29    1:04:51:35

===== mentor tip =====
multi-block fluid volume error exceeds 5%.

maximum volume error is between mesh blocks 1 and 4:
fluid volume flow rate mismatch = 9.18594E+05
% error = 6.09752E+00

1. reduce the number of mesh blocks.
2. reduce grid size variation at inter-block boundaries.
3. align nested block boundaries with mesh planes in the containing blocks.
4. shift inter-block boundaries to where there is less flow variation.
5. increase inter-block interpolation factor alphamb to 0.5 or higher
6. is there excessive fluid break up?
=====
5.38454E+04    457896    1.02E-01    1.02E-01/cx    7    9.21E-01    4.0063E+06    +7.94E+00    0.00    19:31:02    100    12:49:29    1:04:45:48
5.42363E+04    461762    1.01E-01    1.01E-01/cx    7    8.76E-01    4.1010E+06    +7.84E+00    0.00    19:41:02    100    12:59:29    1:04:39:29
5.46241E+04    465616    1.01E-01    1.01E-01/cx    7    9.44E-01    4.2007E+06    +7.68E+00    0.00    19:51:02    100    13:09:30    1:04:33:17
5.50113E+04    469476    9.93E-02    9.93E-02/cy    7    8.95E-01    4.3098E+06    +7.53E+00    0.00    20:01:02    100    13:19:30    1:04:27:03
5.53857E+04    473328    8.43E-02    8.43E-02/cx    6    9.44E-01    4.4222E+06    +7.39E+00    0.00    20:11:02    98    13:29:30    1:04:21:27
5.57073E+04    477205    7.33E-02    7.33E-02/cx    6    8.71E-01    4.5195E+06    +7.26E+00    0.00    20:21:02    98    13:39:30    1:04:18:33
5.59911E+04    481091    8.70E-02    9.84E-02/cy    11    9.68E-01    4.6048E+06    +7.14E+00    0.00    20:31:02    100    13:49:30    1:04:17:32
5.63254E+04    484719    9.73E-02    9.73E-02/cy    9    9.82E-01    4.7056E+06    +6.99E+00    0.00    20:41:02    100    13:59:30    1:04:13:48
5.66849E+04    488434    9.64E-02    9.64E-02/cy    8    9.70E-01    4.8177E+06    +6.83E+00    0.00    20:51:03    100    14:09:30    1:04:08:42
5.70422E+04    492147    9.61E-02    9.61E-02/cy    9    8.72E-01    4.9320E+06    +6.67E+00    0.00    21:01:03    95    14:19:30    1:04:03:38

```

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
5.73945E+04	495820	9.53E-02	9.53E-02/cy	7	9.53E-01	5.0462E+06	+6.53E+00	0.00	21:11:03	98	14:29:30	1:03:58:46
5.77342E+04	499583	8.55E-02	8.55E-02/cy	6	9.85E-01	5.1588E+06	+6.41E+00	0.00	21:21:03	95	14:39:30	1:03:54:29
5.80533E+04	503379	9.73E-02	9.73E-02/cy	8	8.92E-01	5.2635E+06	+6.31E+00	0.00	21:31:03	100	14:49:30	1:03:51:11
5.83619E+04	507178	7.76E-02	7.76E-02/cy	6	9.39E-01	5.3660E+06	+6.21E+00	0.00	21:41:03	100	14:59:31	1:03:48:21
5.86790E+04	510941	9.04E-02	9.04E-02/cy	8	9.38E-01	5.4709E+06	+6.11E+00	0.00	21:51:03	100	15:09:31	1:03:45:00
5.90132E+04	514674	8.84E-02	8.84E-02/cy	6	9.84E-01	5.5835E+06	+6.01E+00	0.00	22:01:03	100	15:19:31	1:03:40:43
5.93648E+04	518622	9.46E-02	9.46E-02/cy	4	9.16E-01	5.7080E+06	+5.91E+00	0.00	22:11:03	98	15:29:31	1:03:35:30
5.97160E+04	522593	9.55E-02	9.55E-02/cy	4	6.44E-01	5.8375E+06	+5.79E+00	0.00	22:21:03	100	15:39:31	1:03:30:15
6.00740E+04	526579	9.63E-02	9.63E-02/cy	4	6.90E-01	5.9714E+06	+5.68E+00	0.00	22:31:04	100	15:49:31	1:03:24:36
6.04339E+04	530570	8.14E-02	9.35E-02/cy	3	6.93E-01	6.1086E+06	+5.57E+00	0.00	22:41:04	100	15:59:31	1:03:18:48
6.07931E+04	534562	9.42E-02	9.42E-02/cy	4	7.39E-01	6.2482E+06	+5.46E+00	0.00	22:51:04	100	16:09:31	1:03:12:59
6.11506E+04	538552	9.33E-02	9.33E-02/cy	4	8.79E-01	6.3887E+06	+5.35E+00	0.00	23:01:04	100	16:19:31	1:03:07:13
6.15061E+04	542535	9.34E-02	9.34E-02/cy	4	9.81E-01	6.5259E+06	+5.25E+00	0.00	23:11:04	98	16:29:31	1:03:01:29
6.18606E+04	546504	9.35E-02	9.35E-02/cy	4	7.19E-01	6.6641E+06	+5.15E+00	0.00	23:21:04	100	16:39:31	1:02:55:45
6.22196E+04	550491	8.82E-02	9.25E-02/cy	4	8.68E-01	6.8055E+06	+5.02E+00	0.00	23:31:04	100	16:49:32	1:02:49:45
6.25754E+04	554485	9.45E-02	9.45E-02/cy	4	7.30E-01	6.9458E+06	+4.89E+00	0.00	23:41:04	98	16:59:32	1:02:43:52
6.29294E+04	558458	9.21E-02	9.21E-02/cy	3	9.81E-01	7.0868E+06	+4.75E+00	0.00	23:51:04	98	17:09:32	1:02:38:01
6.32815E+04	562433	9.18E-02	9.18E-02/cy	3	9.16E-01	7.2261E+06	+4.61E+00	0.00	1:00:01:04	100	17:19:32	1:02:32:13
6.36356E+04	566424	8.38E-02	8.38E-02/cy	3	9.87E-01	7.3699E+06	+4.48E+00	0.00	1:00:11:04	98	17:29:32	1:02:26:16
6.39846E+04	570348	9.06E-02	9.06E-02/cy	3	9.34E-01	7.5187E+06	+4.35E+00	0.00	1:00:21:04	100	17:39:32	1:02:20:31
6.43316E+04	574284	8.93E-02	8.93E-02/cy	4	8.79E-01	7.6648E+06	+4.22E+00	0.01	1:00:31:05	98	17:49:32	1:02:14:49
6.46738E+04	578213	9.32E-02	9.32E-02/cy	15	9.43E-01	7.8095E+06	+4.07E+00	0.01	1:00:41:05	100	17:59:32	1:02:09:18
6.50122E+04	582135	7.85E-02	9.30E-02/cy	3	7.93E-01	7.9513E+06	+3.94E+00	0.01	1:00:51:05	100	18:09:32	1:02:03:55

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
6.53459E+04	586064	8.86E-02	8.86E-02/cy	3	9.95E-01	8.0859E+06	+3.80E+00	0.01	1:01:01:05	100	18:19:32	1:01:58:42
6.56815E+04	590027	8.11E-02	8.11E-02/cy	3	8.19E-01	8.2205E+06	+3.67E+00	0.01	1:01:11:05	98	18:29:32	1:01:53:21
6.60177E+04	593948	9.12E-02	9.12E-02/cy	4	8.78E-01	8.3560E+06	+3.54E+00	0.01	1:01:21:05	100	18:39:32	1:01:47:55
6.63565E+04	597898	8.74E-02	8.74E-02/cy	3	9.93E-01	8.4974E+06	+3.41E+00	0.01	1:01:31:05	93	18:49:33	1:01:42:19

restart and spatial data available at t= 6.66000E+04												

6.66000E+04	600764	8.03E-02	8.03E-02/cy	3	9.05E-01	8.6001E+06	+3.32E+00	0.01	1:01:38:25	98	18:56:52	1:01:38:25
6.66895E+04	601798	9.23E-02	9.23E-02/cy	3	9.65E-01	8.6380E+06	+3.28E+00	0.01	1:01:41:05	95	18:59:33	1:01:36:57
6.70233E+04	605721	8.14E-02	8.14E-02/cy	4	9.20E-01	8.7768E+06	+3.16E+00	0.01	1:01:51:05	98	19:09:33	1:01:31:29
6.73653E+04	609688	7.78E-02	7.78E-02/cy	3	9.05E-01	8.9151E+06	+3.03E+00	0.01	1:02:01:05	100	19:19:33	1:01:25:37
6.77046E+04	613640	8.02E-02	8.02E-02/cy	4	9.16E-01	9.0489E+06	+2.91E+00	0.01	1:02:11:05	100	19:29:33	1:01:19:50
6.80454E+04	617591	8.97E-02	8.97E-02/cy	3	9.65E-01	9.1753E+06	+2.78E+00	0.01	1:02:21:06	95	19:39:33	1:01:13:55
6.83911E+04	621556	9.10E-02	9.10E-02/cy	3	9.83E-01	9.3016E+06	+2.65E+00	0.01	1:02:31:06	100	19:49:33	1:01:07:45
6.87379E+04	625502	8.99E-02	8.99E-02/cy	3	9.18E-01	9.4276E+06	+2.52E+00	0.01	1:02:41:06	95	19:59:33	1:01:01:30
6.90825E+04	629444	8.39E-02	8.39E-02/cx	3	9.26E-01	9.5513E+06	+2.41E+00	0.01	1:02:51:06	98	20:09:33	1:00:55:18
6.94240E+04	633328	9.08E-02	9.08E-02/cy	5	9.47E-01	9.6745E+06	+2.29E+00	0.01	1:03:01:06	100	20:19:33	1:00:49:13
6.97673E+04	637228	8.84E-02	8.84E-02/cy	4	8.87E-01	9.7962E+06	+2.18E+00	0.01	1:03:11:06	100	20:29:33	1:00:42:60
7.01088E+04	641112	8.80E-02	8.80E-02/cy	3	9.57E-01	9.9172E+06	+2.08E+00	0.01	1:03:21:06	98	20:39:33	1:00:36:50
7.04504E+04	645014	8.76E-02	8.76E-02/cy	4	9.30E-01	1.0035E+07	+1.98E+00	0.01	1:03:31:06	100	20:49:34	1:00:30:37
7.07920E+04	648933	8.69E-02	8.69E-02/cy	3	9.38E-01	1.0157E+07	+1.88E+00	0.01	1:03:41:06	100	20:59:34	1:00:24:22
7.11340E+04	652873	8.35E-02	8.35E-02/cx	3	8.73E-01	1.0280E+07	+1.78E+00	0.01	1:03:51:06	100	21:09:34	1:00:18:04
7.14743E+04	656803	8.73E-02	8.73E-02/cy	3	9.57E-01	1.0404E+07	+1.69E+00	0.01	1:04:01:06	98	21:19:34	1:00:11:49
7.18140E+04	660726	8.49E-02	8.49E-02/cx	3	9.28E-01	1.0526E+07	+1.60E+00	0.01	1:04:11:06	98	21:29:34	1:00:05:32
7.21478E+04	664602	8.66E-02	8.66E-02/cy	4	7.43E-01	1.0642E+07	+1.52E+00	0.01	1:04:21:06	100	21:39:34	23:59:29
7.24807E+04	668477	8.71E-02	8.71E-02/cy	4	8.31E-01	1.0757E+07	+1.44E+00	0.01	1:04:31:06	100	21:49:34	23:53:27

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
7.28191E+04	672399	8.70E-02	8.70E-02/cy	3	9.85E-01	1.0876E+07	+1.37E+00	0.01	1:04:41:06	98	21:59:34	23:47:07
7.31554E+04	676303	8.64E-02	8.64E-02/cy	5	9.71E-01	1.0992E+07	+1.31E+00	0.01	1:04:51:07	100	22:09:34	23:40:52
7.34885E+04	680228	8.03E-02	8.03E-02/cx	3	9.14E-01	1.1107E+07	+1.24E+00	0.01	1:05:01:07	100	22:19:34	23:34:42
7.38034E+04	684142	8.31E-02	8.31E-02/cx	4	9.38E-01	1.1215E+07	+1.19E+00	0.01	1:05:11:07	100	22:29:34	23:29:17
7.41254E+04	687928	8.52E-02	8.52E-02/cy	4	8.94E-01	1.1323E+07	+1.14E+00	0.01	1:05:21:07	100	22:39:34	23:23:32
7.44500E+04	691737	8.56E-02	8.56E-02/cy	4	9.81E-01	1.1429E+07	+1.10E+00	0.01	1:05:31:07	100	22:49:34	23:17:37
7.47683E+04	695483	8.53E-02	8.53E-02/cy	4	8.16E-01	1.1533E+07	+1.06E+00	0.01	1:05:41:07	98	22:59:34	23:11:57
7.50950E+04	699334	8.49E-02	8.49E-02/cy	4	7.40E-01	1.1637E+07	+1.02E+00	0.01	1:05:51:07	98	23:09:35	23:05:53
7.54209E+04	703180	8.43E-02	8.43E-02/cy	5	9.97E-01	1.1740E+07	+9.74E-01	0.01	1:06:01:07	98	23:19:35	22:59:49
7.57309E+04	706854	8.44E-02	8.44E-02/cy	6	9.35E-01	1.1831E+07	+9.41E-01	0.01	1:06:11:07	100	23:29:35	22:54:23
7.60446E+04	710577	8.44E-02	8.44E-02/cy	10	9.50E-01	1.1923E+07	+9.06E-01	0.01	1:06:21:07	100	23:39:35	22:48:46
7.63697E+04	714448	8.41E-02	8.41E-02/cx	4	7.35E-01	1.2022E+07	+8.64E-01	0.01	1:06:31:08	100	23:49:35	22:42:38
7.66934E+04	718320	8.39E-02	8.39E-02/cx	3	9.95E-01	1.2122E+07	+8.23E-01	0.01	1:06:41:08	98	23:59:35	22:36:31
7.70111E+04	722131	8.36E-02	8.36E-02/cx	3	9.99E-01	1.2218E+07	+7.86E-01	0.01	1:06:51:08	98	00:09:35	22:30:37
7.73294E+04	725957	8.34E-02	8.34E-02/cx	4	9.04E-01	1.2313E+07	+7.56E-01	0.01	1:07:01:08	95	00:19:35	22:24:40
7.76464E+04	729802	8.42E-02	8.42E-02/cy	5	8.94E-01	1.2406E+07	+7.29E-01	0.01	1:07:11:08	98	00:29:35	22:18:44
7.79419E+04	733550	8.39E-02	8.39E-02/cy	6	8.65E-01	1.2488E+07	+7.11E-01	0.01	1:07:21:08	100	00:39:36	22:13:39
7.82231E+04	737186	6.55E-02	6.55E-02/cx	4	9.58E-01	1.2565E+07	+6.96E-01	0.01	1:07:31:08	100	00:49:36	22:09:08
7.85096E+04	740971	8.32E-02	8.32E-02/cx	5	9.18E-01	1.2641E+07	+6.81E-01	0.01	1:07:41:08	100	00:59:36	22:04:21
7.87971E+04	744777	8.31E-02	8.31E-02/cx	5	9.97E-01	1.2718E+07	+6.67E-01	0.01	1:07:51:08	100	01:09:36	21:59:29
7.90791E+04	748575	7.03E-02	7.03E-02/cx	4	9.76E-01	1.2799E+07	+6.50E-01	0.01	1:08:01:08	100	01:19:36	21:54:48
7.93567E+04	752385	7.18E-02	7.18E-02/cx	4	7.79E-01	1.2883E+07	+6.28E-01	0.01	1:08:11:09	100	01:29:36	21:50:16
7.96430E+04	756211	6.80E-02	6.80E-02/cx	3	9.64E-01	1.2971E+07	+6.11E-01	0.01	1:08:21:09	100	01:39:36	21:45:21

restart and spatial data available at t= 7.99200E+04												

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
7.99200E+04	759912	8.12E-02	8.12E-02/cy	5	8.12E-01	1.3052E+07	+6.00E-01	0.01	1:08:30:43	95	01:49:11	21:40:29
7.99319E+04	760063	6.92E-02	6.92E-02/cx	3	9.48E-01	1.3055E+07	+6.00E-01	0.01	1:08:31:09	98	01:49:36	21:40:17
8.02205E+04	763901	8.22E-02	8.22E-02/cx	4	9.93E-01	1.3140E+07	+5.91E-01	0.01	1:08:41:09	100	01:59:36	21:35:11
8.05101E+04	767744	8.26E-02	8.26E-02/cx	4	9.58E-01	1.3221E+07	+5.85E-01	0.01	1:08:51:09	100	02:09:36	21:30:01
8.07980E+04	771566	6.76E-02	6.76E-02/cx	3	9.93E-01	1.3295E+07	+5.80E-01	0.01	1:09:01:09	100	02:19:36	21:24:53
8.10894E+04	775406	7.41E-02	7.41E-02/cx	3	9.86E-01	1.3372E+07	+5.78E-01	0.01	1:09:11:09	100	02:29:36	21:19:34
8.13802E+04	779201	8.43E-02	8.43E-02/cx	5	9.39E-01	1.3450E+07	+5.79E-01	0.01	1:09:21:09	98	02:39:37	21:14:15
8.16693E+04	783018	7.60E-02	7.60E-02/cy	4	8.67E-01	1.3526E+07	+5.79E-01	0.01	1:09:31:09	100	02:49:37	21:08:58
8.19589E+04	786832	7.53E-02	7.53E-02/cy	4	9.25E-01	1.3600E+07	+5.80E-01	0.01	1:09:41:09	100	02:59:37	21:03:38
8.22421E+04	790563	7.52E-02	7.52E-02/cy	4	8.98E-01	1.3672E+07	+5.81E-01	0.01	1:09:51:09	100	03:09:37	20:58:31
8.25332E+04	794371	7.70E-02	7.70E-02/cy	4	9.63E-01	1.3747E+07	+5.83E-01	0.01	1:10:01:09	100	03:19:37	20:53:03
8.28248E+04	798174	7.70E-02	7.70E-02/cy	4	9.03E-01	1.3822E+07	+5.86E-01	0.01	1:10:11:09	100	03:29:37	20:47:33
8.31177E+04	801953	7.52E-02	7.52E-02/cy	4	8.91E-01	1.3896E+07	+5.89E-01	0.01	1:10:21:09	98	03:39:37	20:41:56
8.34121E+04	805746	8.23E-02	8.23E-02/cy	5	8.69E-01	1.3971E+07	+5.93E-01	0.01	1:10:31:10	100	03:49:37	20:36:15
8.37057E+04	809491	7.97E-02	7.97E-02/cy	6	9.35E-01	1.4046E+07	+6.00E-01	0.01	1:10:41:10	100	03:59:37	20:30:34
8.39989E+04	813224	8.27E-02	8.27E-02/cx	6	9.90E-01	1.4117E+07	+6.12E-01	0.01	1:10:51:10	100	04:09:37	20:24:52
8.42943E+04	816967	7.12E-02	7.53E-02/cy	11	9.29E-01	1.4187E+07	+6.23E-01	0.01	1:11:01:10	98	04:19:37	20:19:03
8.45870E+04	820693	8.17E-02	8.17E-02/cx	5	9.75E-01	1.4257E+07	+6.36E-01	0.01	1:11:11:10	100	04:29:37	20:13:18
8.48769E+04	824408	7.96E-02	7.96E-02/cy	4	9.65E-01	1.4333E+07	+6.48E-01	0.01	1:11:21:10	100	04:39:38	20:07:39
8.51667E+04	828115	7.40E-02	8.17E-02/cx	14	9.19E-01	1.4410E+07	+6.64E-01	0.01	1:11:31:10	100	04:49:38	20:01:58
8.54577E+04	831782	8.16E-02	8.16E-02/cx	6	8.85E-01	1.4486E+07	+6.80E-01	0.01	1:11:41:10	100	04:59:38	19:56:12
8.57473E+04	835393	8.16E-02	8.16E-02/cx	7	9.36E-01	1.4560E+07	+6.97E-01	0.01	1:11:51:10	100	05:09:38	19:50:28
8.60382E+04	839009	8.08E-02	8.08E-02/cy	7	9.33E-01	1.4630E+07	+7.13E-01	0.01	1:12:01:10	100	05:19:38	19:44:39

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
8.63127E+04	842626	6.20E-02	6.20E-02/cy	7	9.78E-01	1.4697E+07	+7.29E-01	0.01	1:12:11:11	98	05:29:38	19:39:26
8.65518E+04	846238	6.63E-02	6.63E-02/cy	6	8.53E-01	1.4746E+07	+7.43E-01	0.01	1:12:21:11	100	05:39:38	19:35:34
8.67971E+04	849894	6.70E-02	6.70E-02/cy	6	9.45E-01	1.4800E+07	+7.58E-01	0.01	1:12:31:11	98	05:49:38	19:31:26
8.70340E+04	853504	6.50E-02	6.50E-02/cy	7	8.14E-01	1.4850E+07	+7.74E-01	0.01	1:12:41:11	100	05:59:38	19:27:35
8.72737E+04	857121	6.99E-02	6.99E-02/cy	6	8.75E-01	1.4897E+07	+7.87E-01	0.01	1:12:51:11	100	06:09:38	19:23:36
8.75101E+04	860719	5.98E-02	5.98E-02/cy	8	9.17E-01	1.4943E+07	+8.01E-01	0.01	1:13:01:11	98	06:19:38	19:19:42
8.77346E+04	864213	6.83E-02	6.83E-02/cy	6	9.36E-01	1.4986E+07	+8.15E-01	0.01	1:13:11:11	100	06:29:38	19:16:14
8.79619E+04	867711	6.55E-02	6.55E-02/cy	8	9.56E-01	1.5027E+07	+8.30E-01	0.01	1:13:21:11	100	06:39:38	19:12:37
8.81891E+04	871213	6.76E-02	6.76E-02/cy	6	9.61E-01	1.5068E+07	+8.44E-01	0.01	1:13:31:11	98	06:49:39	19:09:01
8.84011E+04	874630	6.34E-02	6.34E-02/cy	9	9.48E-01	1.5106E+07	+8.57E-01	0.01	1:13:41:11	100	06:59:39	19:05:54
8.86293E+04	878144	6.06E-02	6.06E-02/cy	10	9.92E-01	1.5148E+07	+8.72E-01	0.01	1:13:51:11	100	07:09:39	19:02:09
8.88440E+04	881555	5.96E-02	6.03E-02/cy	11	9.59E-01	1.5181E+07	+8.86E-01	0.01	1:14:01:11	98	07:19:39	18:58:54
8.90547E+04	884945	6.23E-02	6.23E-02/cy	9	9.47E-01	1.5217E+07	+9.00E-01	0.01	1:14:11:12	100	07:29:39	18:55:46
8.92704E+04	888381	6.56E-02	6.56E-02/cy	9	9.02E-01	1.5254E+07	+9.14E-01	0.01	1:14:21:12	100	07:39:39	18:52:24
8.94820E+04	891827	6.15E-02	6.15E-02/cy	9	9.18E-01	1.5294E+07	+9.28E-01	0.01	1:14:31:12	100	07:49:39	18:49:10
8.96914E+04	895236	6.26E-02	6.26E-02/cy	9	9.73E-01	1.5332E+07	+9.41E-01	0.01	1:14:41:12	100	07:59:39	18:45:60
8.98944E+04	898555	6.07E-02	6.07E-02/cy	10	9.87E-01	1.5365E+07	+9.56E-01	0.01	1:14:51:12	100	08:09:39	18:43:02
9.00988E+04	901913	5.40E-02	5.95E-02/cy	10	9.69E-01	1.5402E+07	+9.71E-01	0.01	1:15:01:12	93	08:19:39	18:39:58
9.02945E+04	905206	5.62E-02	5.97E-02/cy	10	9.90E-01	1.5433E+07	+9.85E-01	0.01	1:15:11:12	98	08:29:40	18:37:14
9.05000E+04	908543	6.49E-02	6.49E-02/cy	9	9.60E-01	1.5466E+07	+1.00E+00	0.01	1:15:21:12	100	08:39:40	18:34:04
9.06923E+04	911848	6.04E-02	6.04E-02/cy	10	9.33E-01	1.5494E+07	+1.01E+00	0.01	1:15:31:12	100	08:49:40	18:31:23
9.08845E+04	915169	6.28E-02	6.28E-02/cy	10	9.25E-01	1.5522E+07	+1.03E+00	0.01	1:15:41:12	98	08:59:40	18:28:41
9.10875E+04	918523	6.00E-02	6.00E-02/cy	9	1.00E+00	1.5555E+07	+1.05E+00	0.01	1:15:51:13	100	09:09:40	18:25:32

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
9.12827E+04	921845	5.37E-02	6.21E-02/cy	10	9.64E-01	1.5583E+07	+1.06E+00	0.01	1:16:01:13	100	09:19:40	18:22:39
9.14745E+04	925155	5.92E-02	5.92E-02/cy	10	9.49E-01	1.5610E+07	+1.07E+00	0.01	1:16:11:13	98	09:29:40	18:19:51
9.16721E+04	928474	5.59E-02	5.59E-02/cy	10	9.37E-01	1.5637E+07	+1.09E+00	0.01	1:16:21:13	93	09:39:40	18:16:49
9.18608E+04	931762	6.05E-02	6.14E-02/cy	11	9.71E-01	1.5664E+07	+1.10E+00	0.01	1:16:31:13	98	09:49:40	18:14:06
9.20533E+04	935069	5.77E-02	6.08E-02/cy	10	9.91E-01	1.5690E+07	+1.12E+00	0.01	1:16:41:13	98	09:59:40	18:11:12
9.22415E+04	938356	5.99E-02	6.02E-02/cy	10	9.99E-01	1.5718E+07	+1.13E+00	0.01	1:16:51:13	98	10:09:41	18:08:26
9.24328E+04	941655	5.87E-02	5.87E-02/cy	11	9.49E-01	1.5744E+07	+1.15E+00	0.01	1:17:01:13	100	10:19:41	18:05:31
9.26205E+04	944940	5.47E-02	6.01E-02/cy	10	9.90E-01	1.5771E+07	+1.16E+00	0.01	1:17:11:13	98	10:29:41	18:02:42
9.28121E+04	948214	5.34E-02	6.03E-02/cy	10	9.72E-01	1.5797E+07	+1.17E+00	0.01	1:17:21:13	98	10:39:41	17:59:43
9.29982E+04	951496	6.02E-02	6.06E-02/cy	11	9.75E-01	1.5824E+07	+1.19E+00	0.01	1:17:31:14	98	10:49:41	17:56:55
9.31867E+04	954783	5.66E-02	5.77E-02/cy	11	9.68E-01	1.5848E+07	+1.20E+00	0.01	1:17:41:14	100	10:59:41	17:53:60

restart and spatial data available at t= 9.32400E+04												

9.32400E+04	955730	5.72E-02	6.00E-02/cy	11	9.60E-01	1.5856E+07	+1.21E+00	0.01	1:17:44:06	98	11:02:34	17:53:11
9.33703E+04	958056	5.69E-02	6.04E-02/cy	11	9.75E-01	1.5875E+07	+1.21E+00	0.01	1:17:51:14	98	11:09:41	17:51:14
9.35571E+04	961341	5.50E-02	6.03E-02/cy	10	9.74E-01	1.5902E+07	+1.23E+00	0.01	1:18:01:14	100	11:19:41	17:48:19
9.37441E+04	964619	5.44E-02	6.10E-02/cy	10	9.65E-01	1.5926E+07	+1.24E+00	0.01	1:18:11:14	100	11:29:41	17:45:22
9.39274E+04	967881	5.38E-02	6.02E-02/cy	10	9.69E-01	1.5951E+07	+1.25E+00	0.01	1:18:21:14	98	11:39:41	17:42:32
9.41118E+04	971159	5.53E-02	6.00E-02/cy	11	9.79E-01	1.5974E+07	+1.27E+00	0.01	1:18:31:14	100	11:49:41	17:39:37
9.42969E+04	974444	5.63E-02	5.98E-02/cy	11	9.63E-01	1.5997E+07	+1.28E+00	0.01	1:18:41:14	98	11:59:42	17:36:40
9.44852E+04	977730	5.97E-02	6.14E-02/cy	11	9.80E-01	1.6023E+07	+1.29E+00	0.01	1:18:51:14	98	12:09:42	17:33:33
9.46698E+04	981013	5.57E-02	5.99E-02/cy	10	9.92E-01	1.6047E+07	+1.30E+00	0.01	1:19:01:14	100	12:19:42	17:30:33
9.48552E+04	984294	5.12E-02	6.03E-02/cy	9	9.69E-01	1.6072E+07	+1.31E+00	0.01	1:19:11:14	100	12:29:42	17:27:30
9.50400E+04	987551	5.45E-02	5.92E-02/cy	10	9.83E-01	1.6097E+07	+1.32E+00	0.01	1:19:21:14	98	12:39:42	17:24:26
9.52253E+04	990831	5.84E-02	6.15E-02/cy	11	9.66E-01	1.6120E+07	+1.34E+00	0.01	1:19:31:15	100	12:49:42	17:21:20

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
9.54096E+04	994114	5.98E-02	6.03E-02/cy	11	9.89E-01	1.6146E+07	+1.35E+00	0.01	1:19:41:15	100	12:59:42	17:18:14
9.55928E+04	997385	5.54E-02	6.07E-02/cy	11	9.62E-01	1.6172E+07	+1.36E+00	0.01	1:19:51:15	98	13:09:42	17:15:09
9.57775E+04	1000668	5.86E-02	6.09E-02/cy	11	9.83E-01	1.6197E+07	+1.37E+00	0.01	1:20:01:15	98	13:19:42	17:11:60
9.59619E+04	1003947	5.85E-02	6.15E-02/cy	11	9.70E-01	1.6222E+07	+1.38E+00	0.01	1:20:11:15	100	13:29:42	17:08:49
9.61459E+04	1007209	5.59E-02	6.05E-02/cy	10	9.91E-01	1.6248E+07	+1.39E+00	0.01	1:20:21:15	98	13:39:42	17:05:38
9.63322E+04	1010491	5.98E-02	6.16E-02/cy	11	9.80E-01	1.6272E+07	+1.40E+00	0.01	1:20:31:15	94	13:49:42	17:02:20
9.65137E+04	1013774	5.35E-02	6.08E-02/cy	10	9.65E-01	1.6298E+07	+1.41E+00	0.01	1:20:41:15	98	13:59:43	16:59:11
9.67006E+04	1017058	5.57E-02	6.14E-02/cy	10	9.88E-01	1.6323E+07	+1.42E+00	0.01	1:20:51:15	100	14:09:43	16:55:48
9.68828E+04	1020338	5.33E-02	6.06E-02/cy	11	9.74E-01	1.6350E+07	+1.43E+00	0.01	1:21:01:15	100	14:19:43	16:52:35
9.70645E+04	1023615	5.89E-02	6.11E-02/cy	11	9.69E-01	1.6377E+07	+1.44E+00	0.01	1:21:11:15	100	14:29:43	16:49:21
9.72429E+04	1026870	5.64E-02	6.23E-02/cy	10	9.75E-01	1.6399E+07	+1.45E+00	0.01	1:21:21:16	98	14:39:43	16:46:14
9.74206E+04	1030147	5.83E-02	6.15E-02/cy	11	9.79E-01	1.6423E+07	+1.46E+00	0.01	1:21:31:16	100	14:49:43	16:43:06
9.76053E+04	1033427	5.82E-02	6.16E-02/cy	10	9.98E-01	1.6446E+07	+1.47E+00	0.01	1:21:41:16	93	14:59:43	16:39:41
9.77916E+04	1036707	5.66E-02	6.14E-02/cy	10	9.90E-01	1.6468E+07	+1.48E+00	0.01	1:21:51:16	100	15:09:43	16:36:11
9.79722E+04	1039986	5.62E-02	6.21E-02/cy	10	9.91E-01	1.6491E+07	+1.49E+00	0.01	1:22:01:16	98	15:19:43	16:32:52
9.81559E+04	1043266	5.55E-02	6.02E-02/cy	10	9.90E-01	1.6513E+07	+1.50E+00	0.01	1:22:11:16	98	15:29:44	16:29:25
9.83412E+04	1046525	5.93E-02	6.27E-02/cy	11	9.70E-01	1.6535E+07	+1.52E+00	0.01	1:22:21:16	98	15:39:44	16:25:52
9.85248E+04	1049799	5.91E-02	6.21E-02/cy	11	9.77E-01	1.6556E+07	+1.53E+00	0.01	1:22:31:16	98	15:49:44	16:22:22
9.87109E+04	1053076	5.47E-02	6.13E-02/cy	10	9.77E-01	1.6576E+07	+1.54E+00	0.01	1:22:41:16	98	15:59:44	16:18:45
9.88959E+04	1056356	5.45E-02	6.26E-02/cy	10	9.73E-01	1.6598E+07	+1.55E+00	0.01	1:22:51:16	100	16:09:44	16:15:09
9.90805E+04	1059634	5.43E-02	6.04E-02/cy	10	9.94E-01	1.6619E+07	+1.56E+00	0.01	1:23:01:16	100	16:19:44	16:11:33
9.92606E+04	1062913	5.31E-02	6.13E-02/cy	10	9.87E-01	1.6640E+07	+1.57E+00	0.01	1:23:11:17	100	16:29:44	16:08:05
9.94427E+04	1066174	5.35E-02	6.06E-02/cy	10	9.77E-01	1.6662E+07	+1.58E+00	0.01	1:23:21:17	100	16:39:44	16:04:31
progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
9.96268E+04	1069449	5.67E-02	6.00E-02/cy	11	9.65E-01	1.6684E+07	+1.59E+00	0.01	1:23:31:17	98	16:49:44	16:00:51
9.98083E+04	1072724	4.83E-02	6.03E-02/cy	10	9.77E-01	1.6703E+07	+1.60E+00	0.01	1:23:41:17	100	16:59:44	15:57:16
9.99897E+04	1076003	5.29E-02	6.08E-02/cy	10	9.95E-01	1.6724E+07	+1.61E+00	0.01	1:23:51:17	100	17:09:44	15:53:40
1.00172E+05	1079267	5.57E-02	6.15E-02/cy	10	9.74E-01	1.6745E+07	+1.62E+00	0.01	2:00:01:17	98	17:19:45	15:49:60
1.00355E+05	1082545	5.73E-02	6.09E-02/cy	11	9.60E-01	1.6766E+07	+1.63E+00	0.01	2:00:11:17	100	17:29:45	15:46:16
1.00537E+05	1085792	5.93E-02	6.11E-02/cy	11	9.80E-01	1.6786E+07	+1.64E+00	0.01	2:00:21:17	100	17:39:45	15:42:36
1.00716E+05	1089065	5.93E-02	6.09E-02/cy	11	9.82E-01	1.6806E+07	+1.65E+00	0.01	2:00:31:17	98	17:49:45	15:38:58
1.00899E+05	1092319	5.61E-02	6.14E-02/cy	10	9.86E-01	1.6825E+07	+1.66E+00	0.01	2:00:41:17	98	17:59:45	15:35:12
1.01081E+05	1095599	5.24E-02	6.01E-02/cy	11	9.76E-01	1.6847E+07	+1.67E+00	0.01	2:00:51:17	98	18:09:45	15:31:26
1.01262E+05	1098876	5.92E-02	6.20E-02/cy	11	9.91E-01	1.6866E+07	+1.68E+00	0.01	2:01:01:18	98	18:19:45	15:27:41
1.01444E+05	1102139	5.48E-02	6.08E-02/cy	10	9.98E-01	1.6888E+07	+1.69E+00	0.01	2:01:11:18	98	18:29:45	15:23:47
1.01625E+05	1105395	5.84E-02	6.13E-02/cy	11	9.86E-01	1.6907E+07	+1.70E+00	0.01	2:01:21:18	98	18:39:45	15:20:03
1.01808E+05	1108655	5.30E-02	6.20E-02/cy	10	9.70E-01	1.6925E+07	+1.71E+00	0.01	2:01:31:18	93	18:49:45	15:16:24
1.01983E+05	1111932	6.02E-02	6.06E-02/cy	11	9.89E-01	1.6946E+07	+1.72E+00	0.01	2:01:41:18	98	18:59:45	15:12:35
1.02161E+05	1115170	5.65E-02	5.95E-02/cy	12	9.97E-01	1.6965E+07	+1.73E+00	0.01	2:01:51:18	98	19:09:45	15:08:50
1.02336E+05	1118428	5.00E-02	5.92E-02/cy	11	9.71E-01	1.6982E+07	+1.74E+00	0.01	2:02:01:18	98	19:19:45	15:05:11
1.02510E+05	1121705	5.75E-02	6.06E-02/cy	11	9.84E-01	1.6997E+07	+1.74E+00	0.01	2:02:11:18	98	19:29:46	15:01:33
1.02689E+05	1124963	5.54E-02	6.15E-02/cy	11	9.70E-01	1.7013E+07	+1.75E+00	0.01	2:02:21:18	98	19:39:46	14:57:41
1.02867E+05	1128218	4.81E-02	6.05E-02/cy	10	9.86E-01	1.7034E+07	+1.76E+00	0.01	2:02:31:18	100	19:49:46	14:53:52
1.03043E+05	1131492	5.32E-02	6.09E-02/cy	10	9.97E-01	1.7051E+07	+1.77E+00	0.01	2:02:41:18	100	19:59:46	14:50:06
1.03213E+05	1134769	5.07E-02	6.16E-02/cy	9	9.92E-01	1.7067E+07	+1.78E+00	0.01	2:02:51:18	100	20:09:46	14:46:30
1.03383E+05	1138028	5.46E-02	6.24E-02/cy	10	9.98E-01	1.7085E+07	+1.79E+00	0.01	2:03:01:19	98	20:19:46	14:42:54
1.03558E+05	1141250	5.58E-02	6.22E-02/cy	11	9.64E-01	1.7104E+07	+1.80E+00	0.01	2:03:11:19	94	20:29:46	14:39:07
progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.03726E+05	1144396	5.83E-02	6.18E-02/cy	11	9.77E-01	1.7121E+07	+1.81E+00	0.01	2:03:21:19	100	20:39:46	14:35:33
1.03895E+05	1147669	5.01E-02	5.98E-02/cy	10	9.79E-01	1.7138E+07	+1.82E+00	0.01	2:03:31:19	100	20:49:46	14:31:58
1.04069E+05	1150929	5.67E-02	6.16E-02/cy	11	9.78E-01	1.7155E+07	+1.83E+00	0.01	2:03:41:19	98	20:59:47	14:28:06
1.04242E+05	1154190	5.45E-02	6.30E-02/cy	10	9.84E-01	1.7171E+07	+1.84E+00	0.01	2:03:51:19	100	21:09:47	14:24:18
1.04415E+05	1157459	5.25E-02	6.23E-02/cy	10	9.74E-01	1.7190E+07	+1.85E+00	0.01	2:04:01:19	98	21:19:47	14:20:28
1.04588E+05	1160719	4.83E-02	6.00E-02/cy	10	9.76E-01	1.7210E+07	+1.85E+00	0.01	2:04:11:20	100	21:29:47	14:16:39
1.04757E+05	1163962	5.31E-02	5.91E-02/cy	11	9.89E-01	1.7227E+07	+1.86E+00	0.01	2:04:21:20	98	21:39:47	14:12:55
1.04931E+05	1167220	5.45E-02	6.02E-02/cy	11	9.81E-01	1.7247E+07	+1.87E+00	0.01	2:04:31:20	98	21:49:47	14:08:59
1.05103E+05	1170472	5.10E-02	6.14E-02/cy	10	9.92E-01	1.7268E+07	+1.88E+00	0.01	2:04:41:20	100	21:59:47	14:05:08
1.05269E+05	1173744	5.14E-02	6.12E-02/cy	11	9.79E-01	1.7284E+07	+1.89E+00	0.01	2:04:51:20	98	22:09:47	14:01:27
1.05441E+05	1177016	5.18E-02	5.93E-02/cy	11	9.79E-01	1.7299E+07	+1.90E+00	0.01	2:05:01:20	98	22:19:48	13:57:32
1.05608E+05	1180275	5.05E-02	6.05E-02/cy	10	9.83E-01	1.7314E+07	+1.90E+00	0.01	2:05:11:20	98	22:29:48	13:53:48
1.05776E+05	1183531	5.20E-02	6.00E-02/cy	11	9.90E-01	1.7324E+07	+1.91E+00	0.01	2:05:21:20	100	22:39:48	13:49:59
1.05943E+05	1186789	5.33E-02	6.08E-02/cy	11	9.91E-01	1.7337E+07	+1.92E+00	0.01	2:05:31:21	98	22:49:48	13:46:14
1.06111E+05	1190059	5.39E-02	6.09E-02/cy	11	9.82E-01	1.7347E+07	+1.93E+00	0.01	2:05:41:21	98	22:59:48	13:42:21
1.06279E+05	1193317	5.00E-02	5.96E-02/cy	10	9.76E-01	1.7358E+07	+1.93E+00	0.01	2:05:51:21	98	23:09:48	13:38:32
1.06448E+05	1196570	4.91E-02	6.06E-02/cy	11	9.70E-01	1.7370E+07	+1.94E+00	0.01	2:06:01:21	98	23:19:48	13:34:37

restart and spatial data available at t= 1.06560E+05

1.06560E+05	1198760	5.23E-02	5.98E-02/cy	11	9.84E-01	1.7378E+07	+1.95E+00	0.01	2:06:08:02	100	23:26:30	13:32:01
1.06613E+05	1199834	5.01E-02	5.95E-02/cy	10	9.97E-01	1.7380E+07	+1.95E+00	0.01	2:06:11:21	93	23:29:48	13:30:49
1.06779E+05	1203090	5.15E-02	5.98E-02/cy	11	9.77E-01	1.7390E+07	+1.96E+00	0.01	2:06:21:21	100	23:39:48	13:26:59
1.06947E+05	1206341	5.07E-02	6.05E-02/cy	11	9.67E-01	1.7401E+07	+1.97E+00	0.01	2:06:31:21	100	23:49:48	13:23:03
1.07114E+05	1209611	5.13E-02	6.14E-02/cy	10	9.97E-01	1.7413E+07	+1.97E+00	0.01	2:06:41:21	100	23:59:49	13:19:08
1.07281E+05	1212886	4.90E-02	6.01E-02/cy	10	9.74E-01	1.7424E+07	+1.98E+00	0.01	2:06:51:21	100	00:09:49	13:15:11

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.07448E+05	1216143	4.79E-02	5.94E-02/cy	10	9.88E-01	1.7434E+07	+1.99E+00	0.01	2:07:01:21	98	00:19:49	13:11:15
1.07616E+05	1219419	4.80E-02	6.01E-02/cy	10	9.74E-01	1.7444E+07	+2.00E+00	0.01	2:07:11:22	94	00:29:49	13:07:14
1.07782E+05	1222674	5.20E-02	6.06E-02/cy	11	9.77E-01	1.7455E+07	+2.01E+00	0.01	2:07:21:22	98	00:39:49	13:03:17
1.07947E+05	1225928	4.85E-02	5.97E-02/cy	10	9.79E-01	1.7466E+07	+2.02E+00	0.01	2:07:31:22	100	00:49:49	12:59:19
1.08114E+05	1229191	5.20E-02	6.07E-02/cy	10	9.98E-01	1.7476E+07	+2.03E+00	0.01	2:07:41:22	100	00:59:49	12:55:18
1.08281E+05	1232449	5.34E-02	6.26E-02/cy	11	9.70E-01	1.7488E+07	+2.04E+00	0.01	2:07:51:22	94	01:09:49	12:51:15
1.08449E+05	1235721	4.87E-02	6.05E-02/cy	10	9.78E-01	1.7500E+07	+2.05E+00	0.01	2:08:01:22	98	01:19:49	12:47:10
1.08615E+05	1238977	5.54E-02	6.11E-02/cy	11	9.93E-01	1.7510E+07	+2.05E+00	0.01	2:08:11:22	98	01:29:50	12:43:08
1.08783E+05	1242232	4.91E-02	6.09E-02/cy	11	9.79E-01	1.7522E+07	+2.06E+00	0.01	2:08:21:22	100	01:39:50	12:38:58
1.08951E+05	1245503	5.21E-02	5.95E-02/cy	11	9.91E-01	1.7533E+07	+2.07E+00	0.01	2:08:31:22	100	01:49:50	12:34:50
1.09114E+05	1248758	5.10E-02	6.03E-02/cy	10	9.99E-01	1.7544E+07	+2.08E+00	0.01	2:08:41:22	98	01:59:50	12:30:50
1.09281E+05	1252034	5.12E-02	6.09E-02/cx	11	9.78E-01	1.7555E+07	+2.09E+00	0.01	2:08:51:23	100	02:09:50	12:26:40
1.09448E+05	1255306	5.16E-02	5.98E-02/cy	11	9.87E-01	1.7566E+07	+2.10E+00	0.01	2:09:01:23	98	02:19:50	12:22:30
1.09614E+05	1258580	5.19E-02	5.94E-02/cy	11	9.84E-01	1.7578E+07	+2.11E+00	0.01	2:09:11:23	98	02:29:50	12:18:21
1.09780E+05	1261831	5.11E-02	6.10E-02/cx	10	9.89E-01	1.7590E+07	+2.12E+00	0.01	2:09:21:23	98	02:39:50	12:14:11
1.09945E+05	1265102	4.91E-02	6.04E-02/cy	10	9.73E-01	1.7602E+07	+2.12E+00	0.01	2:09:31:23	98	02:49:50	12:10:01
1.10113E+05	1268373	5.21E-02	5.99E-02/cy	11	9.67E-01	1.7613E+07	+2.13E+00	0.01	2:09:41:23	98	02:59:50	12:05:43
1.10279E+05	1271648	4.98E-02	6.12E-02/cy	10	9.84E-01	1.7626E+07	+2.14E+00	0.01	2:09:51:23	100	03:09:50	12:01:32
1.10442E+05	1274918	5.03E-02	6.04E-02/cy	11	9.70E-01	1.7637E+07	+2.15E+00	0.01	2:10:01:23	98	03:19:51	11:57:23
1.10609E+05	1278191	5.33E-02	5.94E-02/cy	11	9.85E-01	1.7646E+07	+2.16E+00	0.01	2:10:11:23	100	03:29:51	11:53:06
1.10775E+05	1281446	5.22E-02	6.12E-02/cy	10	9.97E-01	1.7659E+07	+2.17E+00	0.01	2:10:21:23	98	03:39:51	11:48:49
1.10940E+05	1284713	5.04E-02	6.01E-02/cy	10	9.91E-01	1.7669E+07	+2.18E+00	0.01	2:10:31:24	100	03:49:51	11:44:33
1.11107E+05	1287981	5.11E-02	5.97E-02/cy	11	9.78E-01	1.7680E+07	+2.18E+00	0.01	2:10:41:24	100	03:59:51	11:40:12

progress		time step		pressure		fluid #1			performance			
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.11269E+05	1291193	5.02E-02	6.01E-02/cy	11	9.74E-01	1.7689E+07	+2.19E+00	0.01	2:10:51:24	100	04:09:51	11:36:02
1.11435E+05	1294464	5.33E-02	6.02E-02/cy	11	9.70E-01	1.7701E+07	+2.20E+00	0.01	2:11:01:24	98	04:19:51	11:31:41
1.11600E+05	1297737	5.11E-02	6.01E-02/cy	11	9.91E-01	1.7713E+07	+2.21E+00	0.01	2:11:11:24	100	04:29:52	11:27:23
1.11761E+05	1300974	5.12E-02	6.02E-02/cy	11	9.85E-01	1.7722E+07	+2.22E+00	0.01	2:11:21:24	100	04:39:52	11:23:10
1.11926E+05	1304244	5.17E-02	5.92E-02/cy	11	9.93E-01	1.7732E+07	+2.22E+00	0.01	2:11:31:24	100	04:49:52	11:18:49
1.12092E+05	1307515	5.49E-02	6.13E-02/cy	11	9.90E-01	1.7743E+07	+2.23E+00	0.01	2:11:41:25	100	04:59:52	11:14:26
1.12255E+05	1310790	4.75E-02	5.95E-02/cy	10	9.74E-01	1.7755E+07	+2.24E+00	0.01	2:11:51:25	100	05:09:52	11:10:07
1.12418E+05	1314059	5.05E-02	5.99E-02/cy	11	9.69E-01	1.7765E+07	+2.25E+00	0.01	2:12:01:25	98	05:19:52	11:05:46
1.12583E+05	1317331	5.09E-02	6.07E-02/cy	11	9.69E-01	1.7775E+07	+2.26E+00	0.01	2:12:11:25	98	05:29:52	11:01:21
1.12747E+05	1320584	5.00E-02	6.06E-02/cy	10	9.80E-01	1.7785E+07	+2.26E+00	0.01	2:12:21:25	94	05:39:52	10:56:56
1.12908E+05	1323851	5.34E-02	6.10E-02/cy	11	9.79E-01	1.7795E+07	+2.27E+00	0.01	2:12:31:25	98	05:49:52	10:52:39
1.13071E+05	1327122	5.13E-02	5.99E-02/cy	11	9.84E-01	1.7806E+07	+2.28E+00	0.01	2:12:41:25	98	05:59:53	10:48:14
1.13235E+05	1330388	4.71E-02	5.88E-02/cy	10	9.76E-01	1.7816E+07	+2.29E+00	0.01	2:12:51:25	93	06:09:53	10:43:49
1.13398E+05	1333658	4.76E-02	6.07E-02/cy	10	9.78E-01	1.7828E+07	+2.29E+00	0.01	2:13:01:25	98	06:19:53	10:39:22
1.13562E+05	1336930	4.80E-02	5.97E-02/cy	10	9.85E-01	1.7839E+07	+2.30E+00	0.01	2:13:11:25	98	06:29:53	10:34:54
1.13724E+05	1340180	4.98E-02	5.99E-02/cy	11	9.74E-01	1.7846E+07	+2.31E+00	0.01	2:13:21:25	100	06:39:53	10:30:29
1.13888E+05	1343449	4.79E-02	5.99E-02/cy	10	9.95E-01	1.7859E+07	+2.32E+00	0.01	2:13:31:26	98	06:49:53	10:25:58
1.14052E+05	1346719	5.35E-02	5.98E-02/cy	11	9.88E-01	1.7869E+07	+2.32E+00	0.01	2:13:41:26	100	06:59:53	10:21:26
1.14213E+05	1349992	5.13E-02	6.06E-02/cy	11	9.66E-01	1.7879E+07	+2.33E+00	0.01	2:13:51:26	98	07:09:53	10:16:59
1.14378E+05	1353262	4.69E-02	5.94E-02/cy	10	9.73E-01	1.7888E+07	+2.34E+00	0.01	2:14:01:26	98	07:19:53	10:12:23
1.14541E+05	1356532	5.24E-02	6.02E-02/cy	11	9.88E-01	1.7898E+07	+2.34E+00	0.01	2:14:11:26	98	07:29:53	10:07:51
1.14705E+05	1359781	5.17E-02	6.09E-02/cy	11	9.85E-01	1.7907E+07	+2.35E+00	0.01	2:14:21:26	98	07:39:53	10:03:16
1.14868E+05	1363048	4.99E-02	5.81E-02/cy	11	9.83E-01	1.7916E+07	+2.36E+00	0.01	2:14:31:26	100	07:49:54	09:58:41

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.15032E+05	1366317	4.81E-02	6.01E-02/cy	10	9.85E-01	1.7926E+07	+2.37E+00	0.01	2:14:41:26	98	07:59:54	09:54:05
1.15193E+05	1369551	5.08E-02	5.94E-02/cy	11	9.92E-01	1.7935E+07	+2.37E+00	0.01	2:14:51:26	100	08:09:54	09:49:32
1.15356E+05	1372818	4.91E-02	5.95E-02/cy	11	9.73E-01	1.7945E+07	+2.38E+00	0.01	2:15:01:26	98	08:19:54	09:44:57
1.15518E+05	1376091	5.19E-02	6.05E-02/cy	11	9.84E-01	1.7955E+07	+2.39E+00	0.01	2:15:11:27	98	08:29:54	09:40:21
1.15678E+05	1379344	5.10E-02	6.06E-02/cy	11	9.76E-01	1.7964E+07	+2.39E+00	0.01	2:15:21:27	100	08:39:54	09:35:48
1.15841E+05	1382613	4.91E-02	6.10E-02/cy	10	9.87E-01	1.7972E+07	+2.40E+00	0.01	2:15:31:27	100	08:49:54	09:31:09
1.16006E+05	1385881	4.98E-02	5.94E-02/cy	11	9.70E-01	1.7982E+07	+2.41E+00	0.01	2:15:41:27	98	08:59:54	09:26:25
1.16168E+05	1389149	5.04E-02	6.02E-02/cy	11	9.76E-01	1.7990E+07	+2.41E+00	0.01	2:15:51:27	100	09:09:54	09:21:44
1.16331E+05	1392422	5.34E-02	5.97E-02/cy	11	9.72E-01	1.7999E+07	+2.42E+00	0.01	2:16:01:27	94	09:19:55	09:17:02
1.16493E+05	1395689	5.15E-02	5.99E-02/cy	11	9.87E-01	1.8008E+07	+2.42E+00	0.01	2:16:11:27	98	09:29:55	09:12:21
1.16657E+05	1398940	5.07E-02	5.99E-02/cy	11	9.93E-01	1.8018E+07	+2.43E+00	0.01	2:16:21:27	98	09:39:55	09:07:35
1.16818E+05	1402208	4.65E-02	5.97E-02/cy	9	9.79E-01	1.8027E+07	+2.44E+00	0.01	2:16:31:27	100	09:49:55	09:02:54
1.16982E+05	1405474	5.22E-02	6.06E-02/cy	11	9.89E-01	1.8035E+07	+2.44E+00	0.01	2:16:41:27	98	09:59:55	08:58:08
1.17146E+05	1408740	4.80E-02	6.01E-02/cy	10	9.97E-01	1.8044E+07	+2.45E+00	0.01	2:16:51:28	98	10:09:55	08:53:18
1.17309E+05	1412002	4.90E-02	5.97E-02/cy	10	9.62E-01	1.8052E+07	+2.45E+00	0.01	2:17:01:28	100	10:19:55	08:48:30
1.17470E+05	1415259	4.79E-02	6.04E-02/cy	10	9.93E-01	1.8060E+07	+2.46E+00	0.01	2:17:11:28	100	10:29:55	08:43:46
1.17630E+05	1418450	5.09E-02	6.01E-02/cy	10	9.93E-01	1.8068E+07	+2.47E+00	0.01	2:17:21:28	98	10:39:55	08:39:04
1.17793E+05	1421721	5.40E-02	6.06E-02/cy	11	9.91E-01	1.8078E+07	+2.47E+00	0.01	2:17:31:28	100	10:49:55	08:34:13
1.17956E+05	1424991	4.94E-02	5.91E-02/cy	11	9.78E-01	1.8086E+07	+2.48E+00	0.01	2:17:41:28	98	10:59:55	08:29:23
1.18119E+05	1428266	4.72E-02	6.01E-02/cy	9	9.78E-01	1.8095E+07	+2.48E+00	0.01	2:17:51:28	98	11:09:55	08:24:30
1.18283E+05	1431541	4.98E-02	6.10E-02/cy	10	9.74E-01	1.8102E+07	+2.49E+00	0.01	2:18:01:28	98	11:19:56	08:19:36
1.18448E+05	1434813	5.02E-02	5.91E-02/cy	11	9.72E-01	1.8112E+07	+2.49E+00	0.01	2:18:11:28	98	11:29:56	08:14:37
1.18609E+05	1438062	4.96E-02	6.13E-02/cy	10	9.86E-01	1.8121E+07	+2.50E+00	0.01	2:18:21:28	93	11:39:56	08:09:46

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.18775E+05	1441331	5.28E-02	6.20E-02/cy	10	9.92E-01	1.8128E+07	+2.50E+00	0.01	2:18:31:28	98	11:49:56	08:04:45
1.18937E+05	1444599	5.35E-02	6.05E-02/cy	11	9.74E-01	1.8139E+07	+2.51E+00	0.01	2:18:41:29	98	11:59:56	07:59:52
1.19101E+05	1447872	4.63E-02	6.00E-02/cy	10	9.74E-01	1.8146E+07	+2.51E+00	0.01	2:18:51:29	98	12:09:56	07:54:53
1.19266E+05	1451145	5.42E-02	6.08E-02/cy	11	9.73E-01	1.8153E+07	+2.52E+00	0.01	2:19:01:29	100	12:19:56	07:49:50
1.19426E+05	1454418	5.20E-02	6.06E-02/cy	11	9.65E-01	1.8161E+07	+2.52E+00	0.01	2:19:11:29	100	12:29:56	07:44:57
1.19593E+05	1457673	5.63E-02	6.23E-02/cy	11	9.75E-01	1.8168E+07	+2.53E+00	0.01	2:19:21:29	98	12:39:56	07:39:50
1.19757E+05	1460945	5.13E-02	5.91E-02/cy	11	9.70E-01	1.8176E+07	+2.53E+00	0.01	2:19:31:29	98	12:49:56	07:34:47

restart and spatial data available at t= 1.19880E+05												

1.19880E+05	1463361	5.02E-02	6.05E-02/cy	10	9.73E-01	1.8181E+07	+2.54E+00	0.01	2:19:38:53	98	12:57:20	07:30:59
1.19922E+05	1464205	4.75E-02	5.93E-02/cy	11	9.65E-01	1.8184E+07	+2.54E+00	0.01	2:19:41:29	98	12:59:56	07:29:41
1.20086E+05	1467464	5.12E-02	6.07E-02/cy	10	9.88E-01	1.8193E+07	+2.54E+00	0.01	2:19:51:29	98	13:09:56	07:24:38
1.20249E+05	1470739	5.41E-02	6.14E-02/cy	10	9.99E-01	1.8202E+07	+2.55E+00	0.01	2:20:01:29	98	13:19:56	07:19:34
1.20414E+05	1474012	4.69E-02	5.99E-02/cy	10	9.86E-01	1.8209E+07	+2.55E+00	0.01	2:20:11:29	100	13:29:57	07:14:28
1.20580E+05	1477269	5.06E-02	6.16E-02/cy	10	9.88E-01	1.8217E+07	+2.56E+00	0.01	2:20:21:29	100	13:39:57	07:09:15
1.20749E+05	1480542	4.85E-02	5.96E-02/cy	10	9.83E-01	1.8226E+07	+2.56E+00	0.01	2:20:31:29	98	13:49:57	07:03:58
1.20911E+05	1483814	4.89E-02	6.02E-02/cy	10	9.87E-01	1.8234E+07	+2.56E+00	0.01	2:20:41:30	98	13:59:57	06:58:54
1.21077E+05	1487088	4.92E-02	6.19E-02/cy	10	9.79E-01	1.8242E+07	+2.57E+00	0.01	2:20:51:30	100	14:09:57	06:53:40
1.21244E+05	1490361	4.71E-02	5.91E-02/cy	10	9.73E-01	1.8251E+07	+2.57E+00	0.01	2:21:01:30	98	14:19:57	06:48:24
Spatial Data Request Signaled												

restart and spatial data available at t= 1.21376E+05												

1.21376E+05	1492974	5.12E-02	5.98E-02/cy	11	9.70E-01	1.8258E+07	+2.57E+00	0.01	2:21:09:41	98	14:28:08	06:44:14
1.21404E+05	1493556	4.98E-02	6.03E-02/cy	11	9.68E-01	1.8259E+07	+2.57E+00	0.01	2:21:11:30	100	14:29:57	06:43:22
1.21566E+05	1496807	5.42E-02	6.10E-02/cy	11	9.63E-01	1.8268E+07	+2.58E+00	0.01	2:21:21:30	100	14:39:58	06:38:17
1.21731E+05	1500076	4.72E-02	5.93E-02/cy	10	9.89E-01	1.8274E+07	+2.58E+00	0.01	2:21:31:30	98	14:49:58	06:33:01
1.21896E+05	1503346	5.27E-02	6.08E-02/cy	11	9.91E-01	1.8281E+07	+2.59E+00	0.01	2:21:41:30	100	14:59:58	06:27:45
1.22065E+05	1506619	5.05E-02	6.03E-02/cy	10	9.97E-01	1.8290E+07	+2.59E+00	0.01	2:21:51:31	100	15:09:58	06:22:21

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.22228E+05	1509895	5.07E-02	5.89E-02/cy	11	9.88E-01	1.8299E+07	+2.59E+00	0.01	2:22:01:31	98	15:19:58	06:17:10
1.22392E+05	1513164	5.39E-02	6.11E-02/cy	11	9.66E-01	1.8307E+07	+2.60E+00	0.01	2:22:11:31	98	15:29:58	06:11:55
1.22557E+05	1516414	4.57E-02	5.84E-02/cy	10	9.91E-01	1.8314E+07	+2.60E+00	0.01	2:22:21:31	93	15:39:58	06:06:36
1.22720E+05	1519683	4.87E-02	5.87E-02/cy	11	9.65E-01	1.8323E+07	+2.60E+00	0.01	2:22:31:31	100	15:49:58	06:01:21
1.22885E+05	1522953	4.92E-02	5.94E-02/cy	11	9.77E-01	1.8328E+07	+2.61E+00	0.01	2:22:41:31	100	15:59:59	05:56:01
1.23053E+05	1526224	5.22E-02	6.24E-02/cy	10	9.91E-01	1.8336E+07	+2.61E+00	0.01	2:22:51:31	100	16:09:59	05:50:34
1.23221E+05	1529497	5.00E-02	5.92E-02/cy	10	9.98E-01	1.8344E+07	+2.61E+00	0.01	2:23:01:32	98	16:19:59	05:45:08
1.23386E+05	1532761	5.09E-02	6.07E-02/cy	10	9.69E-01	1.8349E+07	+2.61E+00	0.01	2:23:11:32	98	16:29:59	05:39:45
1.23549E+05	1536015	5.25E-02	6.11E-02/cy	11	9.71E-01	1.8354E+07	+2.62E+00	0.01	2:23:21:32	100	16:39:59	05:34:26
1.23716E+05	1539285	4.81E-02	5.88E-02/cy	10	9.82E-01	1.8359E+07	+2.62E+00	0.01	2:23:31:32	98	16:49:59	05:29:00
1.23883E+05	1542553	5.38E-02	6.13E-02/cy	11	9.72E-01	1.8363E+07	+2.62E+00	0.01	2:23:41:32	98	16:59:59	05:23:30
1.24054E+05	1545824	4.68E-02	5.73E-02/cy	11	9.69E-01	1.8369E+07	+2.62E+00	0.01	2:23:51:32	98	17:09:59	05:17:52
1.24220E+05	1549077	5.61E-02	6.12E-02/cy	11	9.79E-01	1.8372E+07	+2.63E+00	0.01	3:00:01:32	100	17:19:59	05:12:25
1.24392E+05	1552348	5.39E-02	6.09E-02/cy	11	9.75E-01	1.8376E+07	+2.63E+00	0.01	3:00:11:32	98	17:29:59	05:06:42
1.24562E+05	1555586	5.67E-02	6.15E-02/cy	11	9.95E-01	1.8381E+07	+2.63E+00	0.01	3:00:21:32	94	17:40:00	05:01:03
1.24721E+05	1558774	5.20E-02	5.98E-02/cy	11	9.70E-01	1.8384E+07	+2.63E+00	0.01	3:00:31:32	98	17:50:00	04:55:49
1.24887E+05	1561971	5.48E-02	6.06E-02/cy	11	9.82E-01	1.8387E+07	+2.63E+00	0.01	3:00:41:32	98	18:00:00	04:50:20
1.25059E+05	1565242	5.26E-02	6.16E-02/cy	10	9.84E-01	1.8390E+07	+2.64E+00	0.01	3:00:51:32	100	18:10:00	04:44:34
1.25227E+05	1568497	5.70E-02	6.08E-02/cy	11	9.88E-01	1.8395E+07	+2.64E+00	0.01	3:01:01:32	100	18:20:00	04:38:59
1.25398E+05	1571765	5.22E-02	6.04E-02/cy	10	9.72E-01	1.8396E+07	+2.64E+00	0.01	3:01:11:33	98	18:30:00	04:33:14
1.25561E+05	1574968	5.46E-02	6.10E-02/cy	11	9.69E-01	1.8401E+07	+2.64E+00	0.01	3:01:21:33	100	18:40:00	04:27:47
1.25731E+05	1578179	5.11E-02	6.08E-02/cy	10	9.78E-01	1.8402E+07	+2.64E+00	0.01	3:01:31:33	100	18:50:00	04:22:04
1.25900E+05	1581433	5.27E-02	5.98E-02/cy	11	9.65E-01	1.8406E+07	+2.65E+00	0.01	3:01:41:33	100	19:00:00	04:16:22
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.26068E+05	1584686	5.18E-02	6.01E-02/cy	10	9.90E-01	1.8409E+07	+2.65E+00	0.01	3:01:51:33	93	19:10:00	04:10:43
1.26238E+05	1587943	5.06E-02	5.92E-02/cy	11	9.69E-01	1.8411E+07	+2.65E+00	0.01	3:02:01:33	98	19:20:01	04:04:56
1.26410E+05	1591215	5.10E-02	6.00E-02/cy	10	9.91E-01	1.8415E+07	+2.65E+00	0.01	3:02:11:33	100	19:30:01	03:59:06
1.26580E+05	1594450	5.13E-02	6.06E-02/cy	10	9.91E-01	1.8417E+07	+2.65E+00	0.01	3:02:21:33	100	19:40:01	03:53:20
1.26751E+05	1597719	4.94E-02	6.02E-02/cy	10	9.84E-01	1.8419E+07	+2.65E+00	0.01	3:02:31:33	100	19:50:01	03:47:30
1.26922E+05	1600971	5.10E-02	6.17E-02/cy	10	9.76E-01	1.8422E+07	+2.65E+00	0.01	3:02:41:34	98	20:00:01	03:41:41
1.27093E+05	1604243	5.15E-02	5.98E-02/cy	10	9.76E-01	1.8424E+07	+2.66E+00	0.01	3:02:51:34	98	20:10:01	03:35:50
1.27264E+05	1607517	5.18E-02	5.98E-02/cy	11	9.57E-01	1.8425E+07	+2.66E+00	0.01	3:03:01:34	98	20:20:01	03:29:58
1.27434E+05	1610772	5.07E-02	5.92E-02/cy	10	9.79E-01	1.8428E+07	+2.66E+00	0.01	3:03:11:34	100	20:30:01	03:24:08
1.27603E+05	1614008	5.35E-02	6.06E-02/cy	10	9.92E-01	1.8431E+07	+2.66E+00	0.01	3:03:21:34	98	20:40:01	03:18:19
1.27774E+05	1617262	4.99E-02	5.92E-02/cy	10	9.85E-01	1.8434E+07	+2.66E+00	0.01	3:03:31:34	90	20:50:01	03:12:26
1.27945E+05	1620534	5.03E-02	5.99E-02/cy	10	9.93E-01	1.8435E+07	+2.66E+00	0.01	3:03:41:34	98	21:00:01	03:06:32
1.28116E+05	1623789	5.45E-02	6.08E-02/cy	11	9.71E-01	1.8436E+07	+2.66E+00	0.01	3:03:51:34	98	21:10:02	03:00:37
1.28287E+05	1627062	5.22E-02	5.97E-02/cy	11	9.73E-01	1.8437E+07	+2.67E+00	0.01	3:04:01:34	90	21:20:02	02:54:42
1.28457E+05	1630316	5.39E-02	5.98E-02/cy	11	9.55E-01	1.8437E+07	+2.67E+00	0.01	3:04:11:35	100	21:30:02	02:48:49
1.28629E+05	1633571	5.28E-02	6.01E-02/cy	10	9.73E-01	1.8438E+07	+2.67E+00	0.01	3:04:21:35	100	21:40:02	02:42:49
1.28801E+05	1636841	5.33E-02	5.94E-02/cy	11	9.53E-01	1.8441E+07	+2.67E+00	0.01	3:04:31:35	98	21:50:02	02:36:49
1.28972E+05	1640092	5.25E-02	6.02E-02/cy	10	9.81E-01	1.8442E+07	+2.67E+00	0.01	3:04:41:35	100	22:00:02	02:30:50
1.29143E+05	1643345	5.16E-02	6.06E-02/cy	10	9.69E-01	1.8443E+07	+2.67E+00	0.01	3:04:51:35	100	22:10:02	02:24:51
1.29315E+05	1646618	5.46E-02	6.05E-02/cy	11	9.57E-01	1.8446E+07	+2.67E+00	0.01	3:05:01:35	100	22:20:03	02:18:51
1.29488E+05	1649861	5.43E-02	6.04E-02/cy	11	9.50E-01	1.8445E+07	+2.68E+00	0.01	3:05:11:35	100	22:30:03	02:12:47
1.29657E+05	1653088	5.51E-02	6.01E-02/cy	11	9.83E-01	1.8448E+07	+2.68E+00	0.01	3:05:21:35	98	22:40:03	02:06:51
1.29828E+05	1656357	5.30E-02	6.03E-02/cy	11	9.55E-01	1.8450E+07	+2.68E+00	0.01	3:05:31:36	100	22:50:03	02:00:49

progress		time step		pressure		fluid #1		performance				
sim_time	cycle	delt	dt_stbl/code	iter	res/epsi	volume	%loss	frac	el_time	%PE	clk_time	est_rem_time
1.30003E+05	1659596	5.30E-02	5.97E-02/cy	11	9.57E-01	1.8450E+07	+2.68E+00	0.01	3:05:41:36	98	23:00:03	01:54:38
1.30175E+05	1662850	5.46E-02	6.10E-02/cy	11	9.55E-01	1.8452E+07	+2.68E+00	0.01	3:05:51:36	98	23:10:03	01:48:34
1.30349E+05	1666104	5.06E-02	5.96E-02/cy	10	9.87E-01	1.8451E+07	+2.68E+00	0.01	3:06:01:36	90	23:20:03	01:42:24
1.30521E+05	1669372	5.13E-02	5.99E-02/cy	10	9.99E-01	1.8448E+07	+2.68E+00	0.01	3:06:11:36	100	23:30:03	01:36:18
1.30693E+05	1672606	5.23E-02	5.98E-02/cy	11	9.55E-01	1.8448E+07	+2.68E+00	0.01	3:06:21:36	100	23:40:04	01:30:11
1.30862E+05	1675855	5.17E-02	5.99E-02/cy	10	9.70E-01	1.8444E+07	+2.68E+00	0.01	3:06:31:36	98	23:50:04	01:24:11
1.31037E+05	1679124	5.19E-02	5.85E-02/cy	11	9.58E-01	1.8444E+07	+2.69E+00	0.01	3:06:41:36	98	00:00:04	01:17:56
1.31211E+05	1682389	5.02E-02	5.98E-02/cy	10	9.77E-01	1.8440E+07	+2.69E+00	0.01	3:06:51:36	90	00:10:04	01:11:43
1.31386E+05	1685643	5.41E-02	5.89E-02/cy	11	9.80E-01	1.8439E+07	+2.69E+00	0.01	3:07:01:36	100	00:20:04	01:05:29
1.31560E+05	1688911	5.36E-02	5.93E-02/cy	10	9.98E-01	1.8437E+07	+2.69E+00	0.01	3:07:11:37	98	00:30:04	00:59:14
1.31730E+05	1692142	5.41E-02	6.02E-02/cy	11	9.54E-01	1.8435E+07	+2.69E+00	0.01	3:07:21:37	100	00:40:04	00:53:08
1.31907E+05	1695409	5.65E-02	6.15E-02/cy	10	9.82E-01	1.8435E+07	+2.69E+00	0.01	3:07:31:37	98	00:50:04	00:46:47
1.32079E+05	1698660	5.55E-02	5.99E-02/cy	11	9.69E-01	1.8432E+07	+2.69E+00	0.01	3:07:41:37	90	01:00:04	00:40:34
1.32255E+05	1701927	5.36E-02	5.99E-02/cy	10	9.63E-01	1.8431E+07	+2.69E+00	0.01	3:07:51:37	98	01:10:04	00:34:15
1.32430E+05	1705180	5.19E-02	5.91E-02/cy	11	9.55E-01	1.8431E+07	+2.69E+00	0.01	3:08:01:37	90	01:20:05	00:27:55
1.32607E+05	1708449	5.17E-02	6.09E-02/cy	10	9.78E-01	1.8429E+07	+2.69E+00	0.01	3:08:11:37	98	01:30:05	00:21:31
1.32779E+05	1711685	5.54E-02	6.04E-02/cy	10	9.92E-01	1.8428E+07	+2.70E+00	0.01	3:08:21:37	98	01:40:05	00:15:16
1.32960E+05	1714955	5.07E-02	6.00E-02/cy	10	9.56E-01	1.8432E+07	+2.70E+00	0.01	3:08:31:37	100	01:50:05	00:08:42
1.33141E+05	1718209	5.33E-02	5.98E-02/cy	11	9.60E-01	1.8432E+07	+2.70E+00	0.01	3:08:41:37	98	02:00:05	00:02:08

restart and spatial data available at t= 1.33200E+05												

1.33200E+05	1719251	5.33E-02	6.05E-02/cy	10	9.68E-01	1.8432E+07	+2.70E+00	0.01	3:08:44:48	100	02:03:16	00:00:00
end of calculation at t = 1.33200E+05, cycle = 1719251												
normal completion												
flsgrf.Copy_of_Portneuf_and_Oxbows_original_terrain_DR__SAVAGE_STL_FINAL_2-D_SIM_TRY_6_Restart_2 file size: 2 gb												
elapsed time = 2.90691E+05 seconds, or												
3 days : 8 hours : 44 minutes : 51 seconds												
cpu time = 9.25244E+06 seconds												
date of completion = 03/08/2021												
time = 02:03:19												
Postprocessor starting												
constructing time edit index												
constructing mesh sub-domain maps												
processing plot requests												
dt_history												
iter_history												
Postprocessor Done												
Simulation run complete												

Preprocessor Messages:

```
*****
      warning
      irating(2) for block # 1 is reset to 0
*****

*****
**      warning      **
**  turbulence models are not used  **
**    with shallow water model:    **
**      ifvis reset to zero      **
*****
```

Solver Messages:

```
===== mentor tip =====
multi-block fluid volume error exceeds 5%.

maximum volume error is between mesh blocks 1 and 4:
      fluid volume flow rate mismatch = 9.18594E+05
      % error = 6.09752E+00

1. reduce the number of mesh blocks.
2. reduce grid size variation at inter-block
   boundaries.
3. align nested block boundaries with mesh
   planes in the containing blocks.
4. shift inter-block boundaries to where
   there is less flow variation.
5. increase inter-block interpolation
   factor alphamb to 0.5 or higher
6. is there excessive fluid break up?
=====
```

