Royal River, Yarmouth, Maine Section206, Aquatic Ecosystem Restoration

Appendix C: Hydrology & Hydraulics Appendix (Part 3)

PREPARED BY: Hydrology, Hydraulics & Coastal
Geotechnical & Water Resources Branch
Engineering Division

June 24, 2024
Rev. 02SEP24

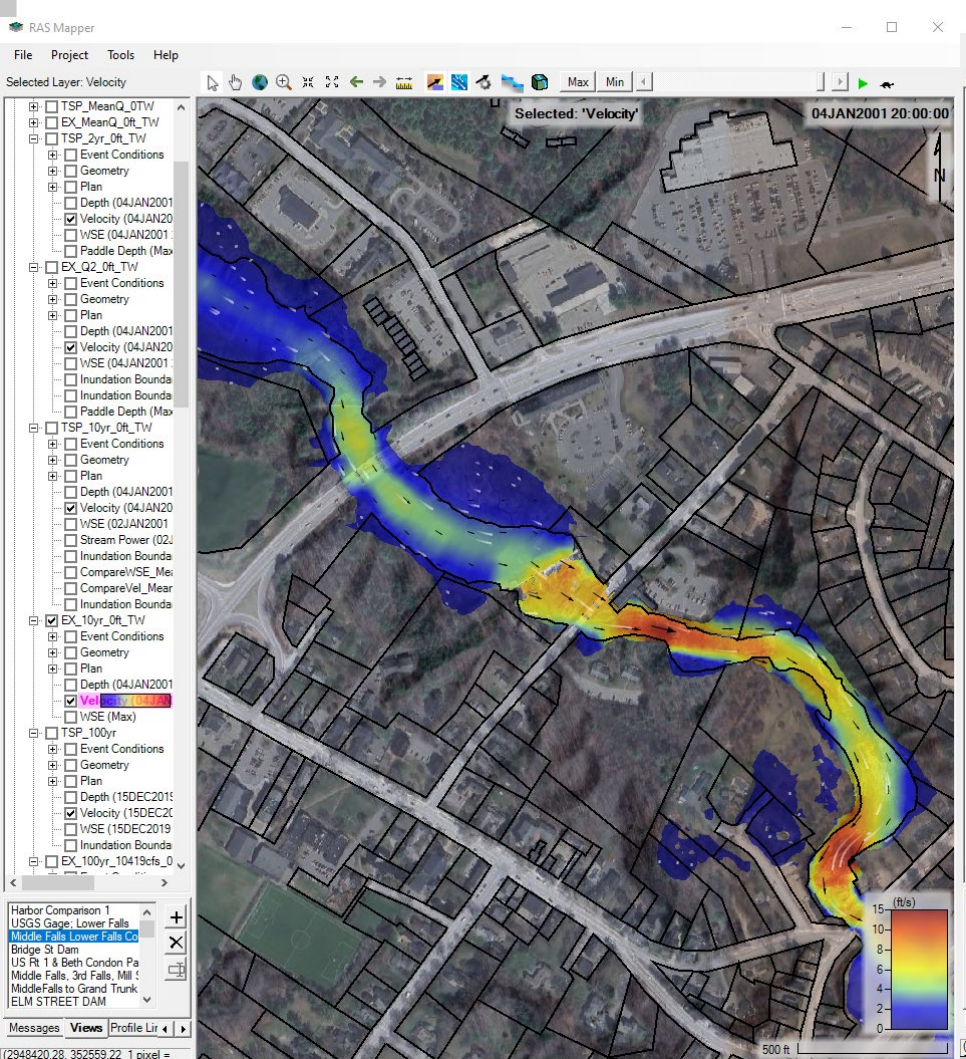
US Army Corps of Engineers®
New England District

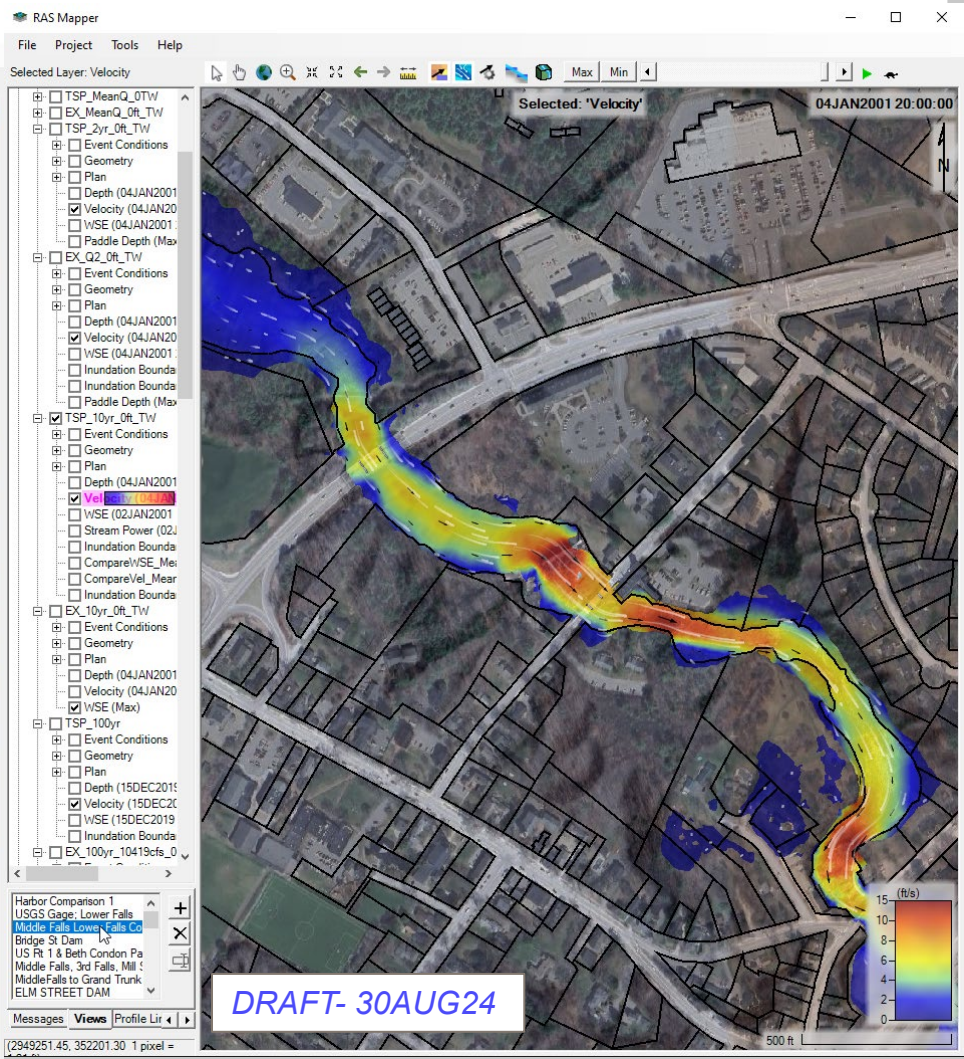
YARMOUTH MAINE

VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
LOWER FALLS TO MIDDLE FALLS OVERVIEW

EXISTING CONDITIONS

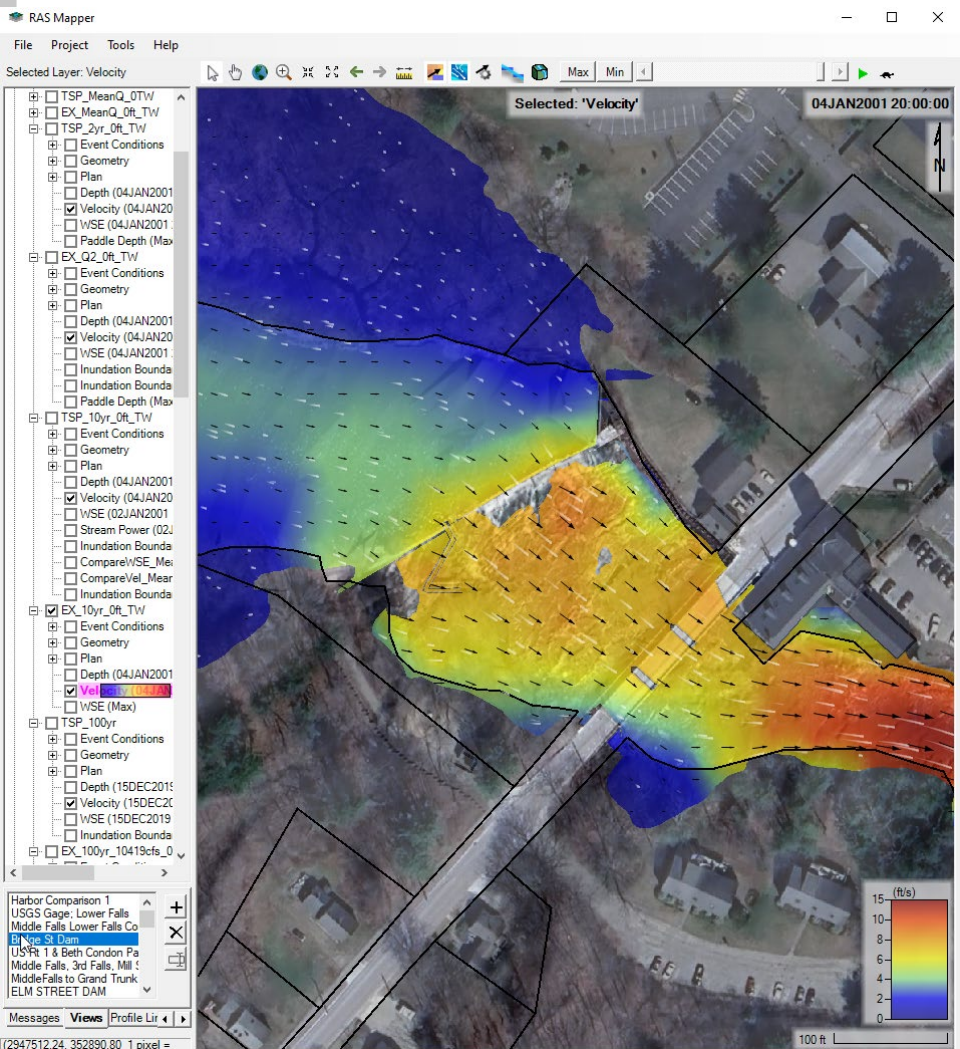
TENTATIVELY SELECTED PLAN



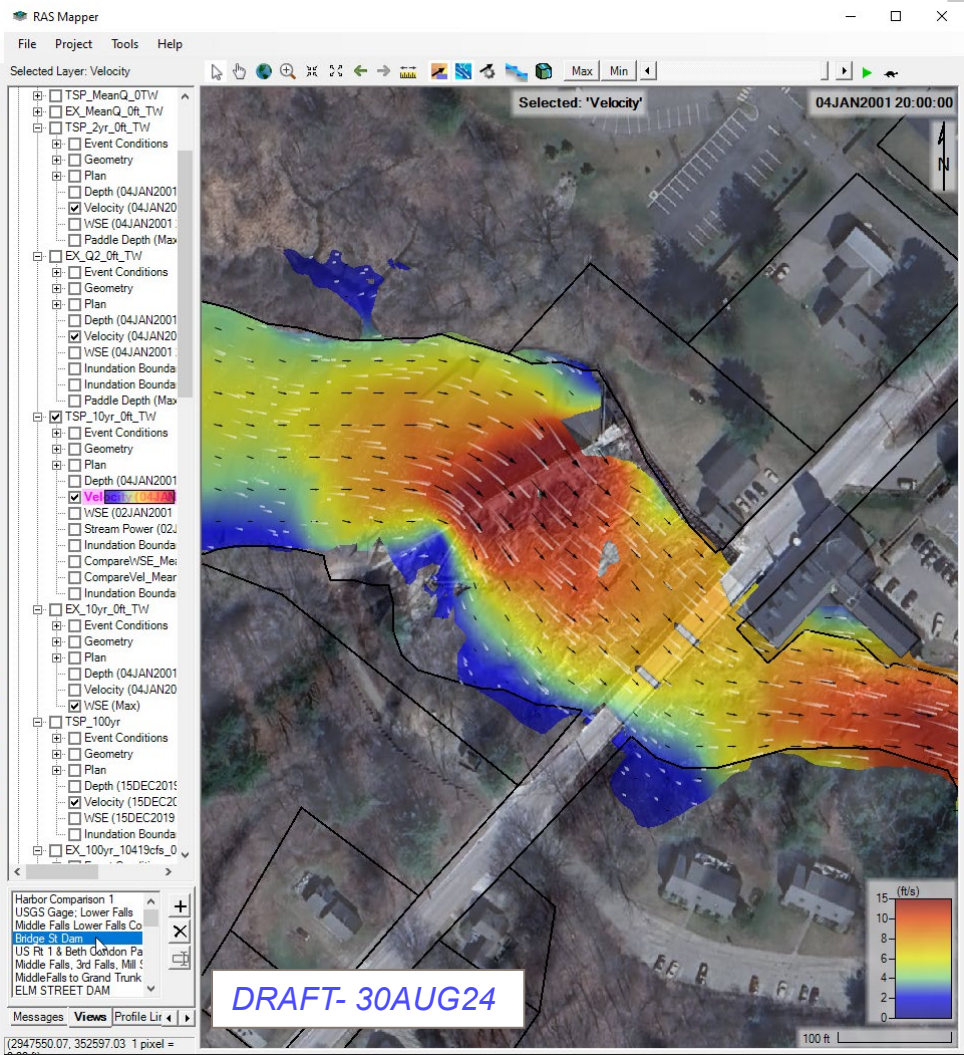


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
BRIDGE STREET DAM

EXISTING CONDITIONS

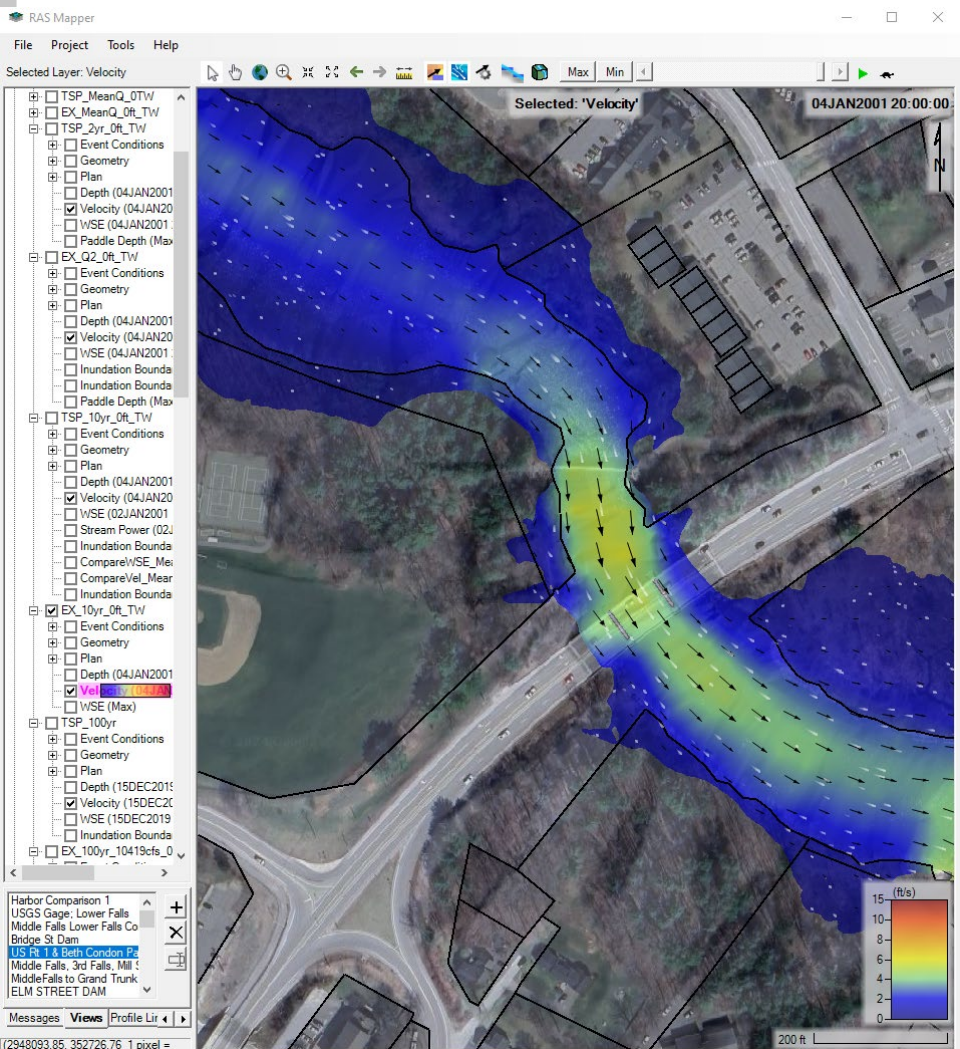


TENTATIVELY SELECTED PLAN



VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
US ROUTE 1 & BETH CONDON FOOTBRIDGE

EXISTING CONDITIONS



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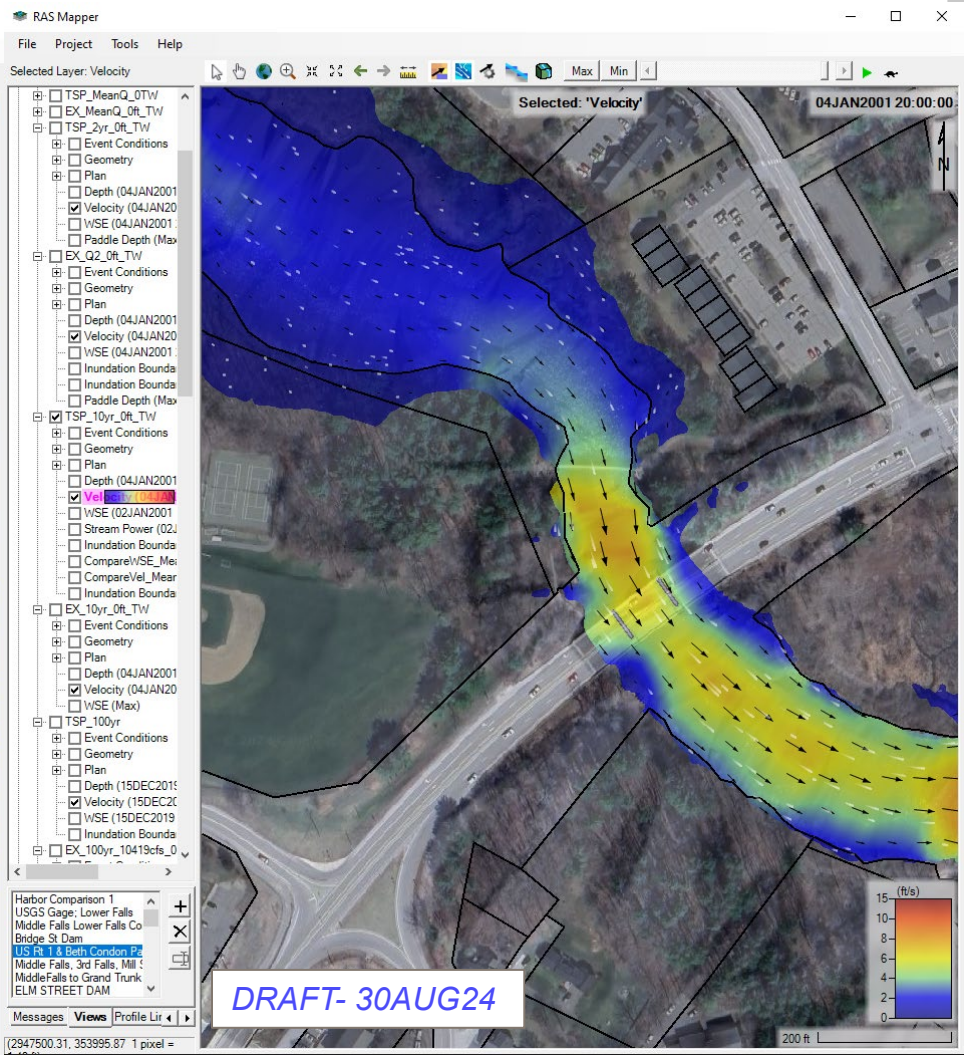
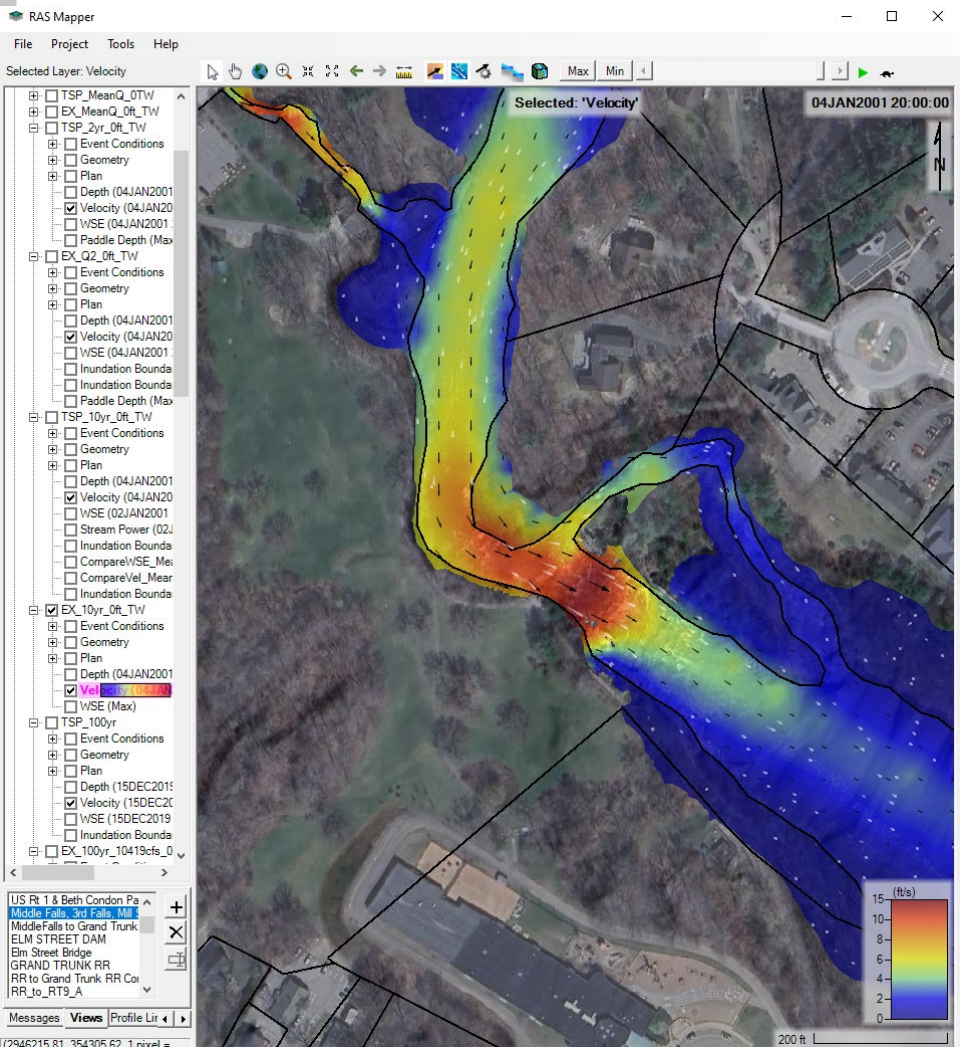


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
MIDDLE FALLS

EXISTING CONDITIONS



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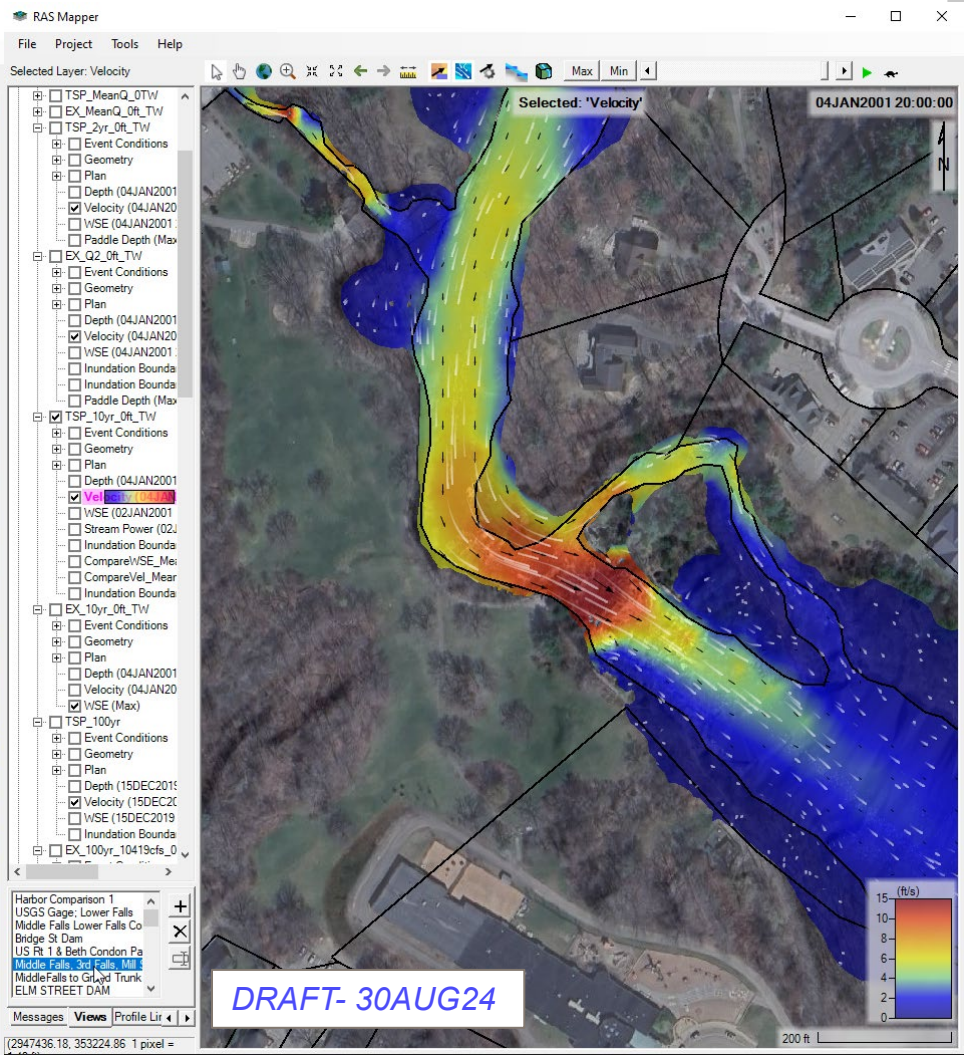
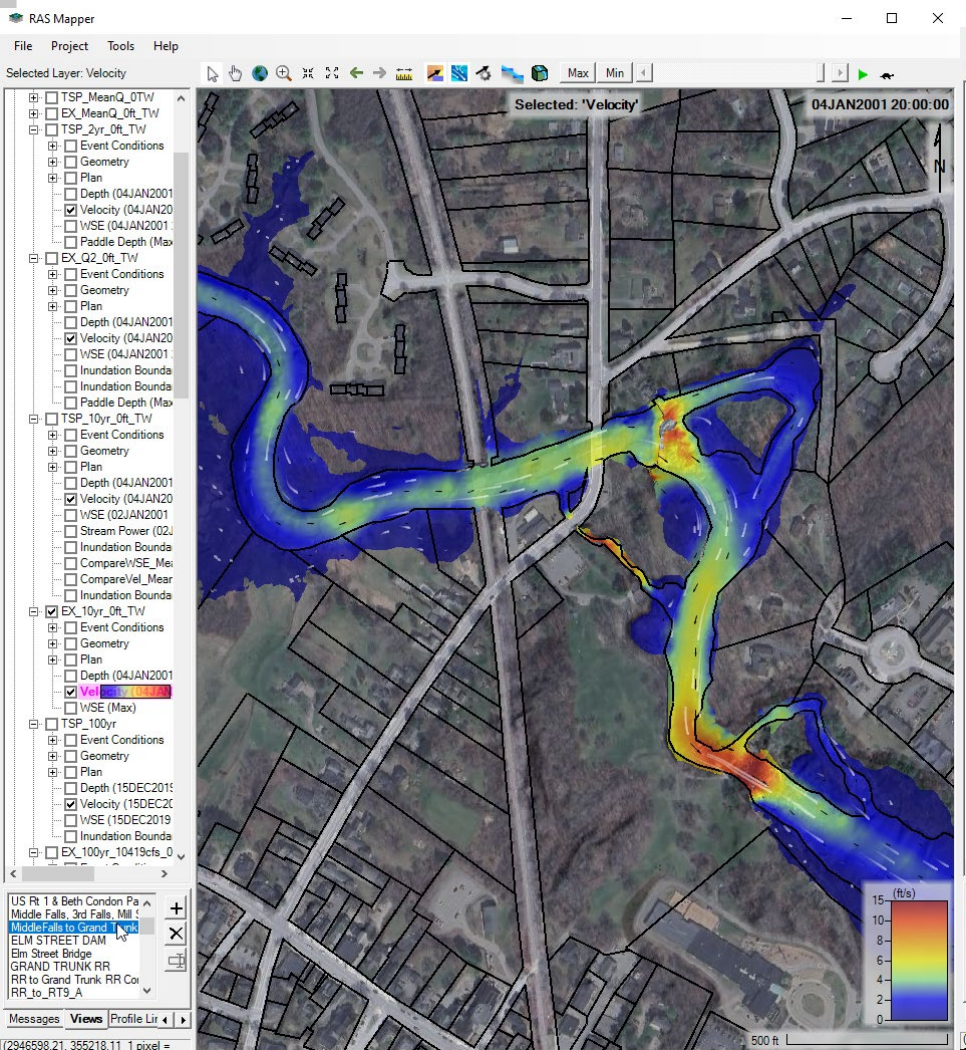
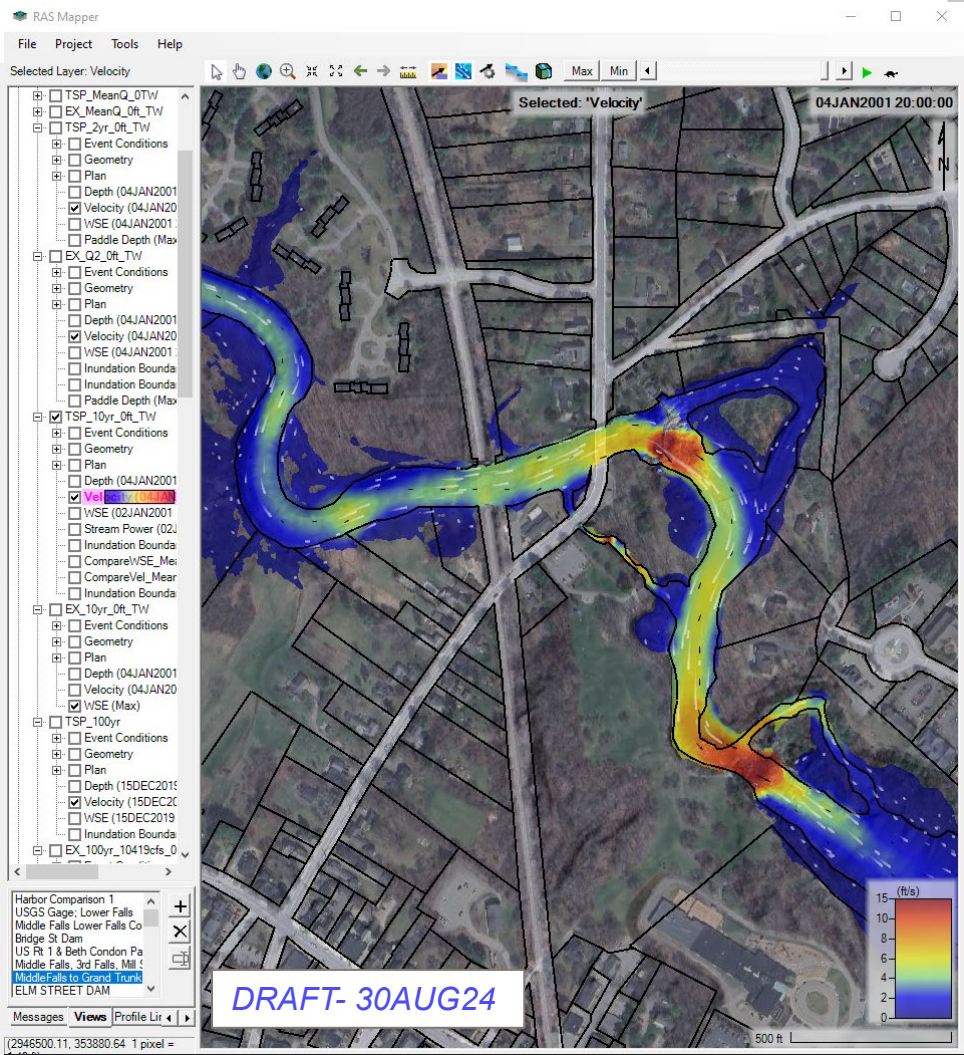


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
ELM STREET DAM OVERVIEW

EXISTING CONDITIONS

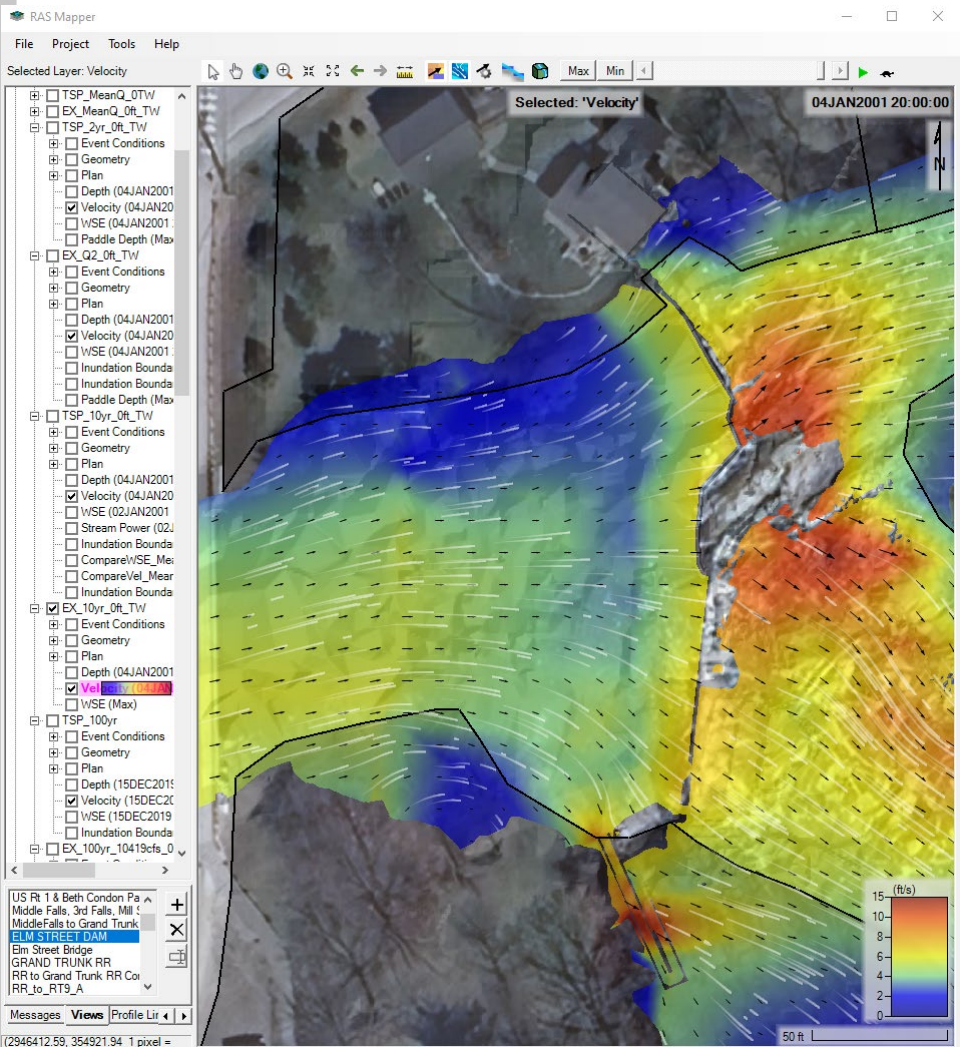
TENTATIVELY SELECTED PLAN





VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
ELM STREET DAM

EXISTING CONDITIONS



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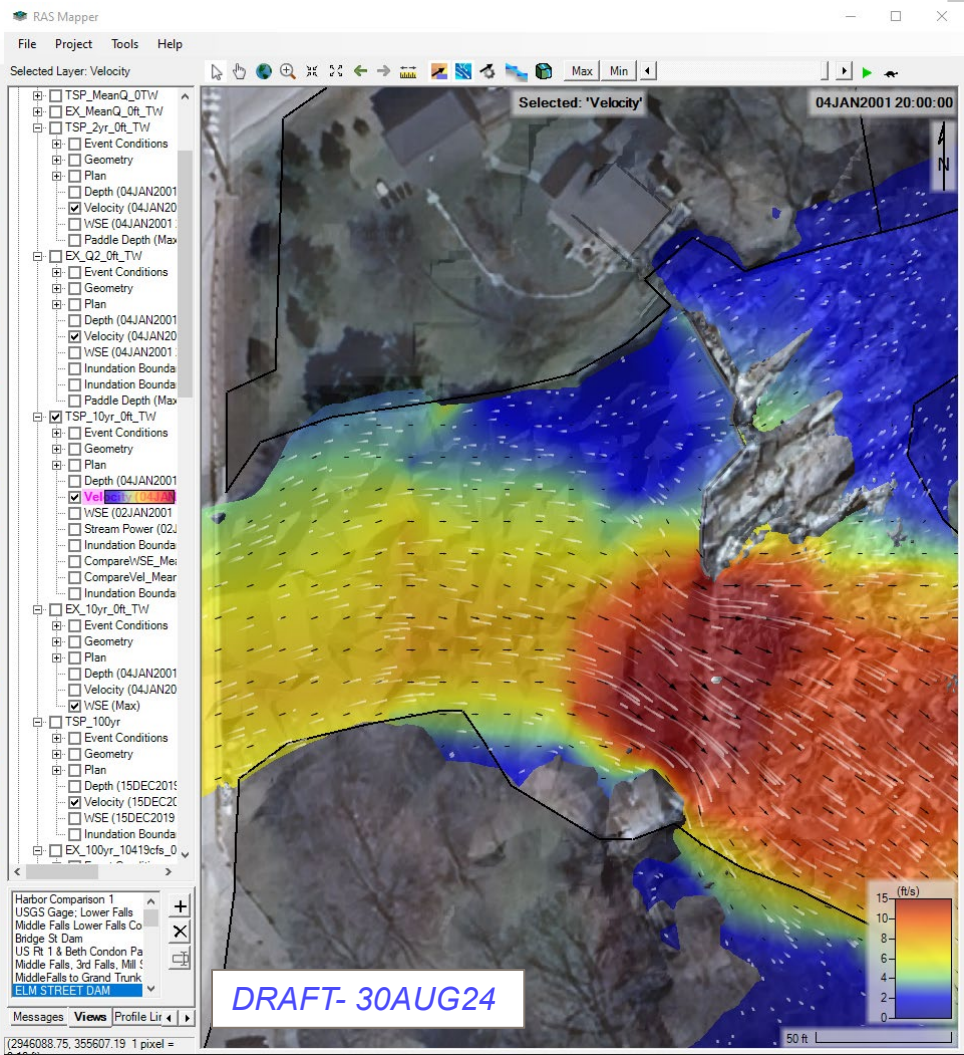
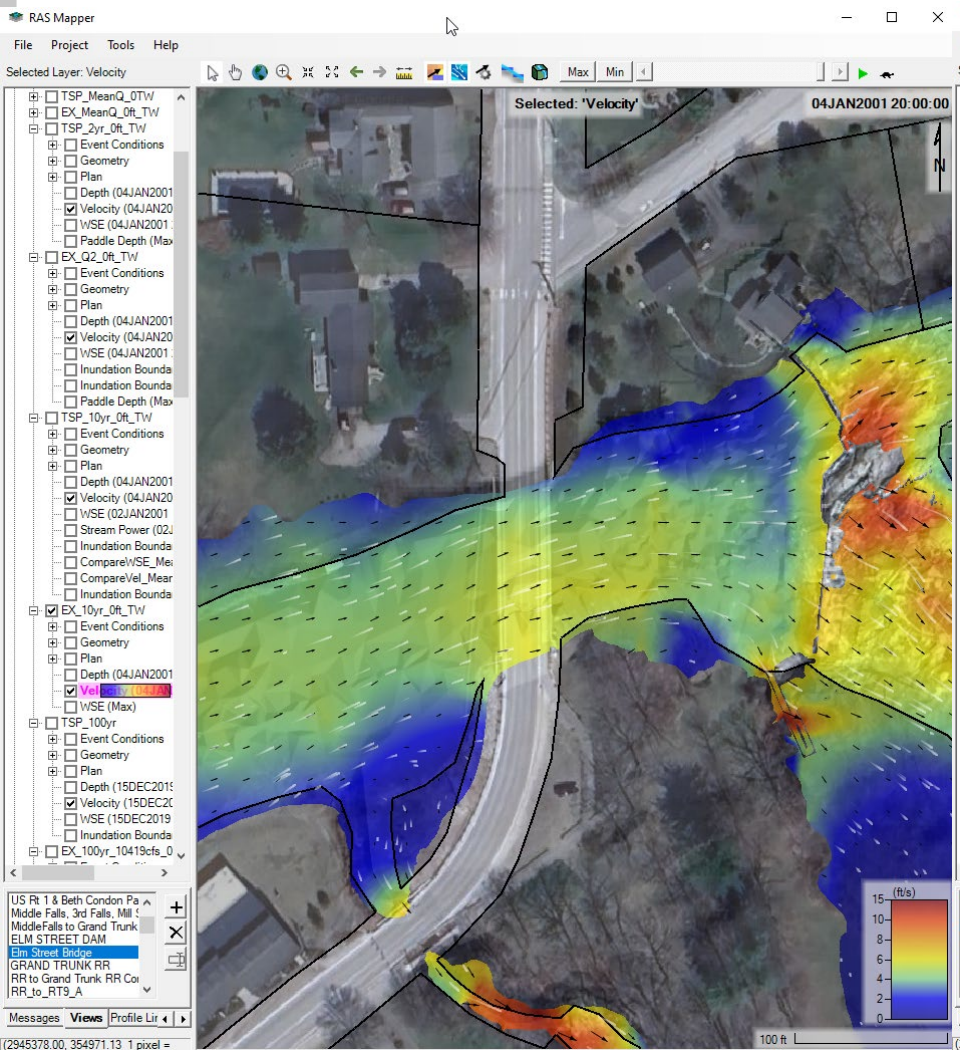
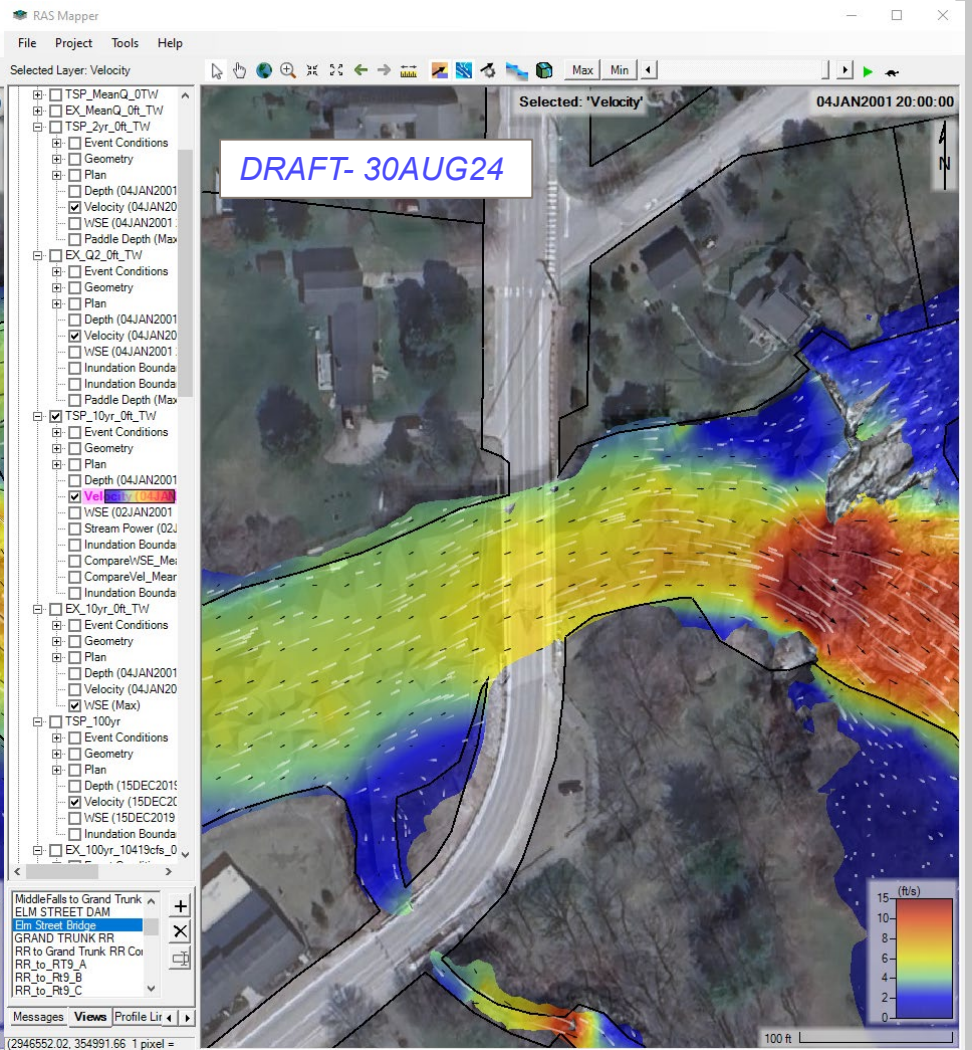


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
EAST ELM STREET

EXISTING CONDITIONS

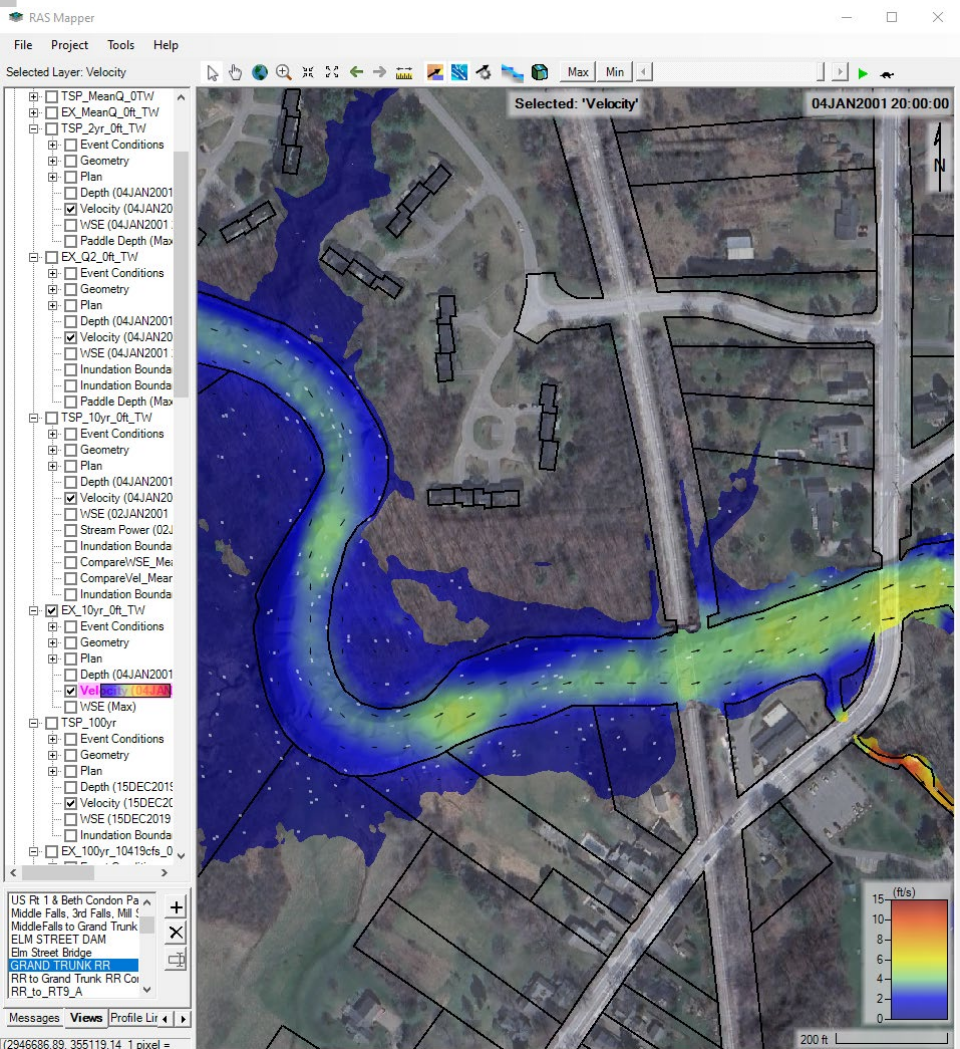
TENTATIVELY SELECTED PLAN





VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
GRAND TRUNK RR

EXISTING CONDITIONS



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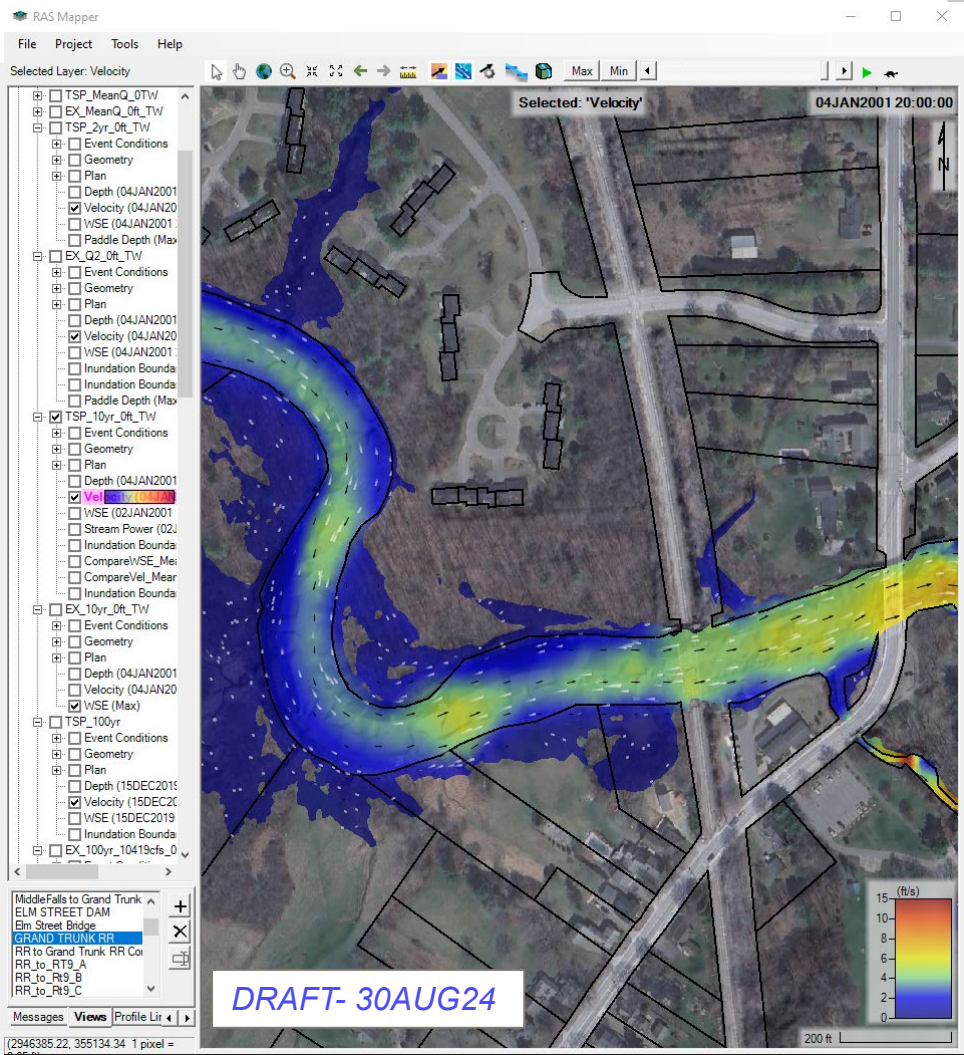
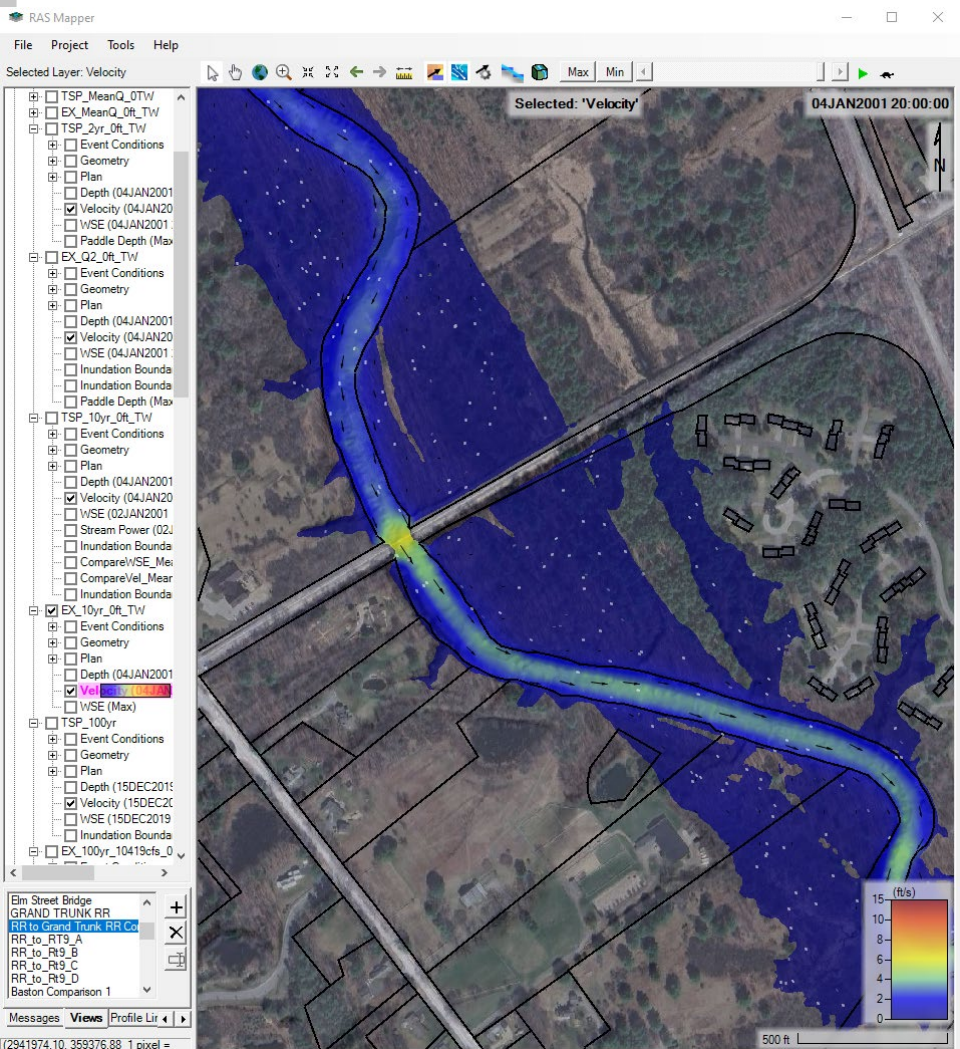


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
MAINE CENTRAL RR

EXISTING CONDITIONS



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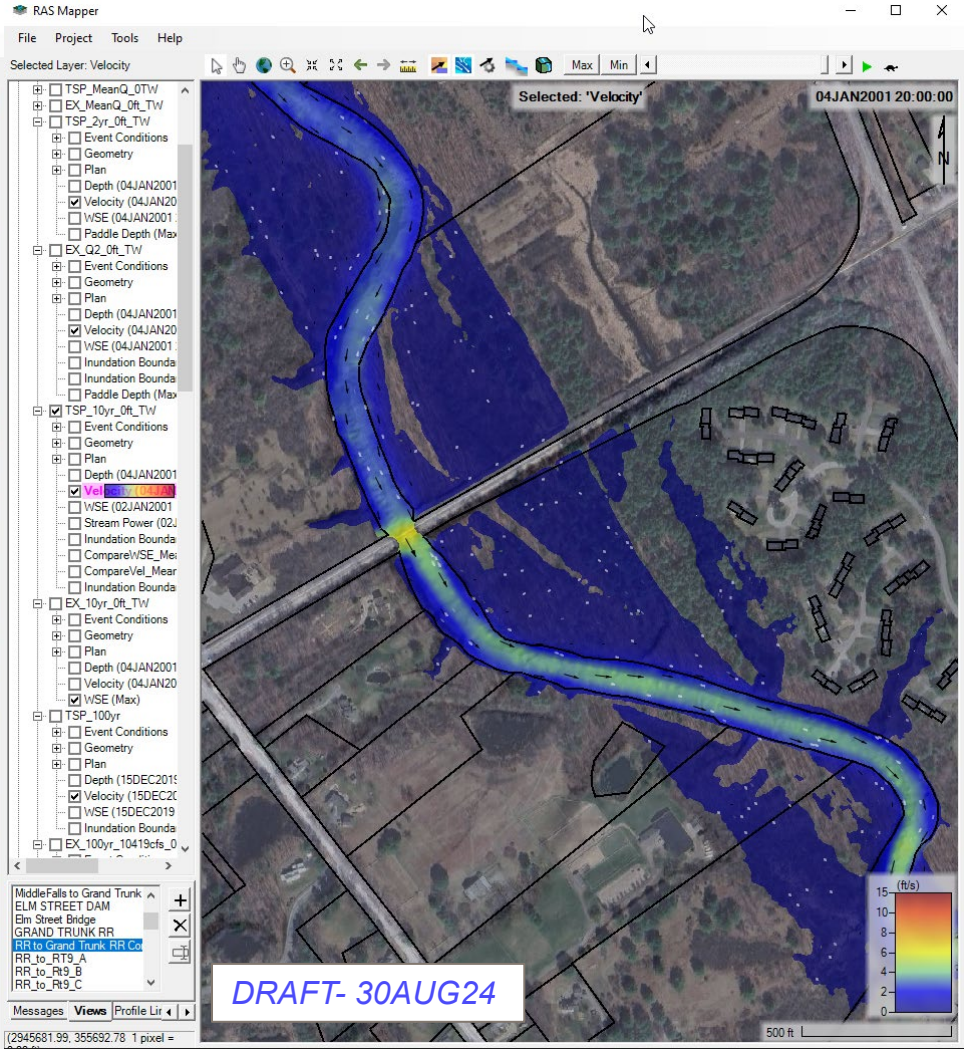
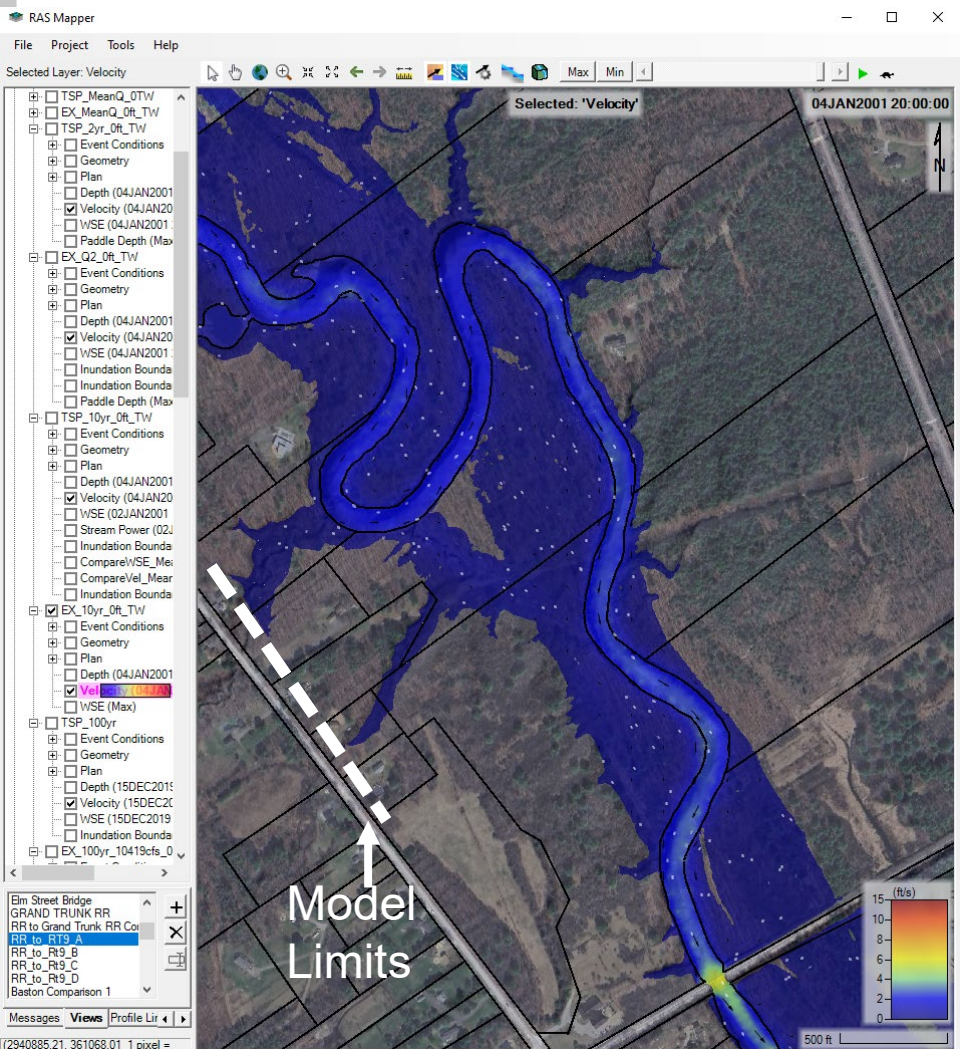


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
UPSTREAM OF MAINE CENTRAL RR (1)

EXISTING CONDITIONS



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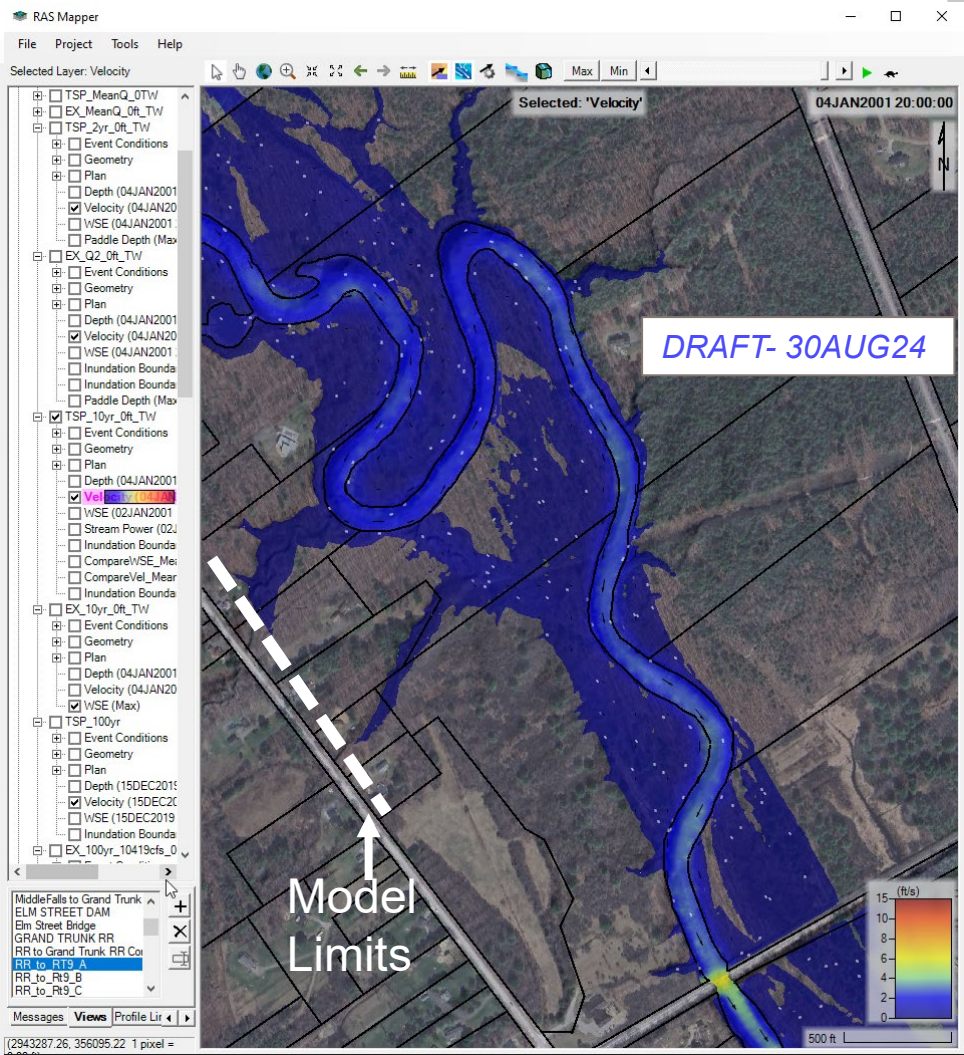
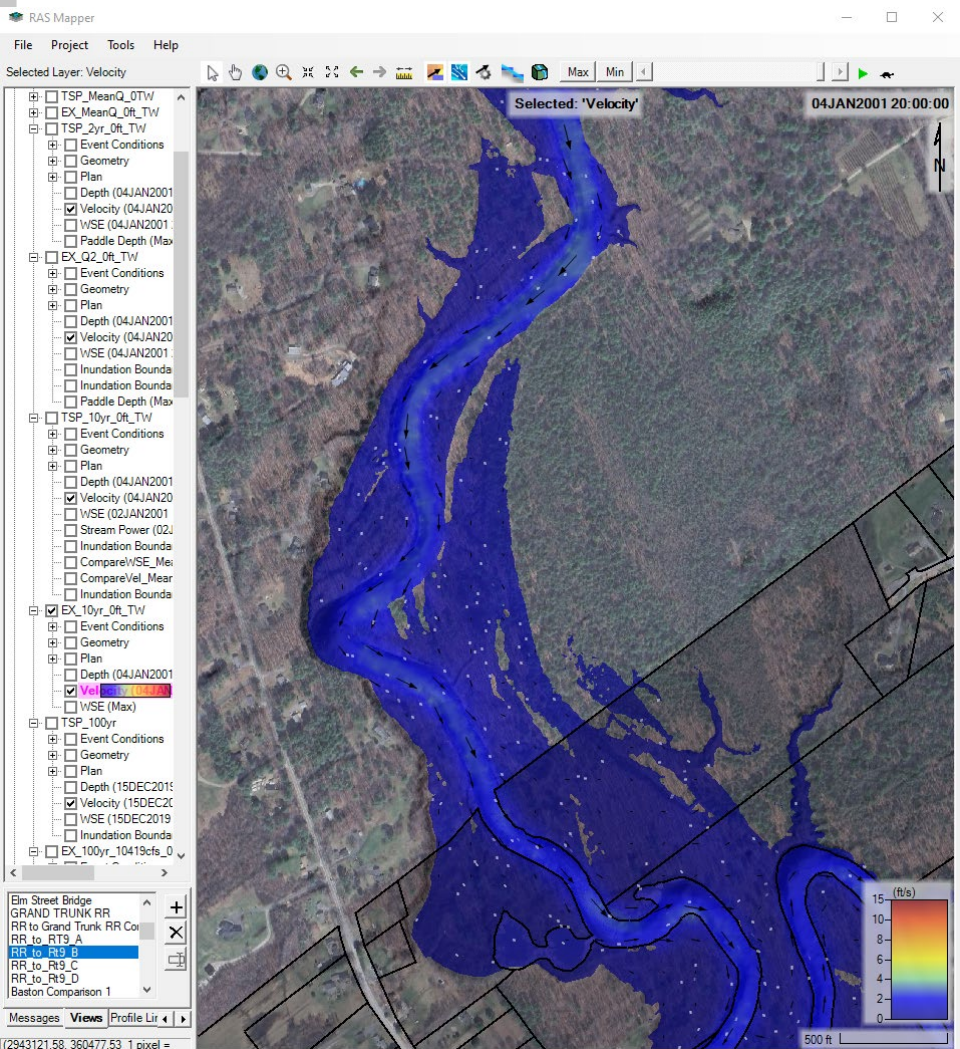


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
UPSTREAM OF MAINE CENTRAL RR (2)

EXISTING CONDITIONS



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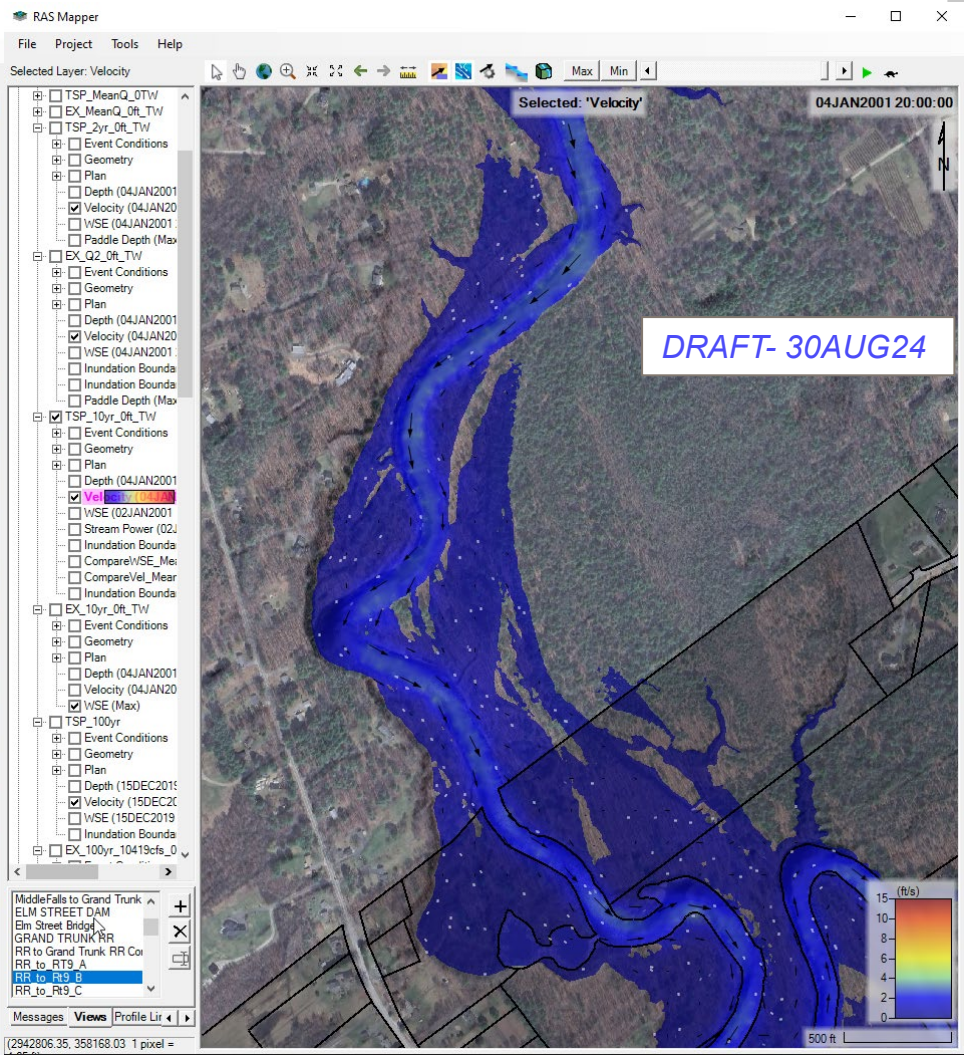
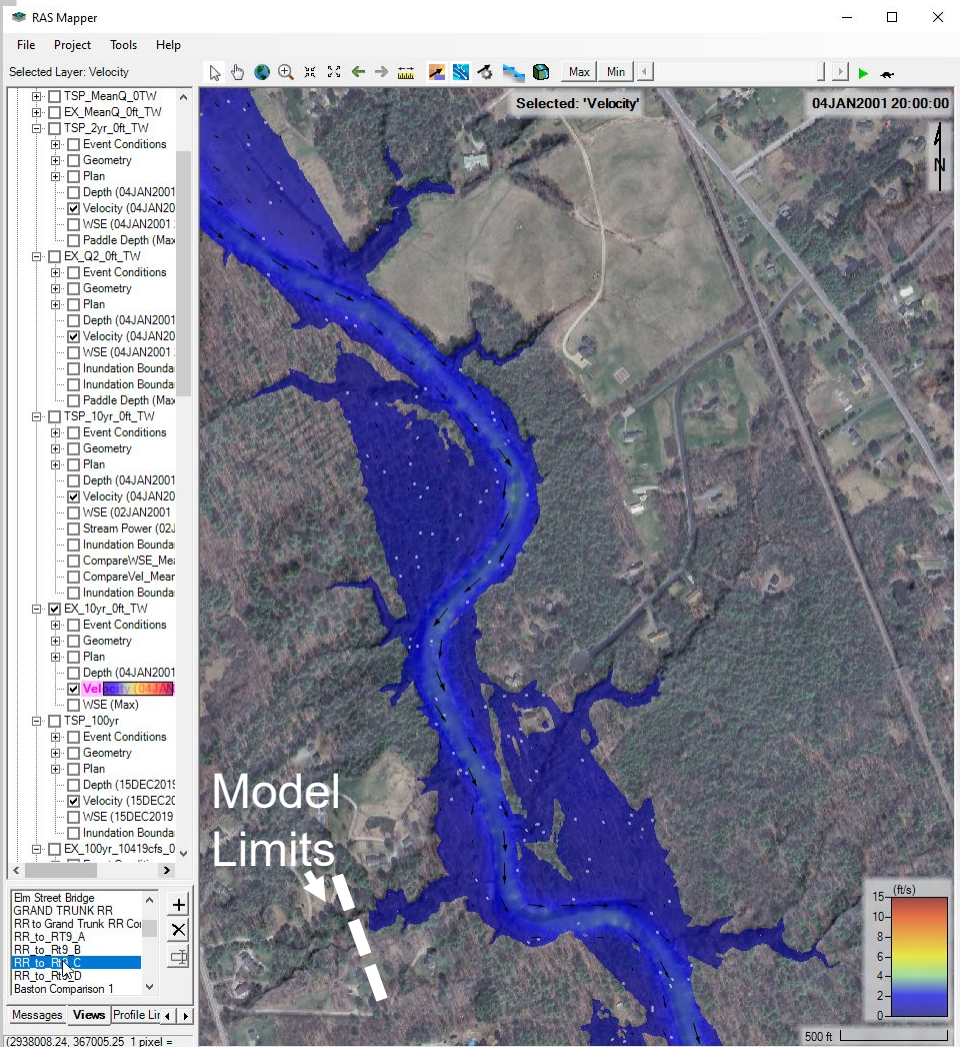


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
UPSTREAM OF MAINE CENTRAL RR (3)

EXISTING CONDITIONS



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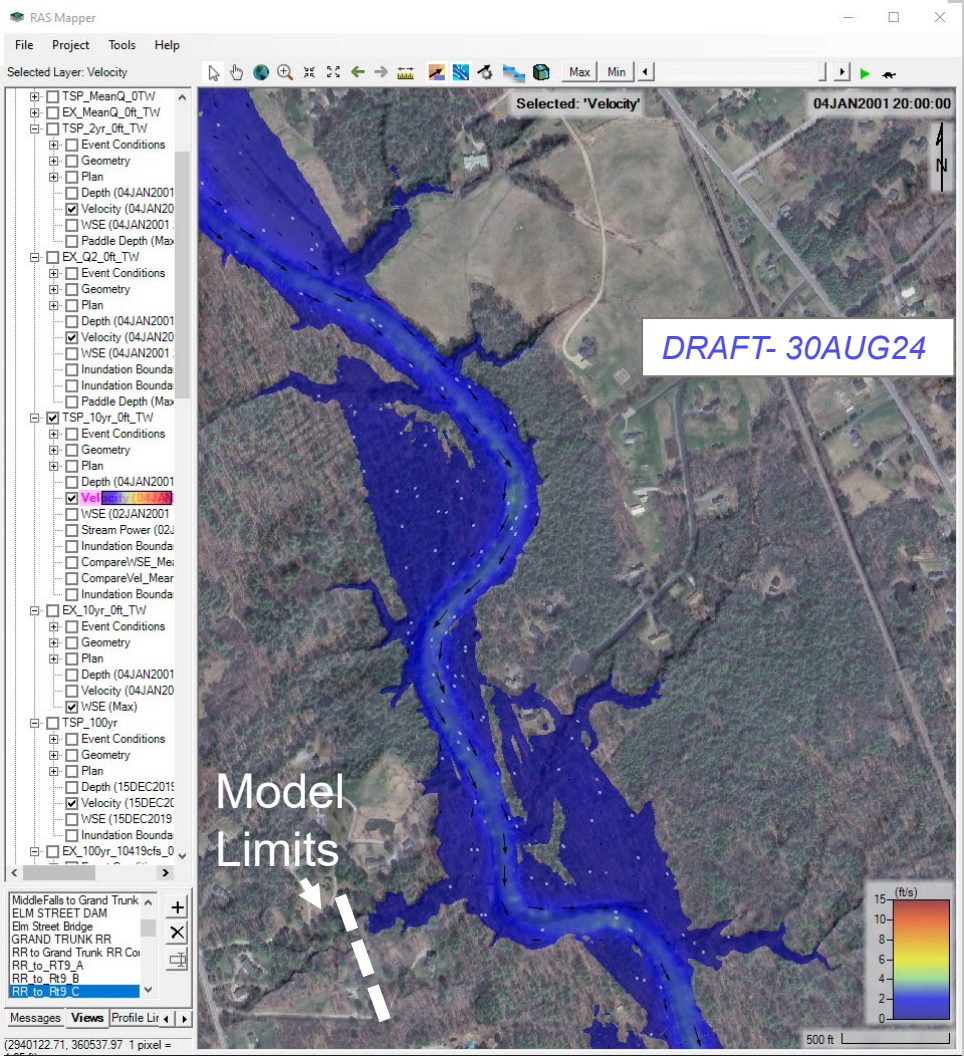
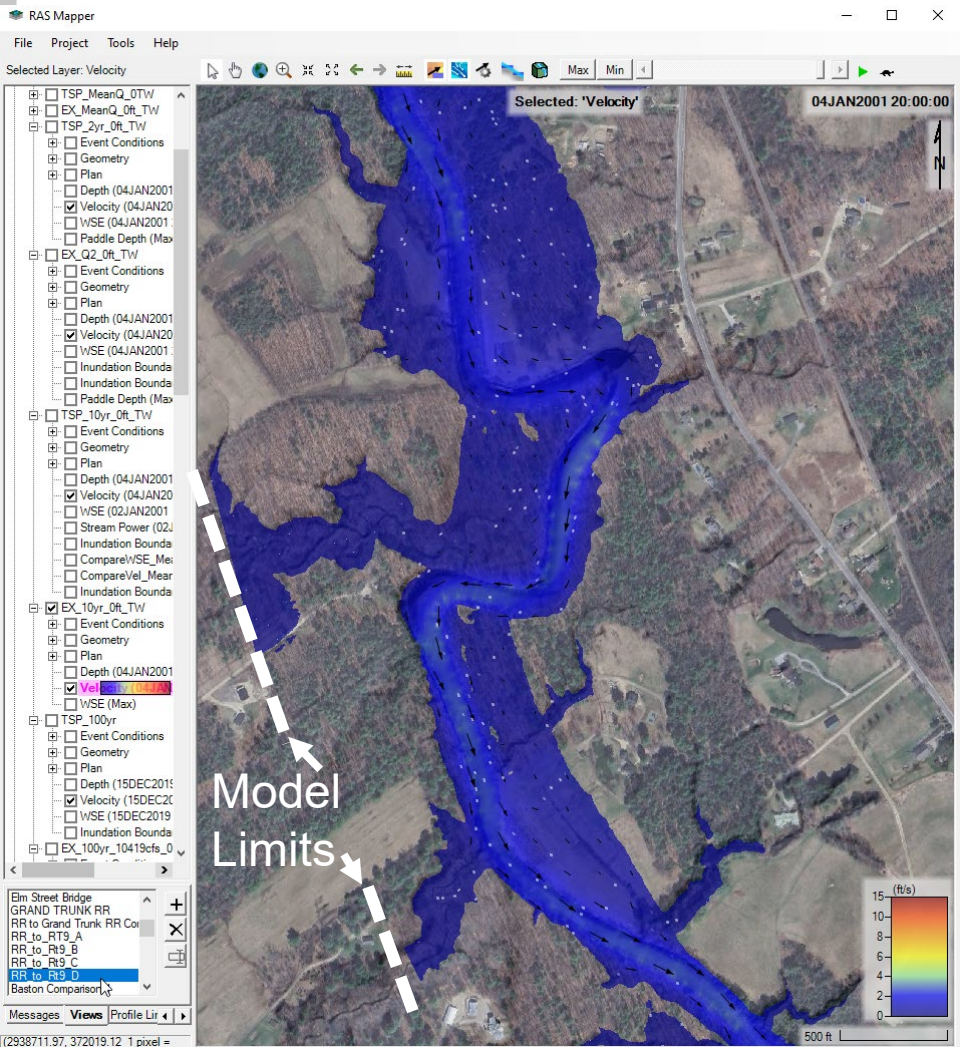


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM NEAR TODDY BROOK

EXISTING CONDITIONS



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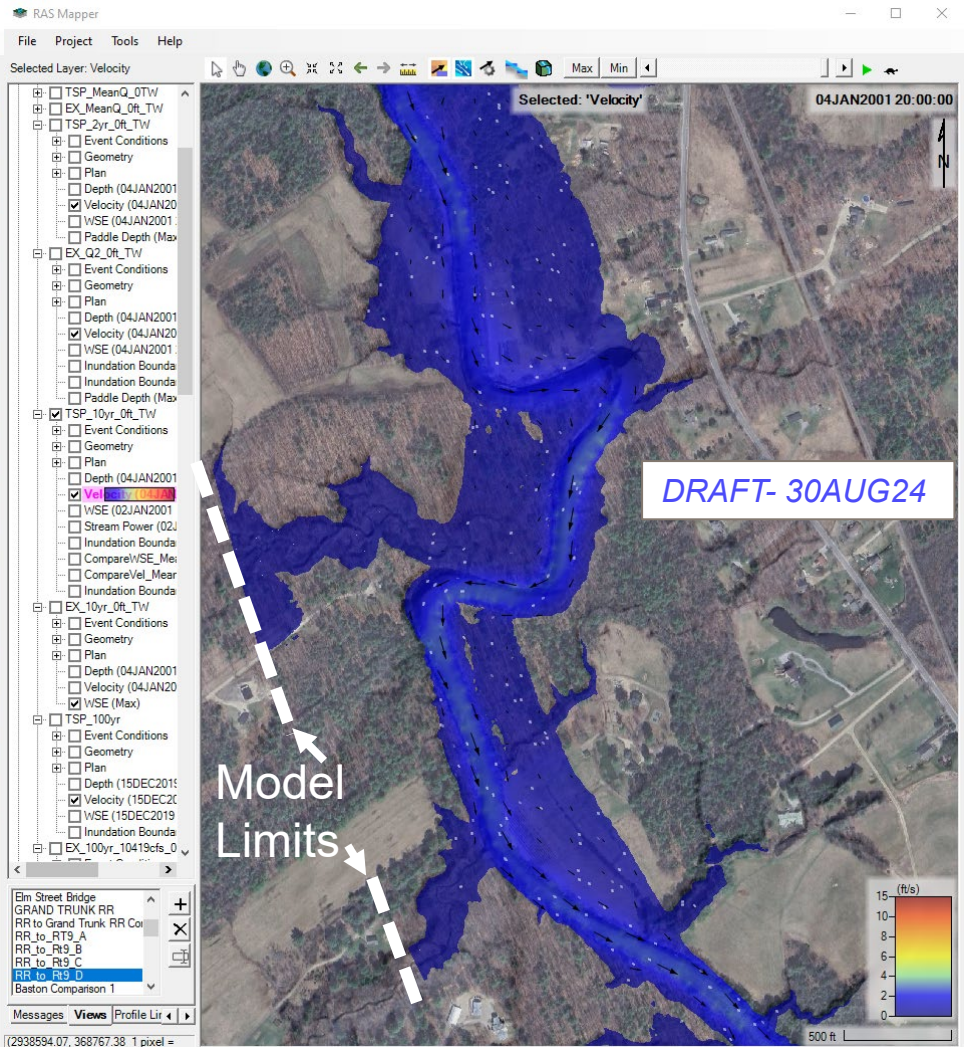
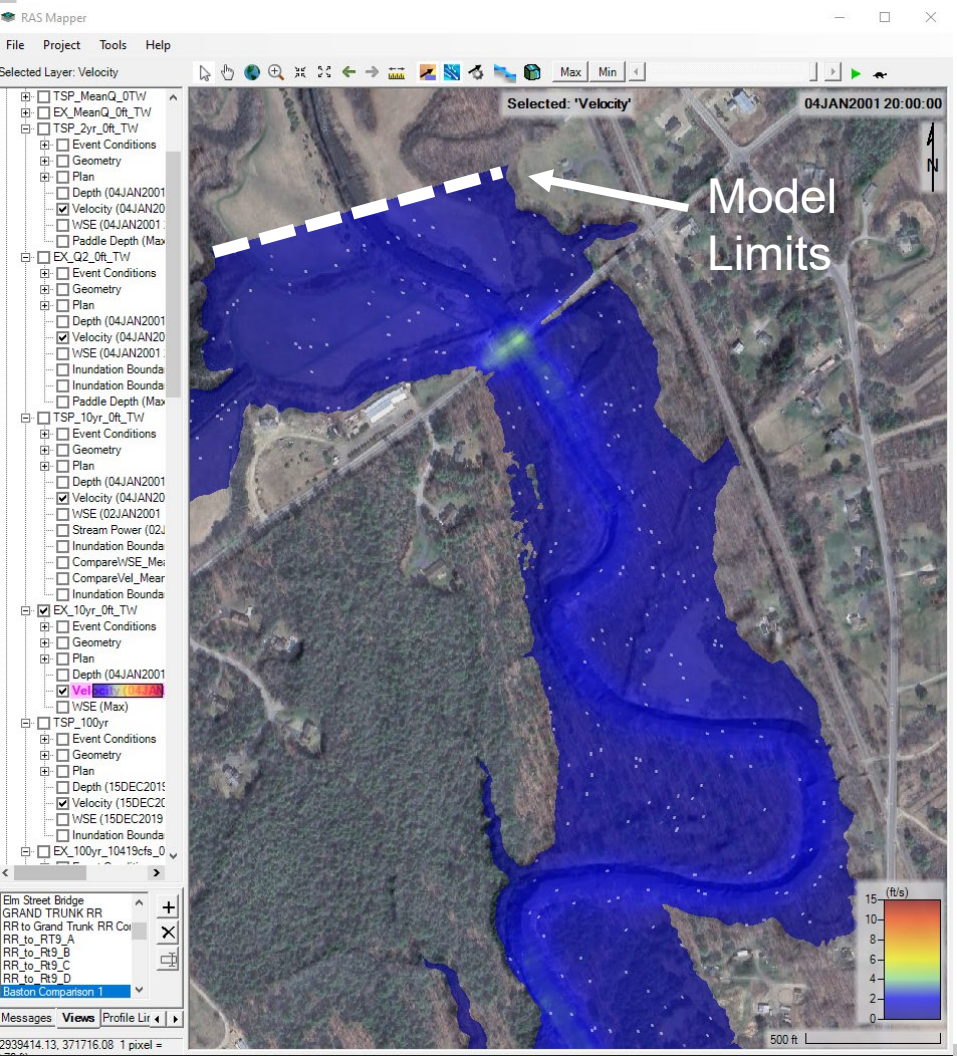


VELOCITY/INUNDATION COMPARISON – 10% AEP (10-YR) STORM
BASTON PARK / US ROUTE 9

EXISTING CONDITIONS



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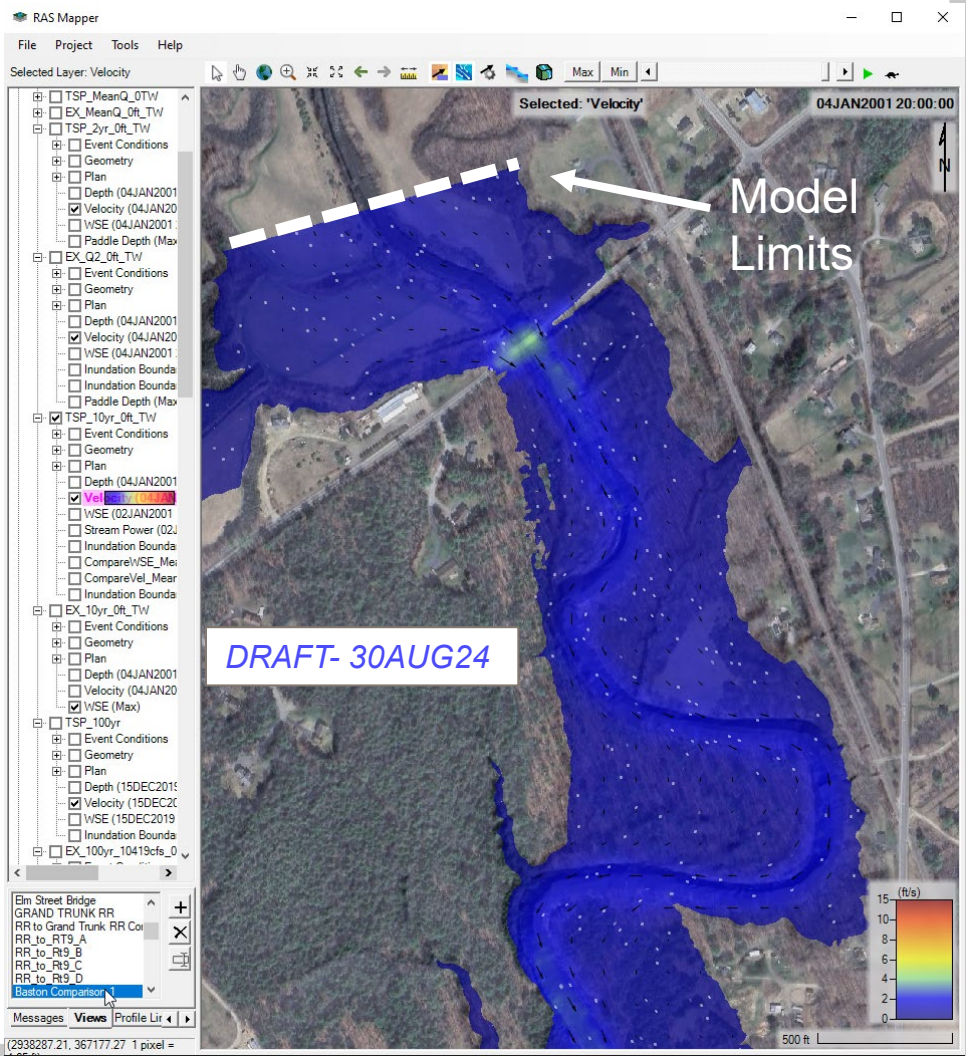


SECTION 206 ROYAL RIVER FISH PASSAGE
TSP HEC-RAS RESULTS

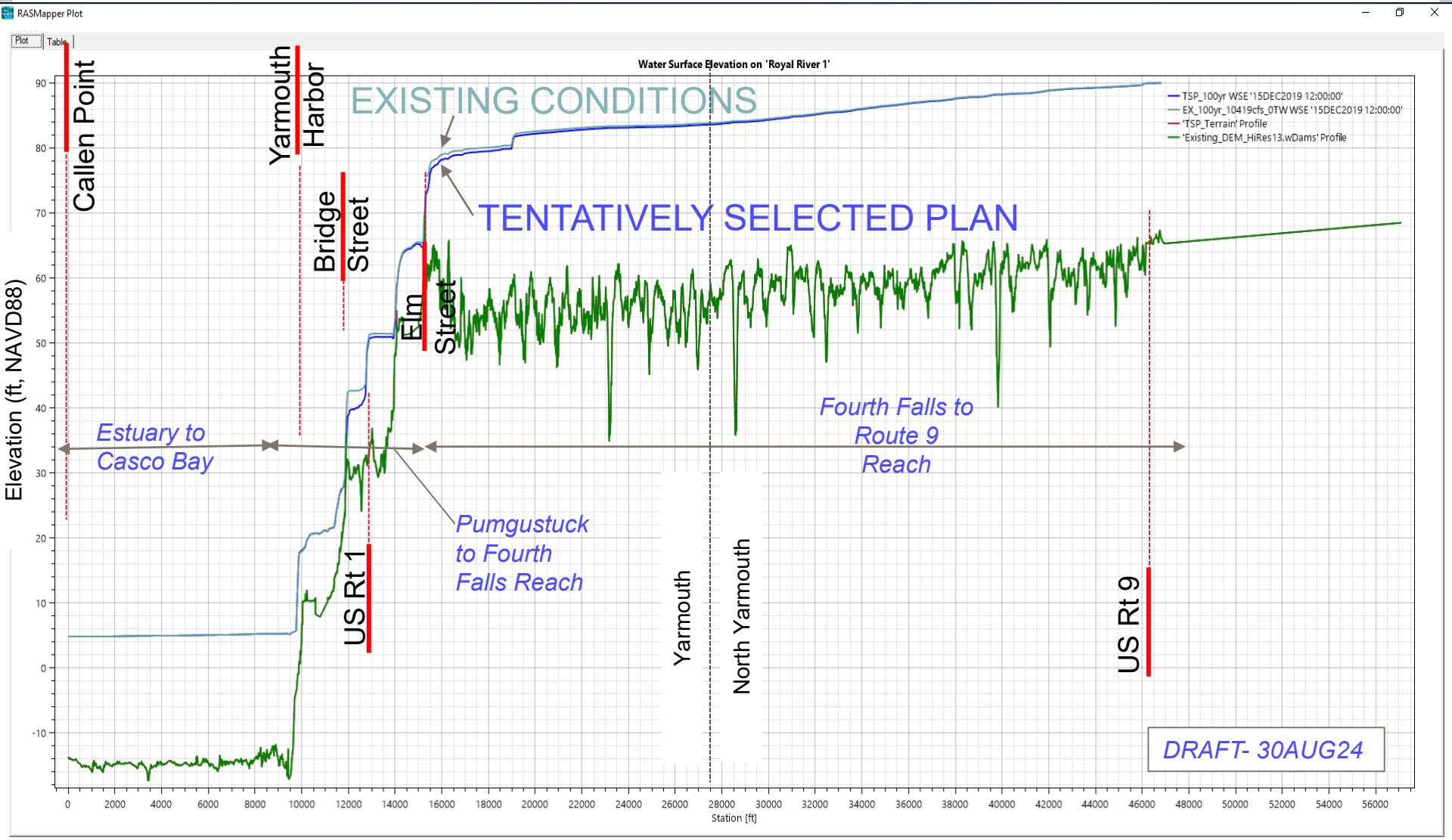
1% AEP (100-yr) Flows

- Water Surface & Velocity centerline profiles
- Boundary Conditions
- Flow & Water Surface Hydrographs
- Velocity/Inundation Comparisons
- Potential Changes in Flood Levels

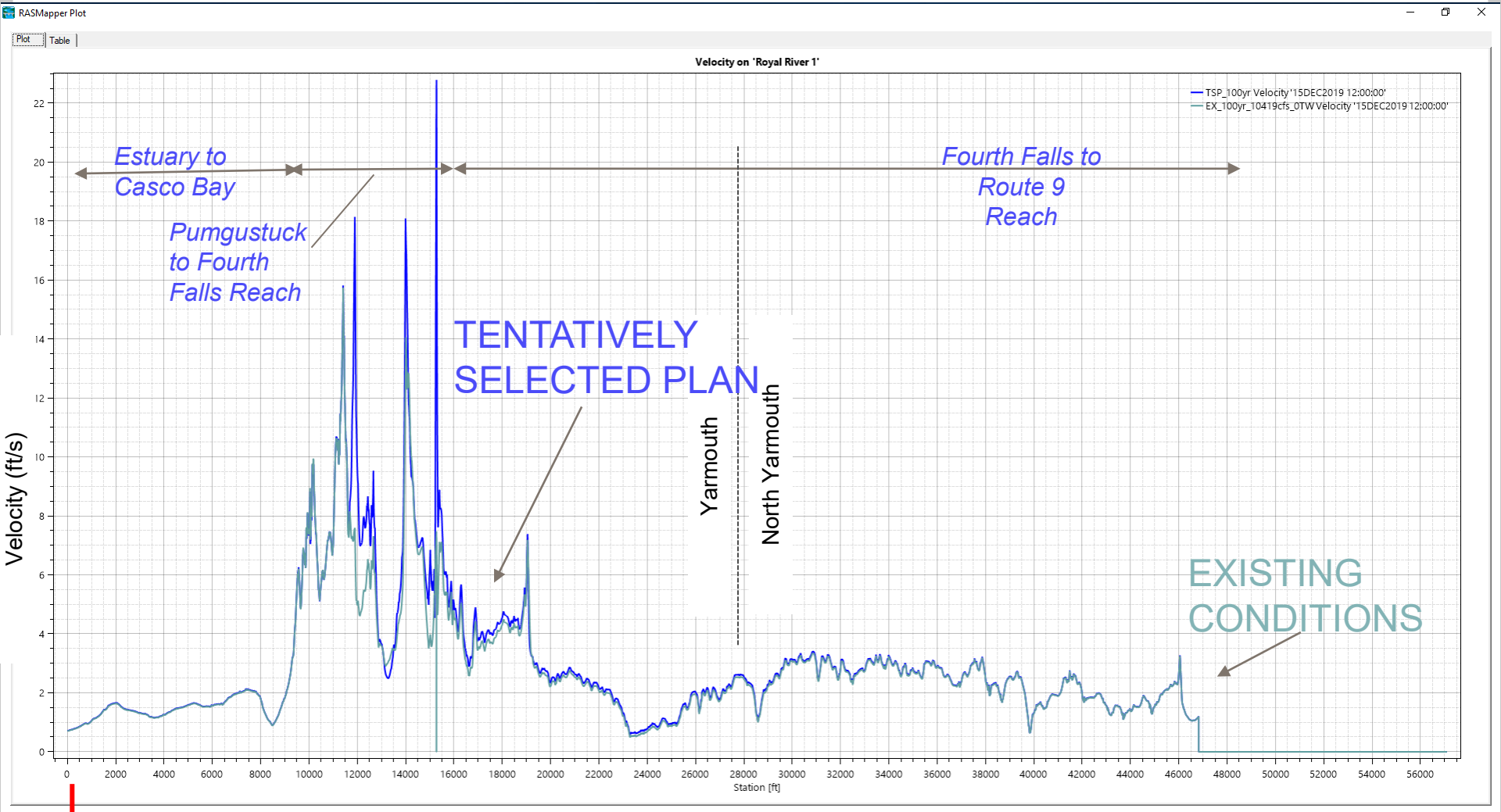
Modeled Event	Results Time	Peak Discharge (cfs)
7Q10	04JAN2001 20:00:00	25
Annual Median Flows	Max	120
95% Exceedance MidMay-MidJune	02JAN2001 12:00:00	62
5% Exceedance MidMay-MidJune	04JAN2001 20:00:00	641
50% AEP	04JAN2001 20:00:00	3,643
10% AEP	04JAN2001 20:00:00	6,480
1%AEP	15DEC2019 12:00:00	10,419
10-22DEC2019 Validation	15DEC2019 12:00:00	4,300

- Geometry:
  - Existing
  - TSP

WATER SURFACE PROFILE COMPARISON – 1% AEP (100-YR) STORM



VELOCITY PROFILE COMPARISON – 1% AEP (100-YR) STORM



Callen Point

Bridge Street

Elm Street

US Rt 9

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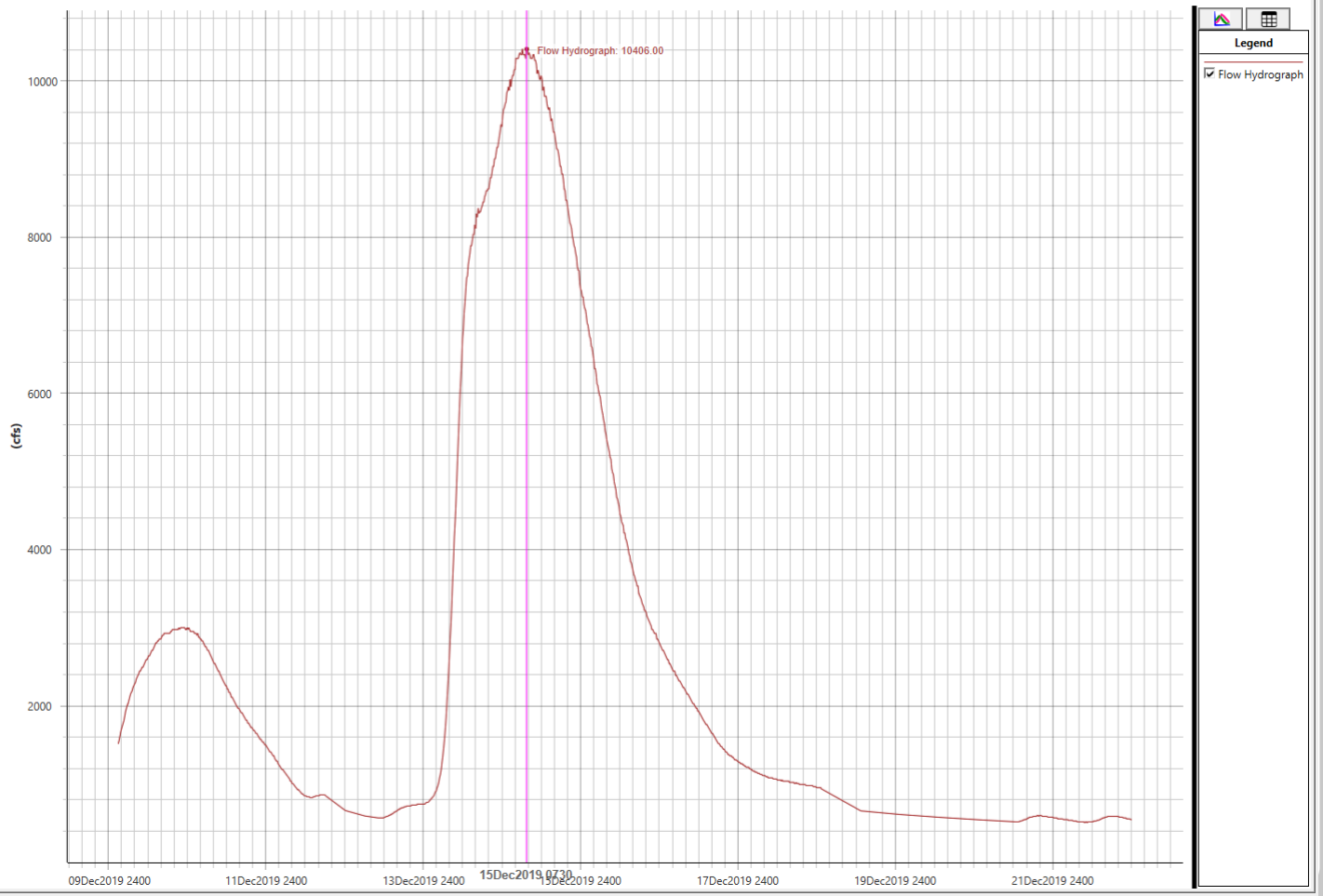
1% AEP (100-YR) STORM - FLOWS

UPSTREAM BOUNDARY CONDITION – FLOW HYDROGRAPH
USGS 15-MIN RECORDED FLOW 10-22DEC2019 X 2.42 =~ 1% AEP STORM

Time Series
Options

Ordinate		Flow Hydrograph (cfs)
490	15Dec2019 0515	10333.40
491	15Dec2019 0530	10357.60
492	15Dec2019 0545	10333.40
493	15Dec2019 0600	10333.40
494	15Dec2019 0615	10406.00
495	15Dec2019 0630	10333.40
496	15Dec2019 0645	10333.40
497	15Dec2019 0700	10333.40
498	15Dec2019 0715	10285.00
499	15Dec2019 0730	10406.00
500	15Dec2019 0745	10406.00
501	15Dec2019 0800	10333.40
502	15Dec2019 0815	10357.60
503	15Dec2019 0830	10333.40
504	15Dec2019 0845	10285.00
505	15Dec2019 0900	10285.00
506	15Dec2019 0915	10285.00
507	15Dec2019 0930	10333.40
508	15Dec2019 0945	10333.40
509	15Dec2019 1000	10260.80
510	15Dec2019 1015	10260.80
511	15Dec2019 1030	10212.40
512	15Dec2019 1045	10091.40
513	15Dec2019 1100	10139.80
514	15Dec2019 1115	10091.40
515	15Dec2019 1130	10018.80
516	15Dec2019 1145	10018.80
517	15Dec2019 1200	10067.20
518	15Dec2019 1215	10018.80
519	15Dec2019 1230	9873.60
520	15Dec2019 1245	9922.00
521	15Dec2019 1300	9801.00
522	15Dec2019 1315	9801.00
523	15Dec2019 1330	9801.00
524	15Dec2019 1345	9704.20
525	15Dec2019 1400	9655.80
526	15Dec2019 1415	9631.60
527	15Dec2019 1430	9655.80
528	15Dec2019 1445	9559.00
529	15Dec2019 1500	9486.40
530	15Dec2019 1515	9510.60
531	15Dec2019 1530	9413.80
532	15Dec2019 1545	9341.20
533	15Dec2019 1600	9341.20
534	15Dec2019 1615	9268.60
535	15Dec2019 1630	9196.00
536	15Dec2019 1645	9123.40
537	15Dec2019 1700	9123.40



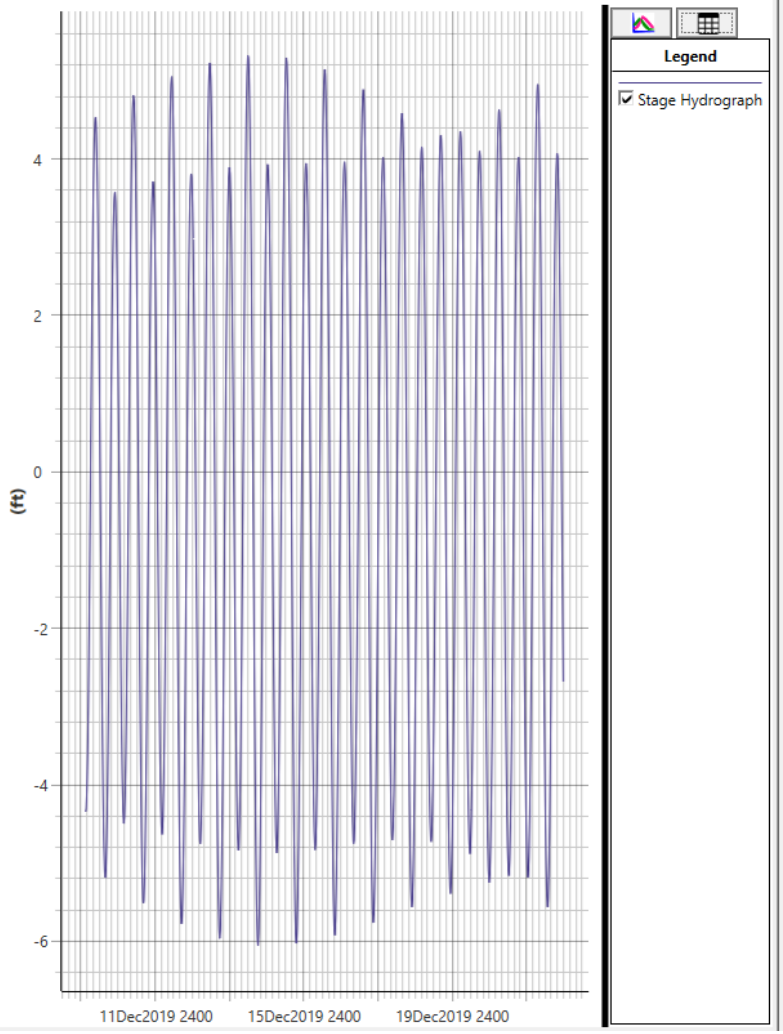
1% AEP (100-YR) STORM - FLOWS

NOAA PORTLAND TIDE GAGE (6-MIN)
10-22DEC2019 (NOT ADJUSTED)

Time Series

File Options

Ordinate		Stage Hydrograph (ft)
1	10Dec2019 0300	-4.33
2	10Dec2019 0306	-4.34
3	10Dec2019 0312	-4.34
4	10Dec2019 0318	-4.33
5	10Dec2019 0324	-4.31
6	10Dec2019 0330	-4.28
7	10Dec2019 0336	-4.25
8	10Dec2019 0342	-4.20
9	10Dec2019 0348	-4.13
10	10Dec2019 0354	-4.07
11	10Dec2019 0400	-3.99
12	10Dec2019 0406	-3.90
13	10Dec2019 0412	-3.80
14	10Dec2019 0418	-3.69
15	10Dec2019 0424	-3.57
16	10Dec2019 0430	-3.44
17	10Dec2019 0436	-3.31
18	10Dec2019 0442	-3.16
19	10Dec2019 0448	-3.01
20	10Dec2019 0454	-2.84
21	10Dec2019 0500	-2.67
22	10Dec2019 0506	-2.49
23	10Dec2019 0512	-2.31
24	10Dec2019 0518	-2.11
25	10Dec2019 0524	-1.91
26	10Dec2019 0530	-1.70
27	10Dec2019 0536	-1.49
28	10Dec2019 0542	-1.27
29	10Dec2019 0548	-1.05
30	10Dec2019 0554	-0.82
31	10Dec2019 0600	-0.59
32	10Dec2019 0606	-0.36
33	10Dec2019 0612	-0.12
34	10Dec2019 0618	0.11
35	10Dec2019 0624	0.34
36	10Dec2019 0630	0.58
37	10Dec2019 0636	0.81
38	10Dec2019 0642	1.04
39	10Dec2019 0648	1.27
40	10Dec2019 0654	1.49

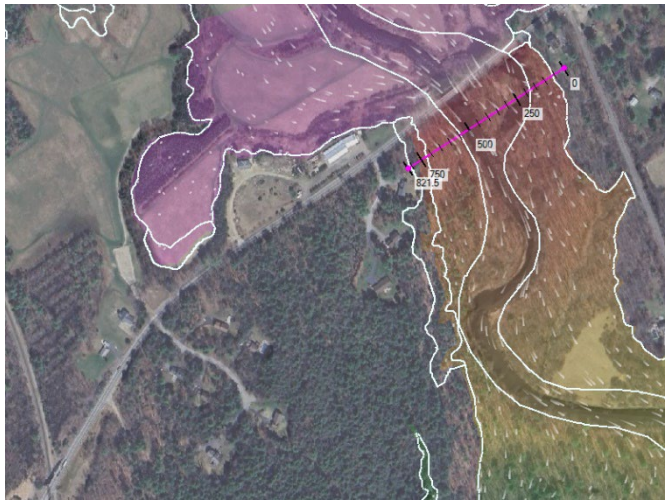


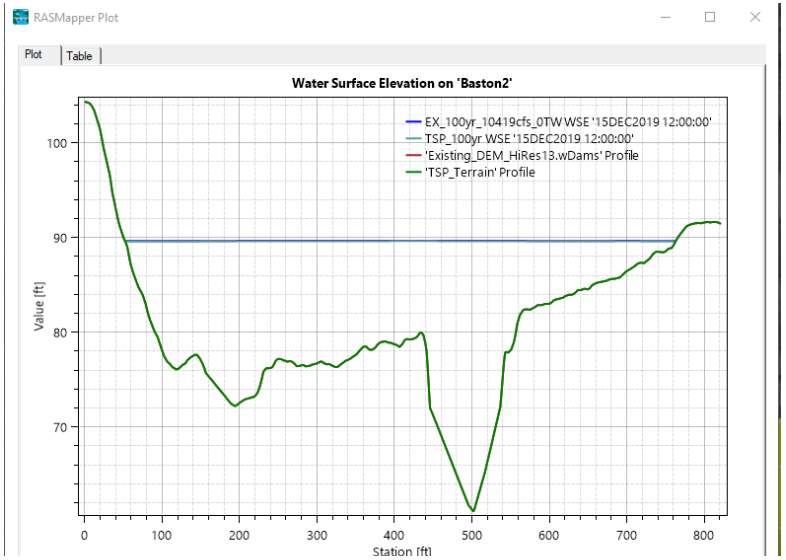
1% AEP (100-YR) STORM

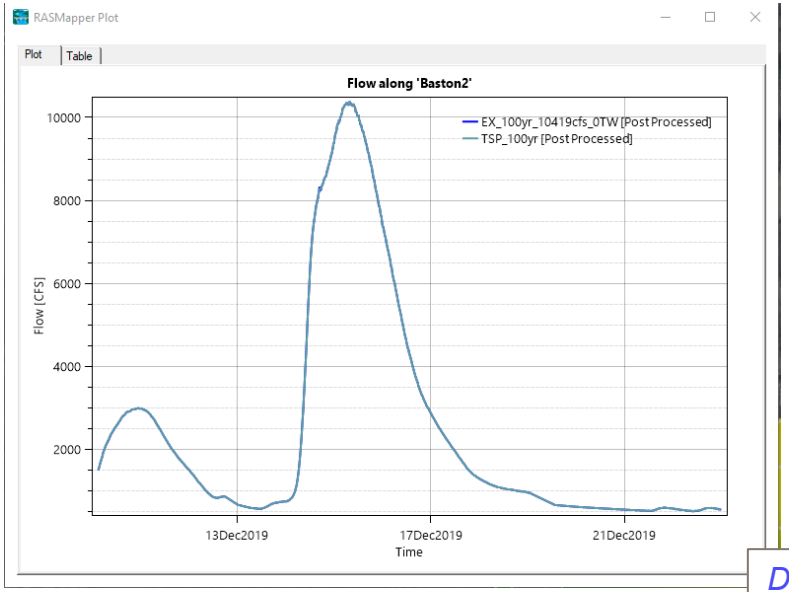
EXISTING CONDITIONS

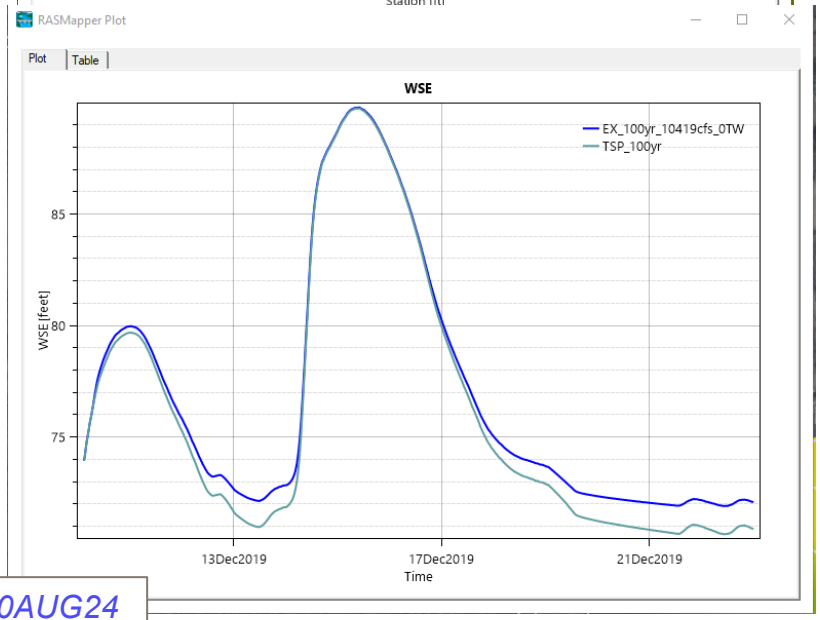
TENTATIVELY SELECTED PLAN

BASTON PARK / MEMORIAL HIGHWAY / STATE ROUTE 9









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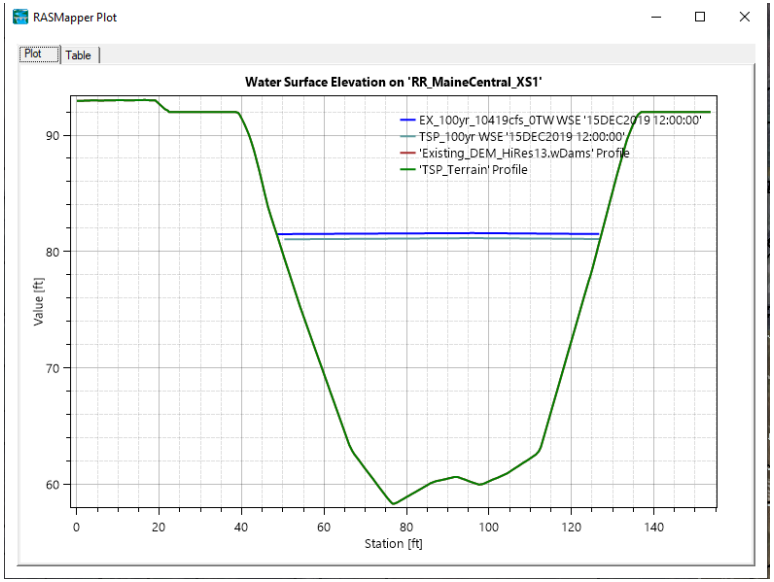
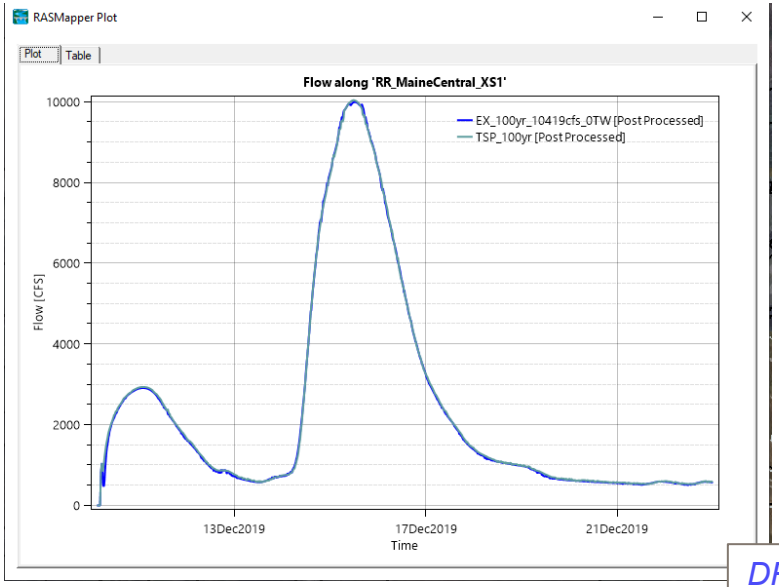
1% AEP (100-YR) STORM

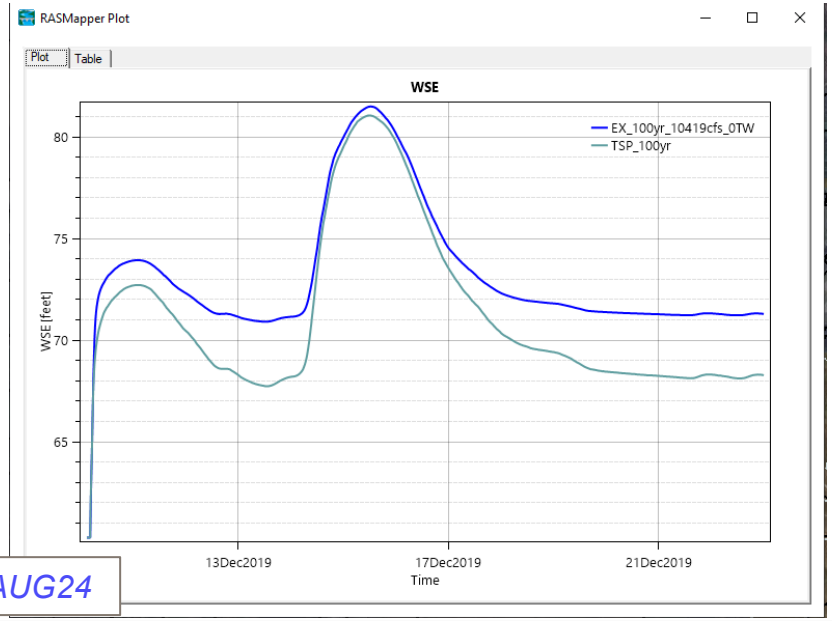
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

MAINE CENTRAL RAILROAD







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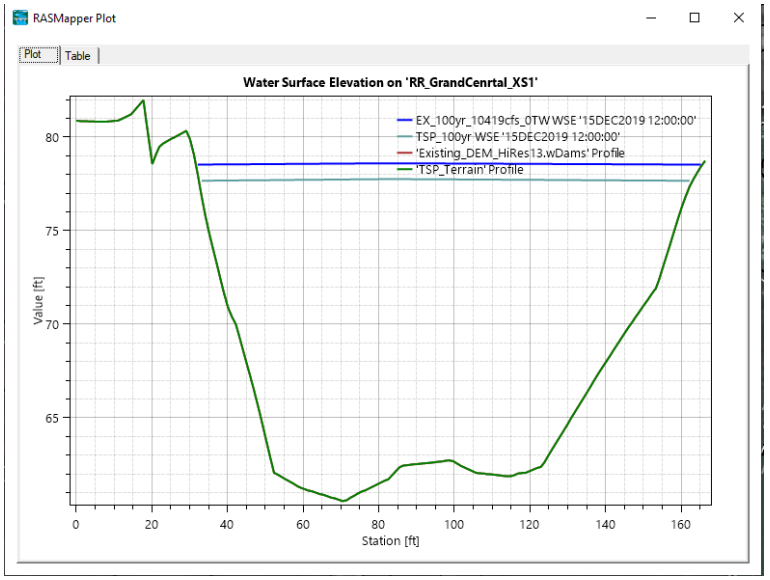
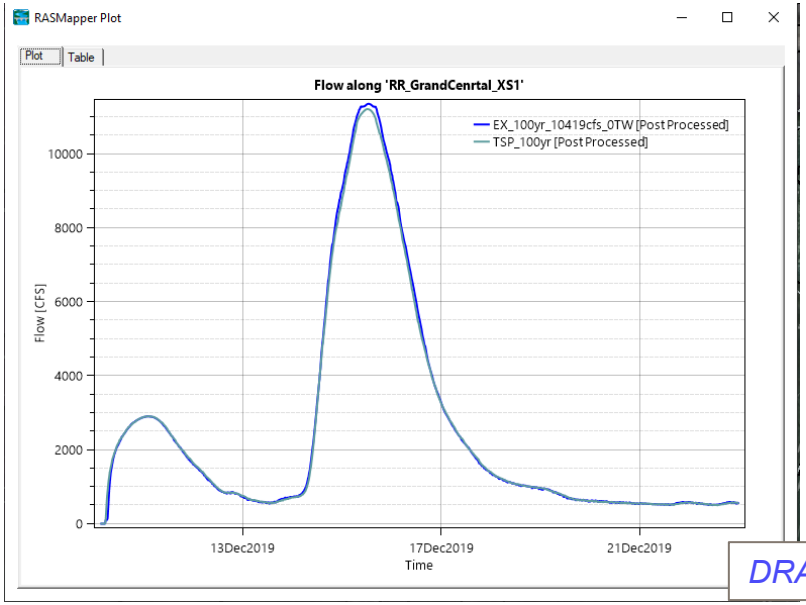
1% AEP (100-YR) STORM

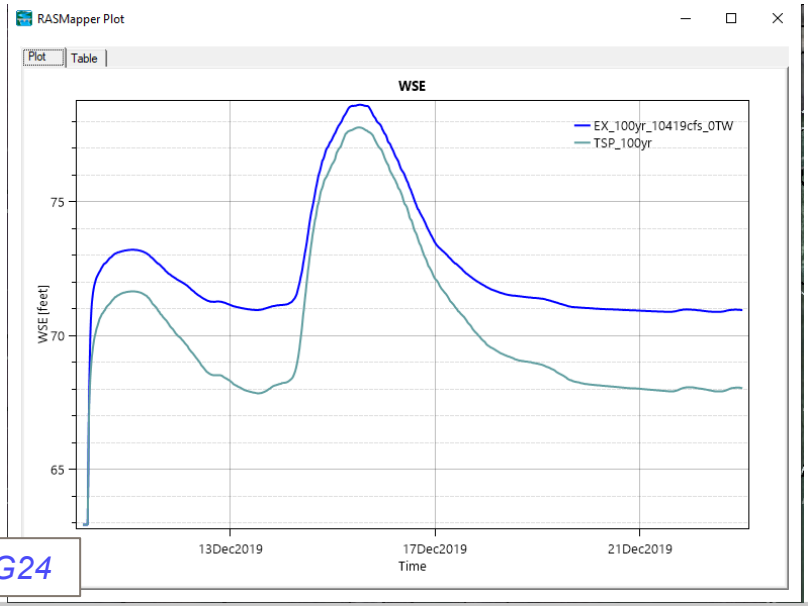
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

GRAND CENTRAL RAILROAD







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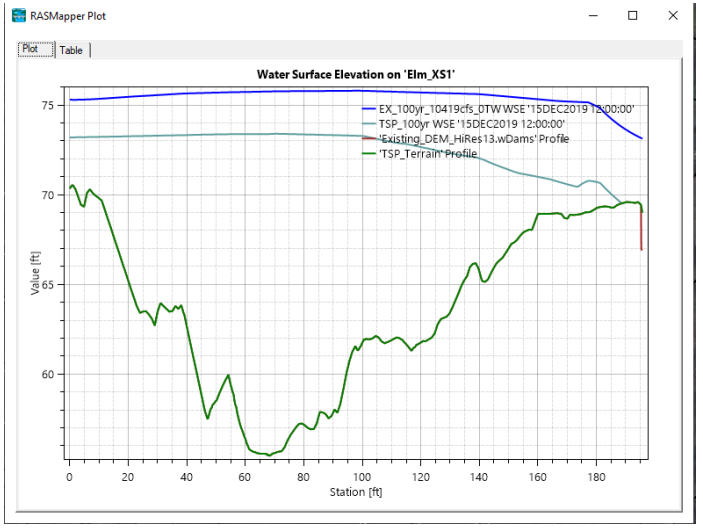
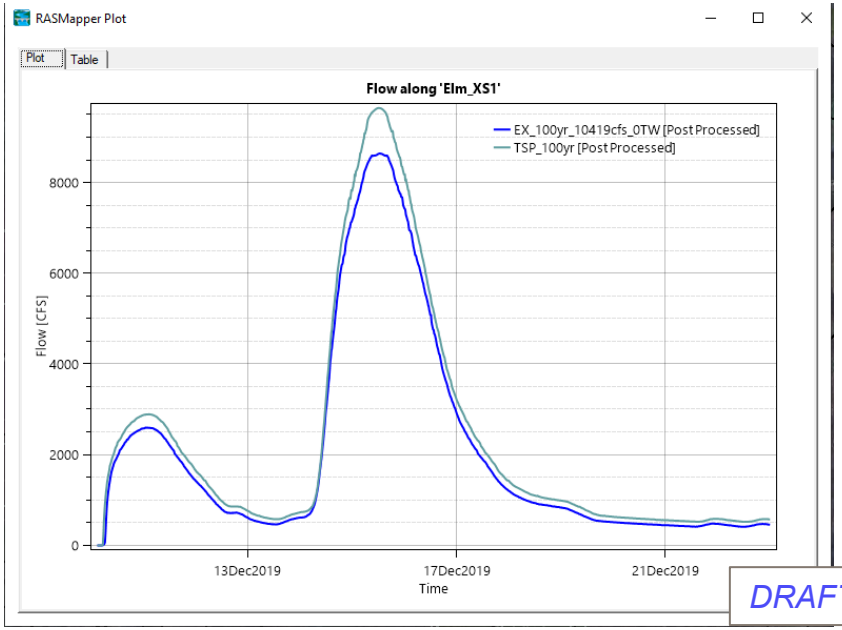
1% AEP (100-YR) STORM

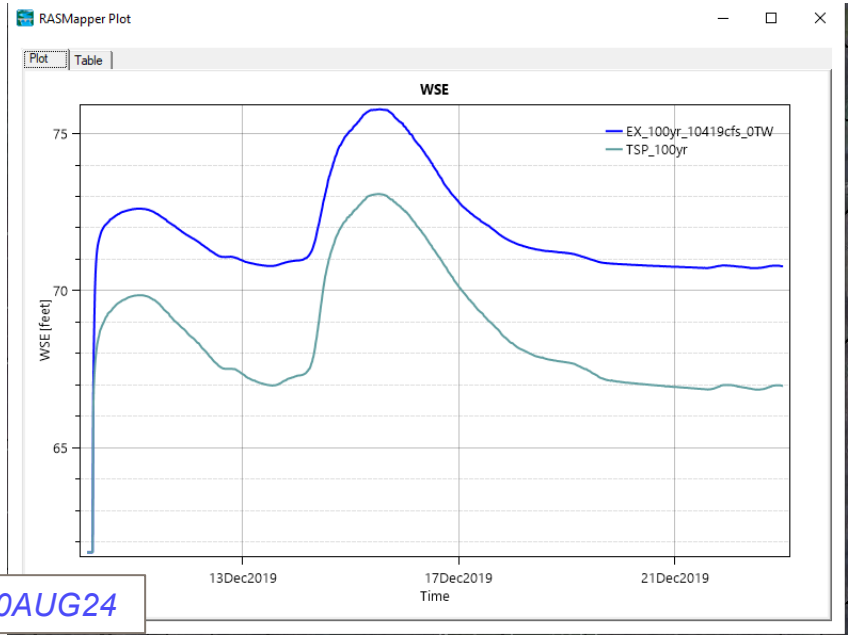
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

U/S ELM STREET DAM







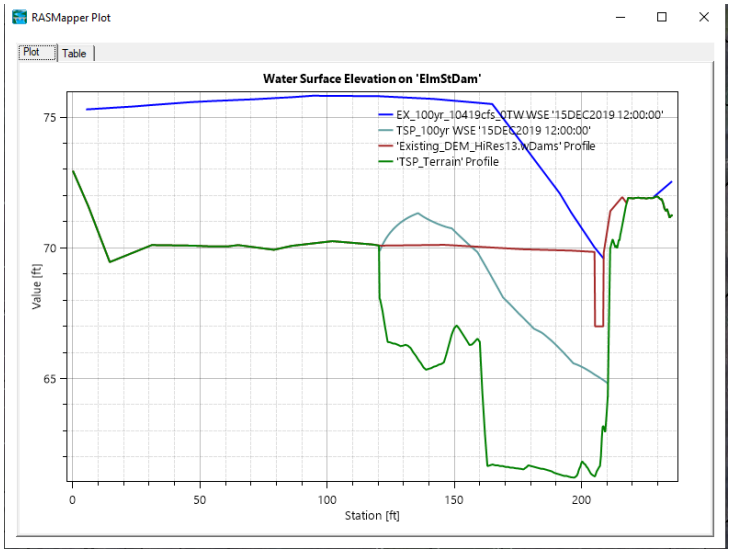
DRAFT- 30AUG24

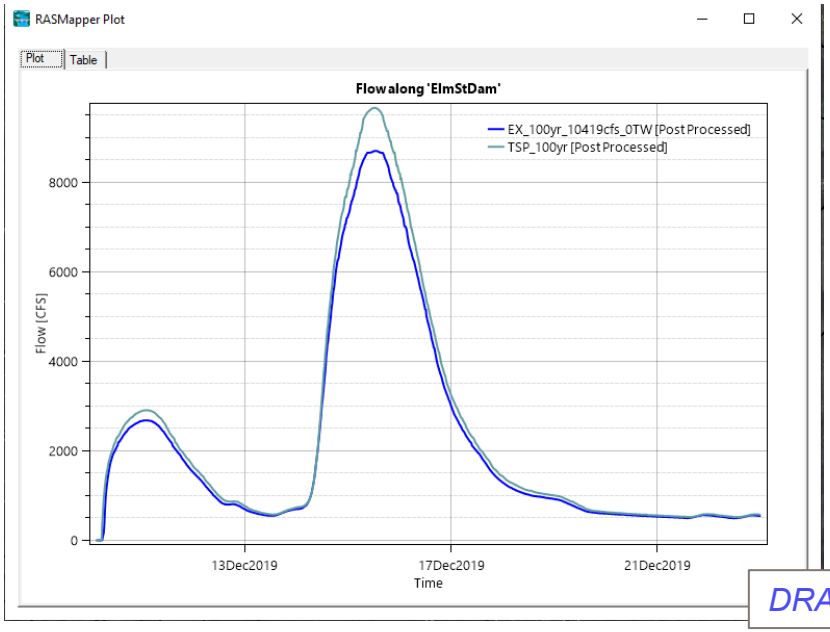
1% AEP (100-YR) STORM

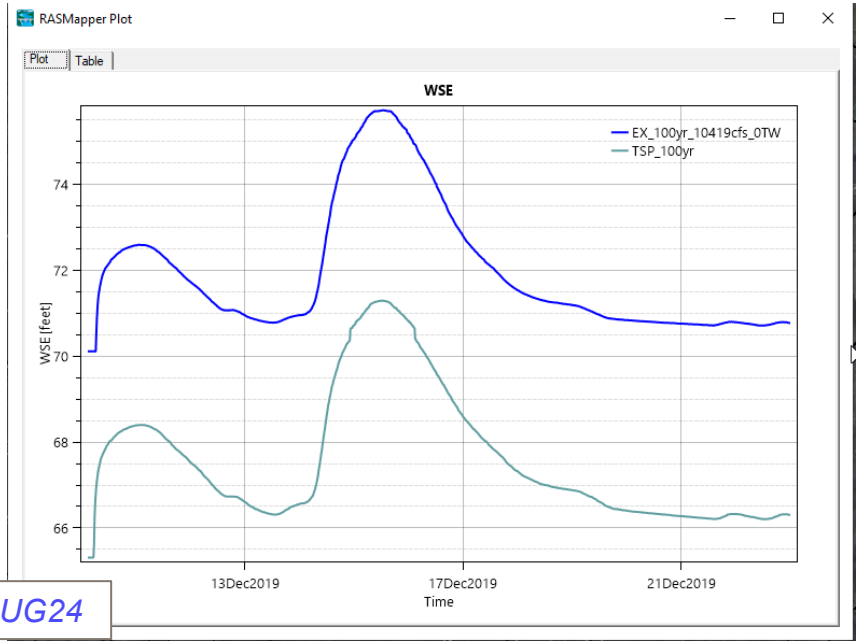
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

ELM STREET DAM







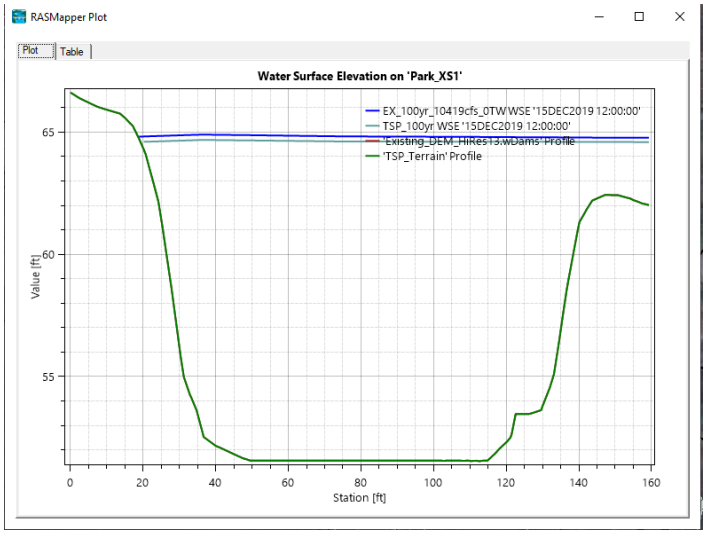
DRAFT- 30AUG24

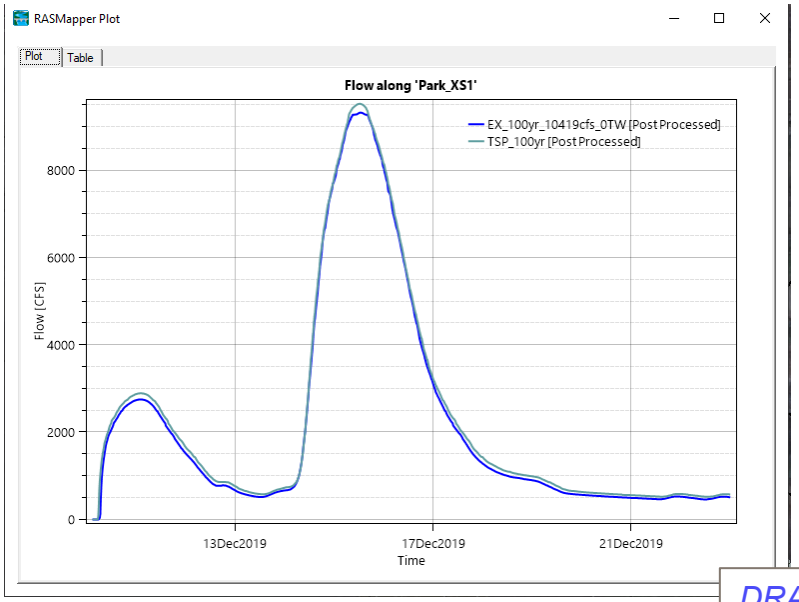
1% AEP (100-YR) STORM

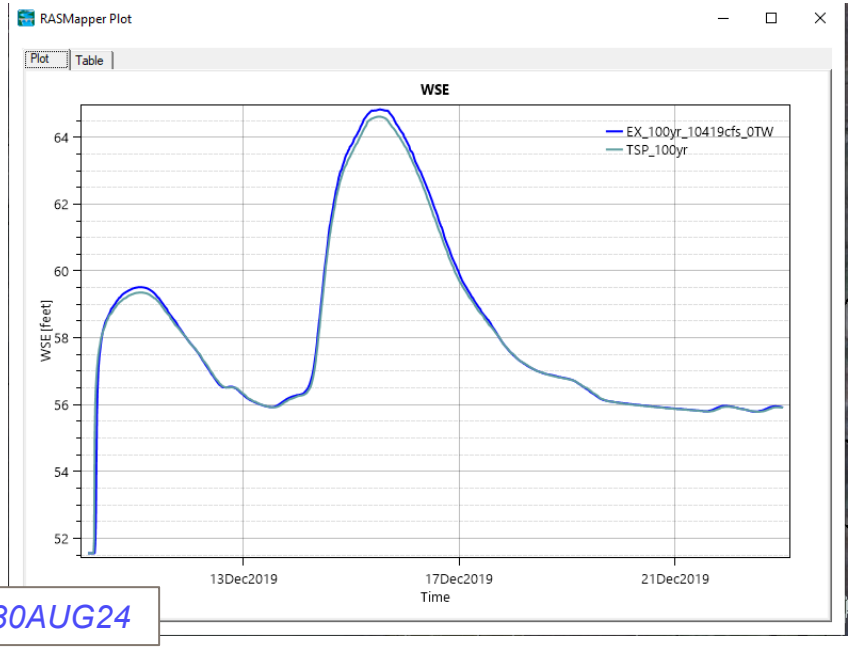
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

ROYAL RIVER PARK







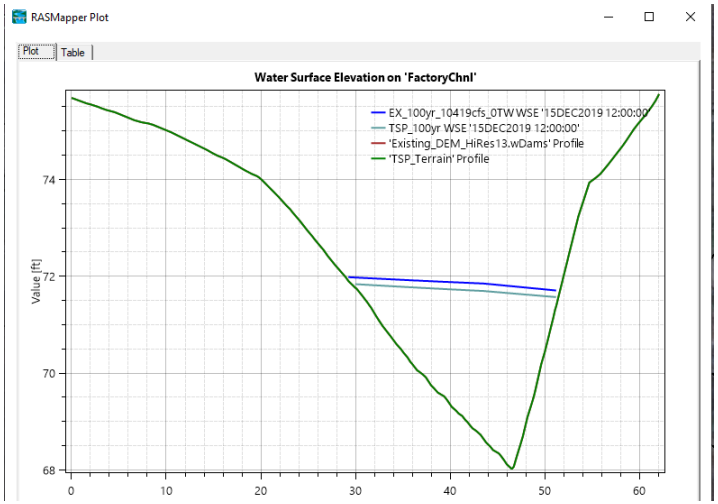
DRAFT- 30AUG24

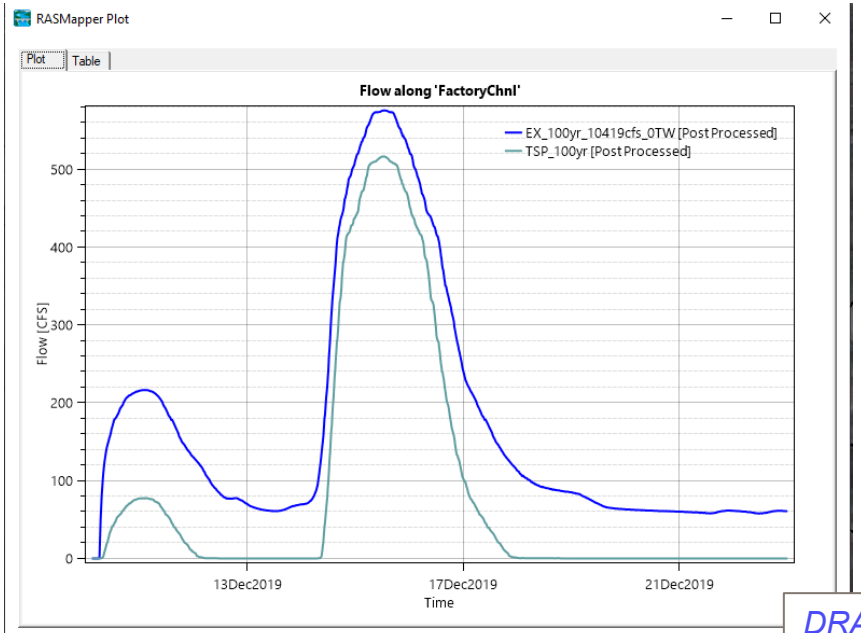
1% AEP (100-YR) STORM

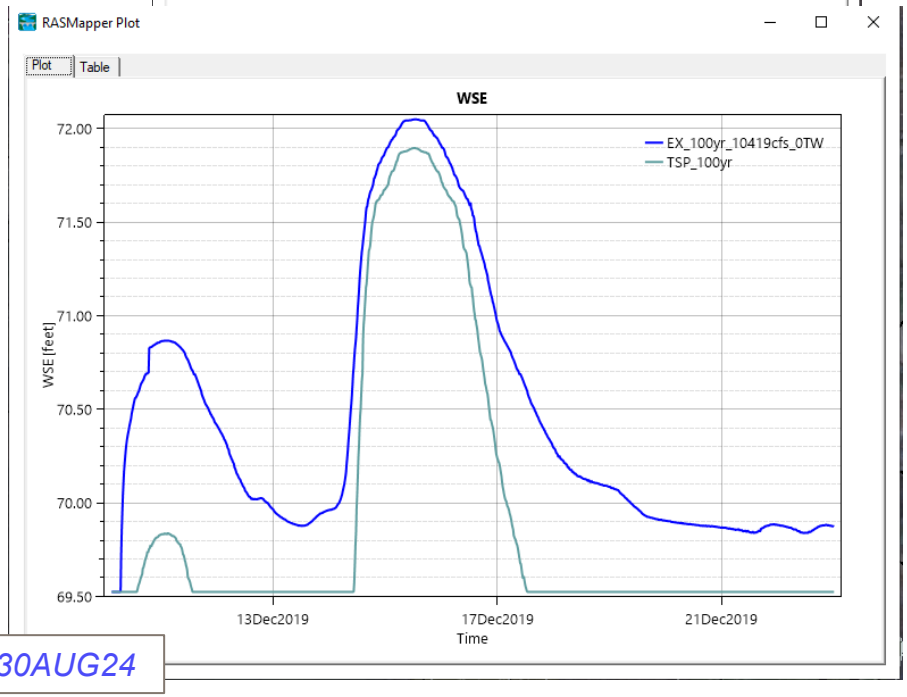
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

FACTORY CHANNEL







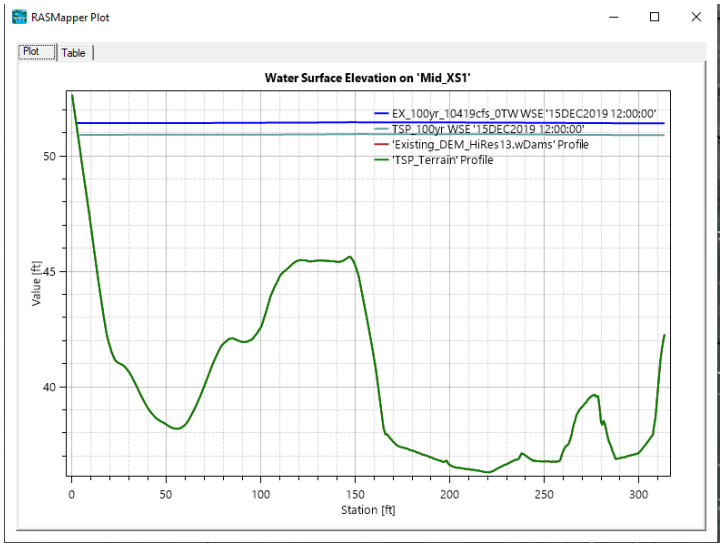
DRAFT- 30AUG24

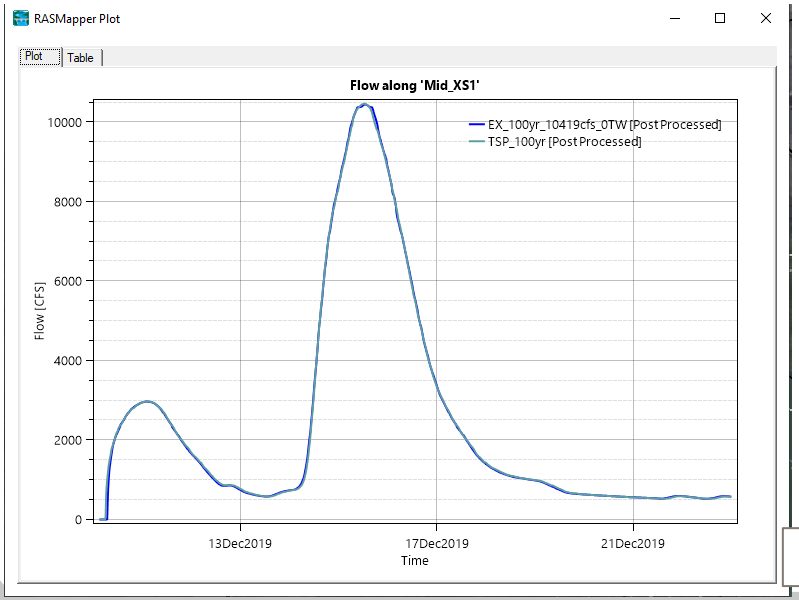
1% AEP (100-YR) STORM

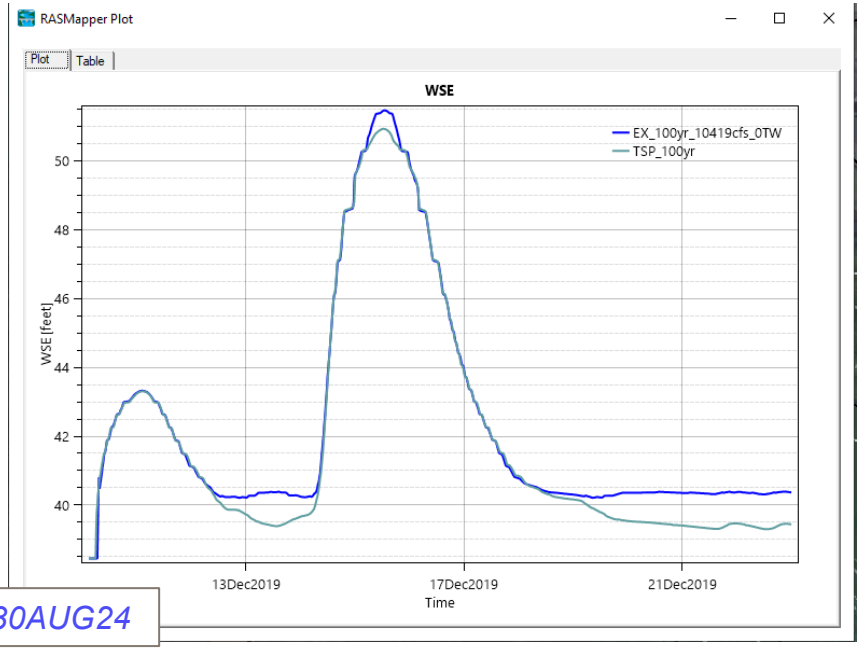
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

MIDDLE FALLS







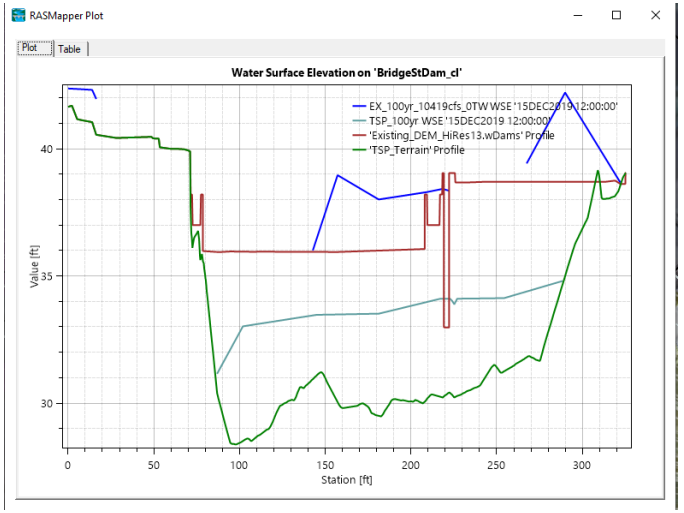
DRAFT- 30AUG24

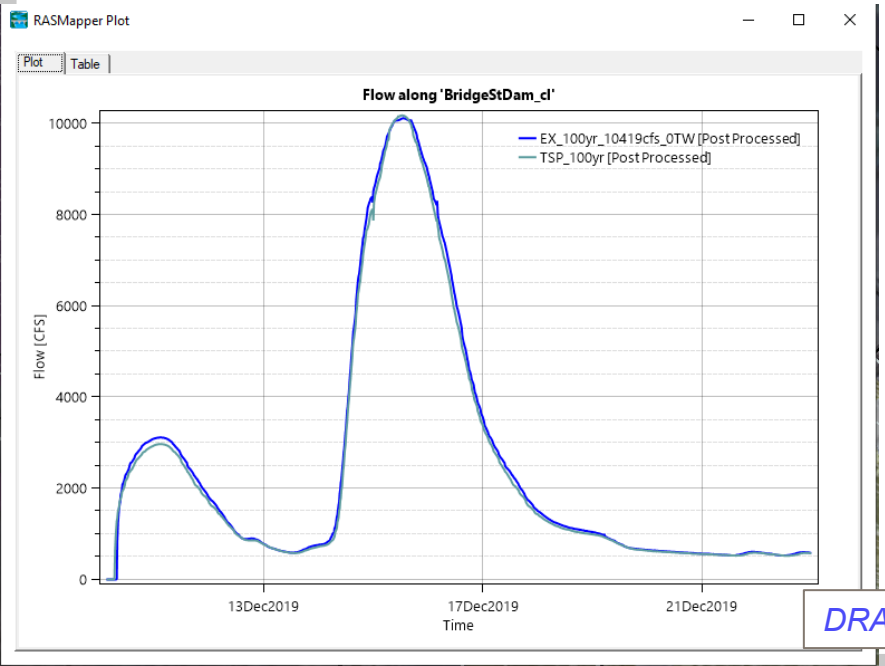
1% AEP (100-YR) STORM

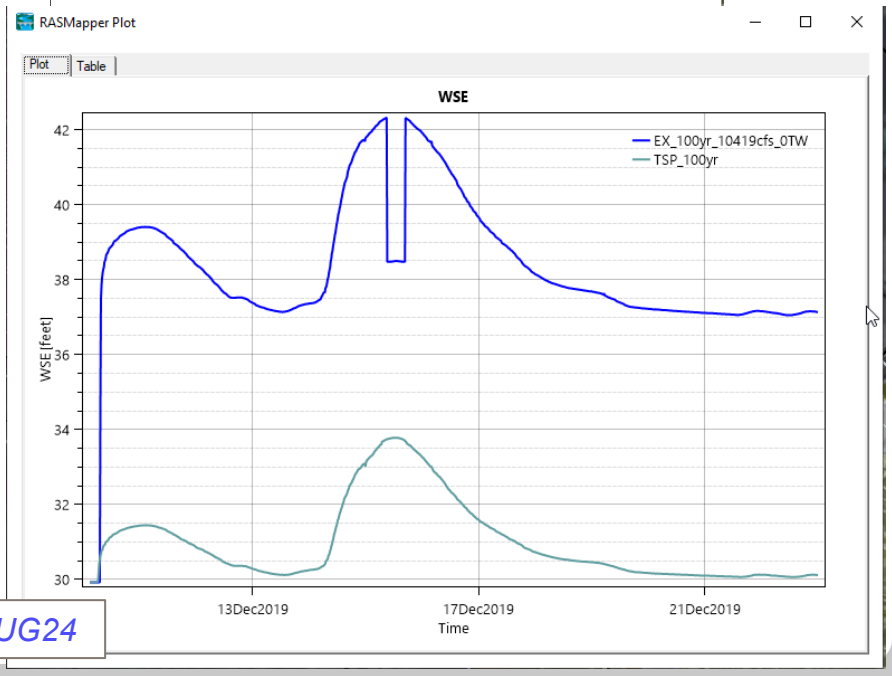
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

BRIDGE STREET DAM







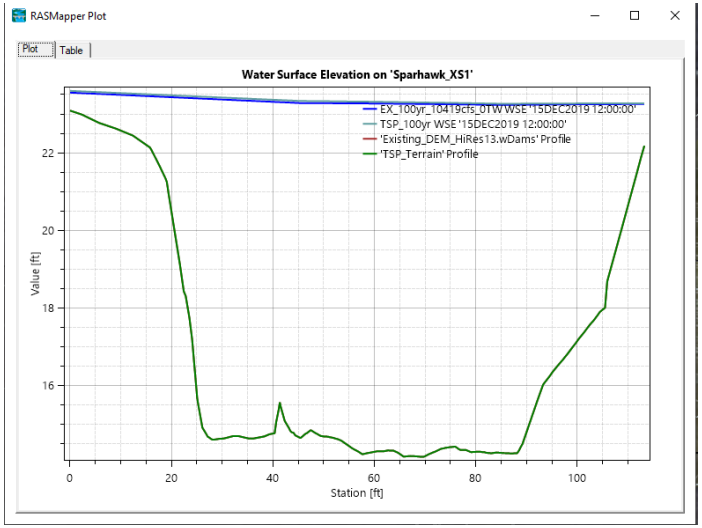
DRAFT- 30AUG24

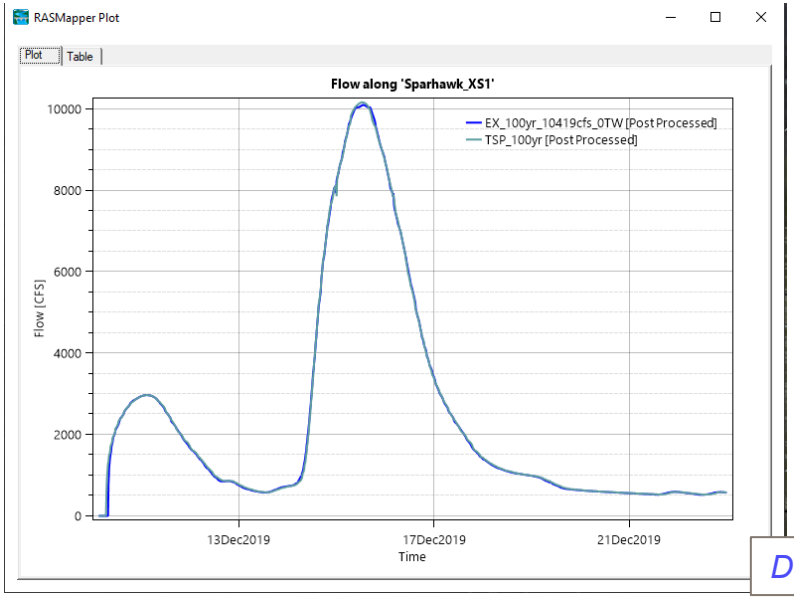
1% AEP (100-YR) STORM

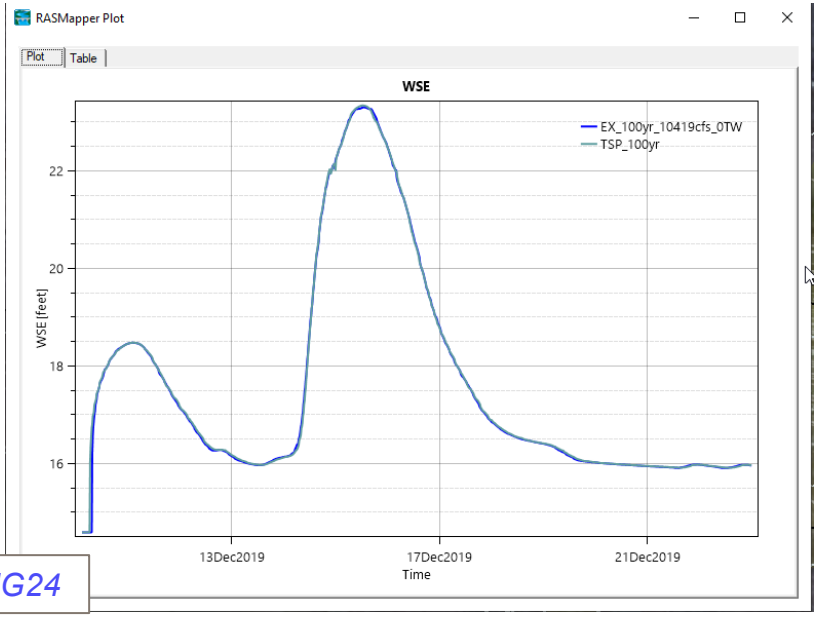
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

SPARHAWK MILL







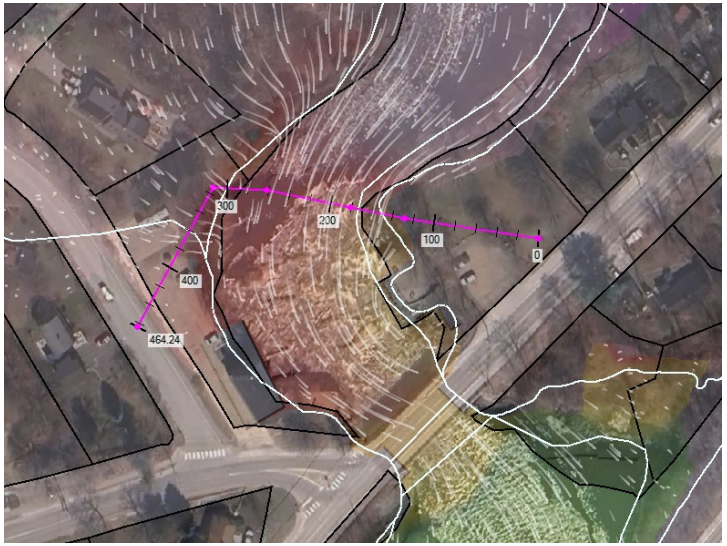
DRAFT- 30AUG24

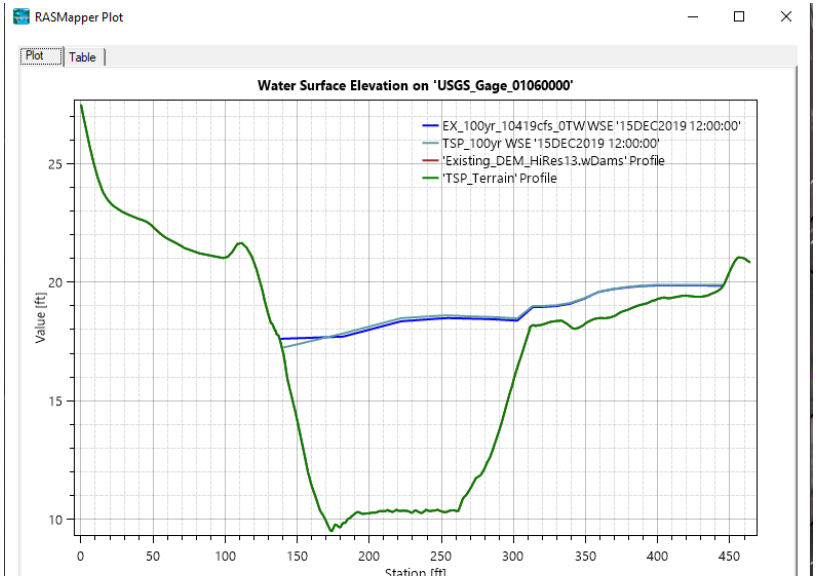
1% AEP (100-YR) STORM

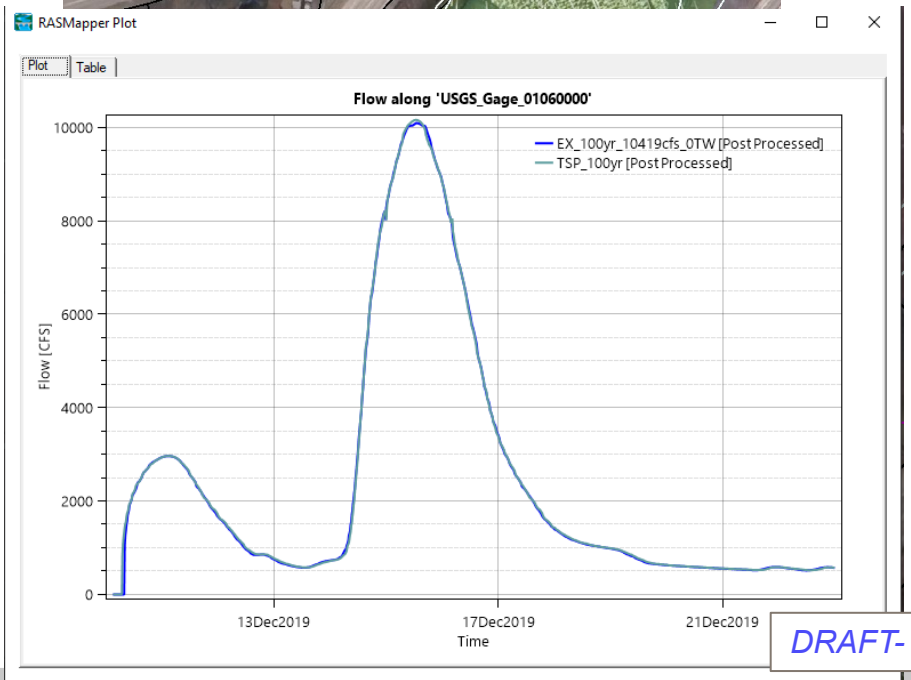
EXISTING CONDITIONS

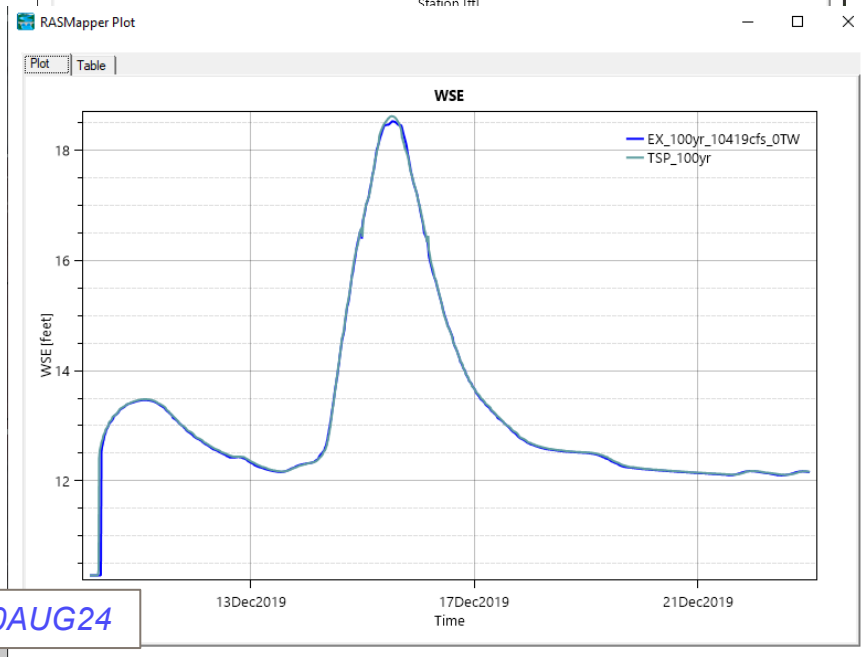
TENTATIVELY SELECTED PLAN

USGS GAGE 01060000









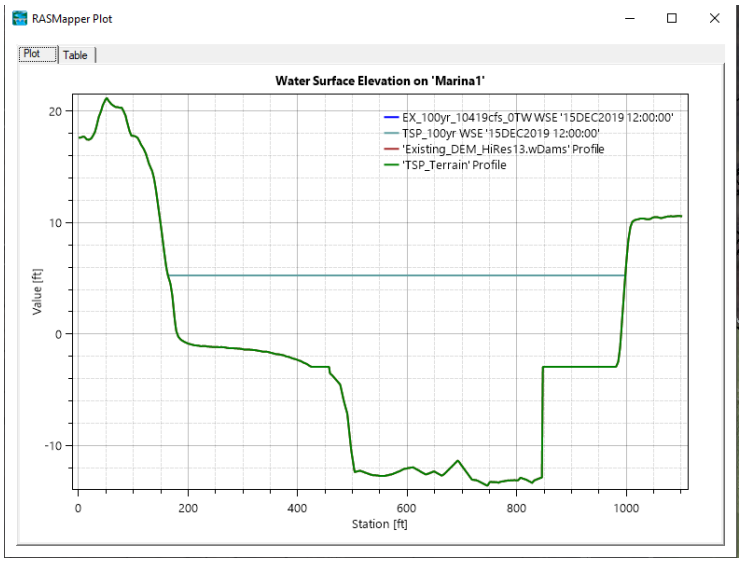
DRAFT- 30AUG24

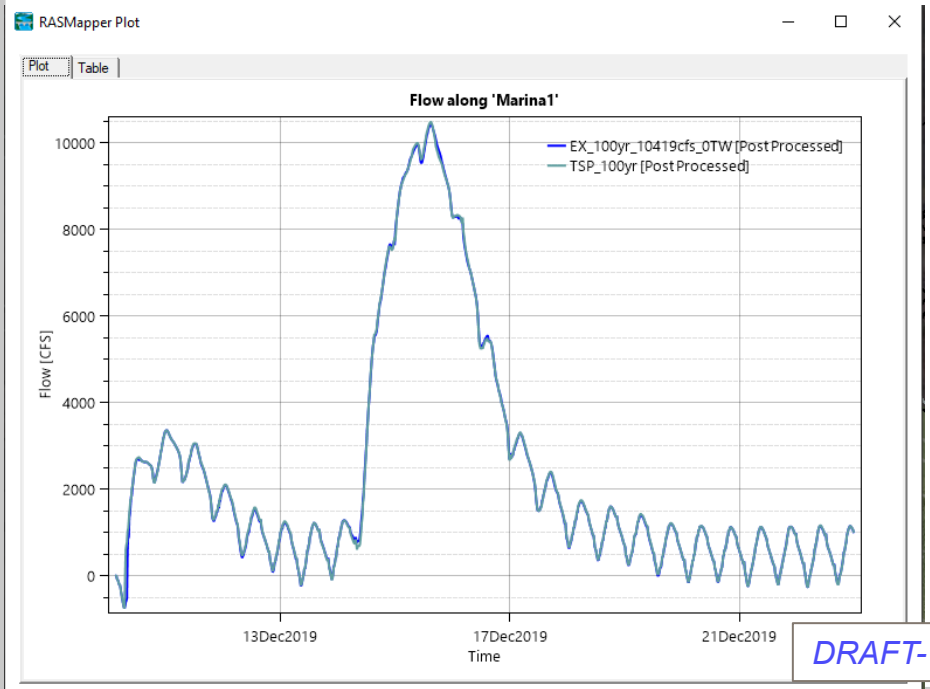
1% AEP (100-YR) STORM

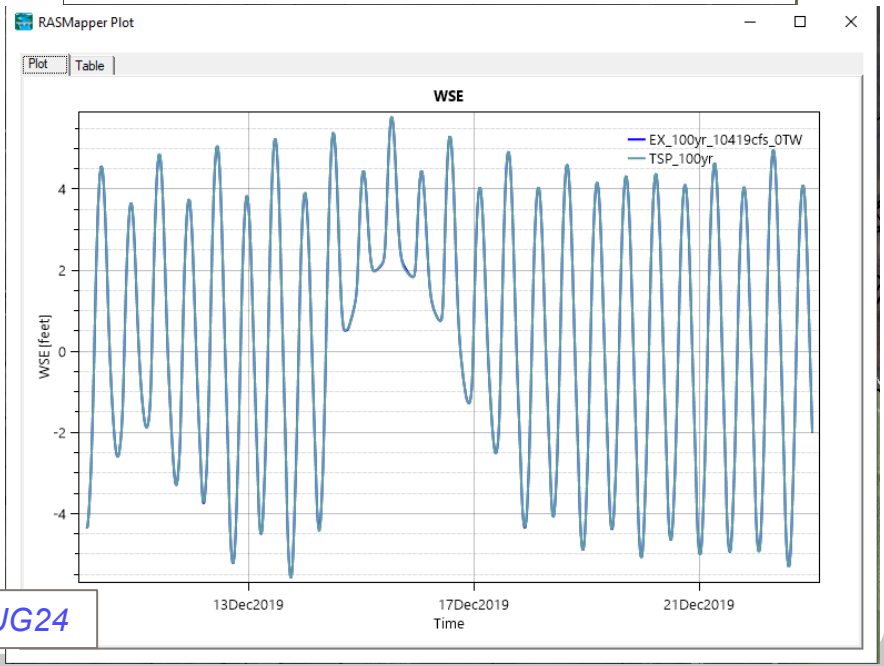
EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

MARINA







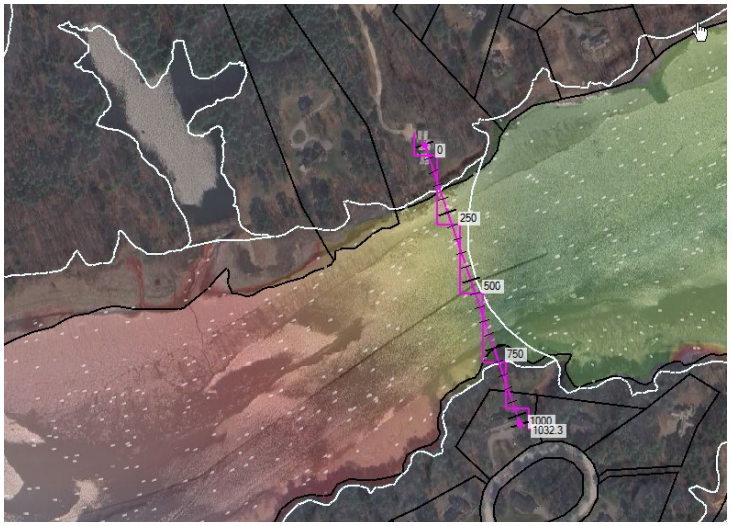
DRAFT- 30AUG24

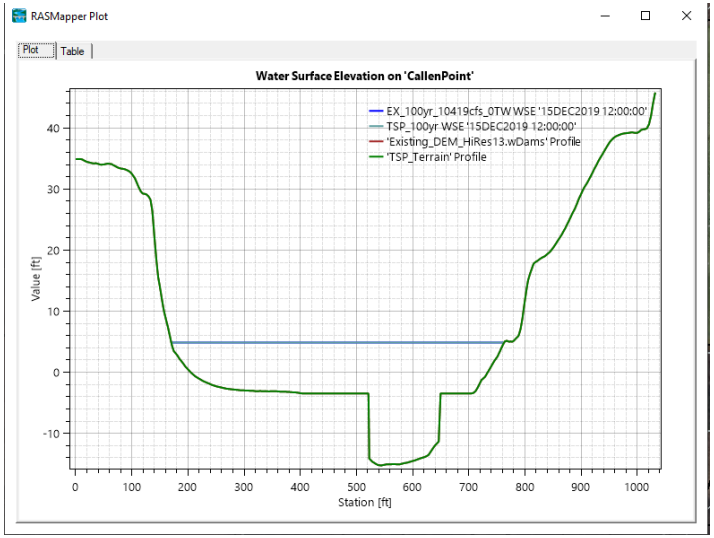
1% AEP (100-YR) STORM

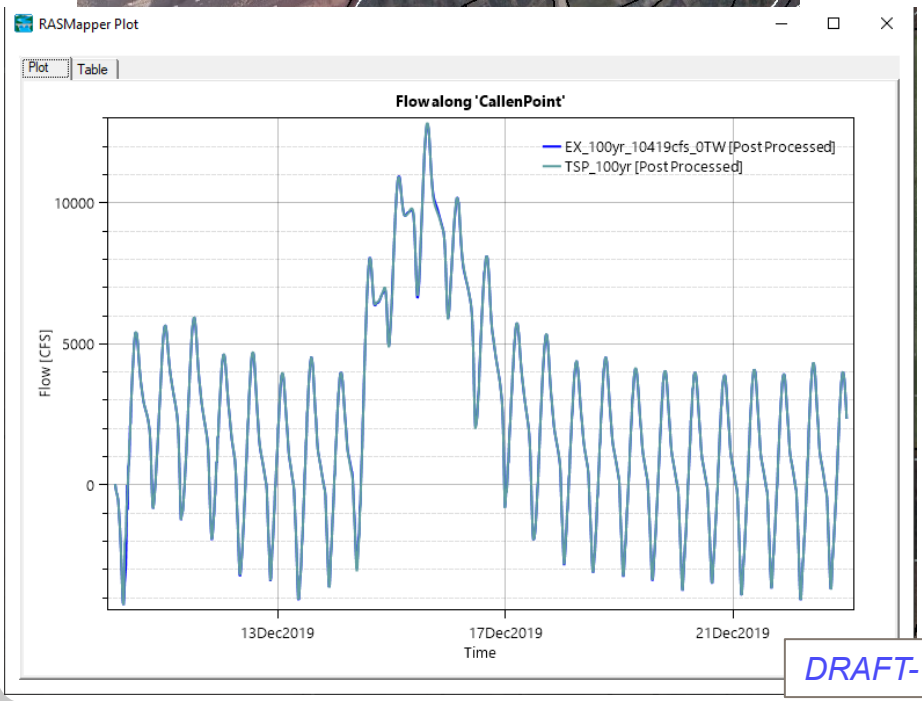
EXISTING CONDITIONS

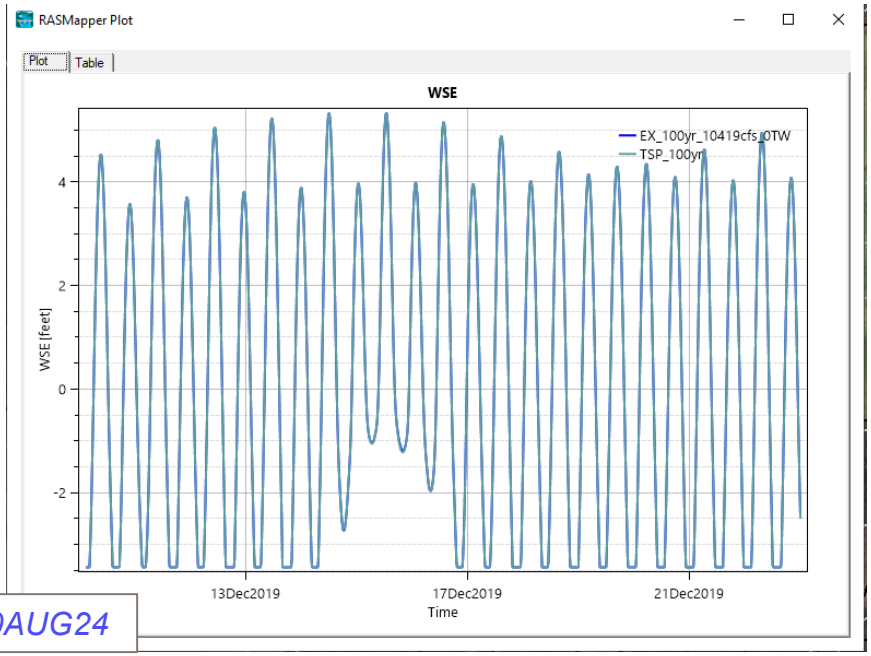
TENTATIVELY SELECTED PLAN

CALLEN POINT







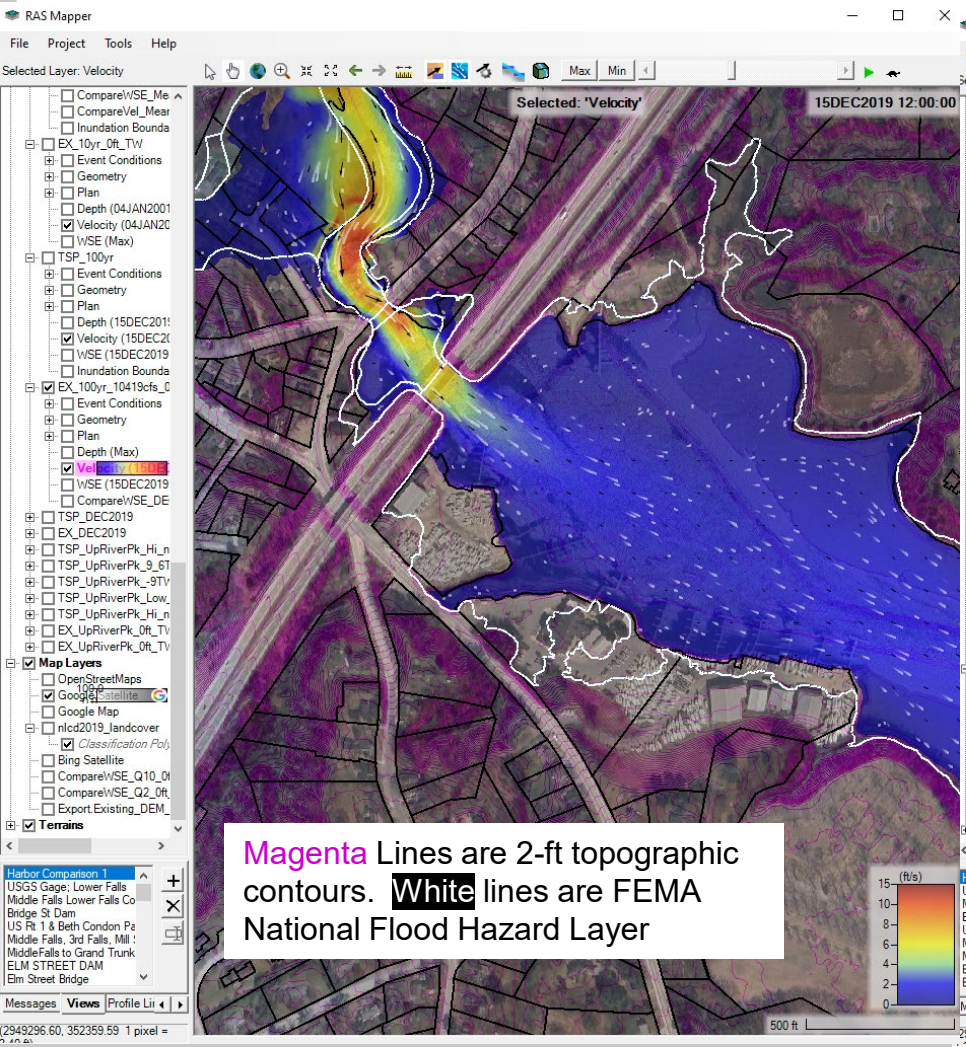


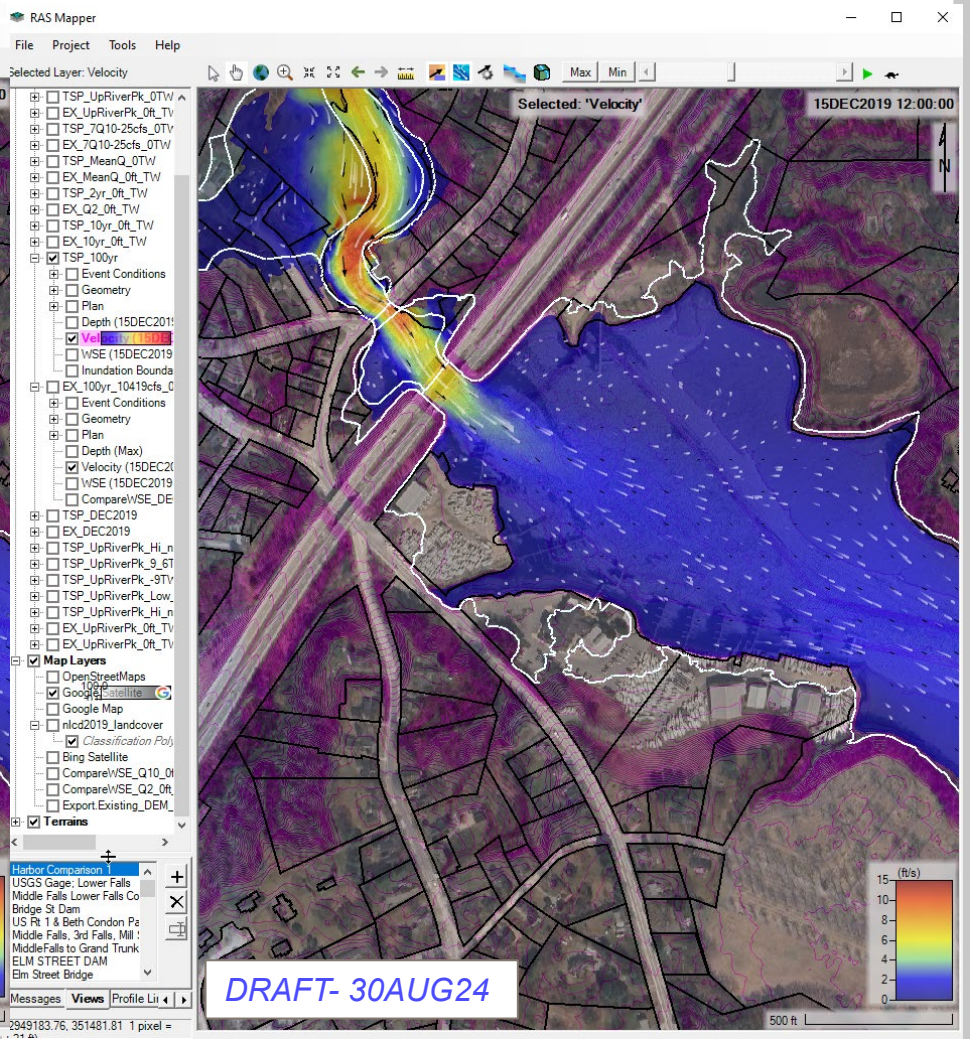
DRAFT- 30AUG24

VELOCITY/INUNDATION COMPARISON – 100-YR STORM
HARBOR TO LOWER FALLS OVERVIEW

EXISTING CONDITIONS

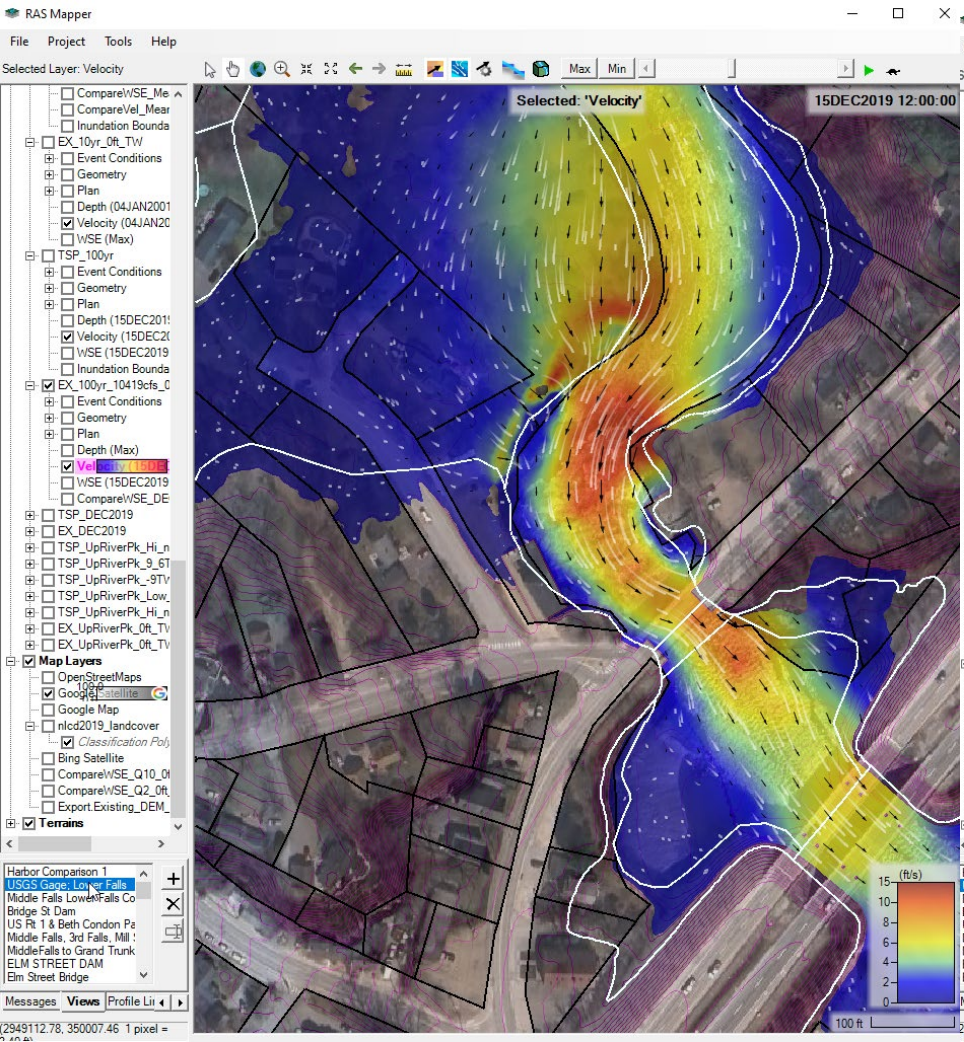
TENTATIVELY SELECTED PLAN



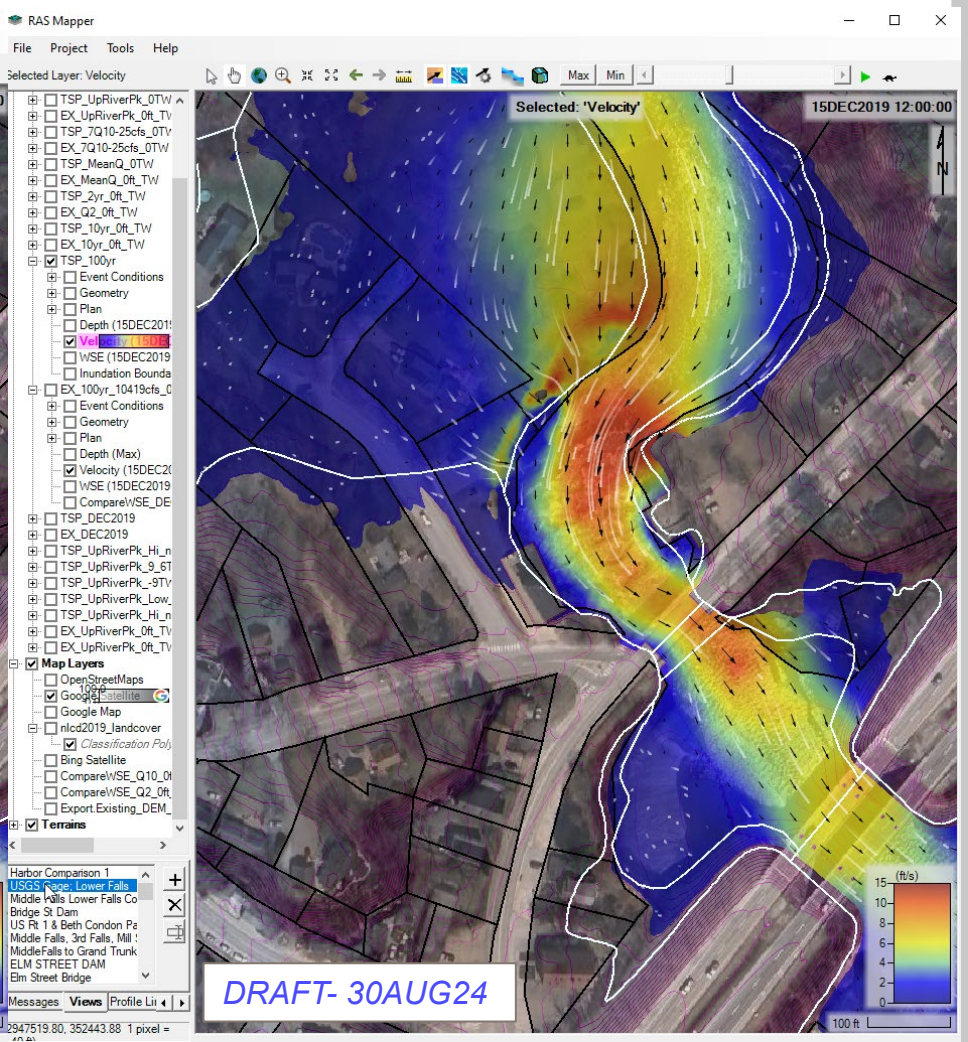


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
LOWER FALLS

EXISTING CONDITIONS



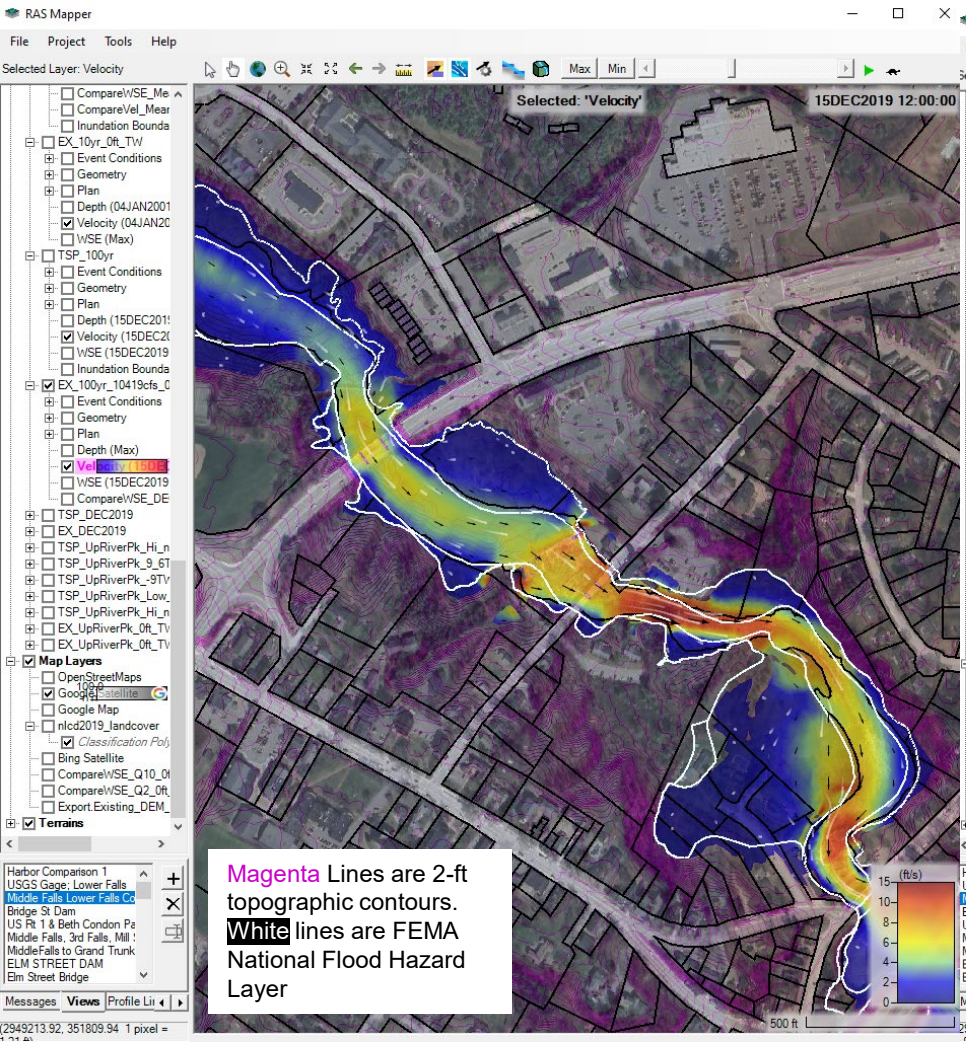
TENTATIVELY SELECTED PLAN

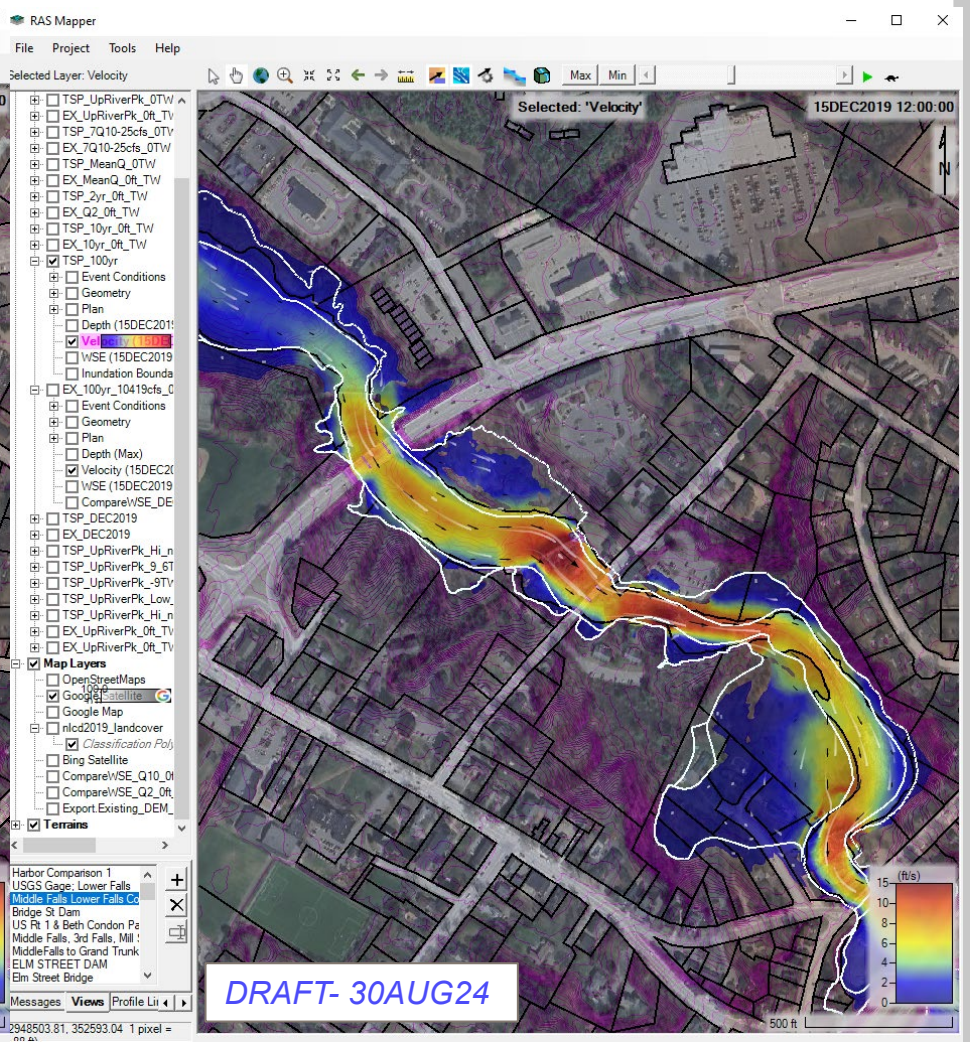


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
LOWER FALLS TO MIDDLE FALLS OVERVIEW

EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

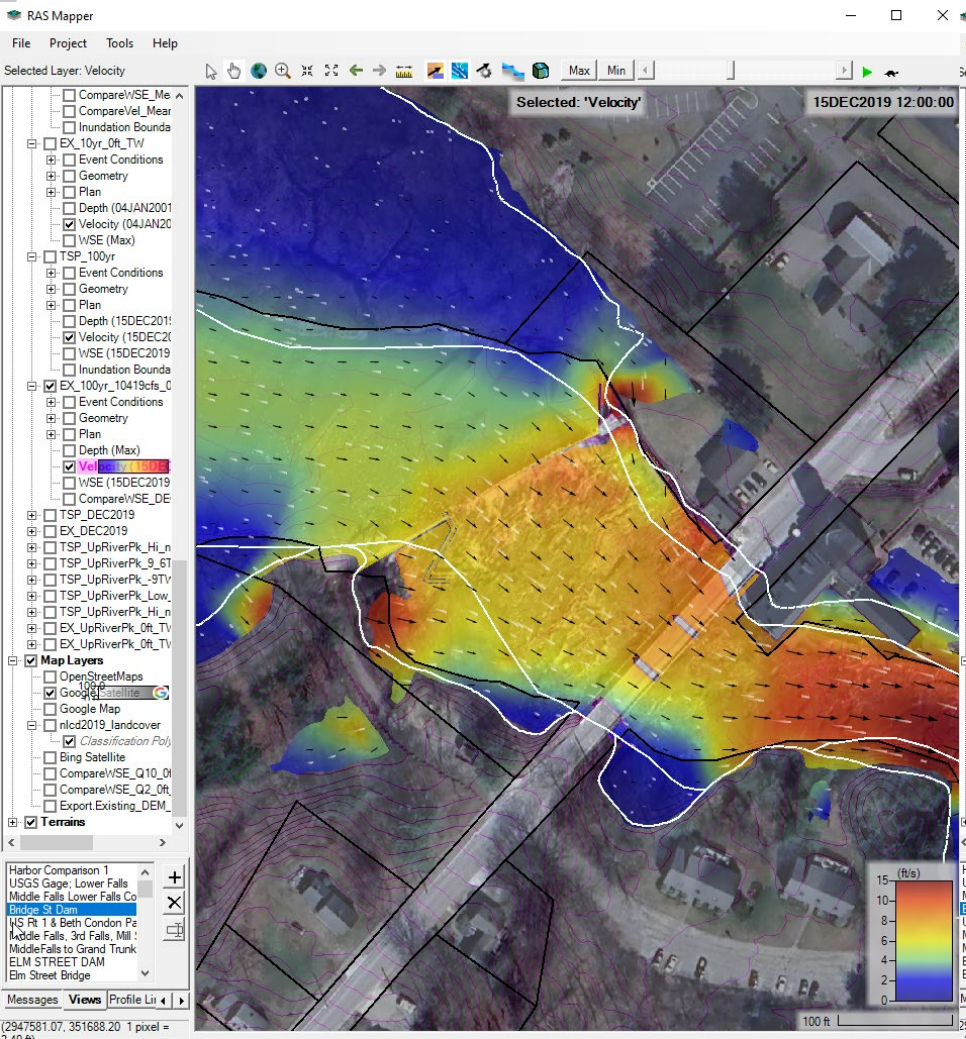


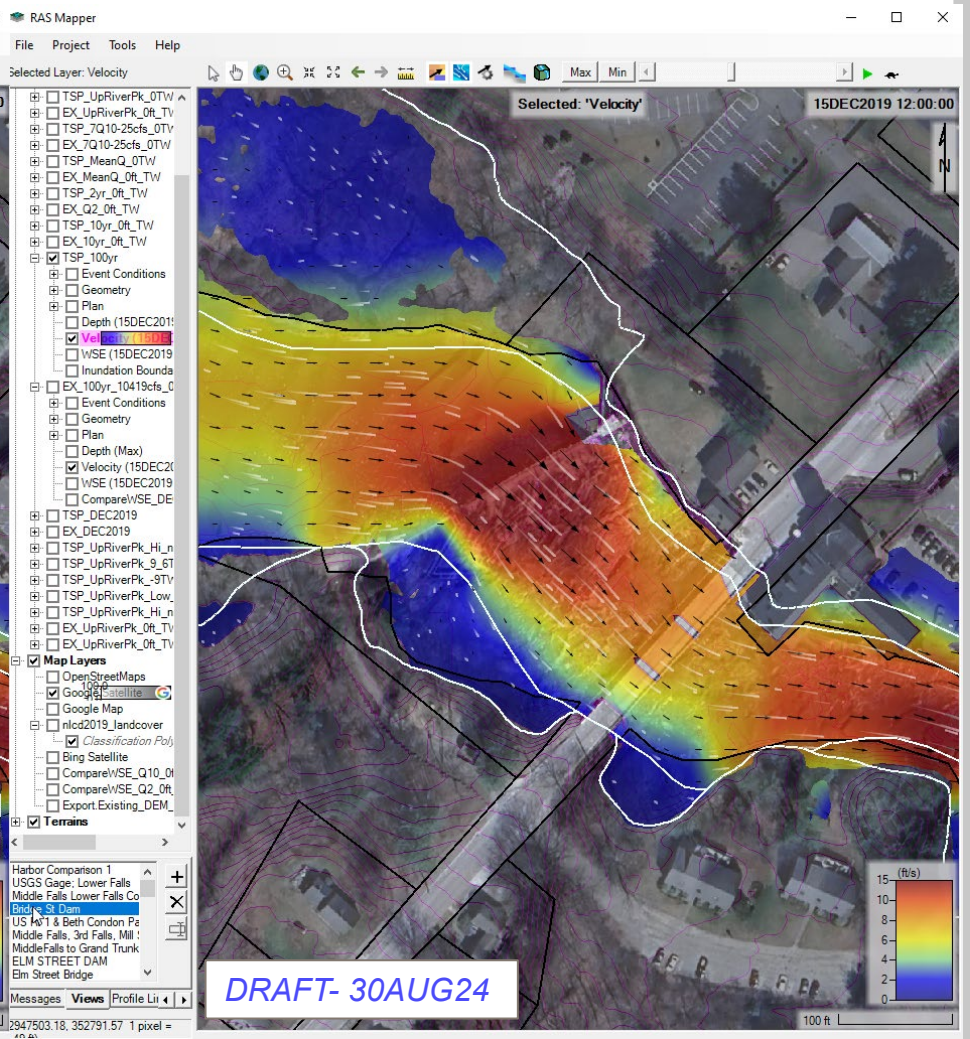


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
BRIDGE STREET DAM

EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

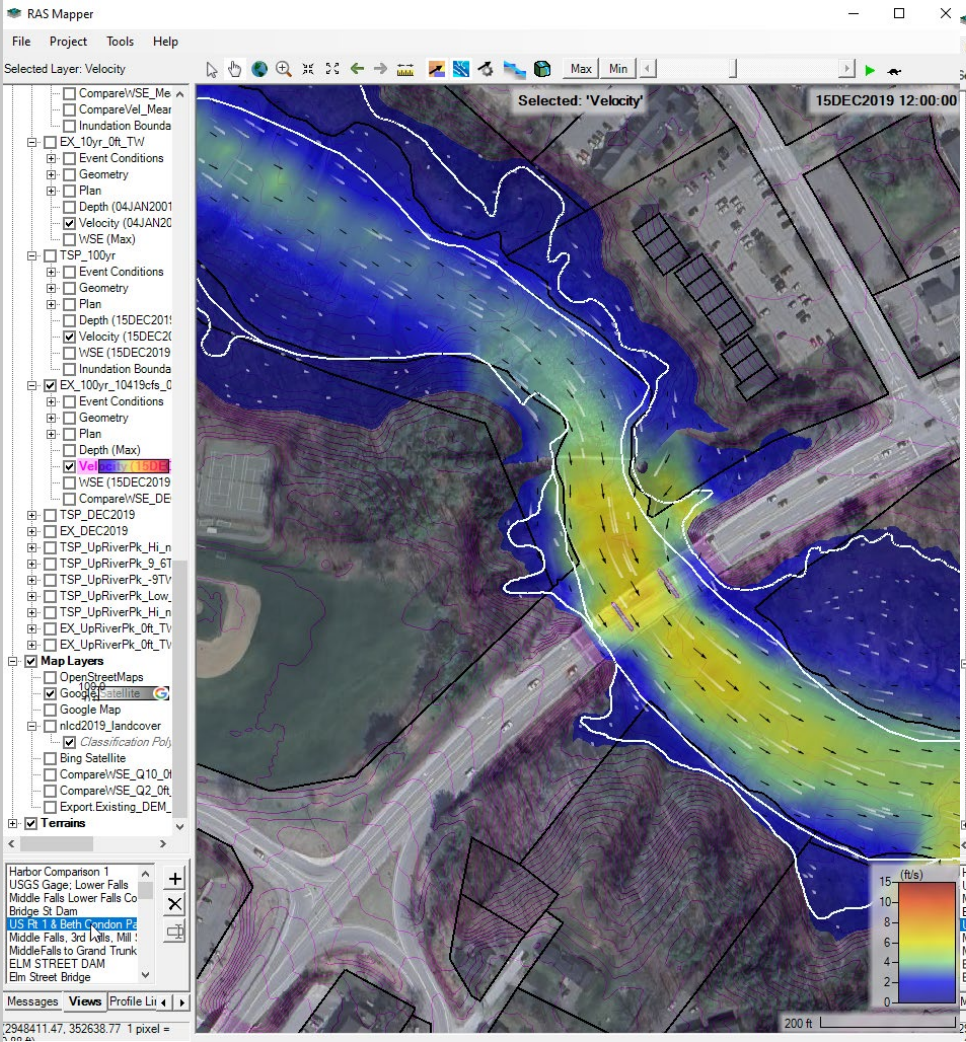


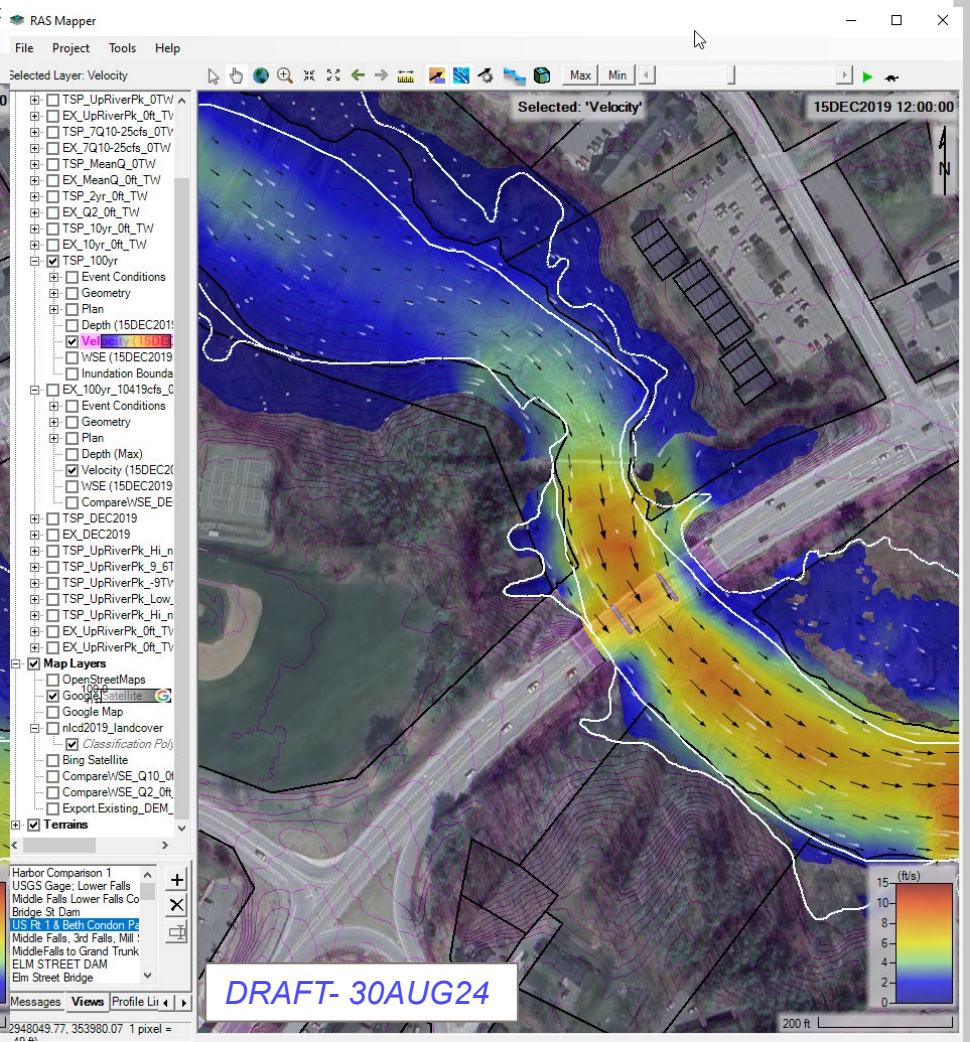


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
US ROUTE 1 & BETH CONDON FOOTBRIDGE

EXISTING CONDITIONS

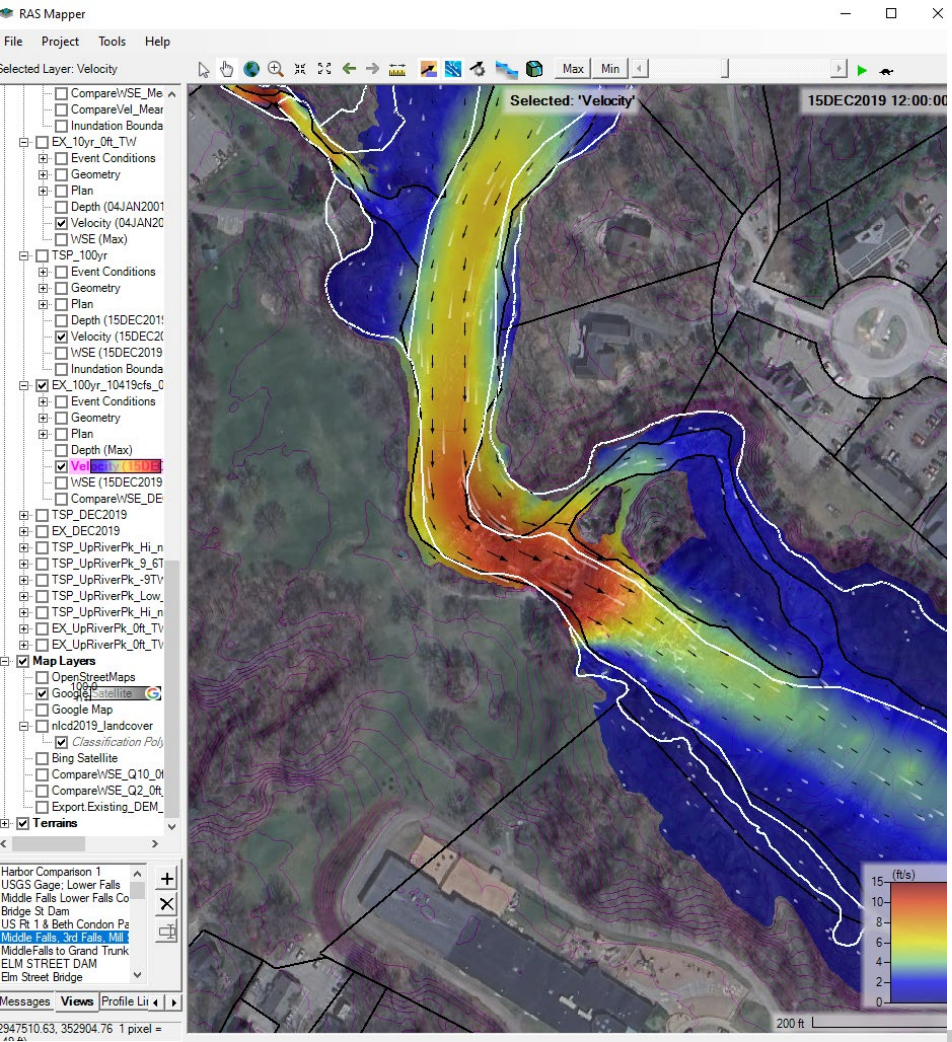
TENTATIVELY SELECTED PLAN



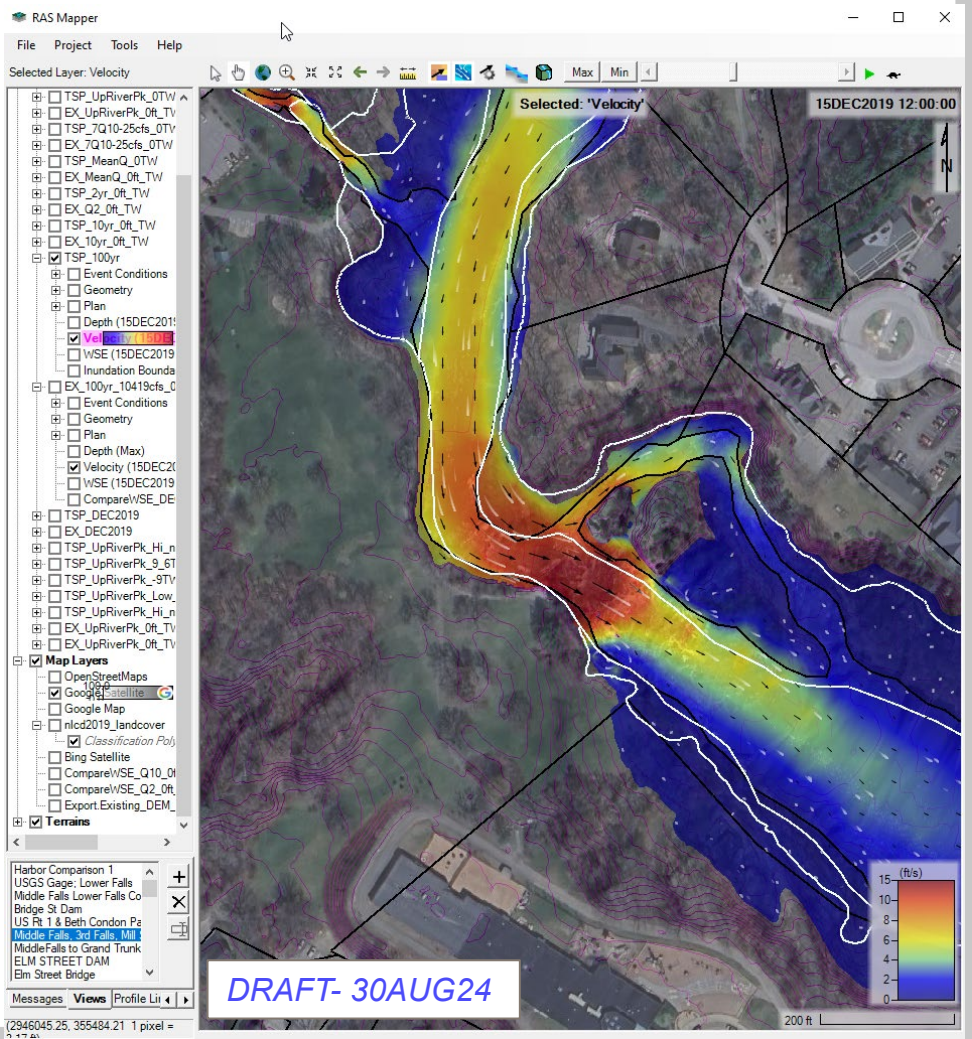


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
MIDDLE FALLS

EXISTING CONDITIONS



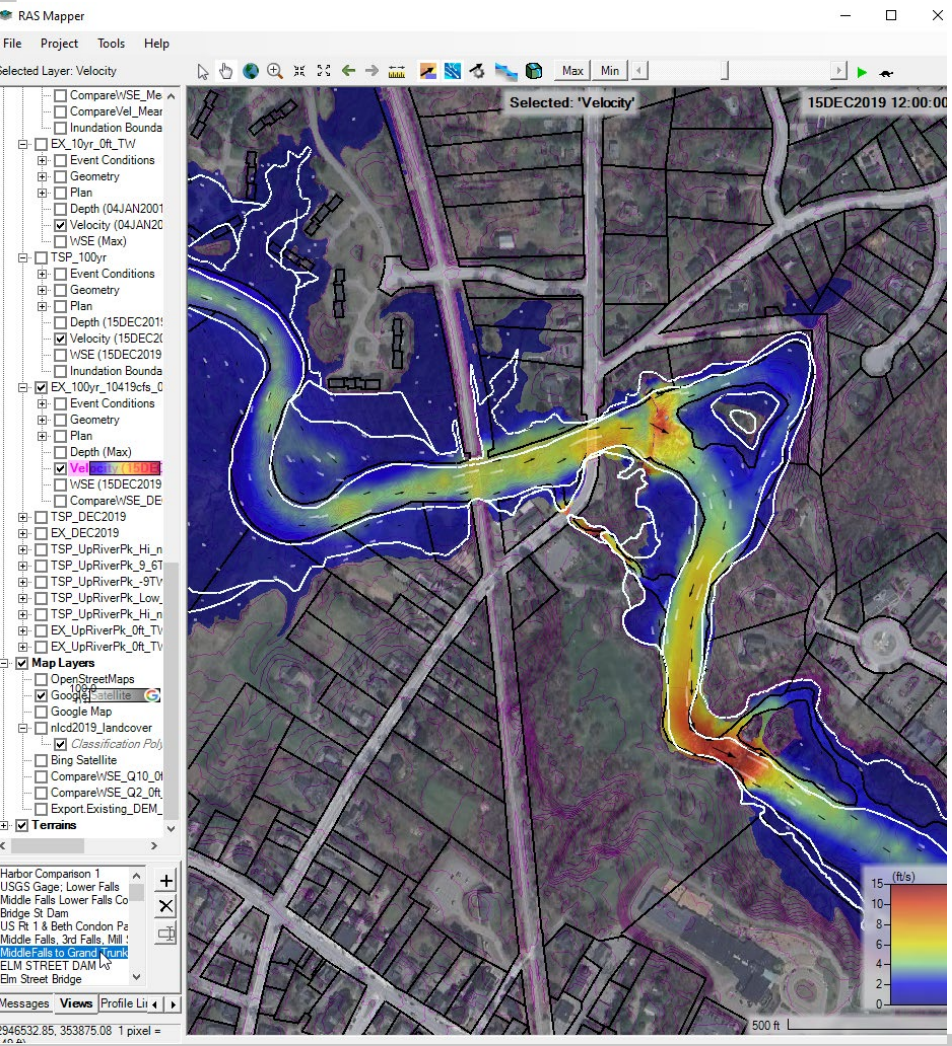
TENTATIVELY SELECTED PLAN

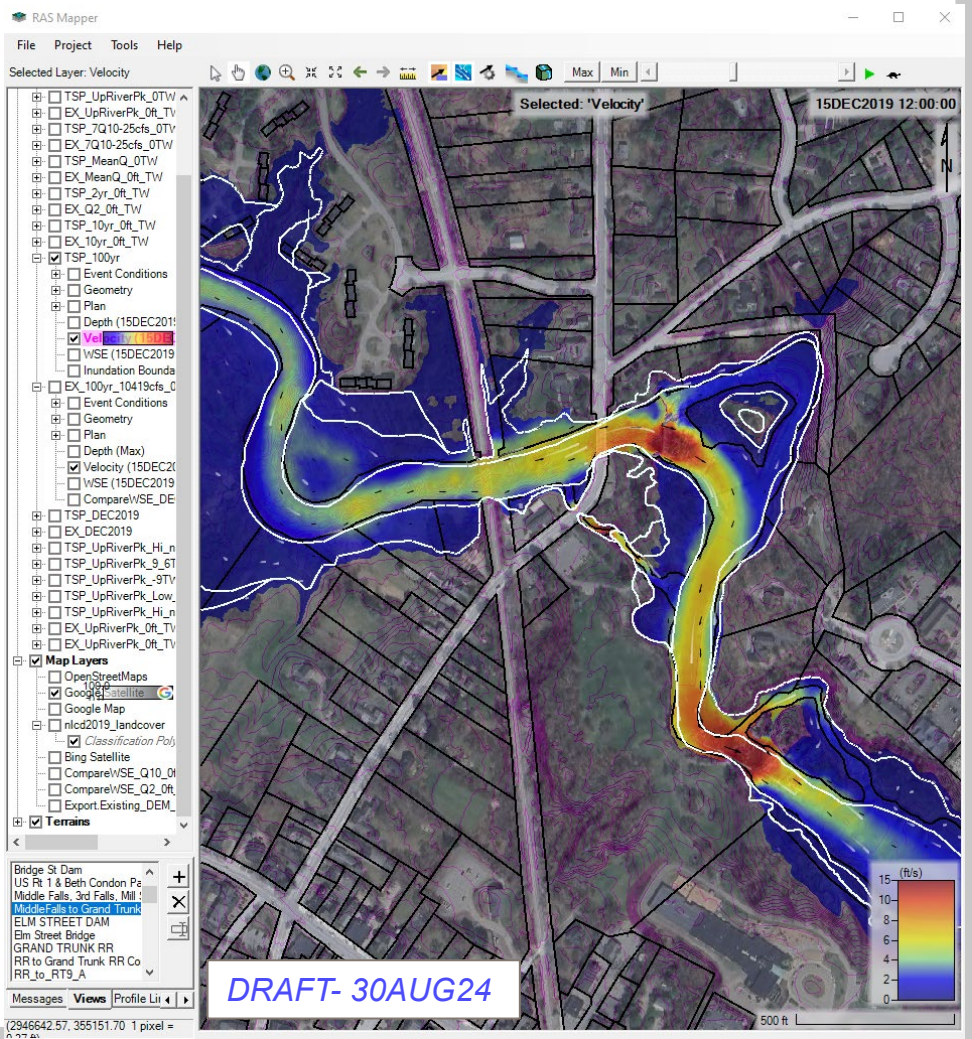


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
ELM STREET DAM OVERVIEW

EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

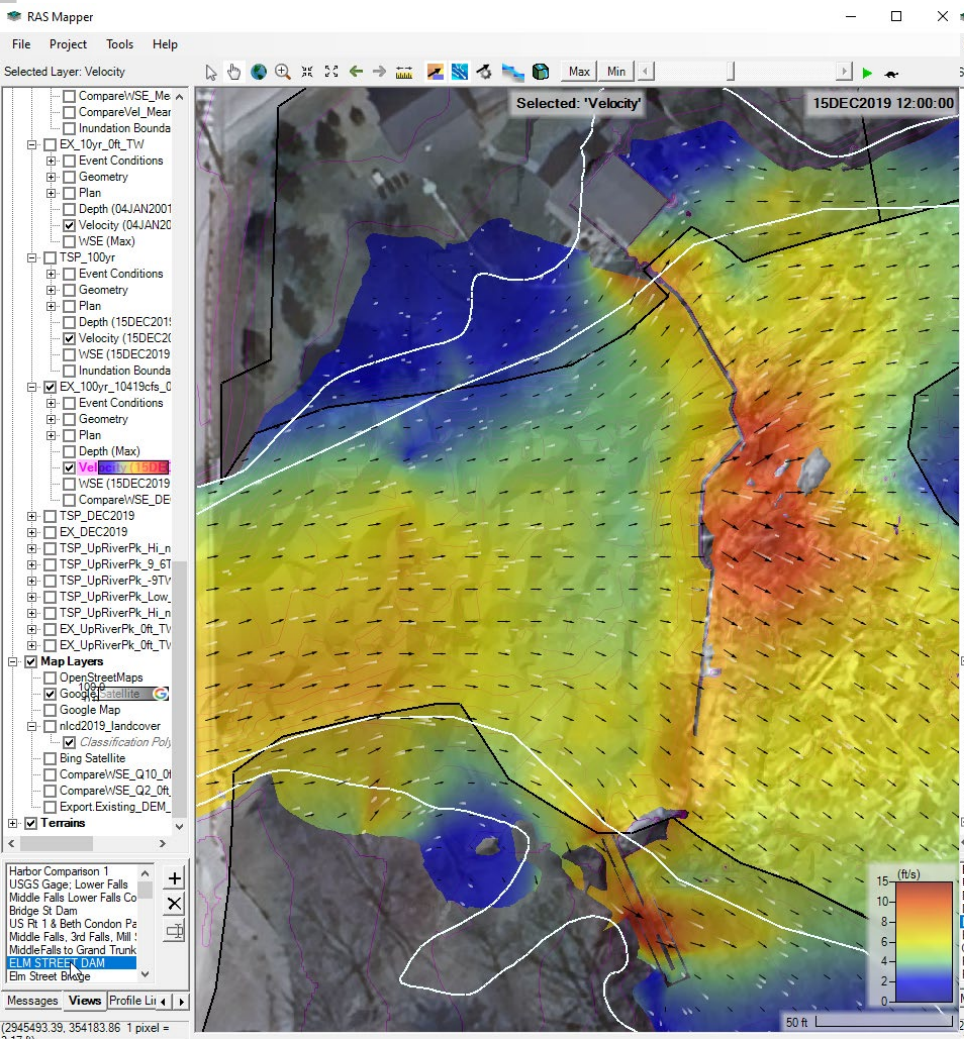


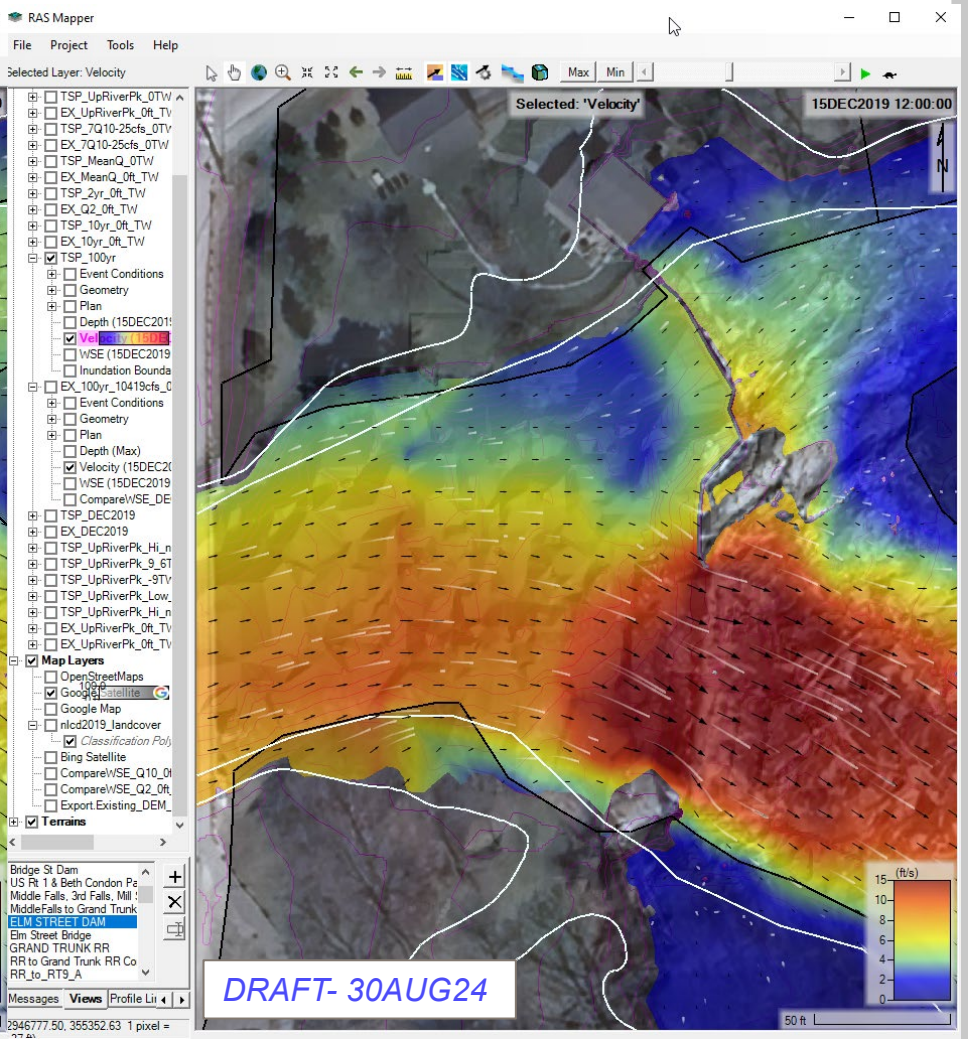


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
ELM STREET DAM

EXISTING CONDITIONS

TENTATIVELY SELECTED PLAN

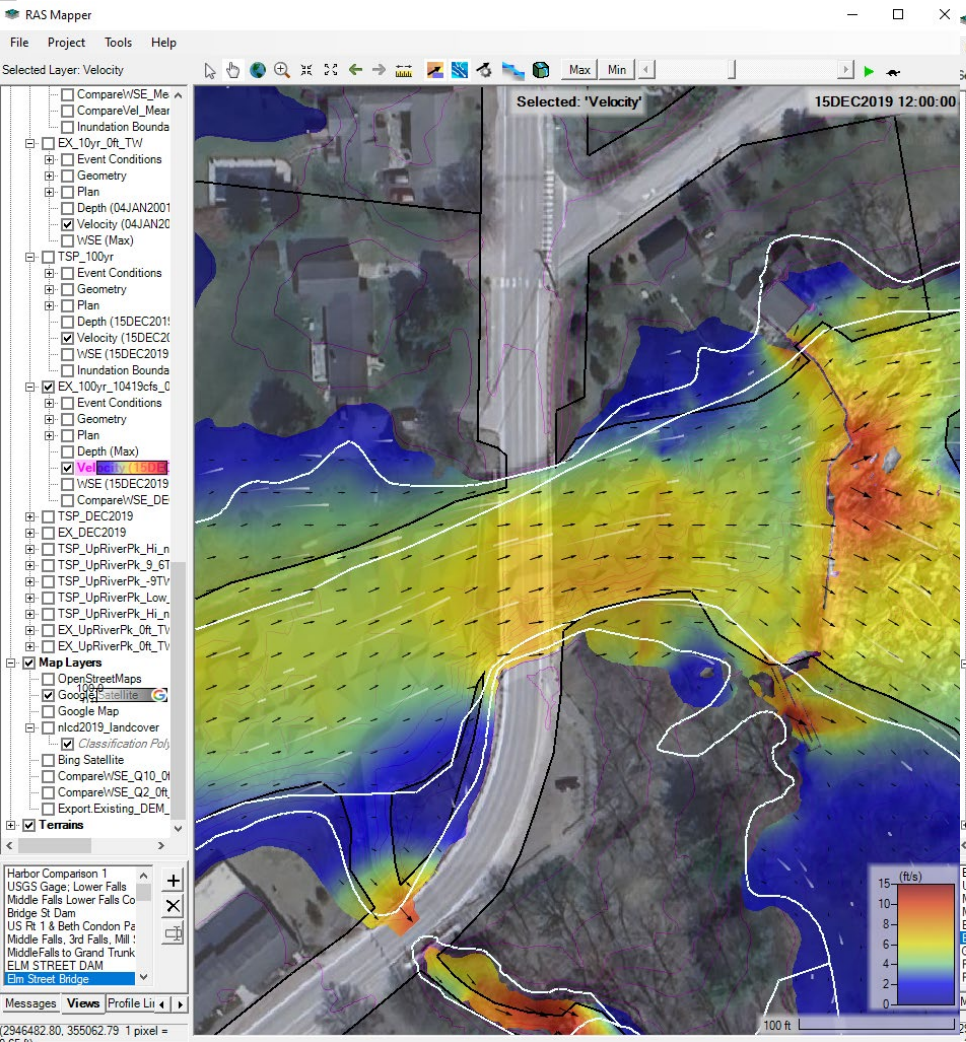


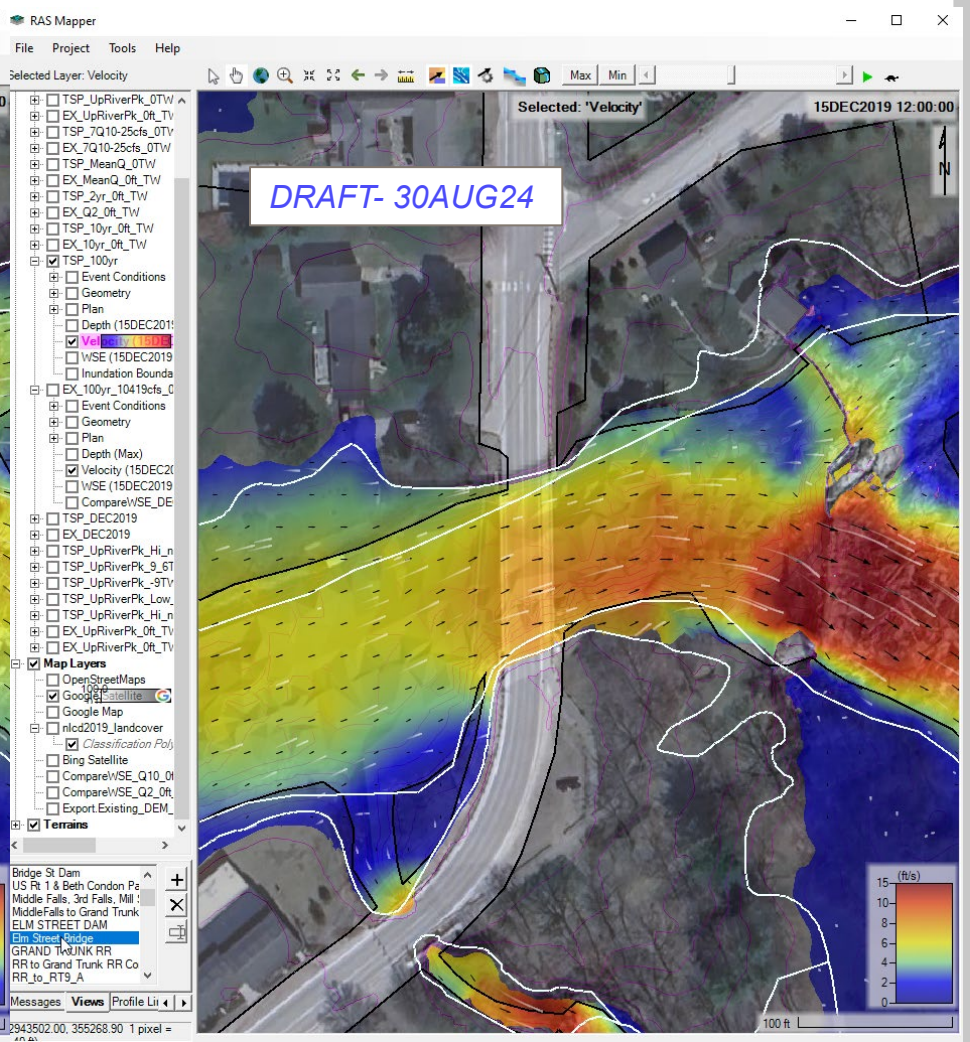


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
EAST ELM STREET

EXISTING CONDITIONS

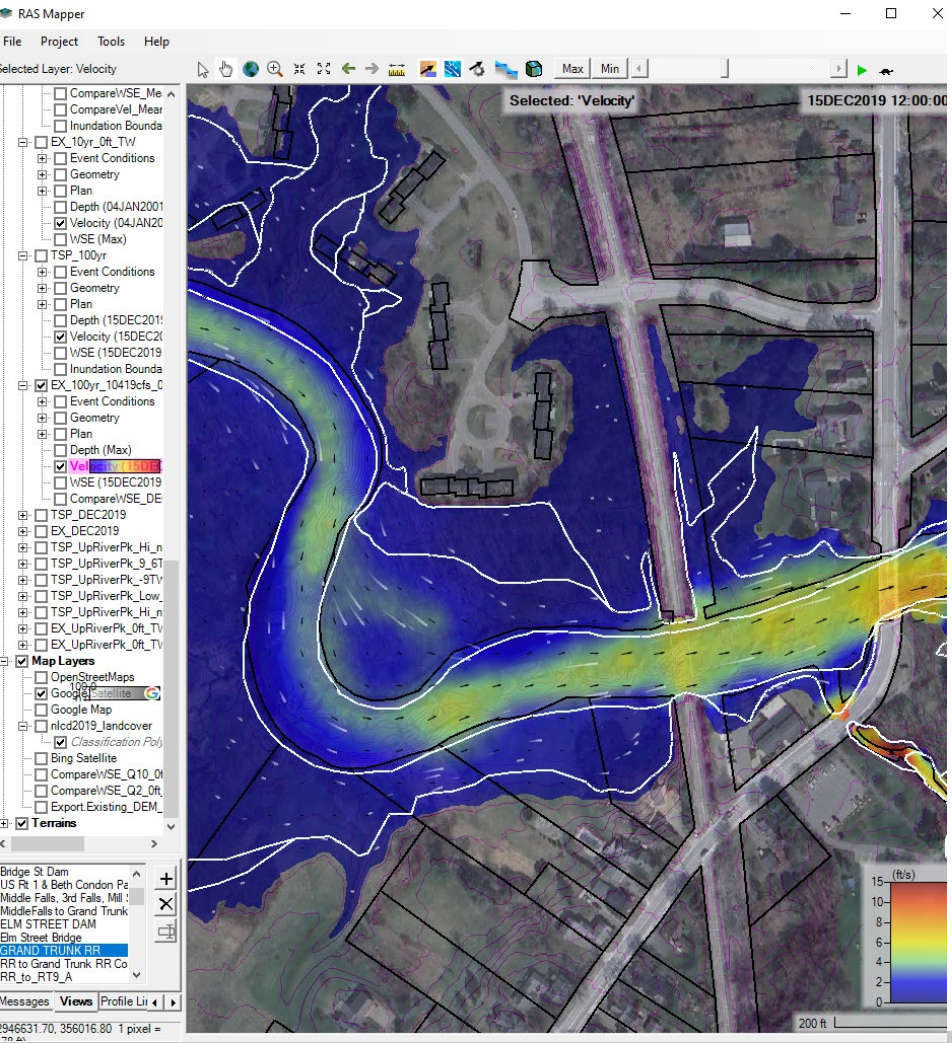
TENTATIVELY SELECTED PLAN



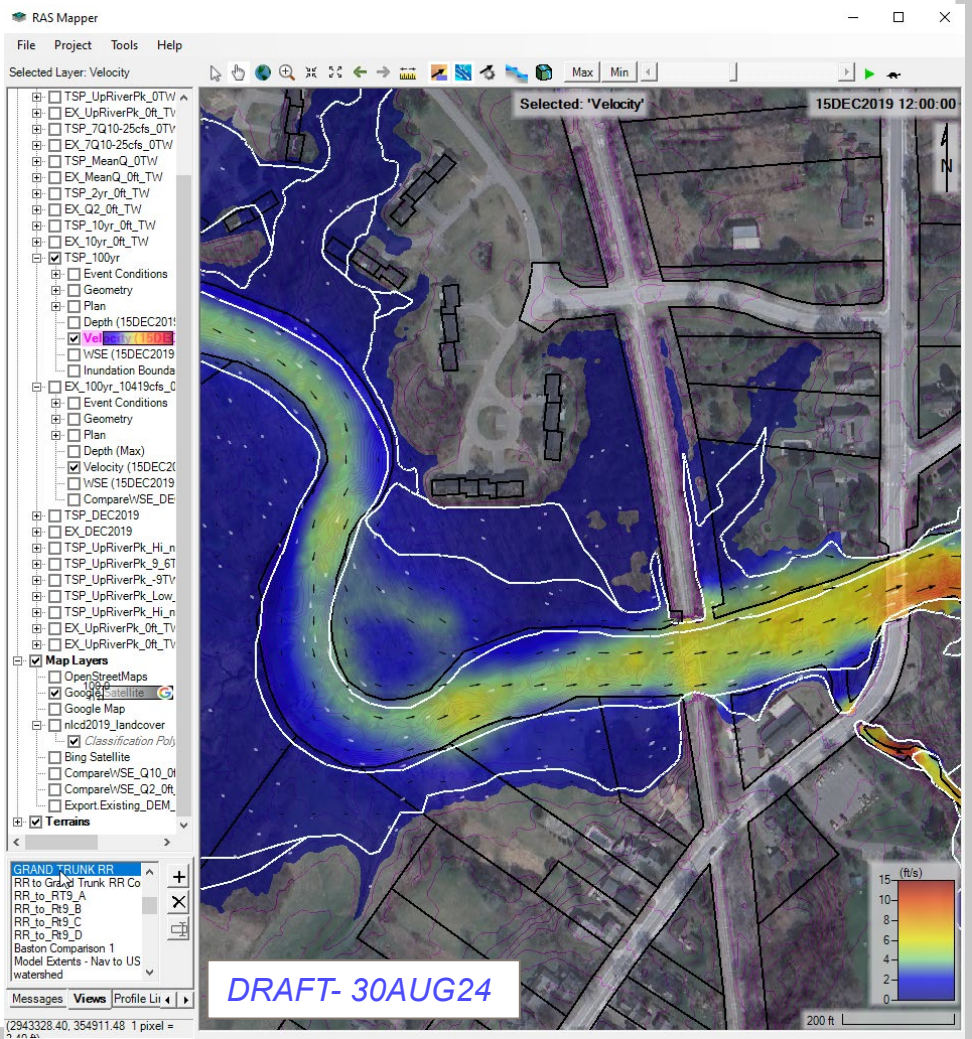


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
GRAND TRUNK RR

EXISTING CONDITIONS



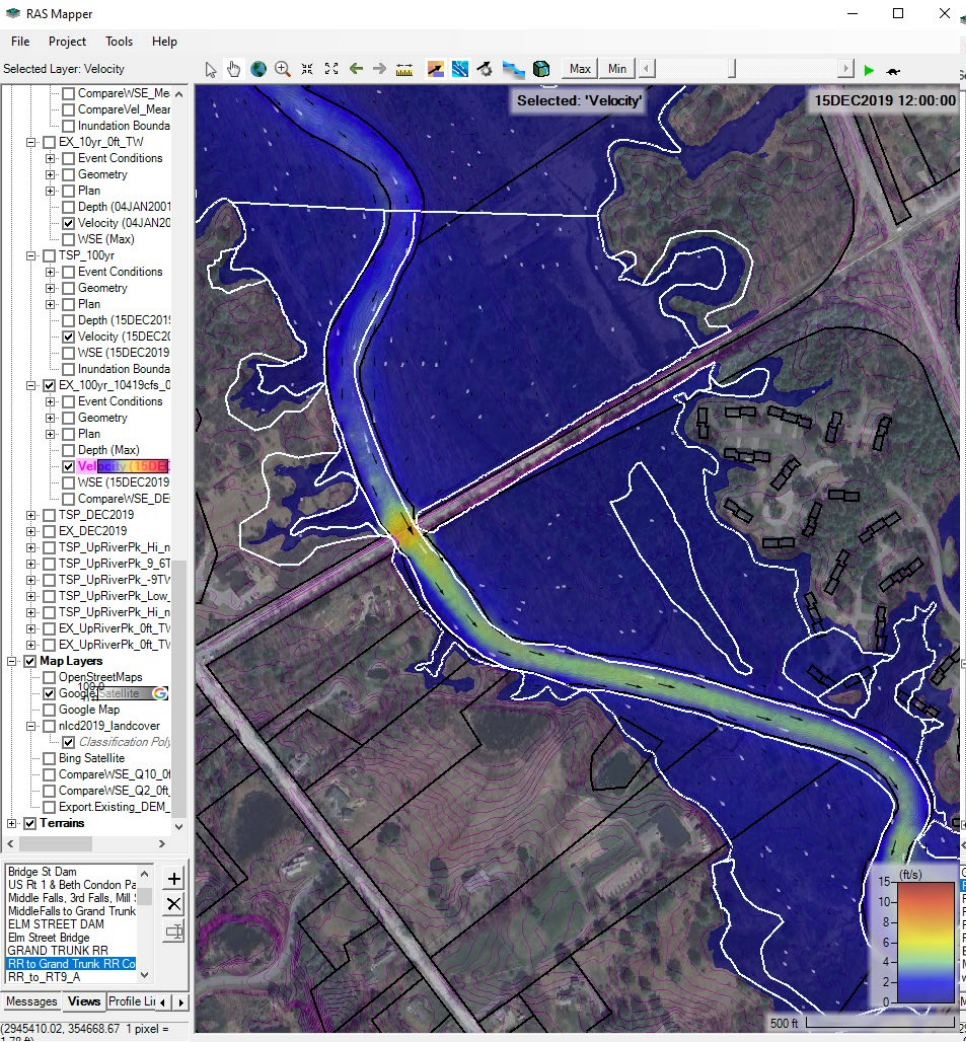
TENTATIVELY SELECTED PLAN

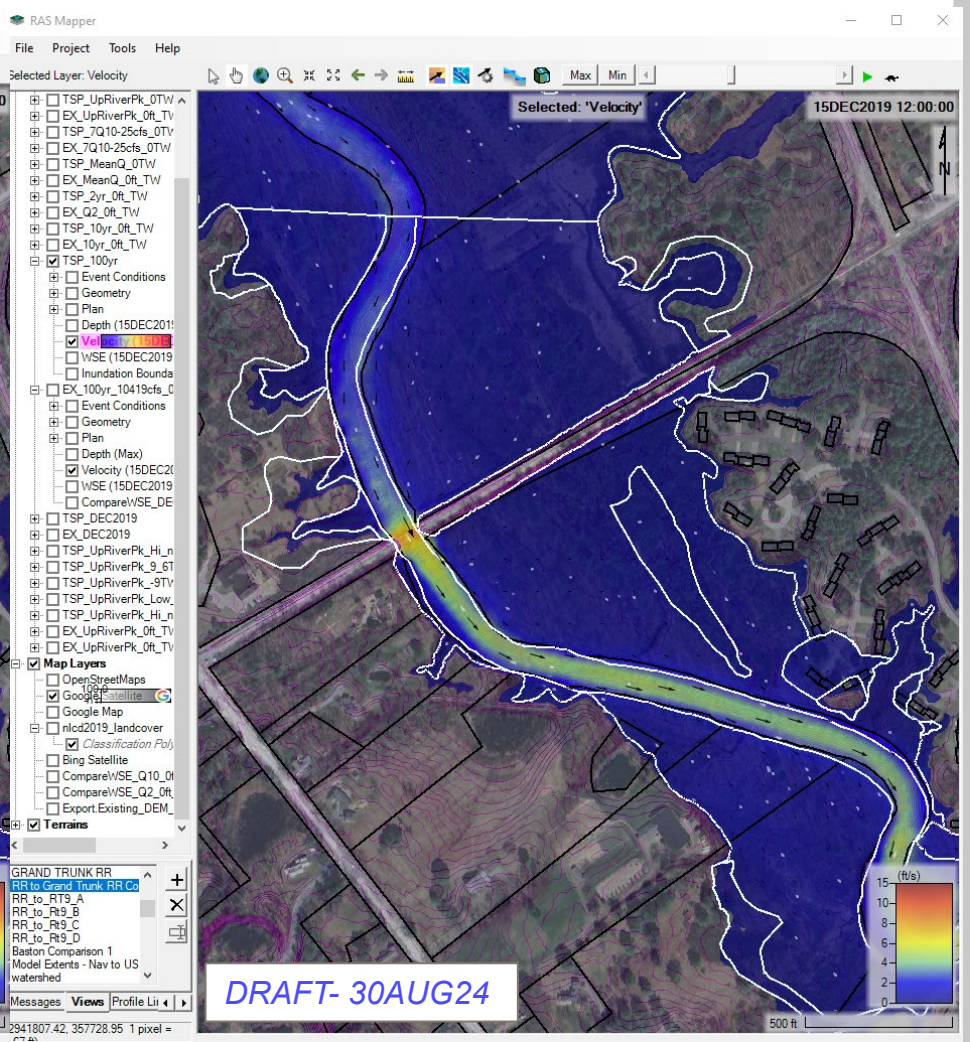


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
MAINE CENTRAL RR

EXISTING CONDITIONS

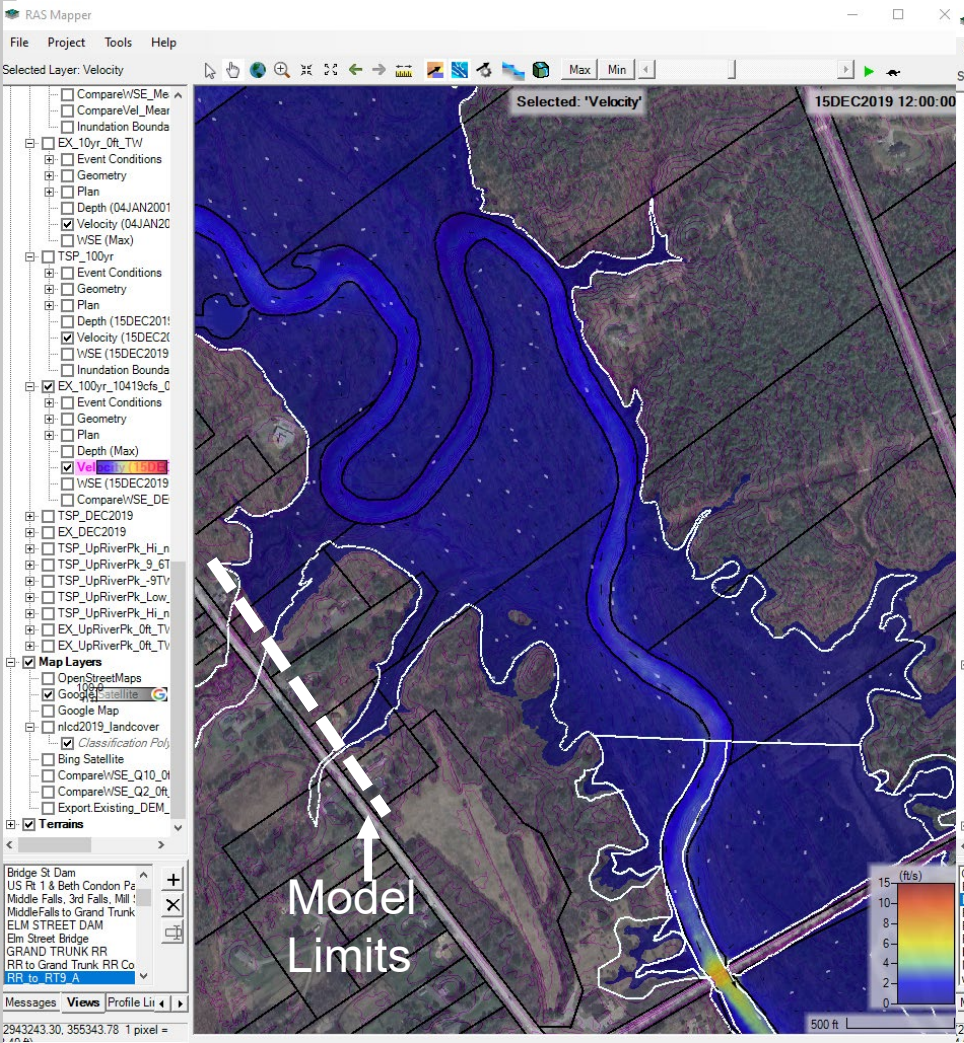
TENTATIVELY SELECTED PLAN



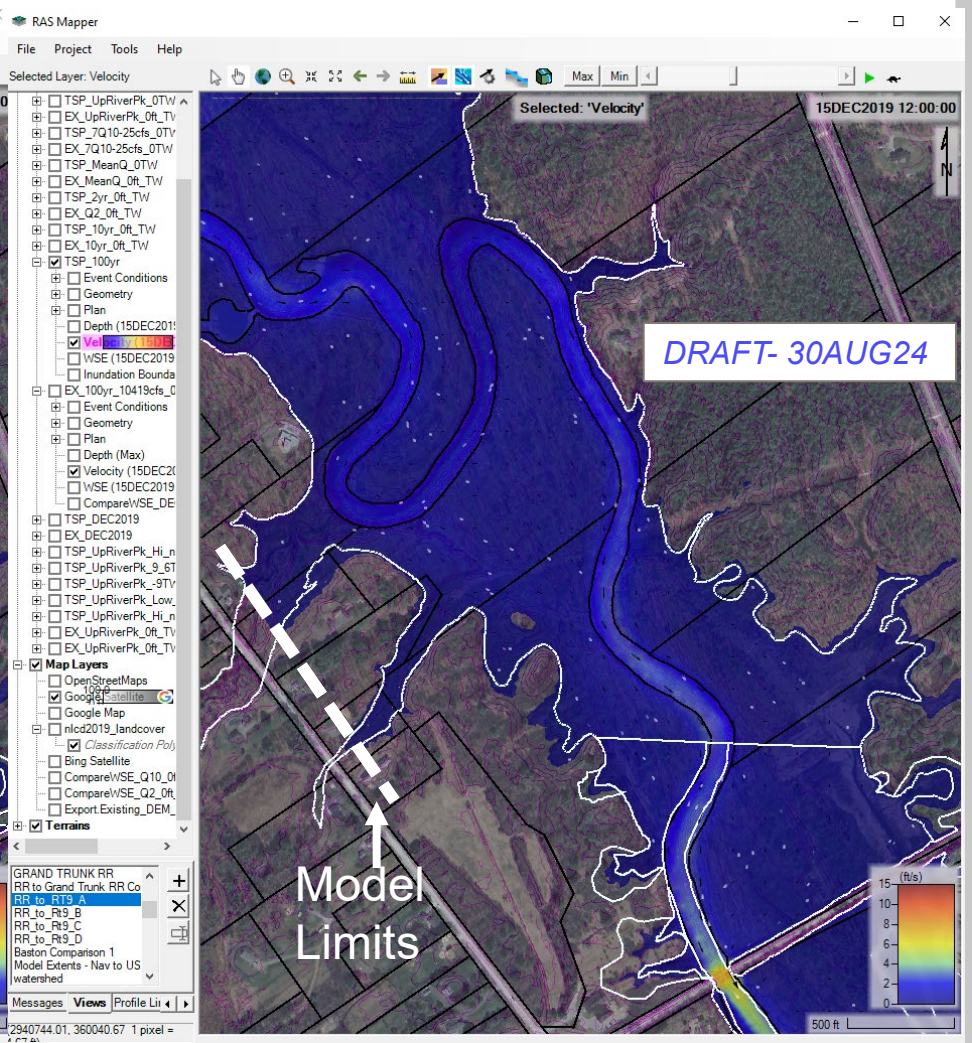


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
UPSTREAM OF MAINE CENTRAL RR (1)

EXISTING CONDITIONS

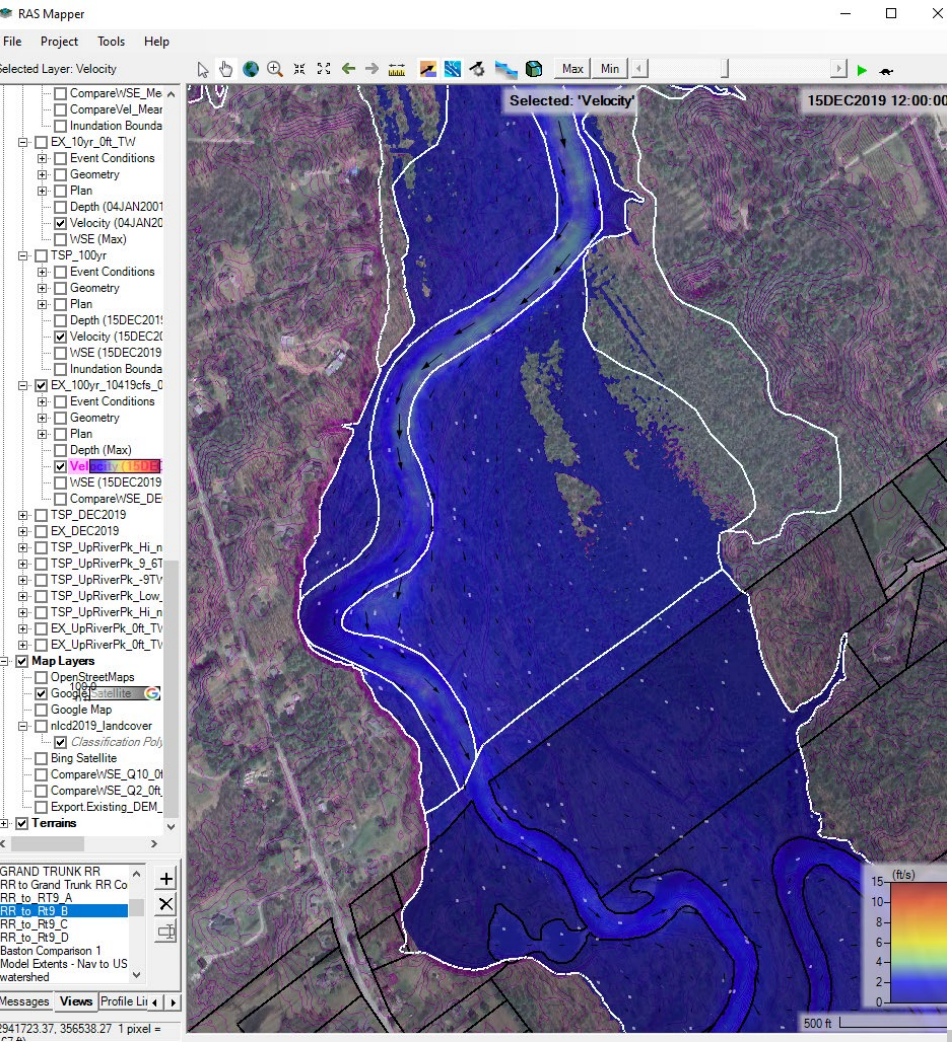


TENTATIVELY SELECTED PLAN



VELOCITY/INUNDATION COMPARISON – 100-YR STORM
UPSTREAM OF MAINE CENTRAL RR (2)

EXISTING CONDITIONS



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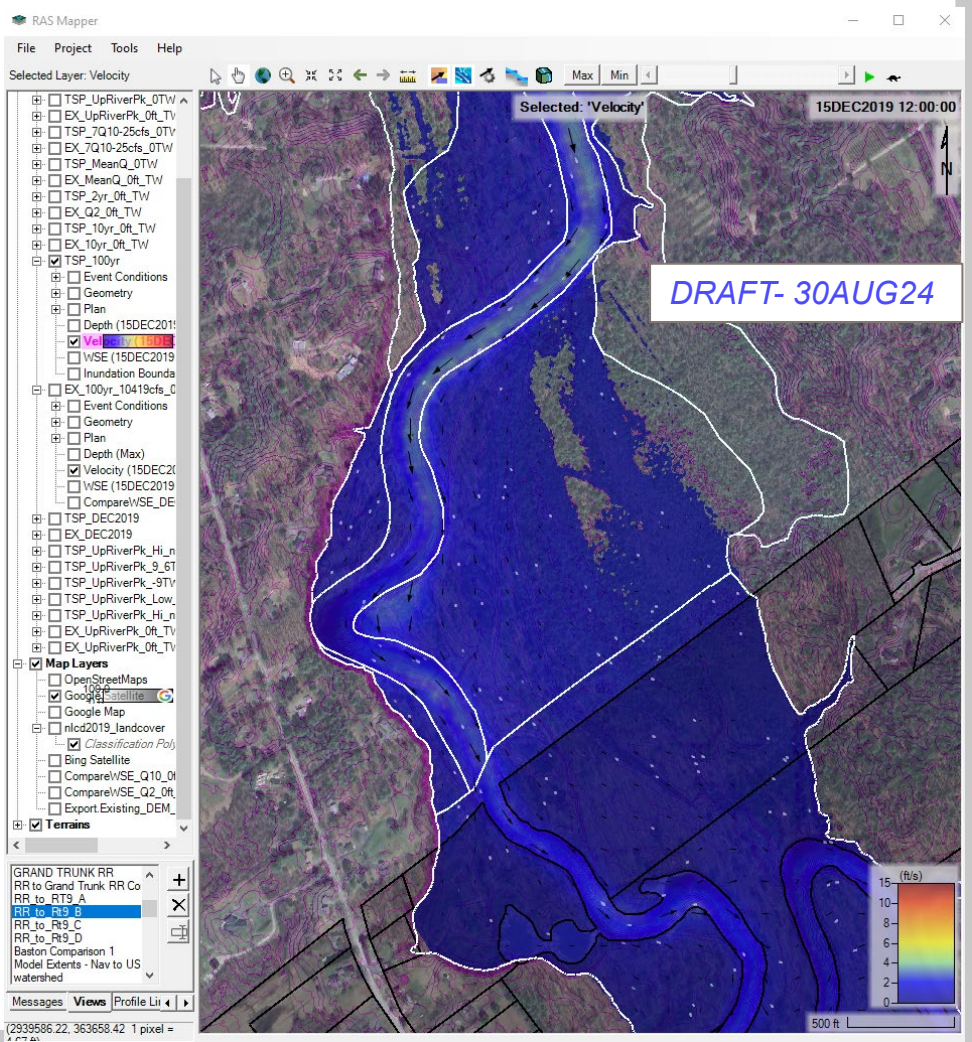
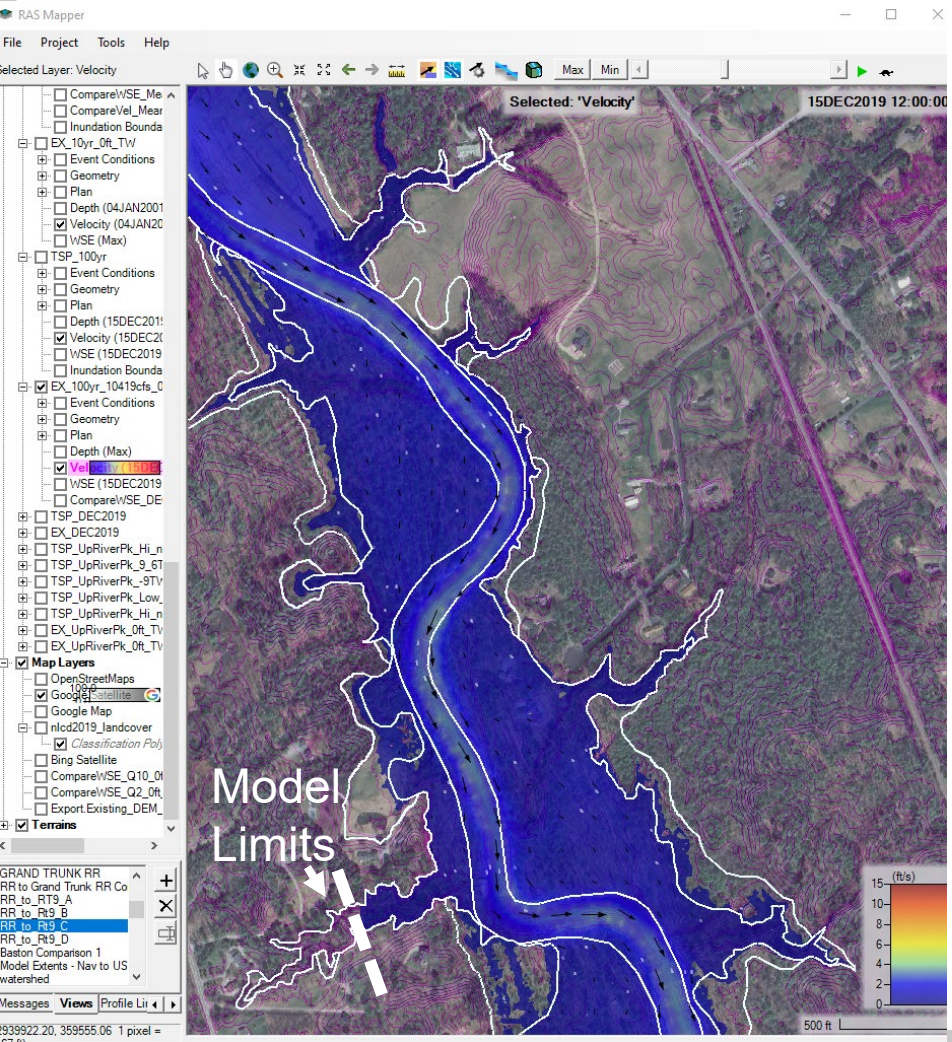


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
UPSTREAM OF MAINE CENTRAL RR (3)

EXISTING CONDITIONS



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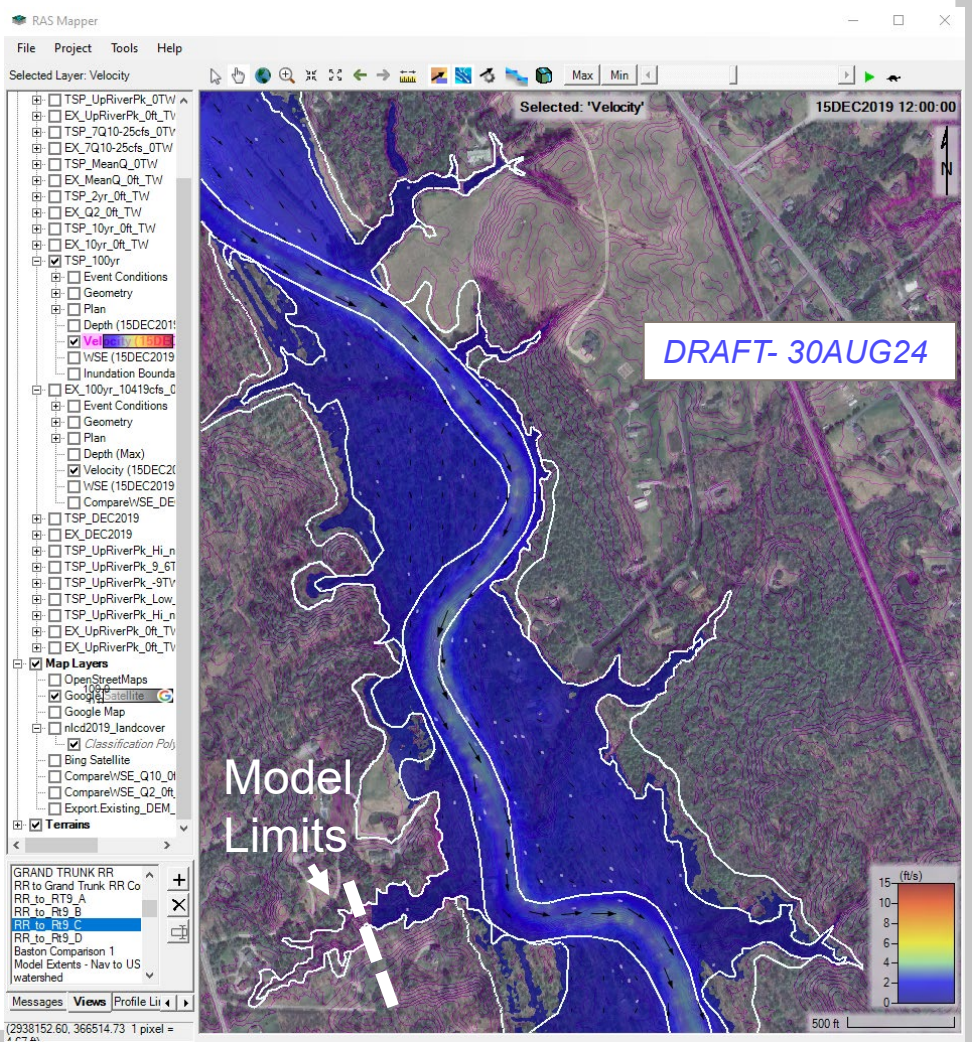
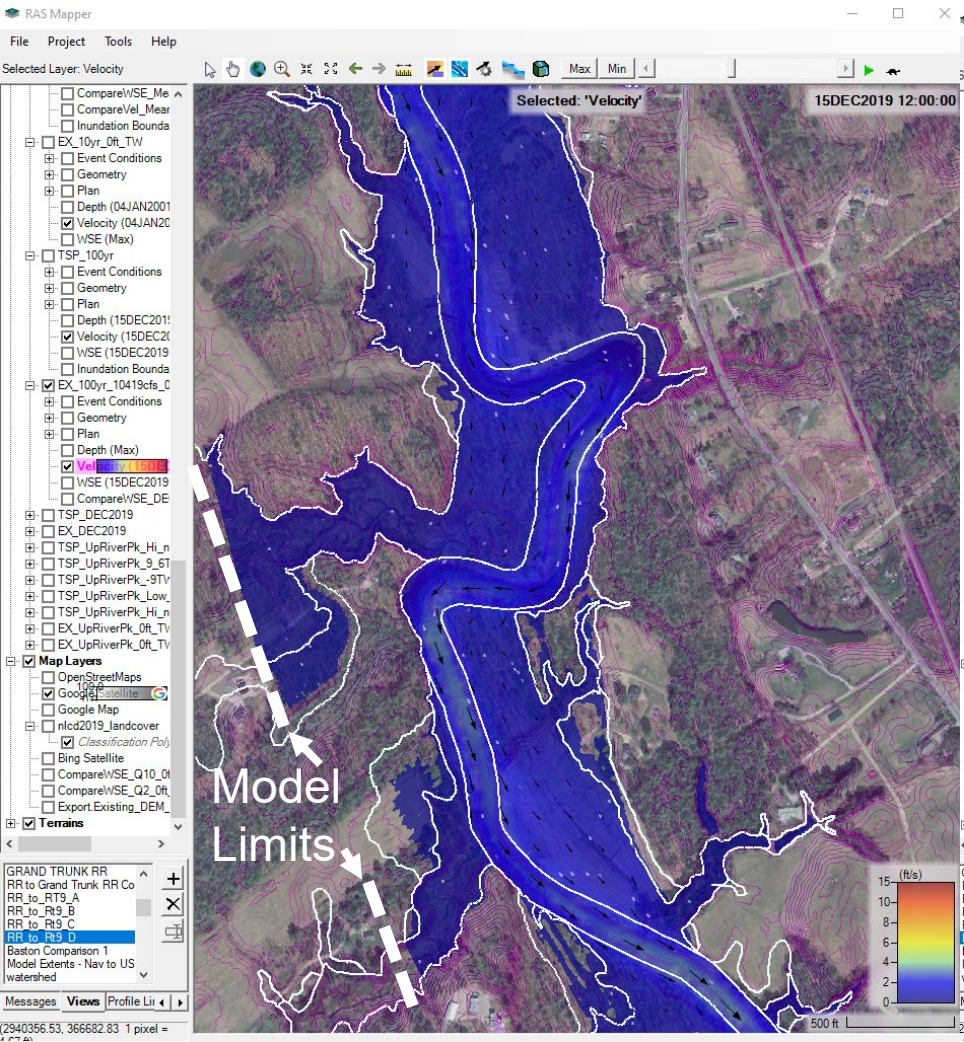


VELOCITY/INUNDATION COMPARISON – 100-YR STORM NEAR TODDY BROOK

EXISTING CONDITIONS



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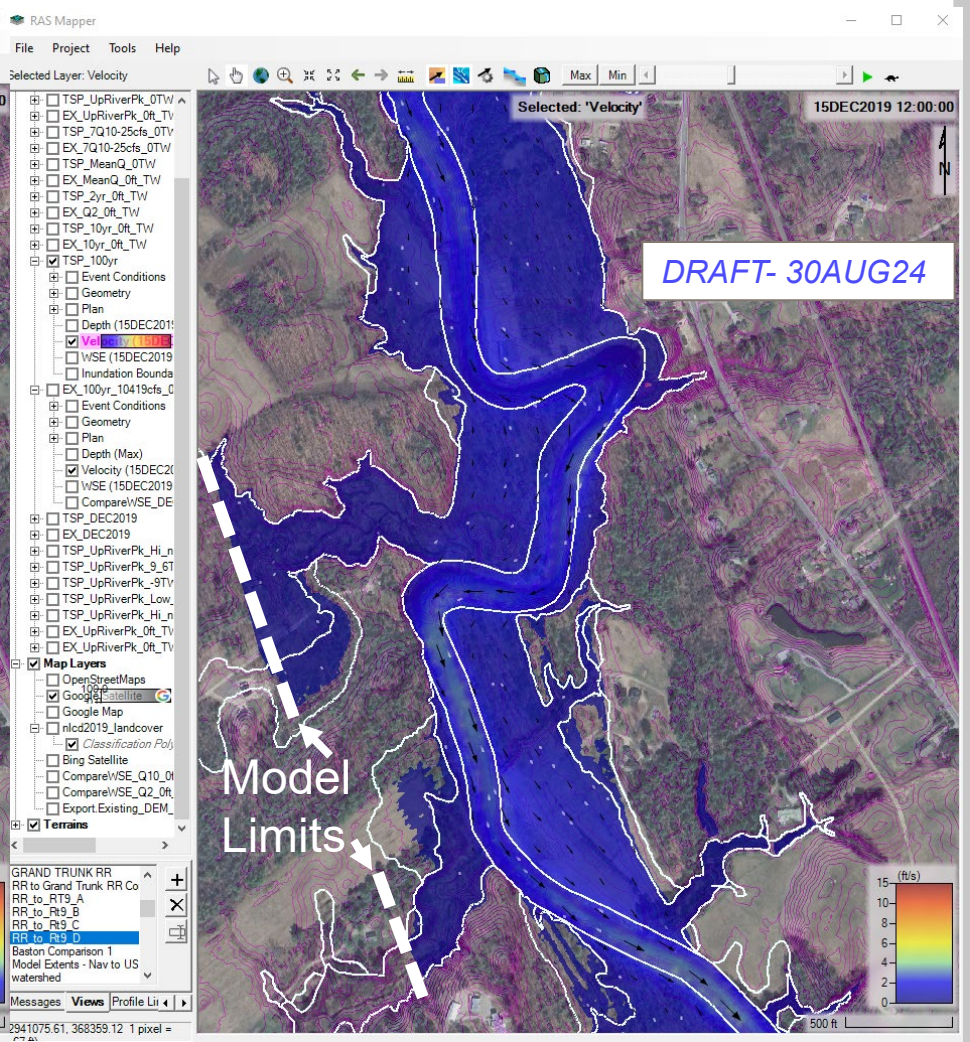
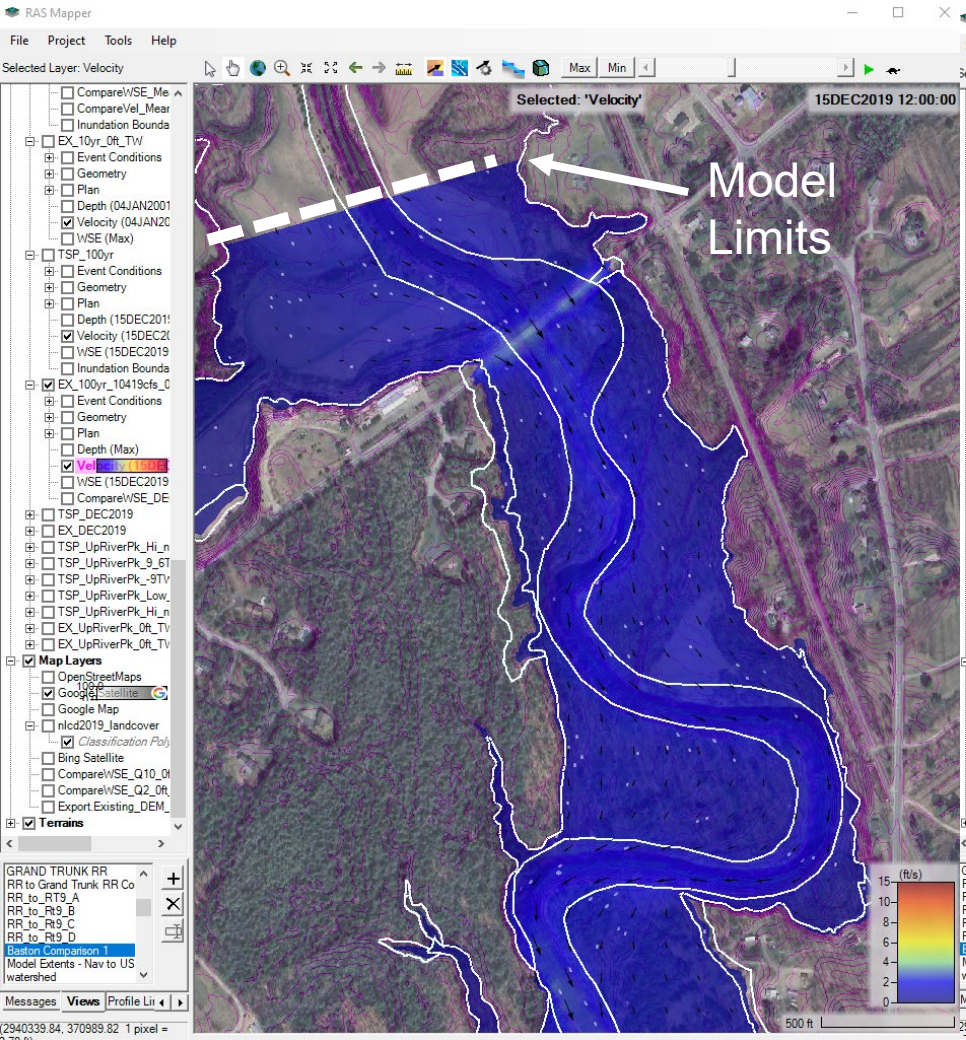
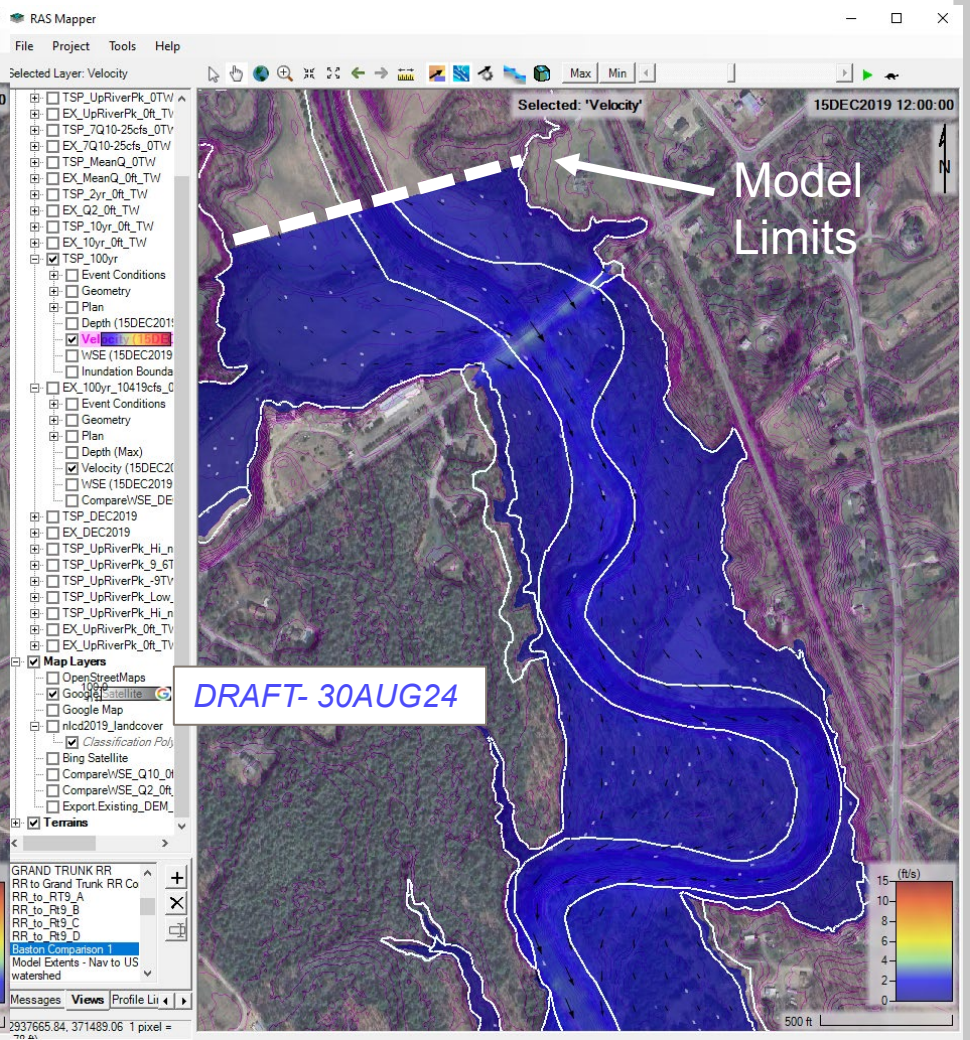


VELOCITY/INUNDATION COMPARISON – 100-YR STORM
BASTON PARK / US ROUTE 9

EXISTING CONDITIONS

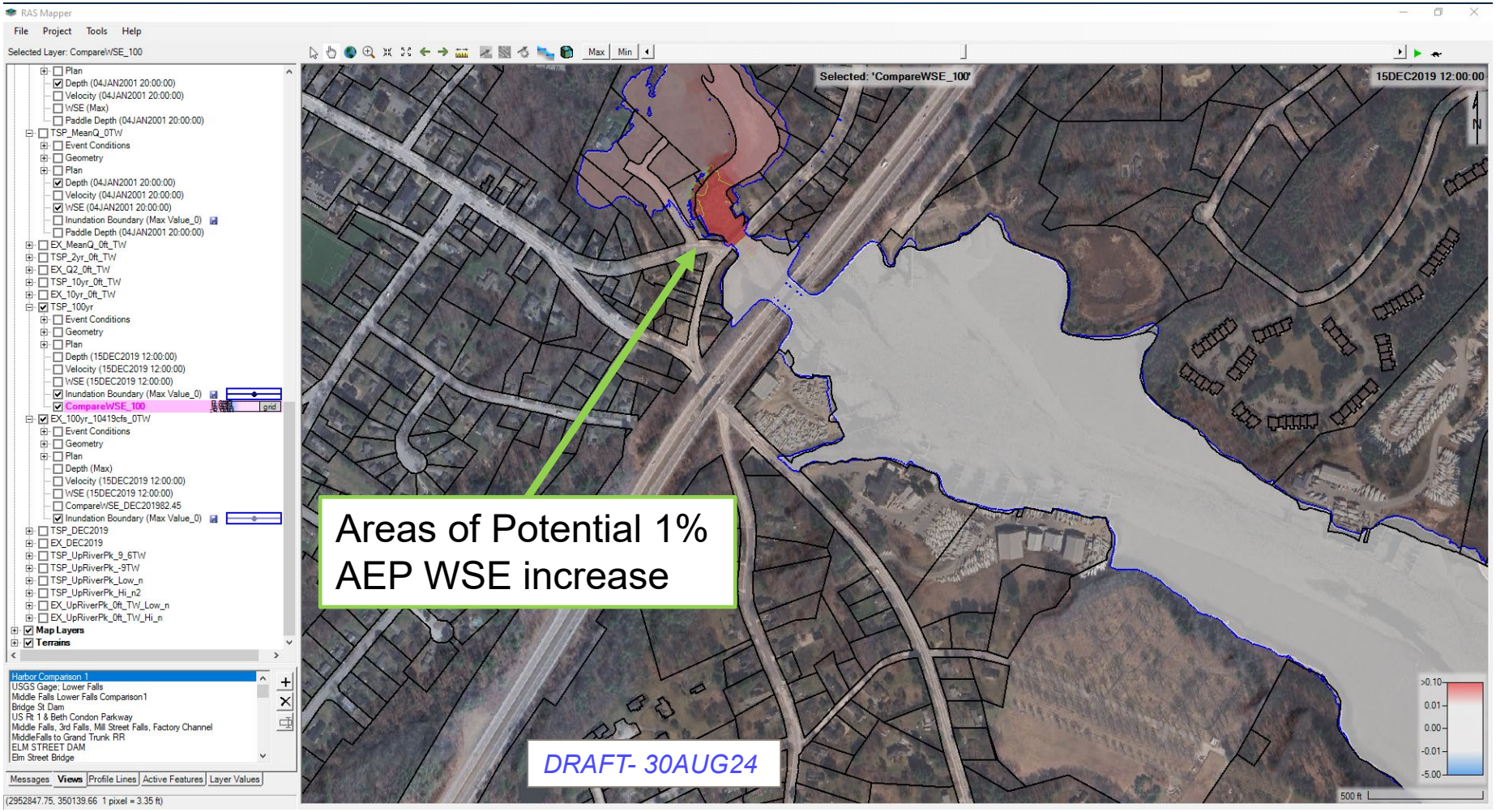
TENTATIVELY SELECTED PLAN





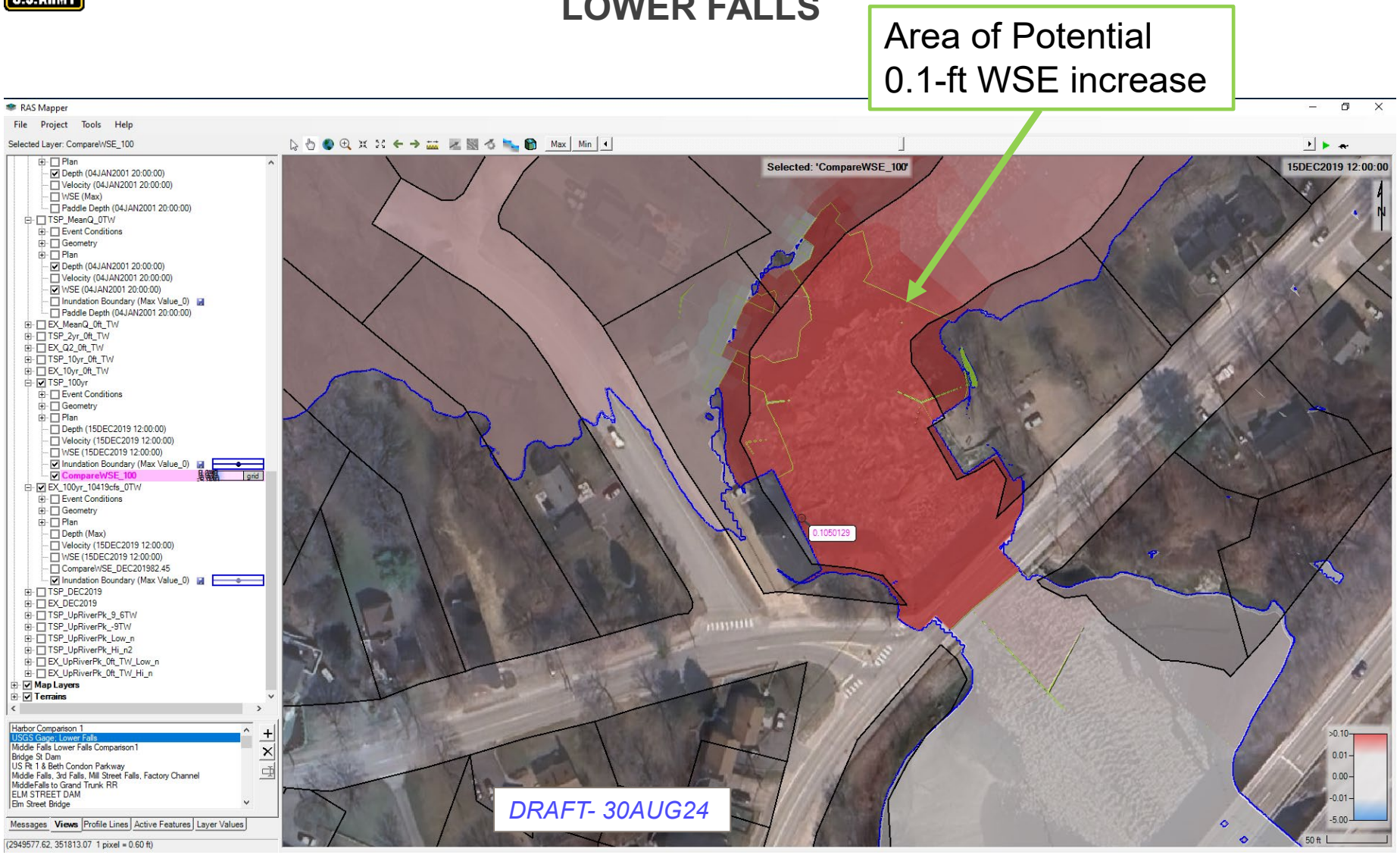
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

HARBOR TO LOWER FALLS OVERVIEW



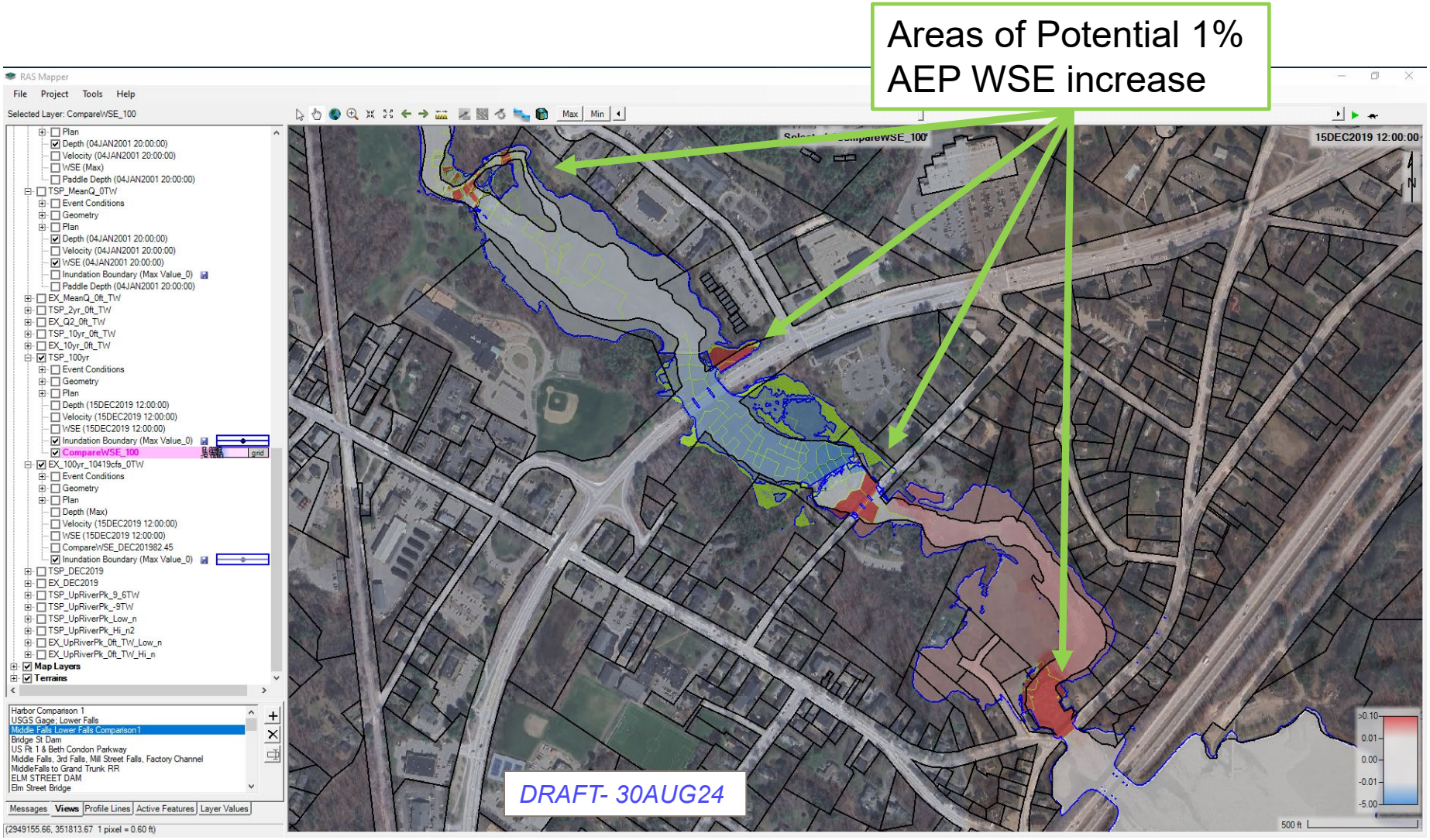
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

LOWER FALLS

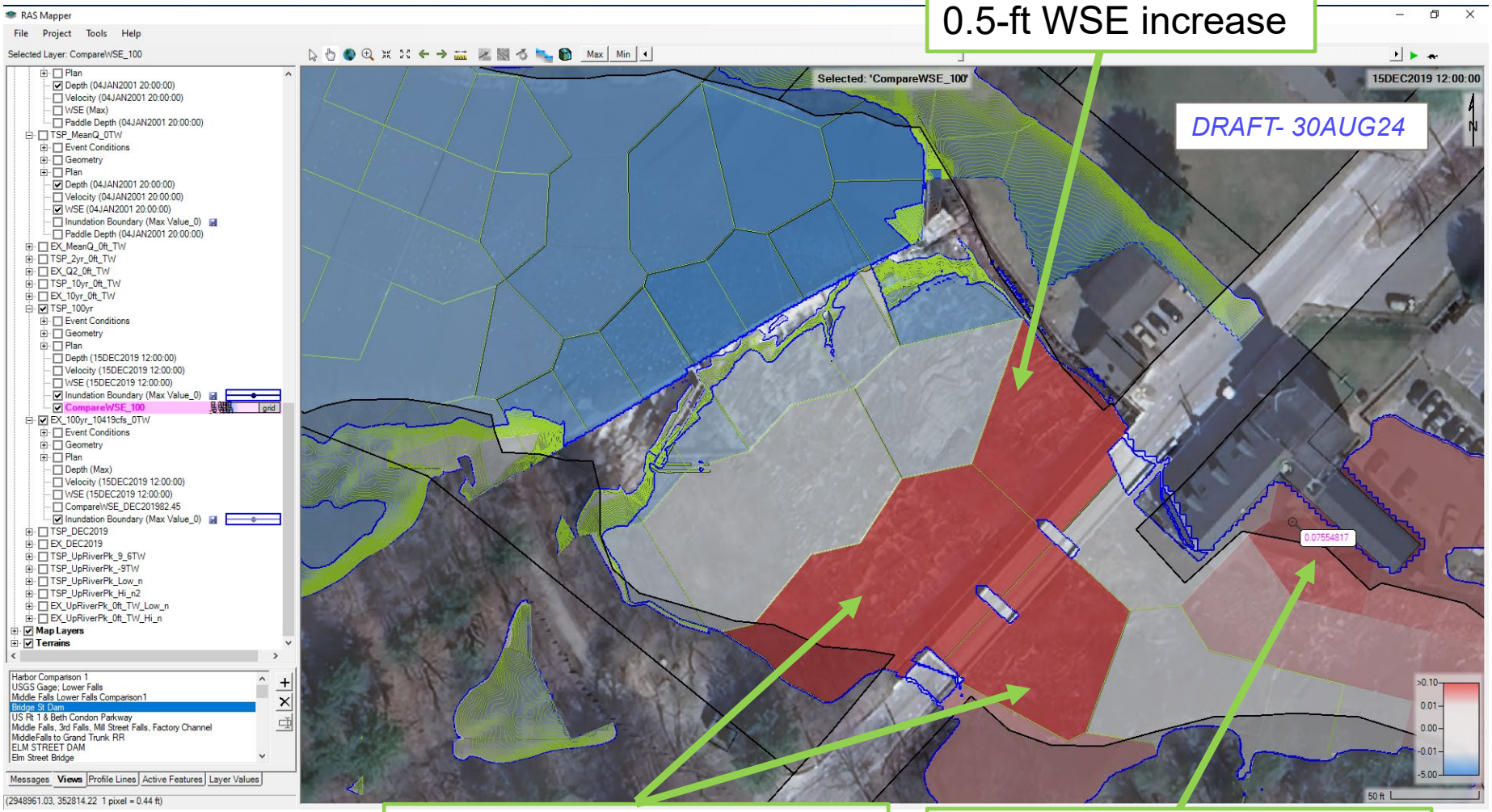


POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

LOWER FALLS TO MIDDLE FALLS OVERVIEW

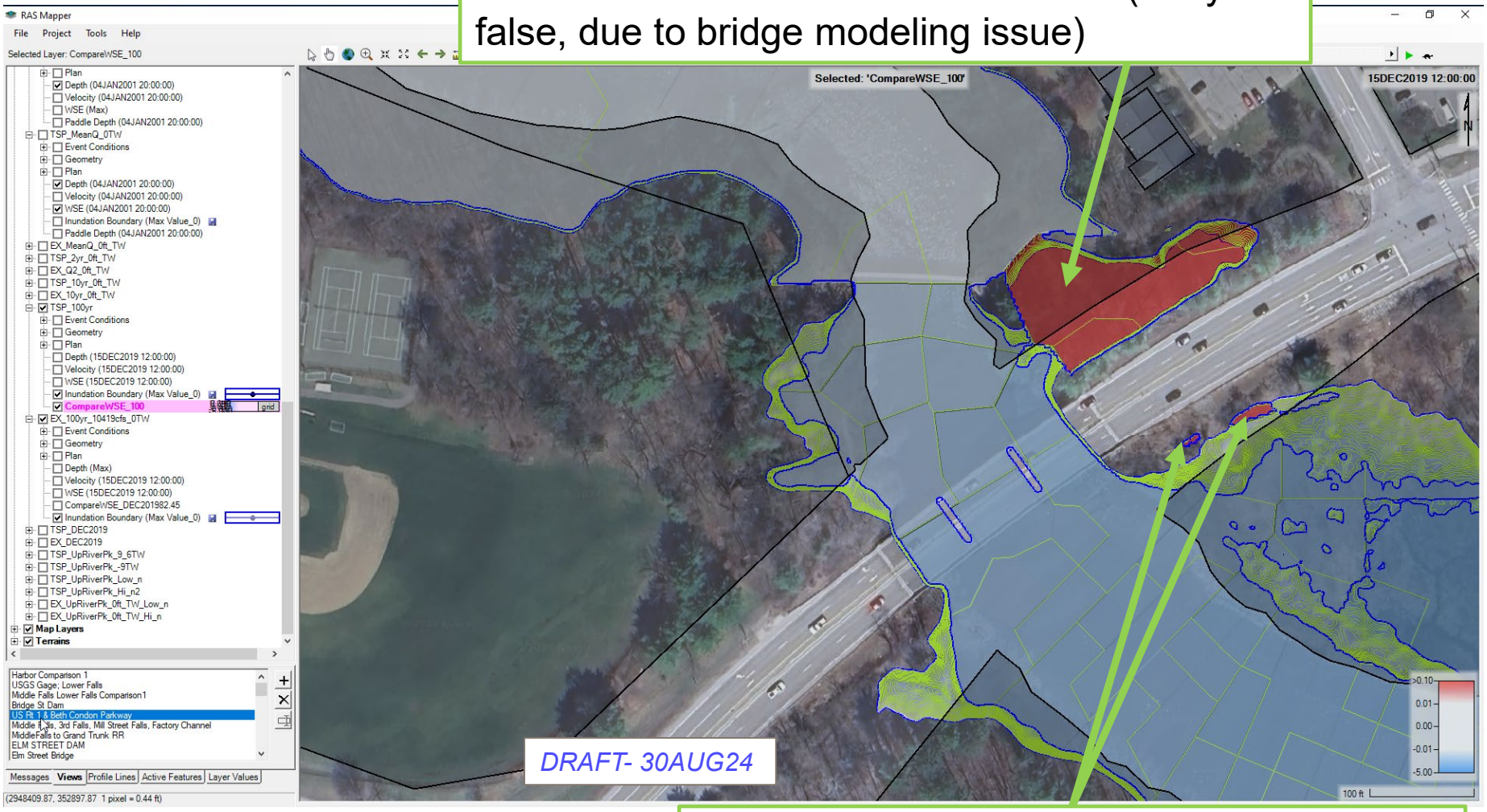


POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS
BRIDGE STREET DAM

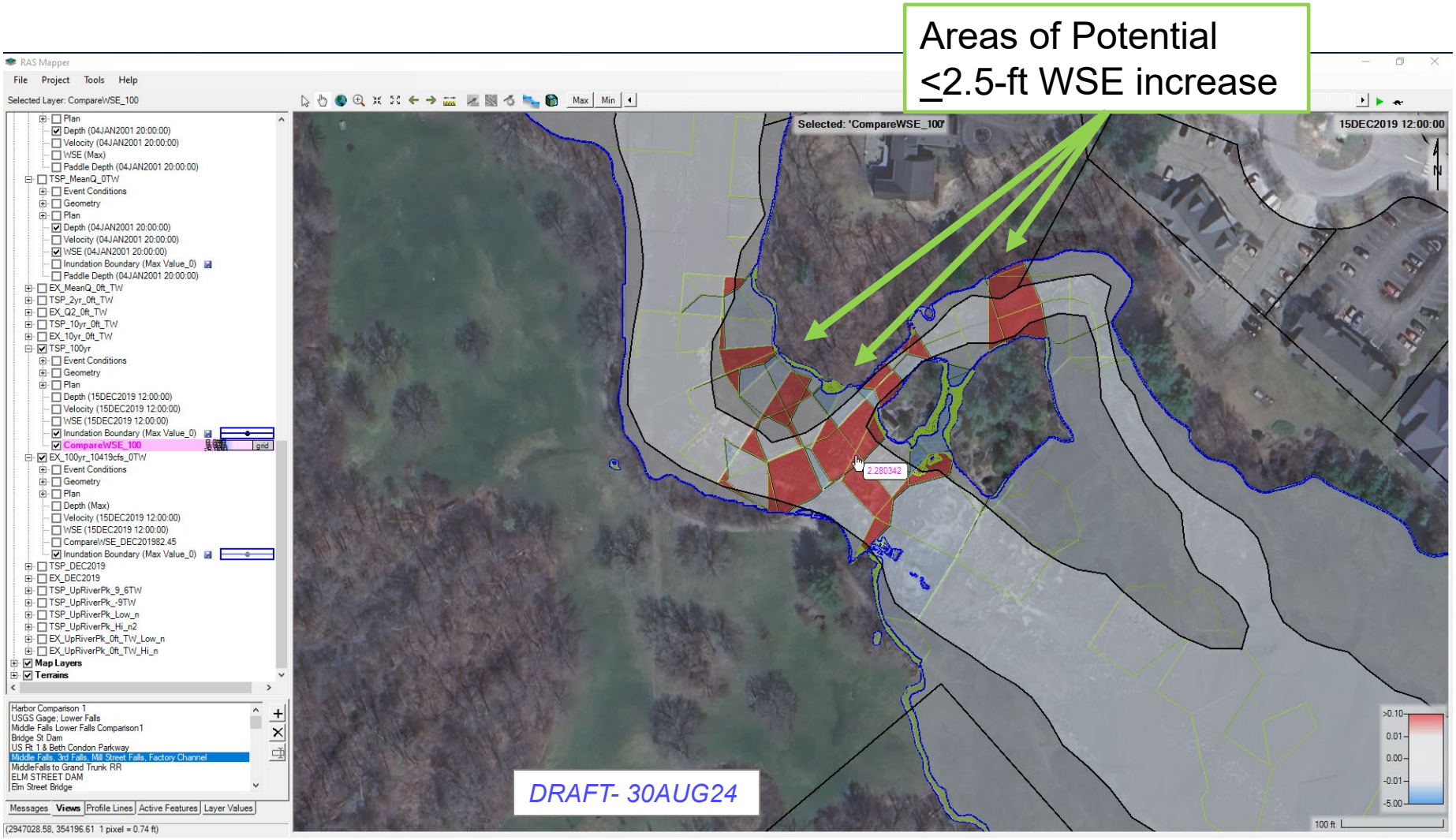


POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS
US ROUTE 1 & BETH CONDON FOOTBRIDGE

Area of Potential 1.0-ft WSE increase (likely false, due to bridge modeling issue)



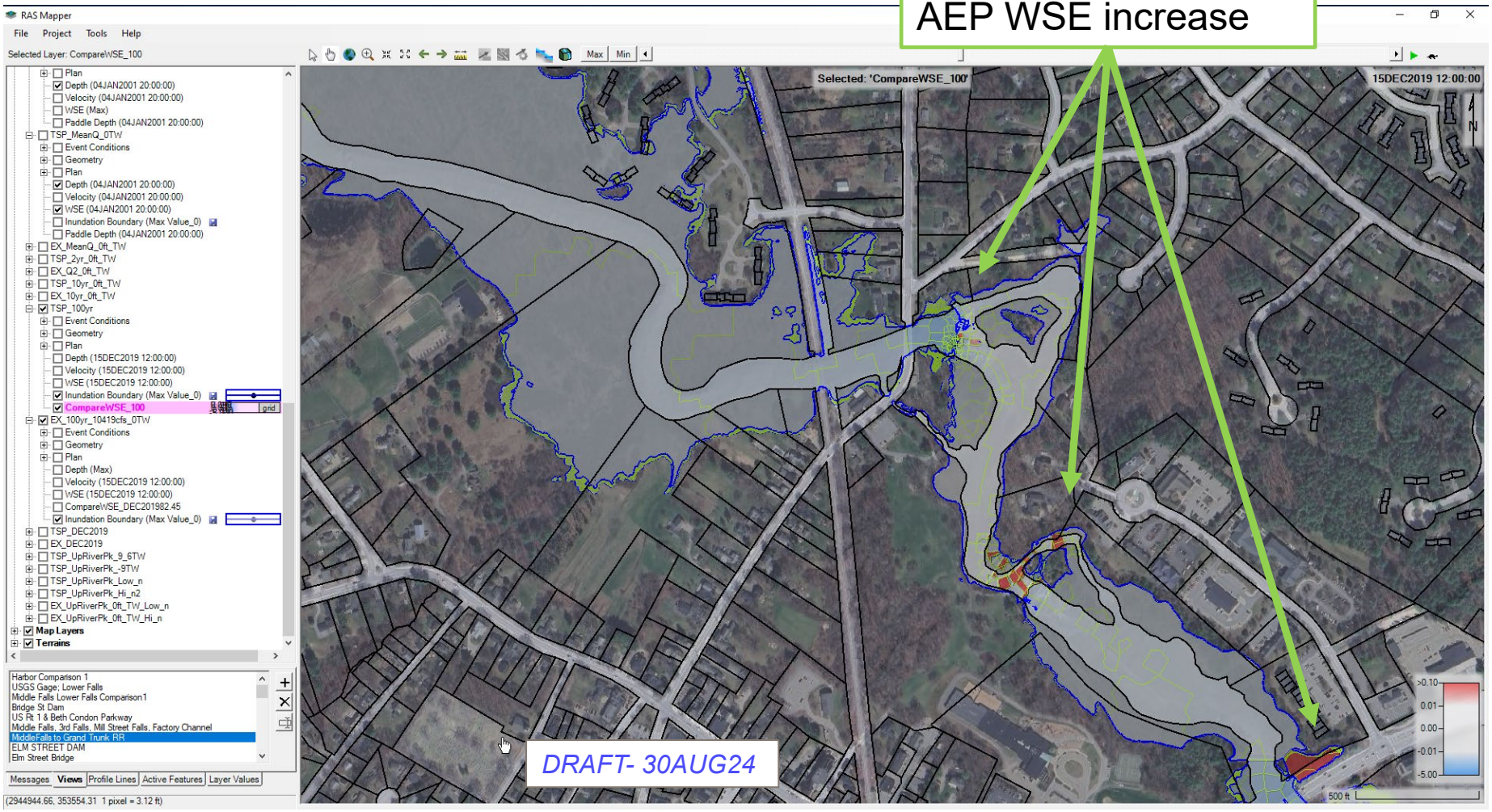
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS
MIDDLE FALLS



POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

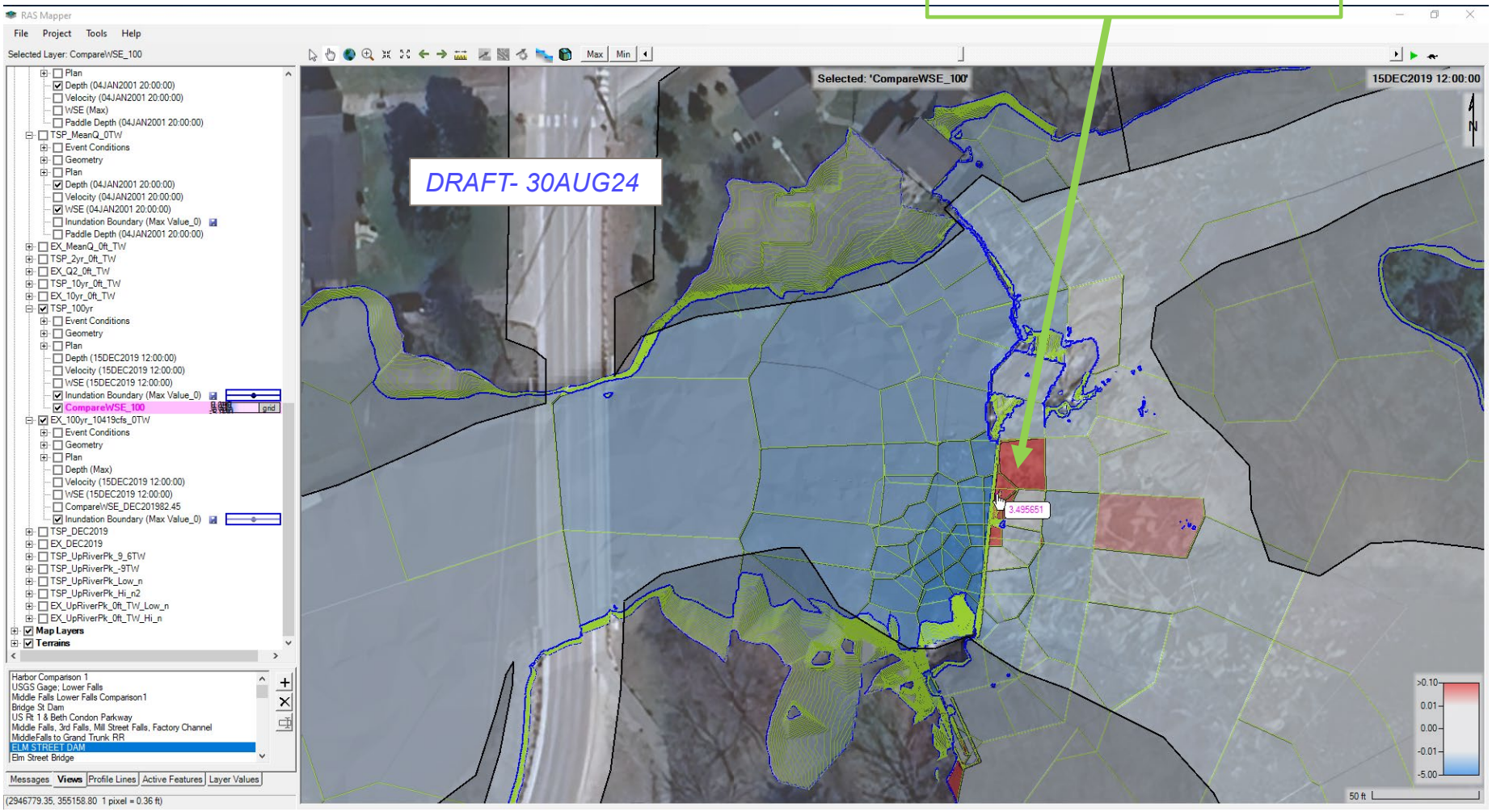
ELM STREET DAM OVERVIEW

Areas of Potential 1% AEP WSE increase



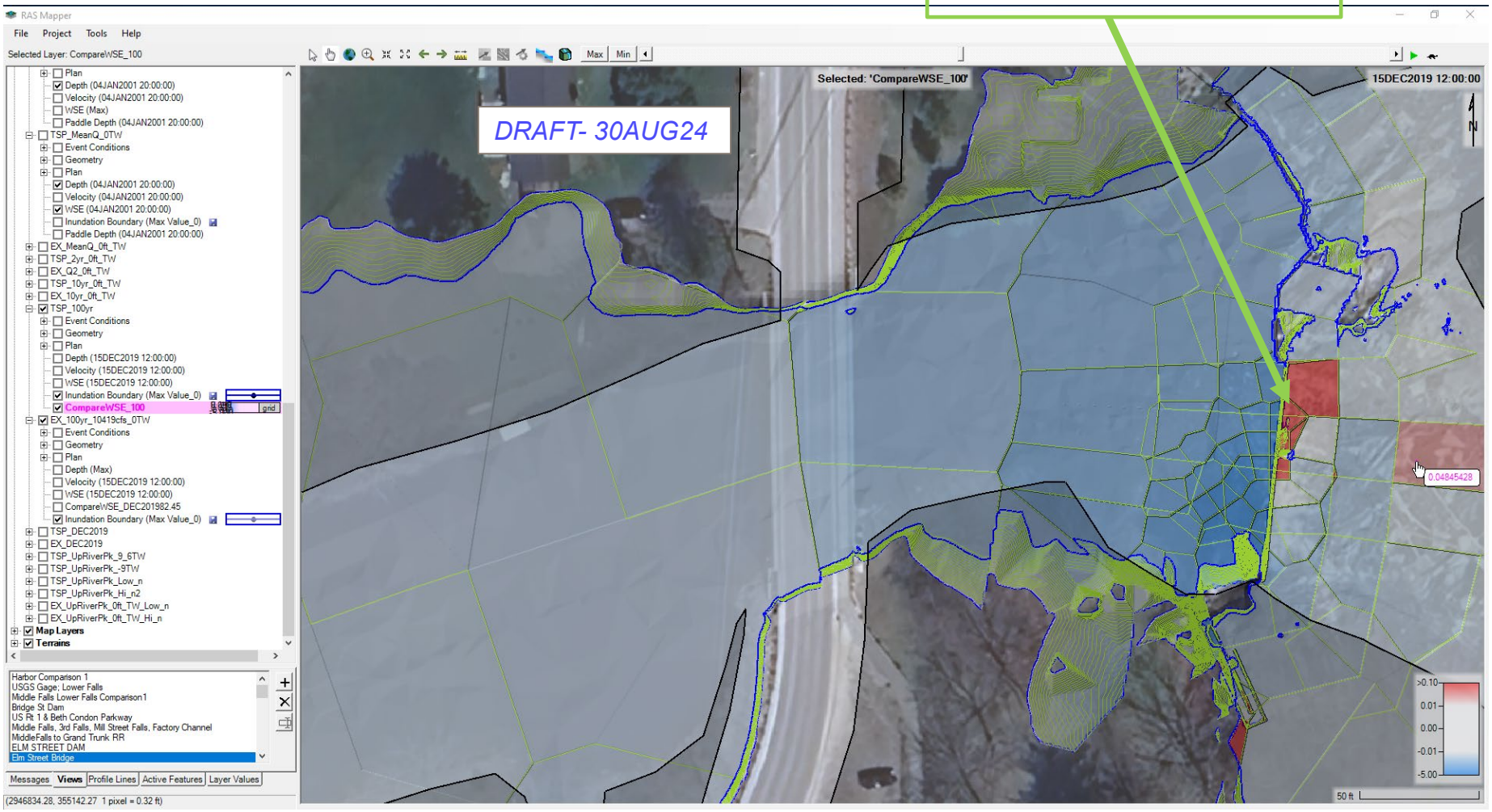
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

ELM STREET DAM



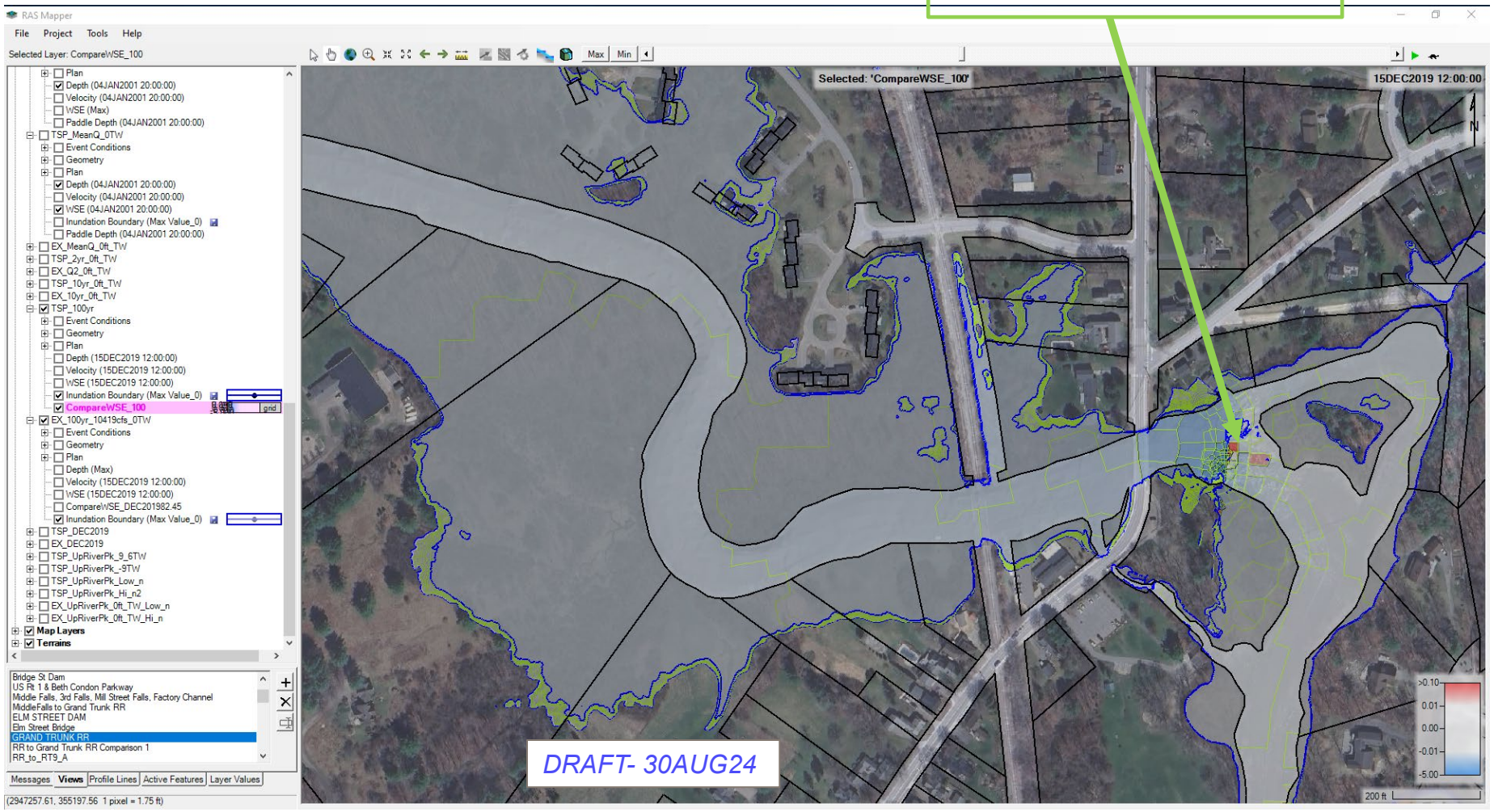
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

EAST ELM STREET



POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

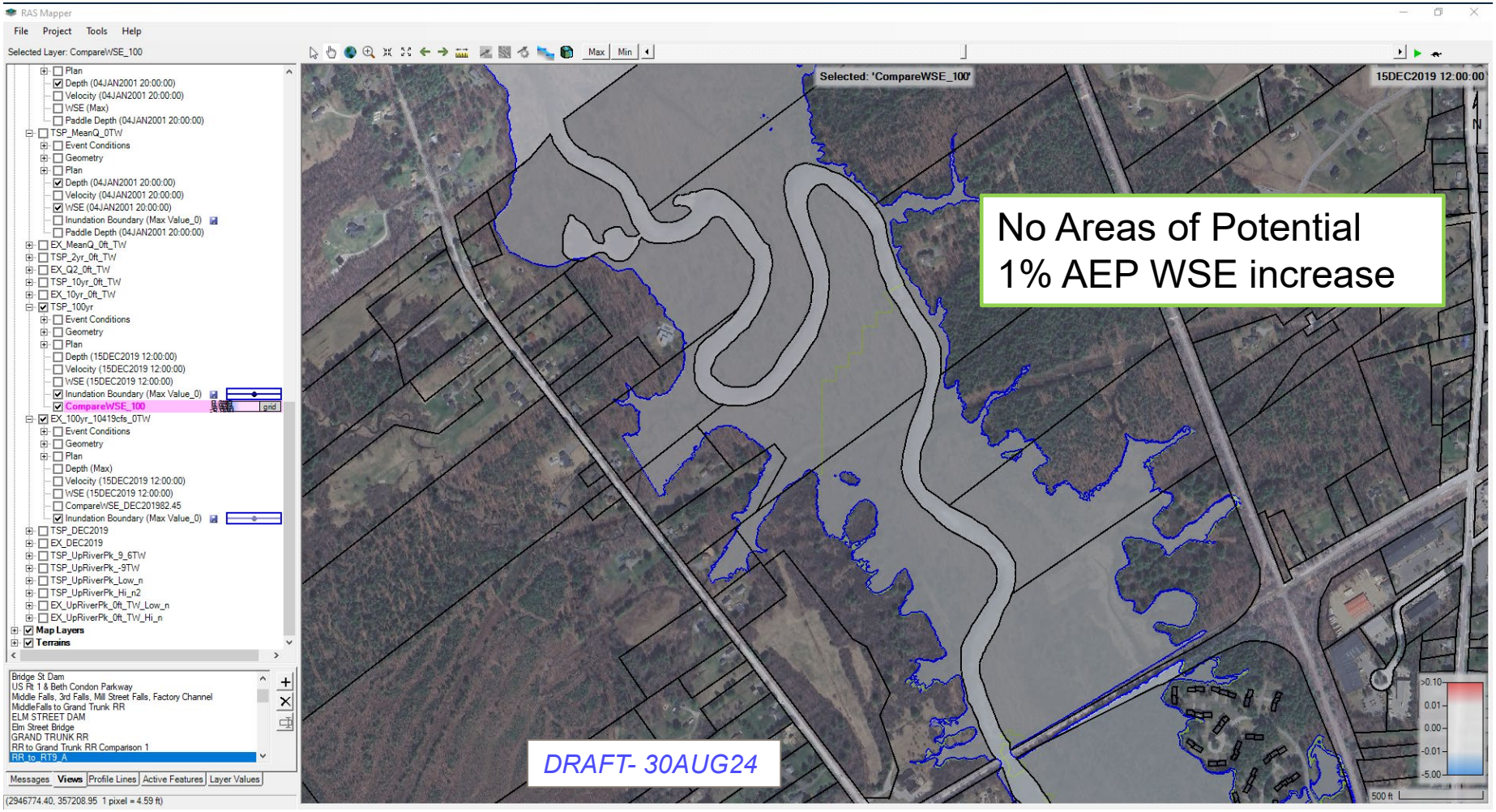
GRAND TRUNK RR



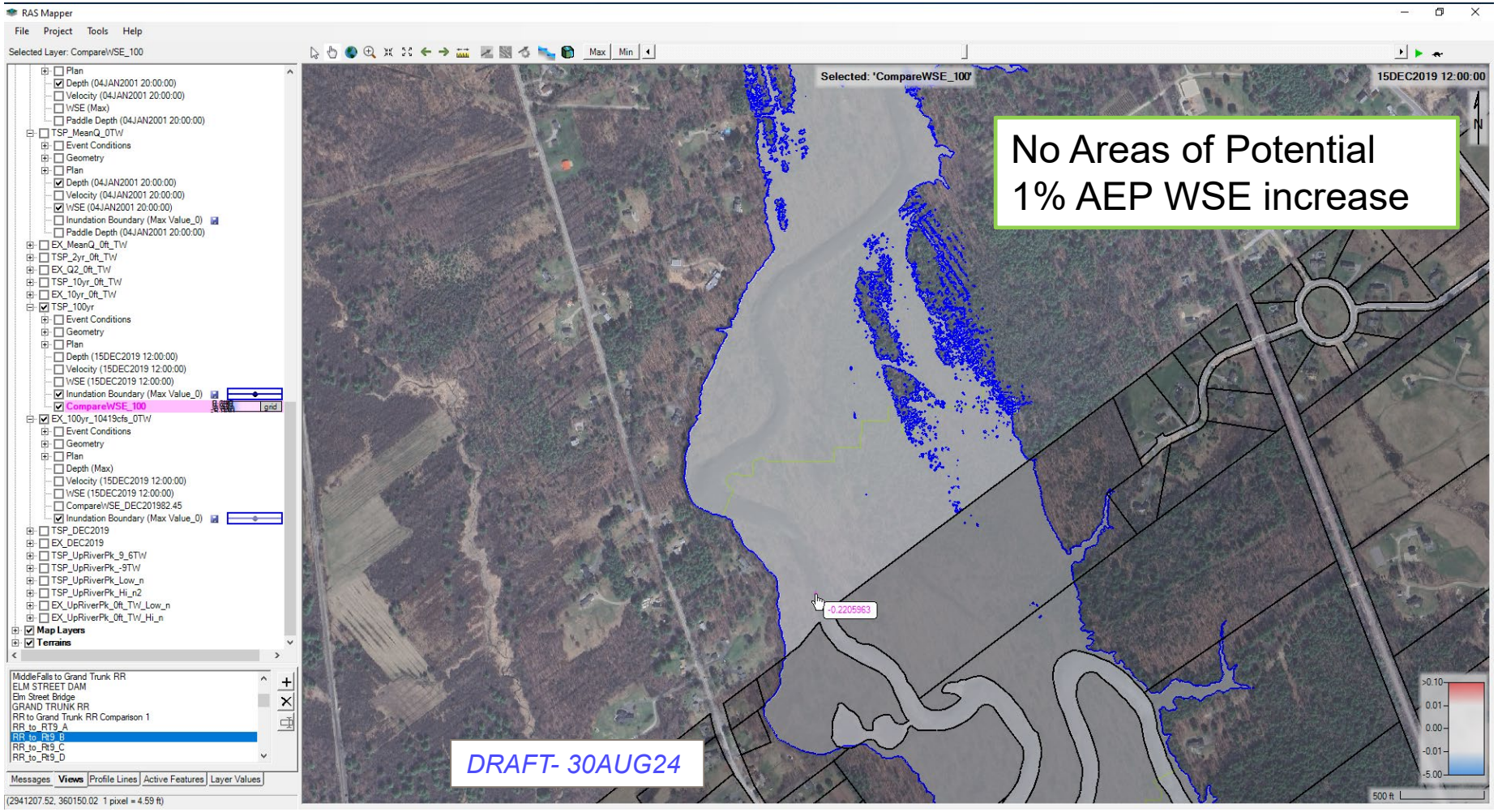
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

MAINE CENTRAL RR

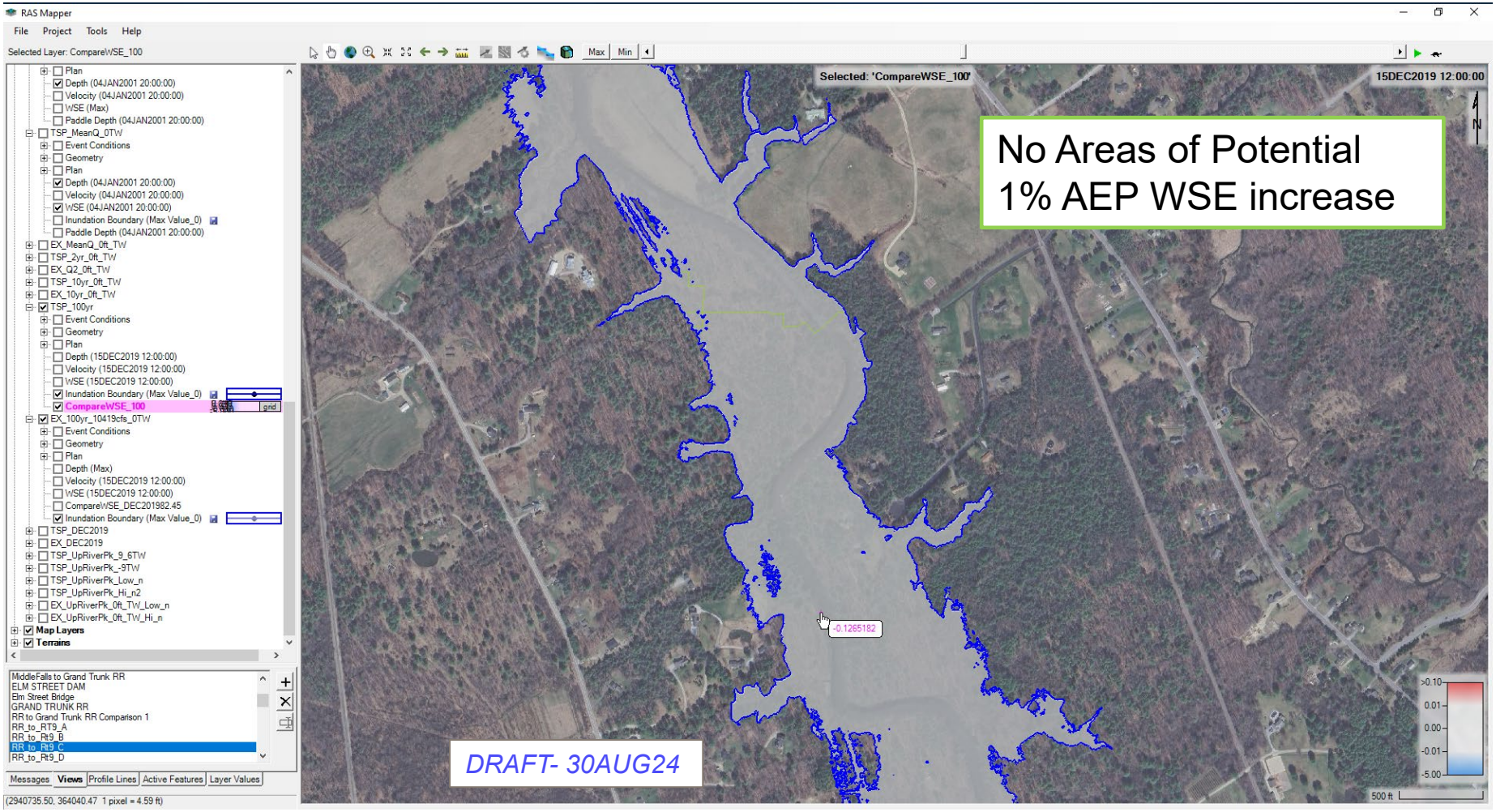
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS UPSTREAM OF MAINE CENTRAL RR (1)



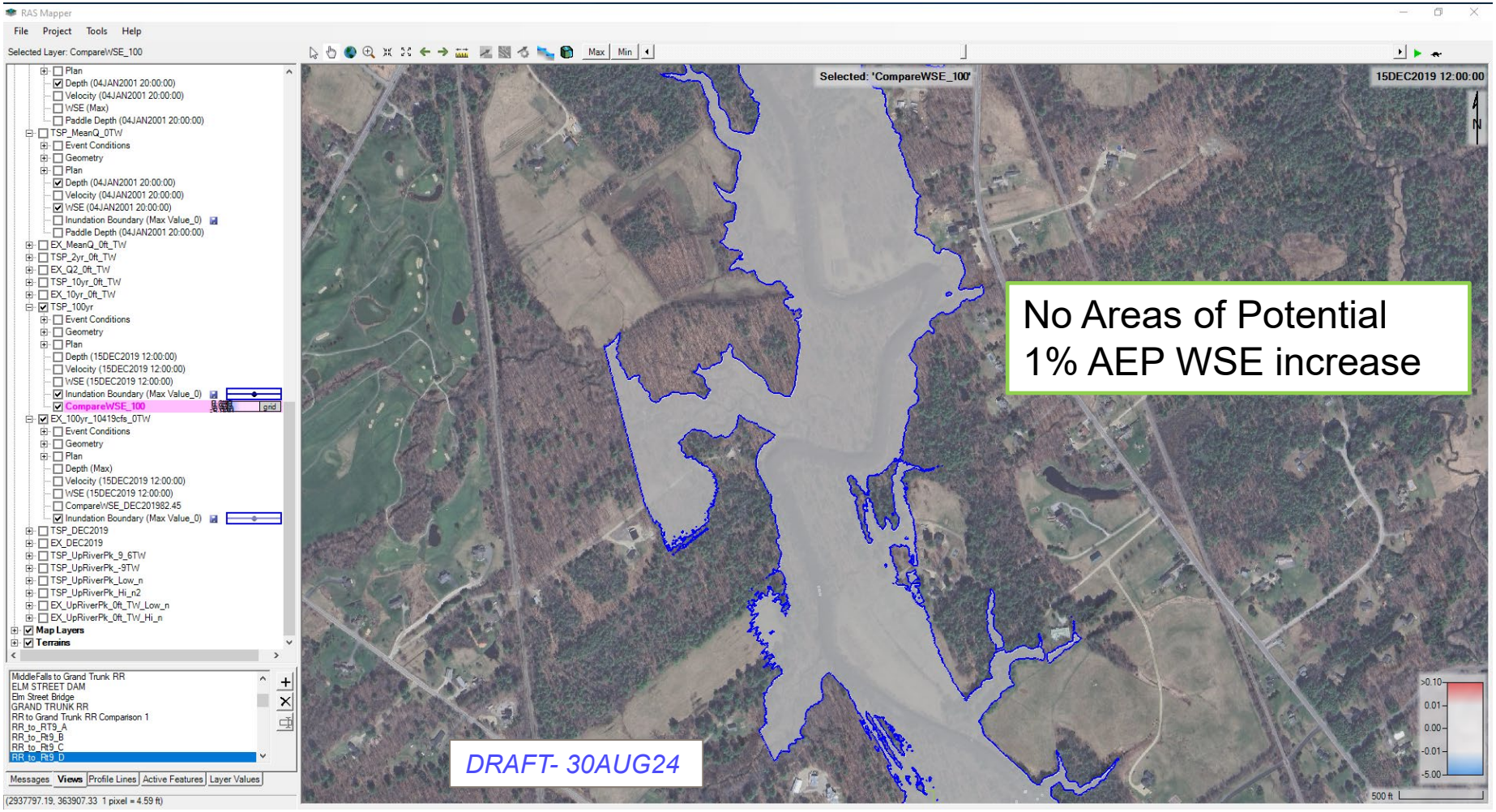
POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS UPSTREAM OF MAINE CENTRAL RR (2)



POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS UPSTREAM OF MAINE CENTRAL RR (3)



POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS NEAR TODDY BROOK



POTENTIAL CHANGES IN 1% AEP (100-YR) FLOOD LEVELS

BASTON PARK / US ROUTE 9

GRIST MILL 1893

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Gooch Island Focus

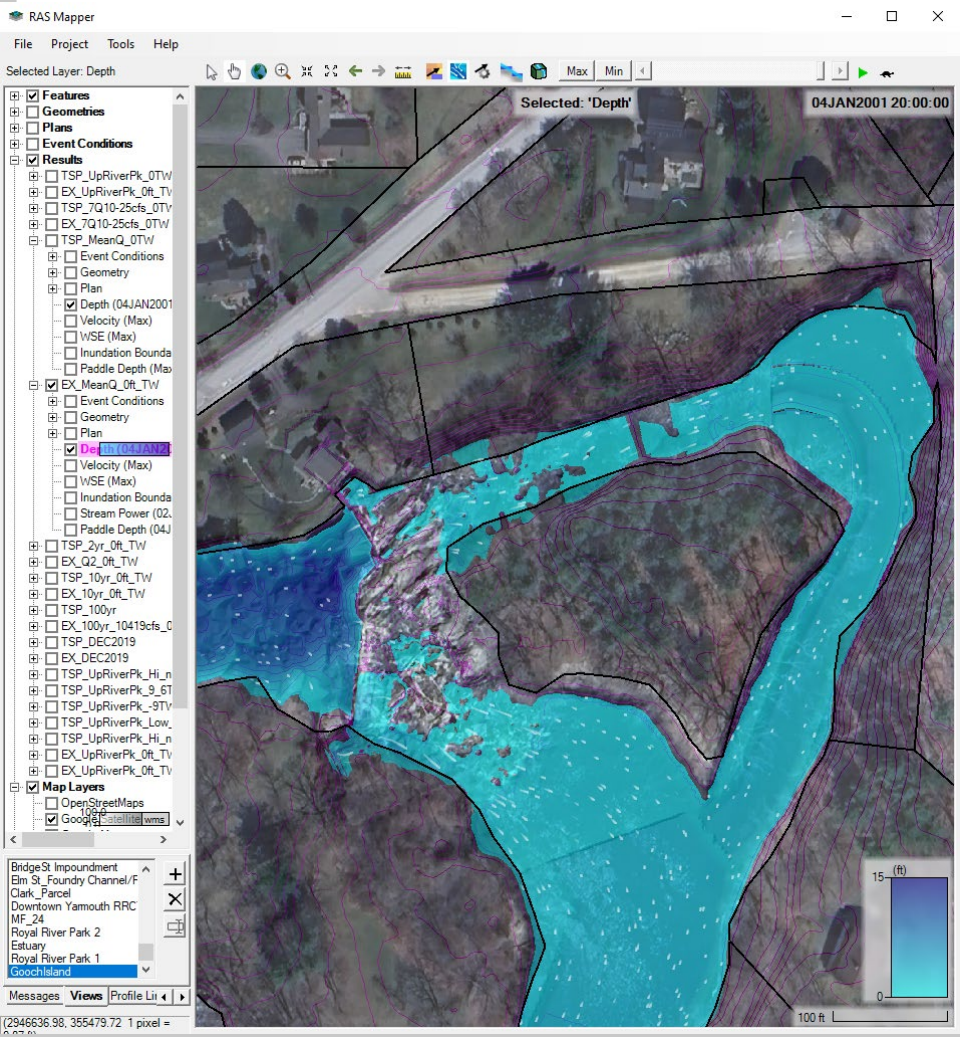
- Depth/Inundation Comparisons
  - » Annual Median Flows
- Velocity/Inundation Comparisons
  - » 95% flow percentile (62 cfs)
  - » 5% flow percentile (641 cfs)
  - » 1% AEP (100-yr)

Modeled Event	Results Time	Peak Discharge (cfs)
7Q10	04JAN2001 20:00:00	25
Annual Median Flows	Max	120
95% Exceedance MidMay-MidJune	02JAN2001 12:00:00	62
5% Exceedance MidMay-MidJune	04JAN2001 20:00:00	641
50% AEP	04JAN2001 20:00:00	3,643
10% AEP	04JAN2001 20:00:00	6,480
1%AEP	15DEC2019 12:00:00	10,419
10-22DEC2019 Validation	15DEC2019 12:00:00	4,300

- Geometry:
  - Existing
  - TSP
  - “Full Removal”

DEPTH COMPARISON – ANNUAL MEDIAN FLOW
GOOCH ISLAND

EXISTING CONDITIONS



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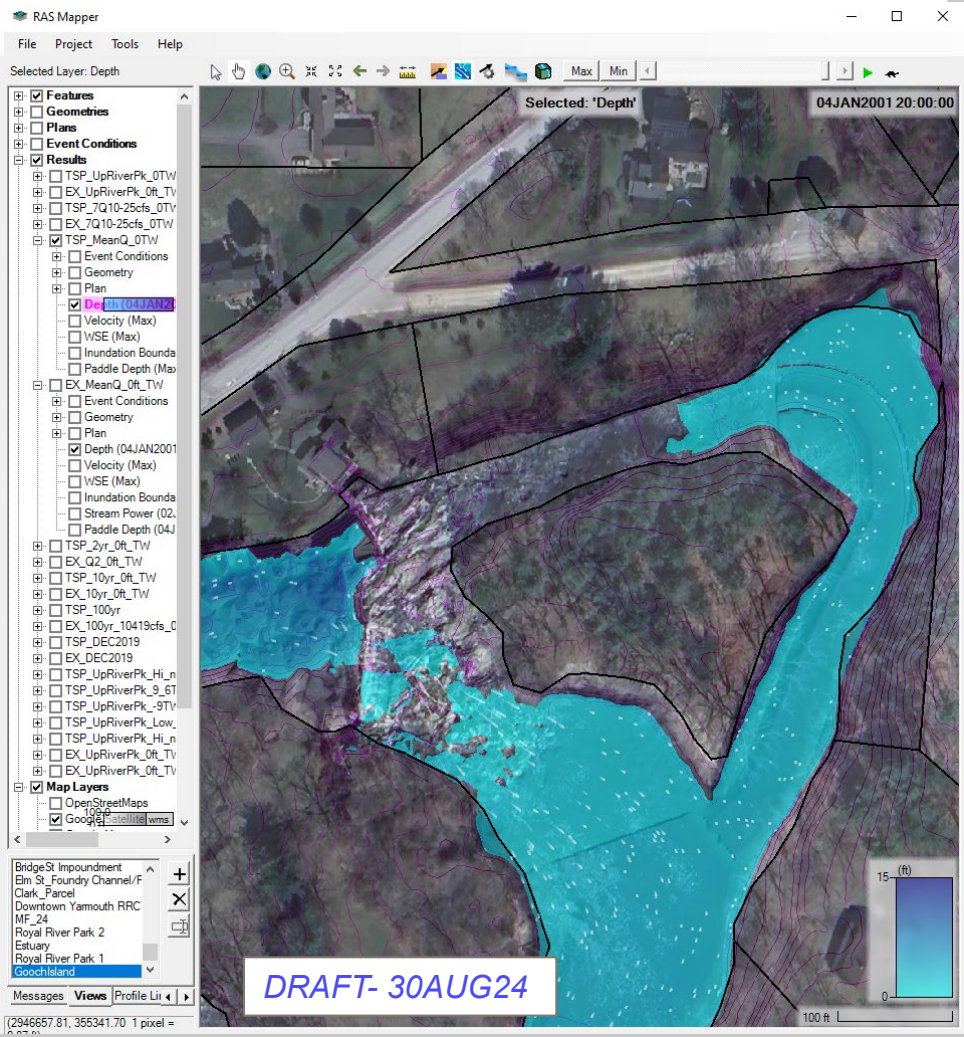
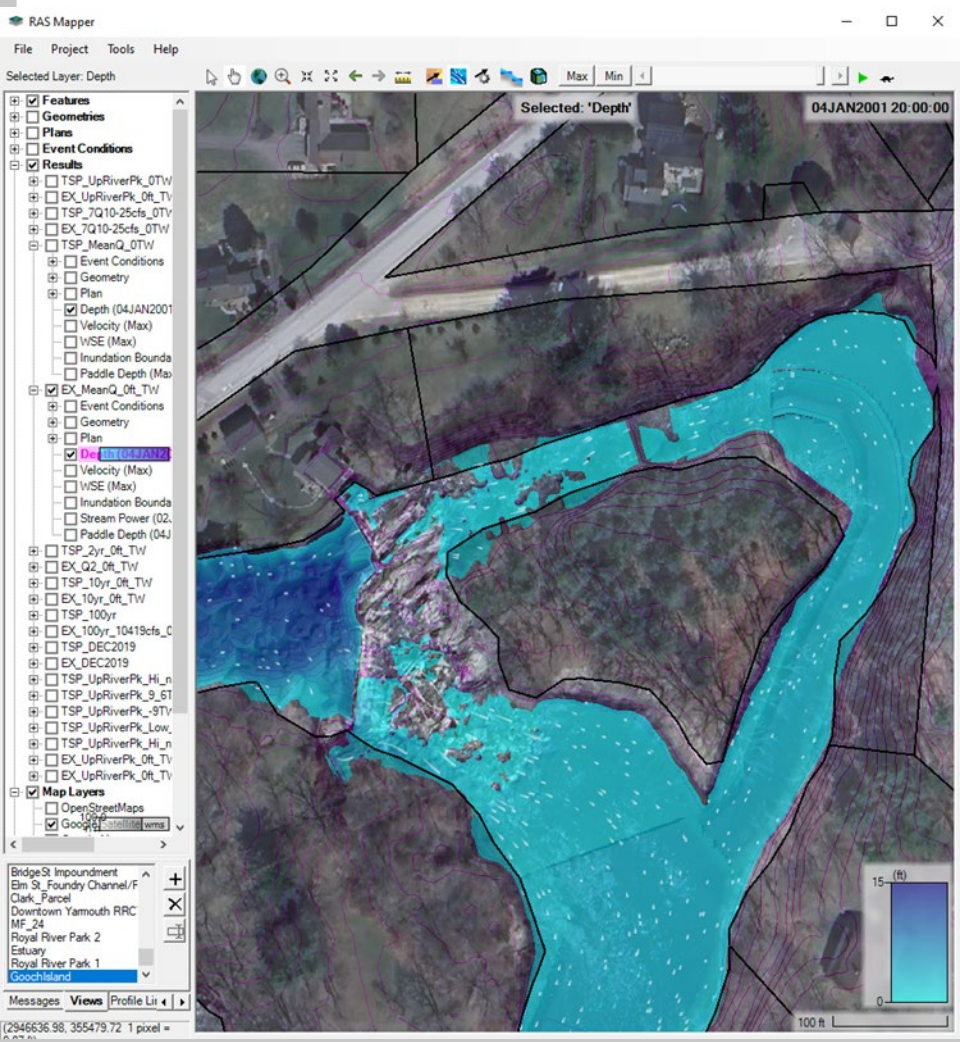
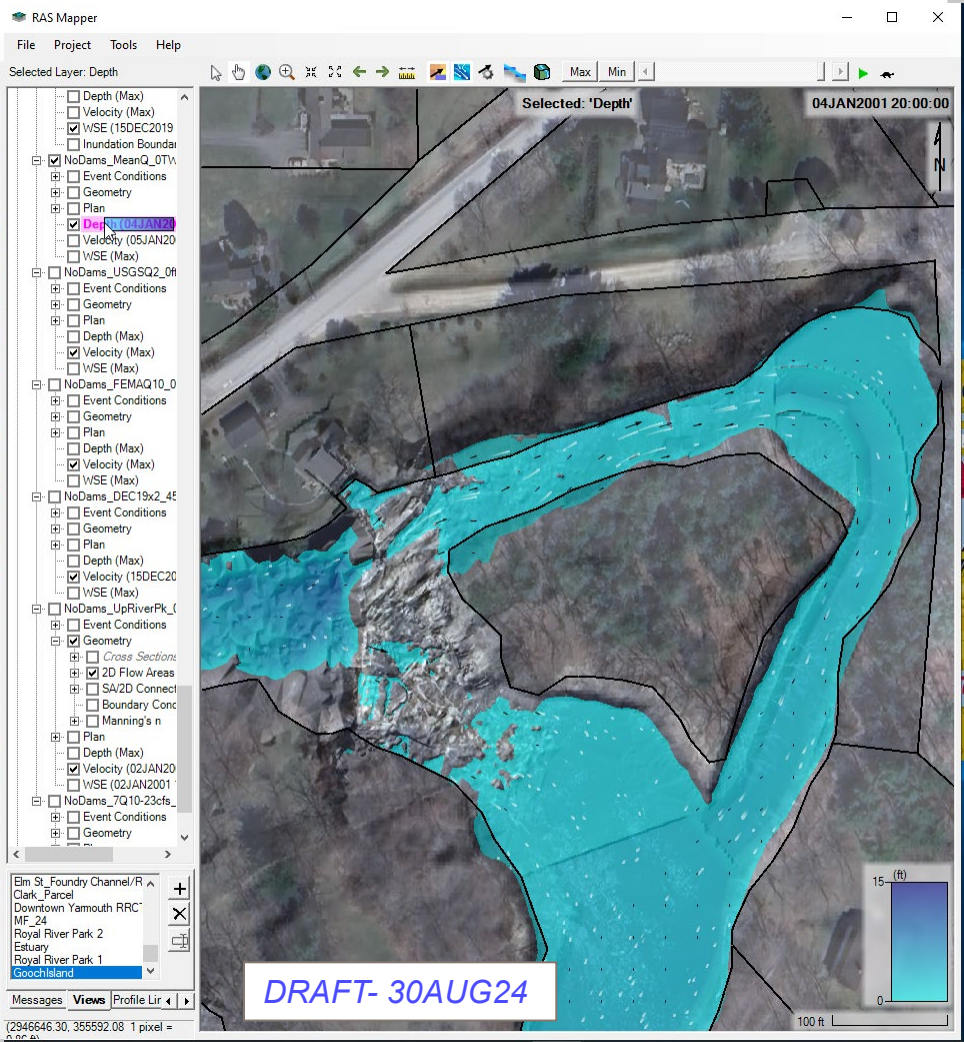


DEPTH COMPARISON – ANNUAL MEDIAN FLOW
GOOCH ISLAND

EXISTING CONDITIONS

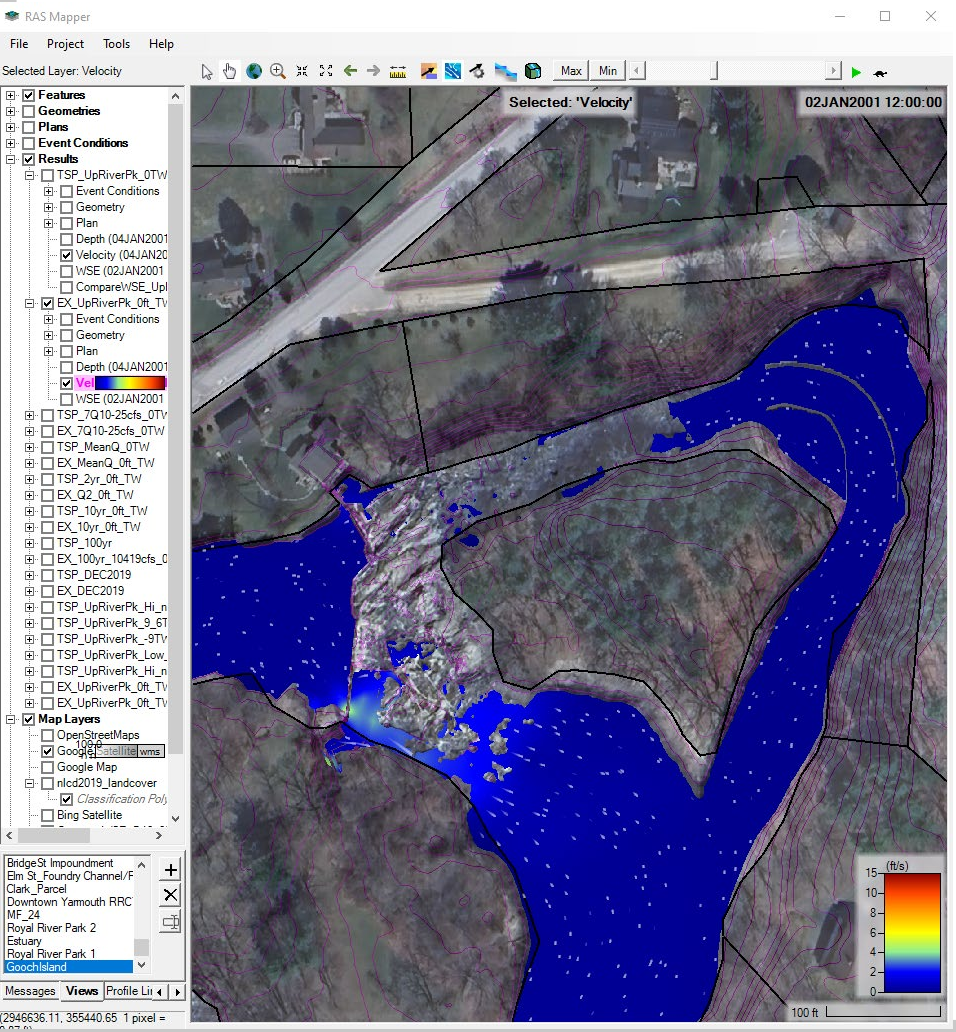
FULL REMOVAL





VELOCITY COMPARISON – UPRIVER PEAK MIGRATION 95% FLOW EXCEEDANCE GOOCH ISLAND

EXISTING CONDITIONS



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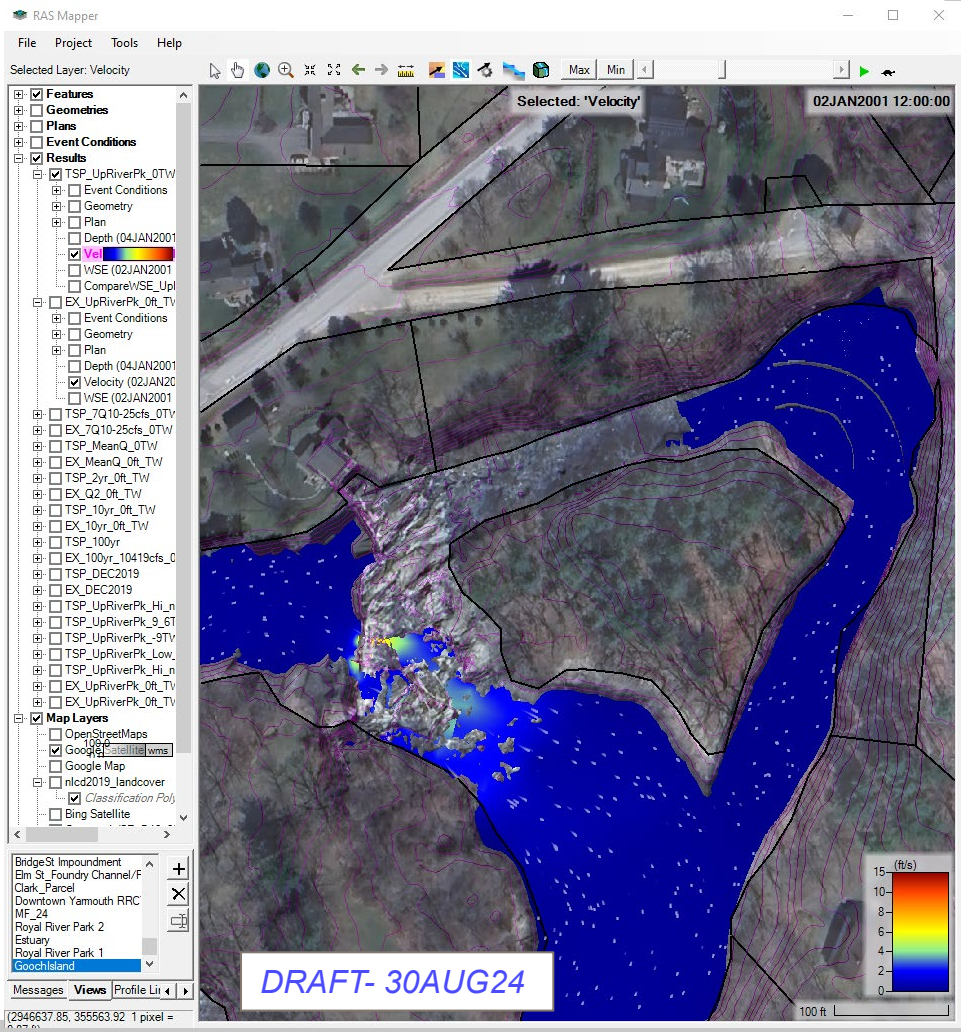
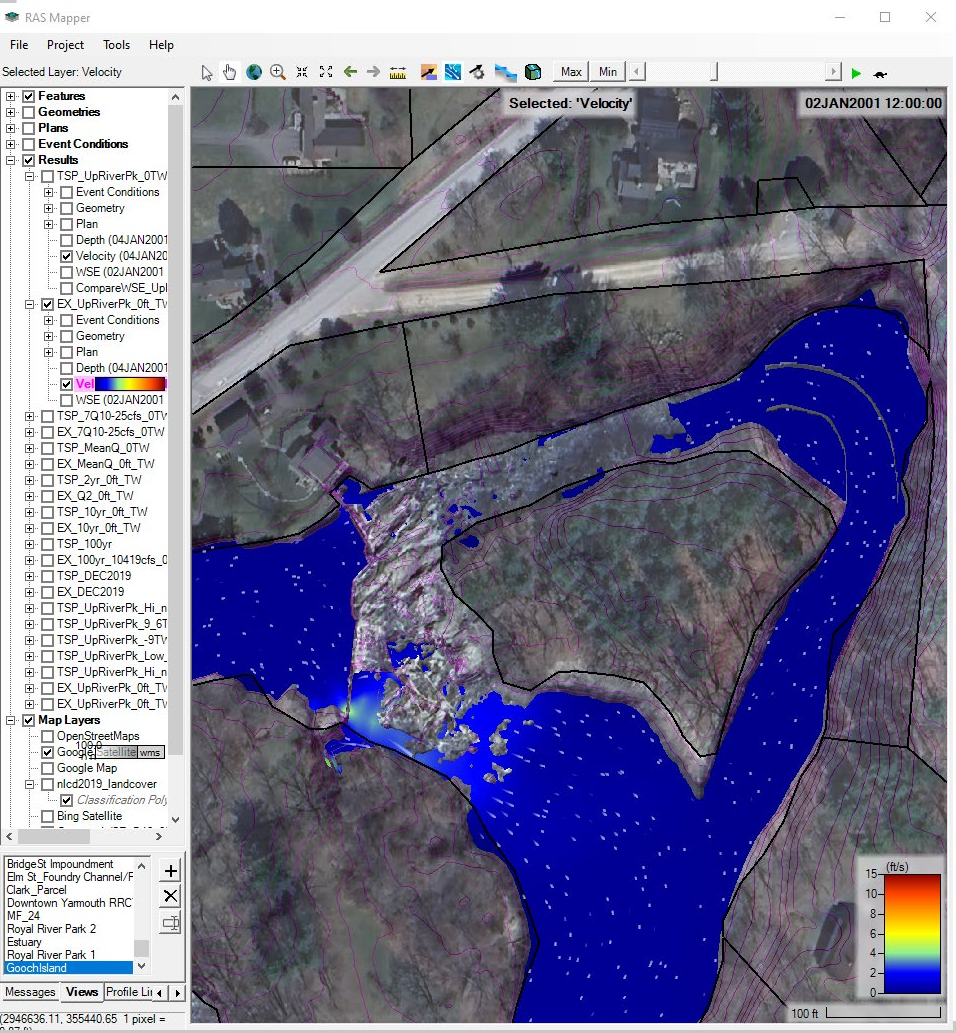
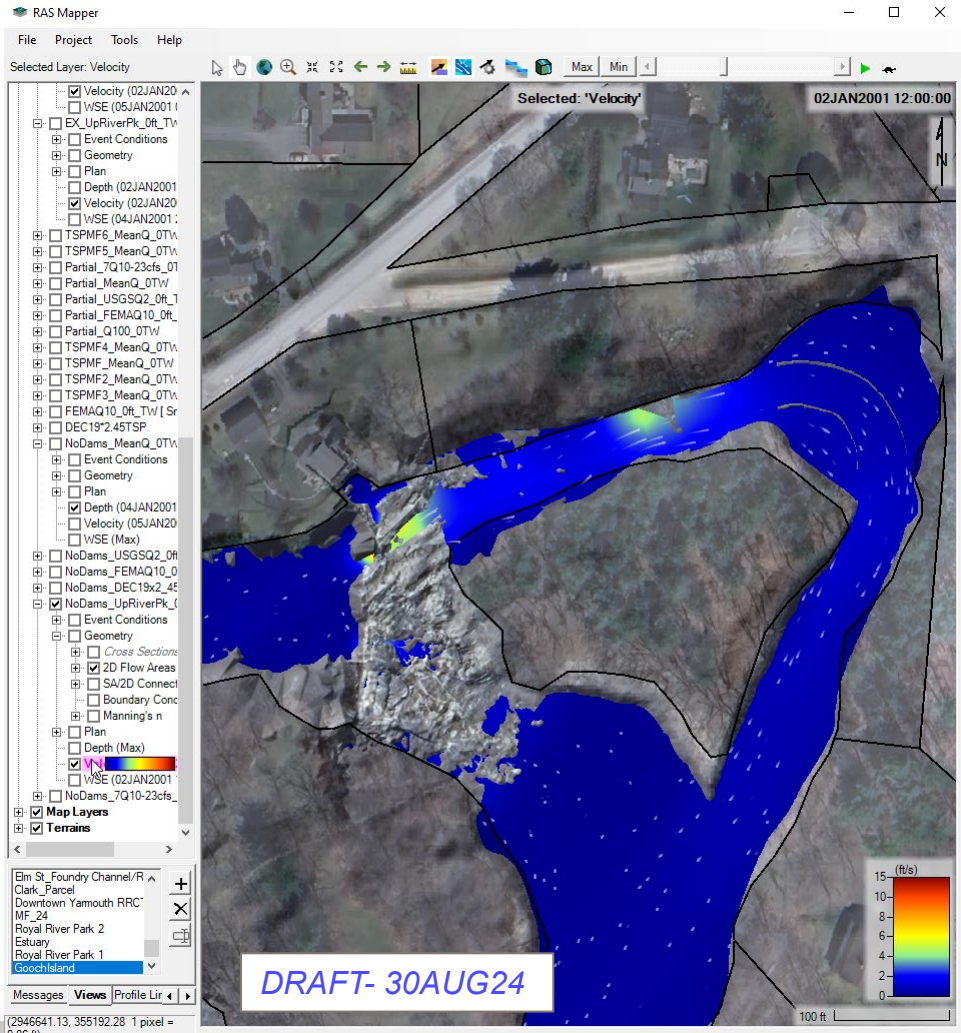


VELOCITY COMPARISON – UPRIVER PEAK MIGRATION 95% FLOW EXCEEDANCE GOOCH ISLAND

EXISTING CONDITIONS

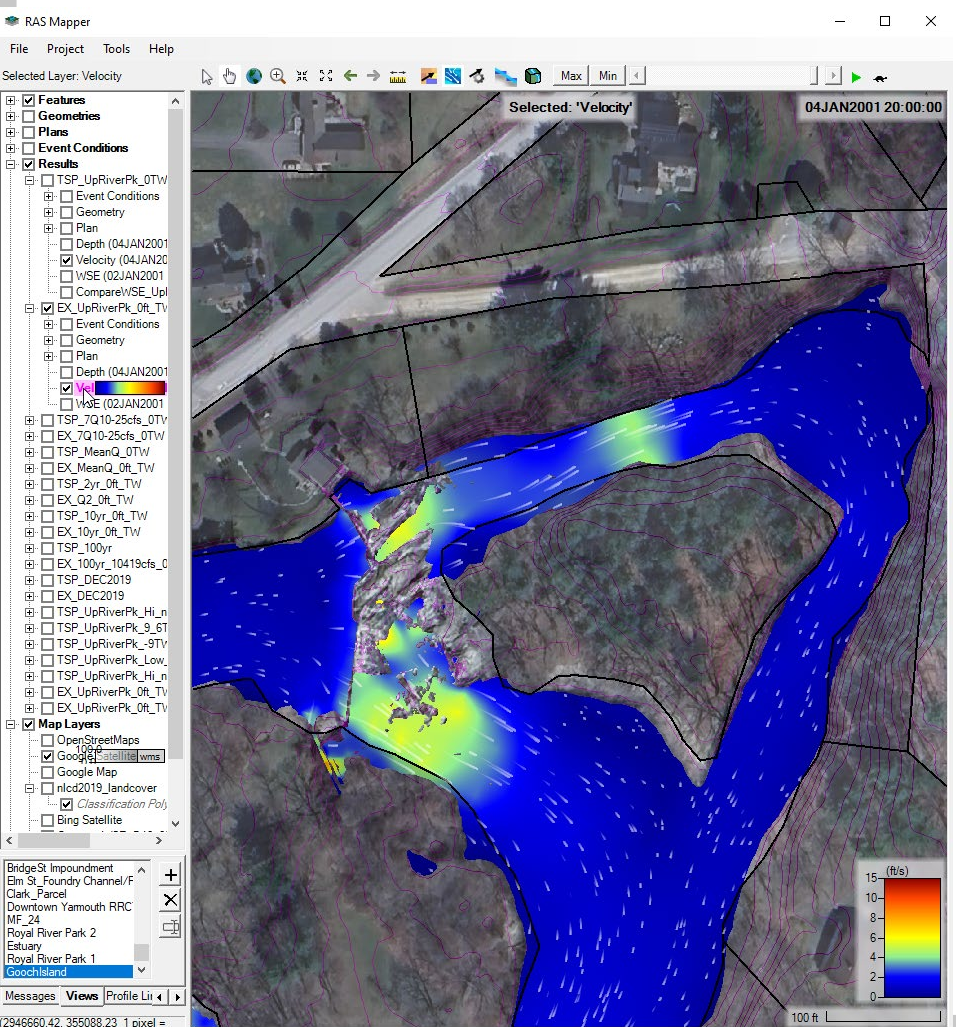


FULL REMOVAL

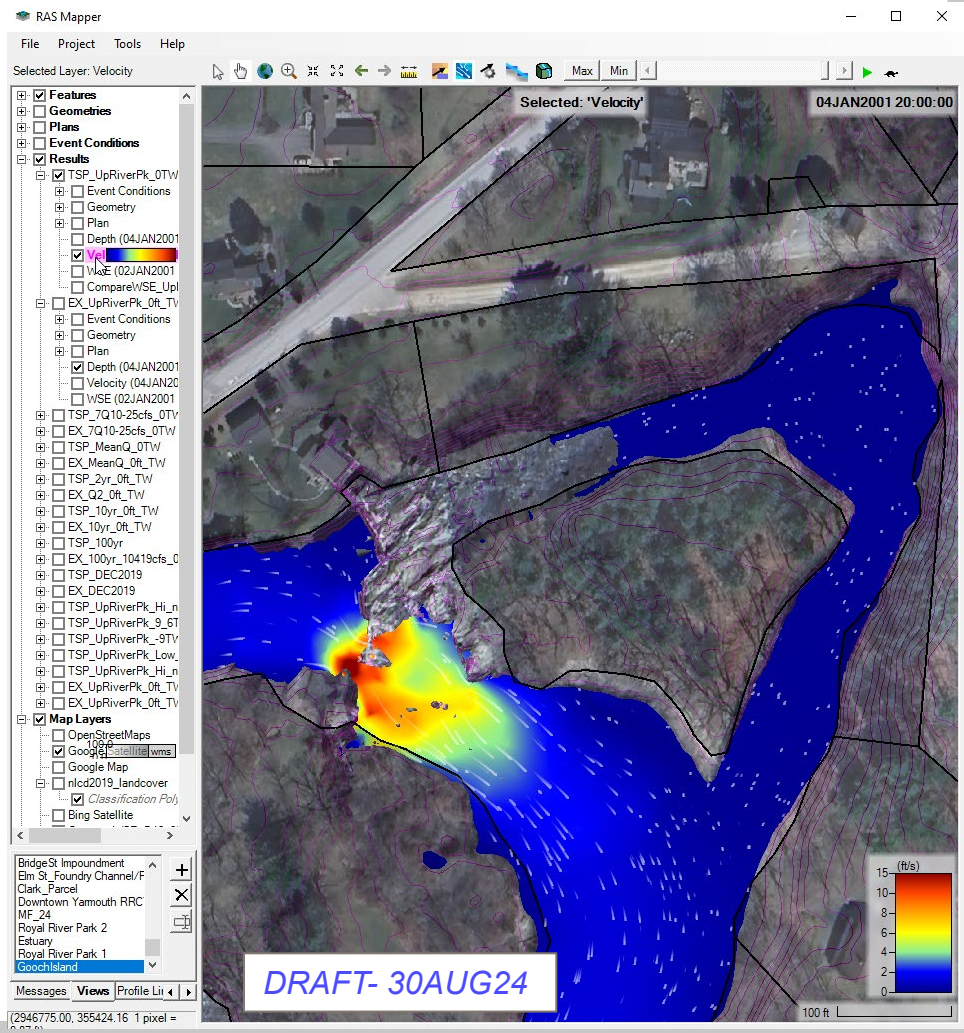


VELOCITY COMPARISON – UPRIVER PEAK MIGRATION 5% FLOW EXCEEDANCE GOOCH ISLAND

EXISTING CONDITIONS



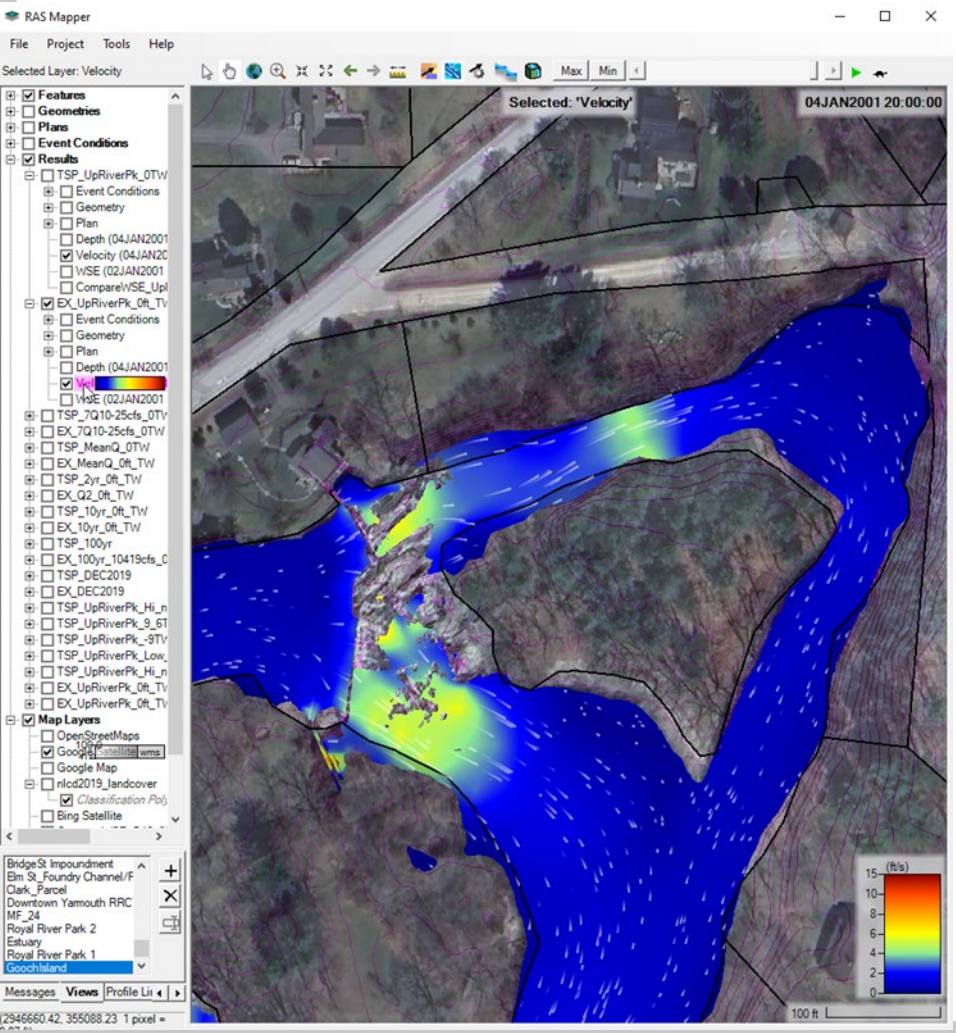
TENTATIVELY SELECTED PLAN

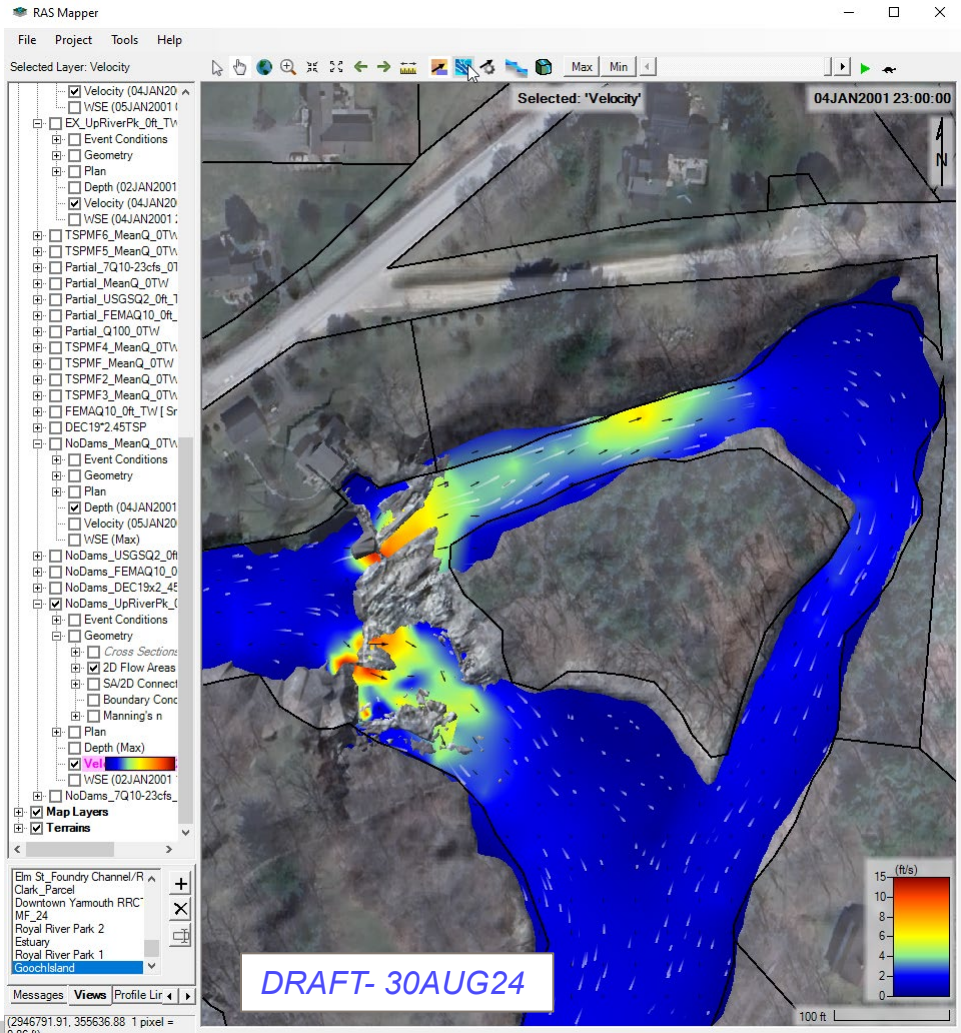


VELOCITY COMPARISON – UPRIVER PEAK MIGRATION 5% FLOW EXCEEDANCE GOOCH ISLAND

EXISTING CONDITIONS

FULL REMOVAL





Vol. 121, No. 232 30 Cents Portland, Maine, Monday, March 21, 1983

PORTLAND PRESS HERALD

The Royal River in Yarmouth overflows its banks Sunday, endangering the Thomas Trainor home.

PORTLAND PRESS HERALD MARCH 21, 1983

Spring comes in like a roaring lion

From Staff and Wire Reports

Mainers splashed their way into spring at 11:39 p.m. Sunday facing the prospect of more rain today.

"Right now, it looks like we could get another inch or so," said meteorologist Charlie Foley of the National Weather Service's Portland office. "This could be another good soaker."

Foley said this month already is the 10th wettest March since records were first kept in 1862.

Southern Maine experienced flooded roads and basements Saturday night and Sunday after about 2.3 inches of rain fell Saturday on already saturated ground.

In East Sebago, about five families at the mouth of the Northwest River were evacuated early Sunday when high water threatened to collapse a concrete, cut-stone and earthen dam.

"About four o'clock, she (water level) was going down," and the families returned to their residences, said Sebago Fire Chief Richard Fox.

In Yarmouth, about 40 volunteer firefighters and local residents packed sandbags alongside the Royal River to protect a house at the water's edge from flood damage.

Thomas Trainor, occupant of the house, said he cannot remember the river overflowing after a single day's rainstorm. The river was running about 8 feet higher than normal, officials said.

Part of the Royal River Parkway, a walkway along the river, was lost to erosion.

In North Yarmouth, a Pownal man in a motorized dory rescued a 26-year-old canoeist who had been sucked under the Dunn's Depot Bridge serving Route 9 across the Royal River.

The canoe carrying two men couldn't make it under the bridge because of high water, and the canoe capsized. One of the men was able to pull himself up onto the bridge.

Yarmouth authorities stretched a rope across the river near East Elm Street as a protection for the dory from the falls.

See RAIN Page 11

Rain FROM PAGE 1

North Yarmouth Rescue would not disclose the identity of the men and did not know who made the rescue.

The man sucked under Dunn's Depot Bridge was treated at Mercy Hospital for hypothermia and released.

Authorities were to resume searching today for a woman they believe may have been swept into the swollen Sebasticook River in Benton, a community three miles northwest of Waterville, as she drove to a variety store in a torrential downpour.

Terry Harris, whose 26th birthday was Sunday, left her Benton home around 9:30 Saturday night but never reached the variety store and did not return home, her husband, Ronald, told police.

She was driving on Route 139 in a black and yellow Chevy Nova.

In Windham, the entrance to a bridge on the Brand & Knight Road was undermined by the Pleasant River. The bridge was closed.

One lane on the Anderson Road was undermined.

The water softened the ground over a culvert in Manchester, and it caved in as Todd Webb, 17, was driving over it early Sunday morning. Police said Webb only suffered a bumped head but that the car frame was damaged.

Riverside Street in Portland was closed for most of Sunday because of flooding.

Five roads in Gorham were closed Saturday night but reopened Sunday. "Some of the roads have washed out a bit," but there was no major damage, said a police dispatcher. "If it rains (Monday), it might be different."

York County communities reported minor flooding Saturday night but roads were open Sunday.

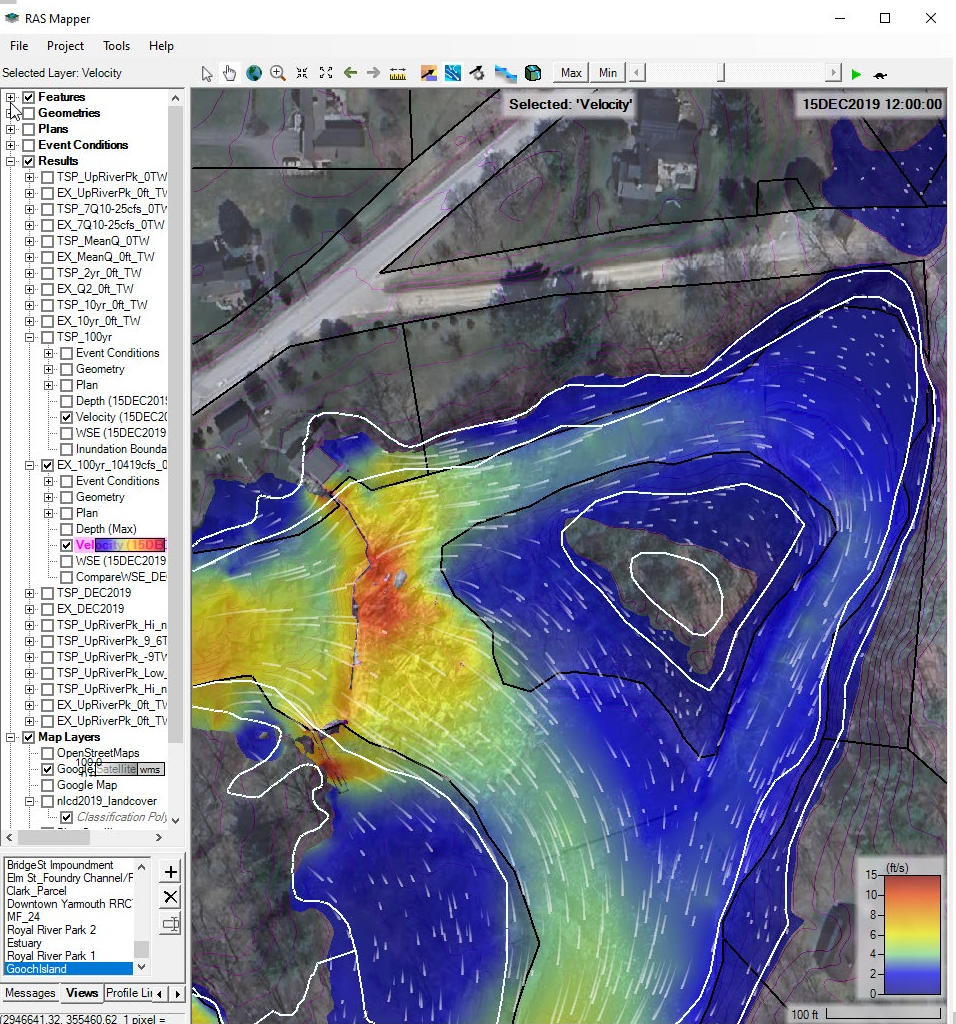
In Springvale, a family was evacuated from their home because rain had filled the cellar "up to the fuse box," a local official said.

The 2.3 inches that fell Saturday was a record for the day, surpassing the previous mark of .9 inches on March 19, 1907, the weather service reported.

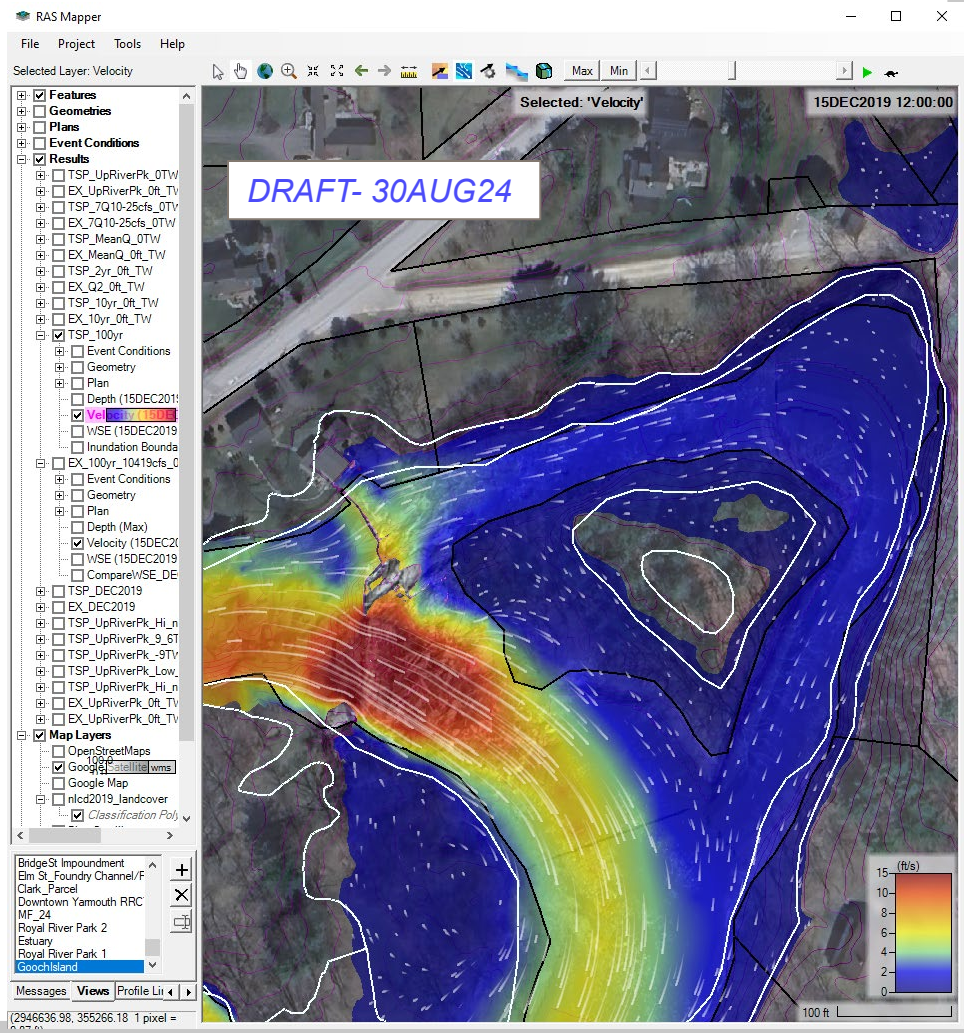
A storm moving up from the Tennessee Valley is threatening to dump rain on Maine starting this afternoon. "It looks right now that we could have some periods of heavy rain," Foley said.

VELOCITY COMPARISON –1% AEP (100-YR) FLOW
GOOCH ISLAND

EXISTING CONDITIONS

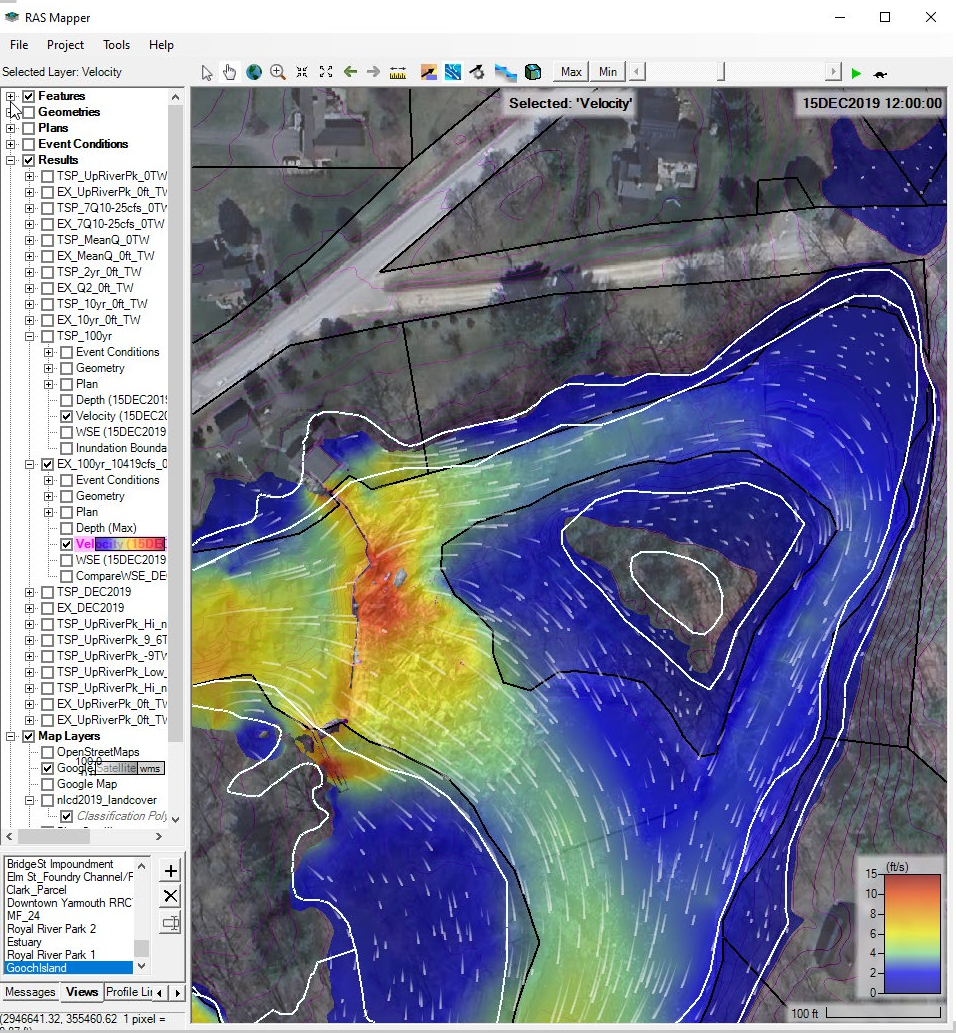


TENTATIVELY SELECTED PLAN

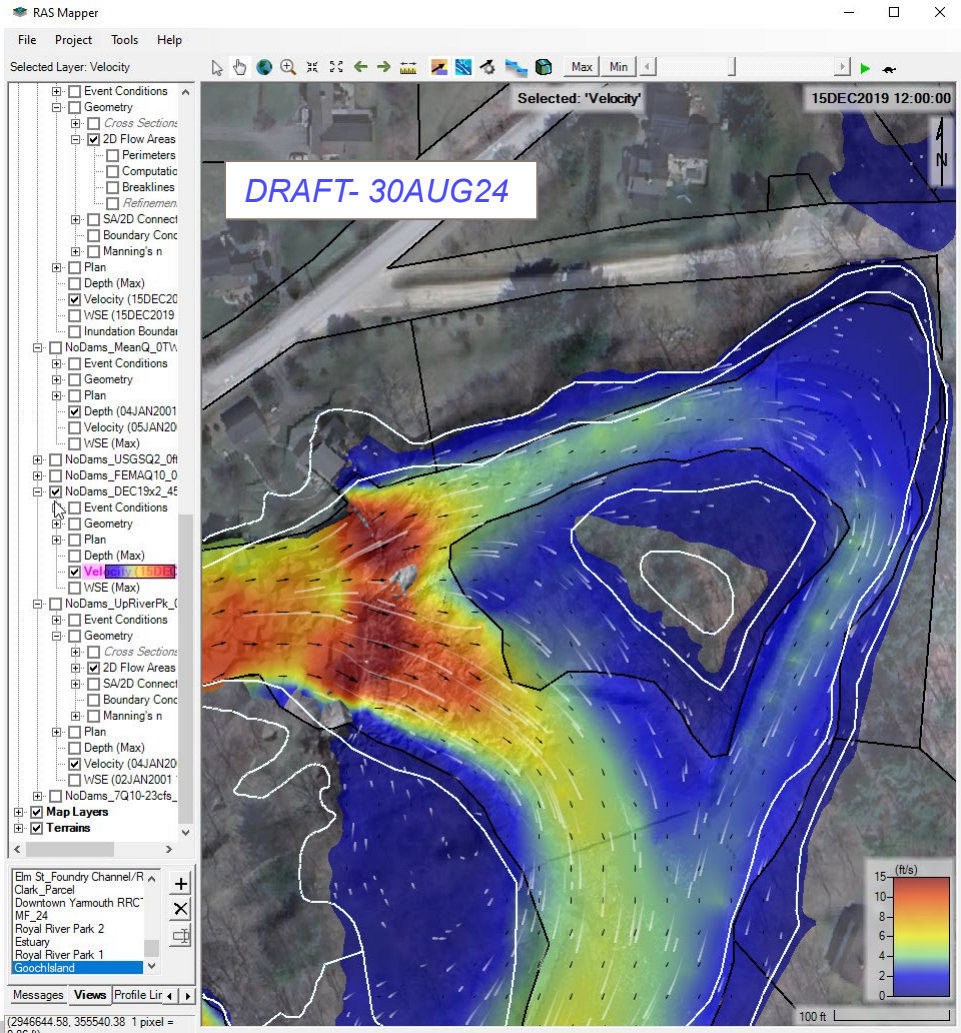


VELOCITY COMPARISON –1% AEP (100-YR) FLOW
GOOCH ISLAND

EXISTING CONDITIONS



FULL REMOVAL



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Sensitivity Review

- Tailwater Conditions Low/High
- Manning's n Roughness Low/High
- "All Muck" at East Elm Street Dam

- Water Surface centerline profiles

Modeled Event	Results Time	Peak Discharge (cfs)
7Q10	04JAN2001 20:00:00	25
Annual Median Flows	Max	120
95% Exceedance MidMay-MidJune	02JAN2001 12:00:00	62
5% Exceedance MidMay-MidJune	04JAN2001 20:00:00	641
50% AEP	04JAN2001 20:00:00	3,643
10% AEP	04JAN2001 20:00:00	6,480
1%AEP	15DEC2019 12:00:00	10,419
10-22DEC2019 Validation	15DEC2019 12:00:00	4,300

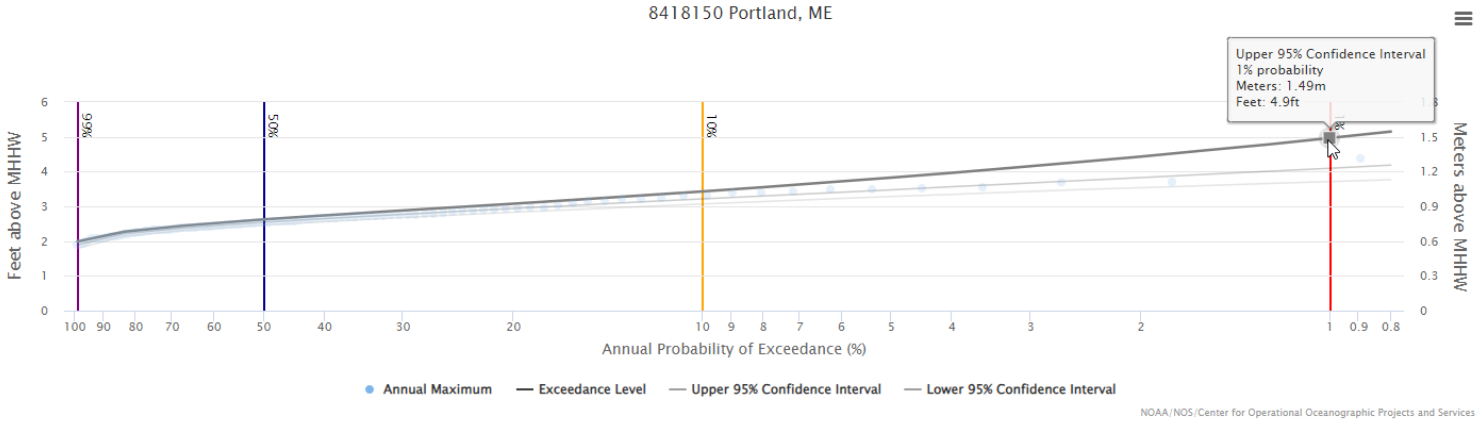
- Geometry:
  - Existing
  - TSP
  - "All Muck"

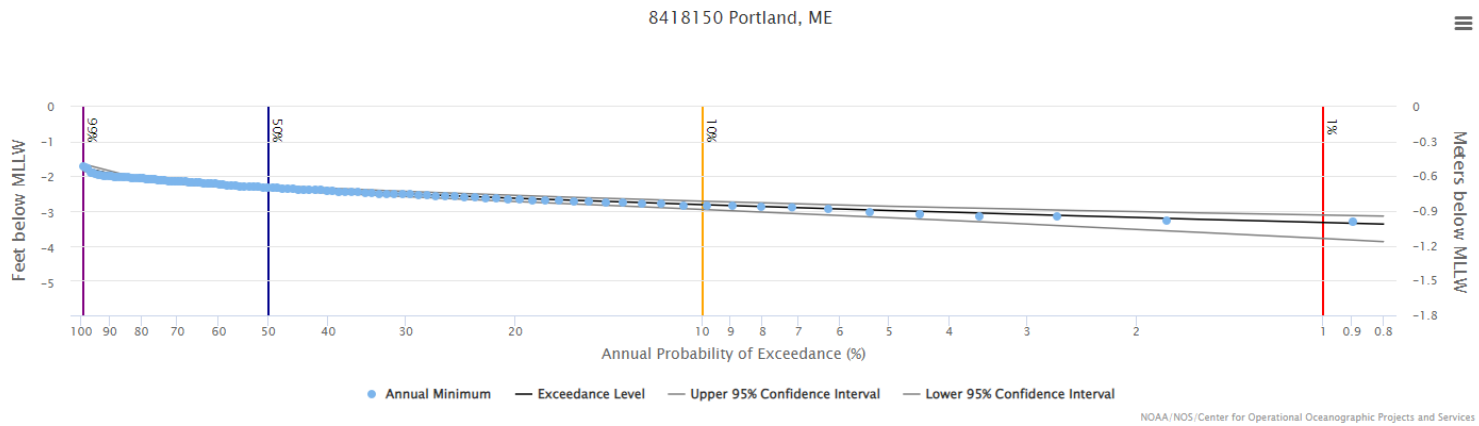
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Sensitivity Review – High Tailwater Conditions

Mean Higher High Water (MHHW) = 4.65 ft NAVD88

1% AEP High Tide (95% CI) = 9.55 ft NAVD88





The 1% annual exceedance probability levels are 1.23 meters (4.04 feet) above Mean Higher High Water and -1 meters (-3.28 feet) below Mean Lower Low Water.

Methods and Limitations

The exceedance probability curves were calculated using the Extremes Toolkit software package which fits the Generalized Extreme Value (GEV) probability distribution function to annual maximum or annual minimum data.

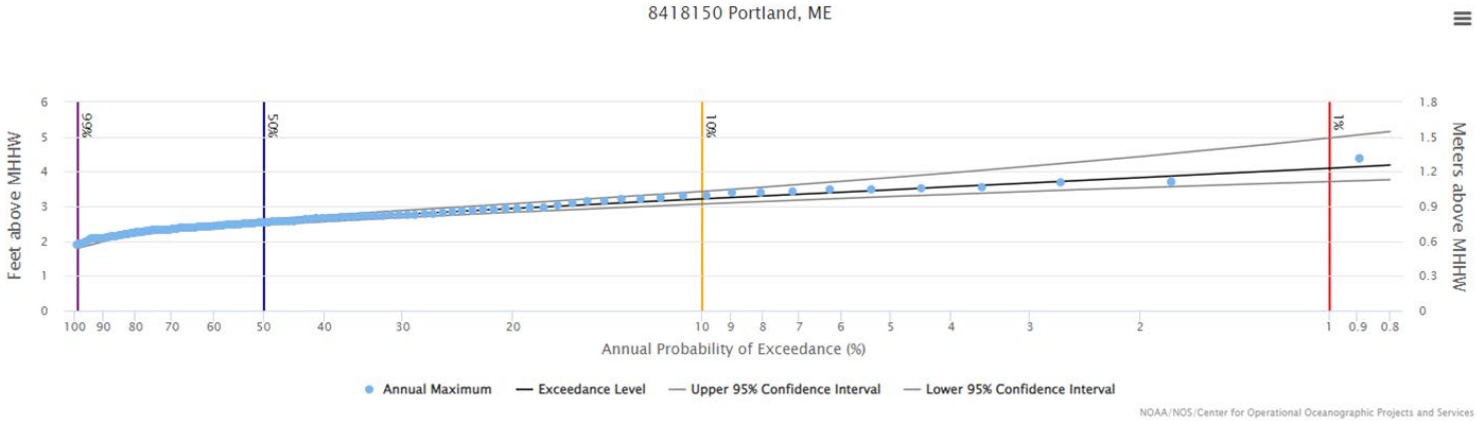
The spread of the 95% confidence intervals depends on the variability of the source data and the length of the series used. For more extreme annual exceedance probability levels, the 95% confidence interval increases and should always be

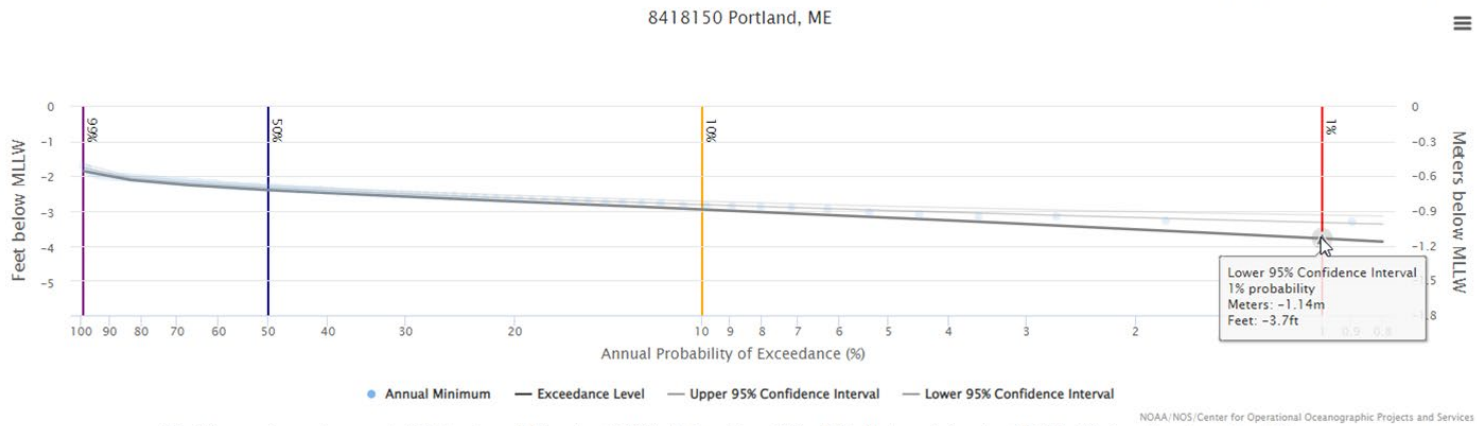
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Sensitivity Review – High Tailwater Conditions

Mean Lower Low Water (MLLW) = -5.26 ft NAVD88

1% AEP Low Tide (95% CI) = -8.96 ft NAVD88



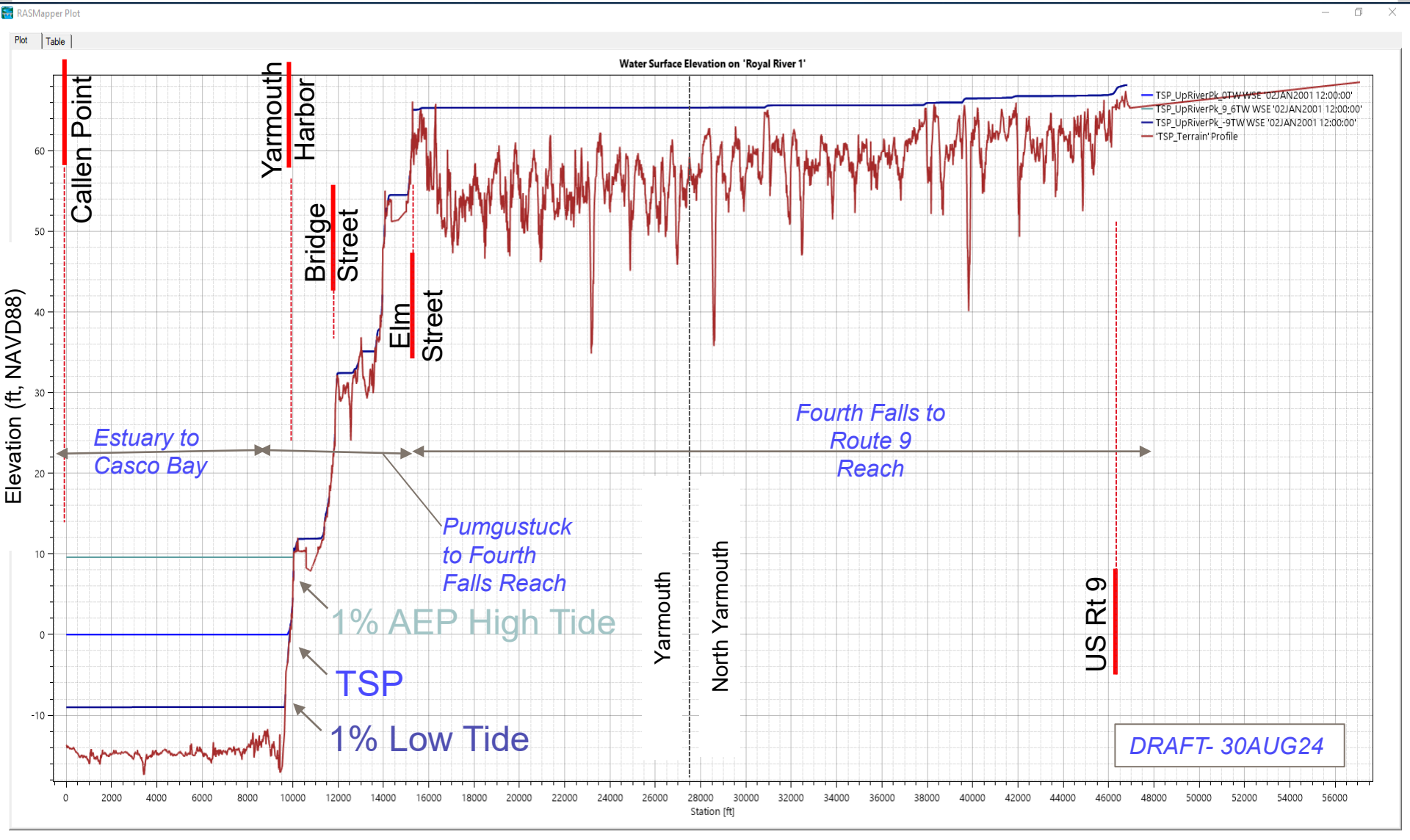


The 1% annual exceedance probability levels are 1.23 meters (4.04 feet) above Mean Higher High Water and -1 meters (-3.28 feet) below Mean Lower Low Water.

Methods and Limitations

The exceedance probability curves were calculated using the Extremes Toolkit software package which fits the Generalized Extreme Value (GEV) probability distribution function to annual maximum or annual minimum data.

WATER SURFACE PROFILE COMPARISON – UPRIVER PEAK MIGRATION - 95% EXCEEDANCE – TAILWATER SENSITIVITY



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

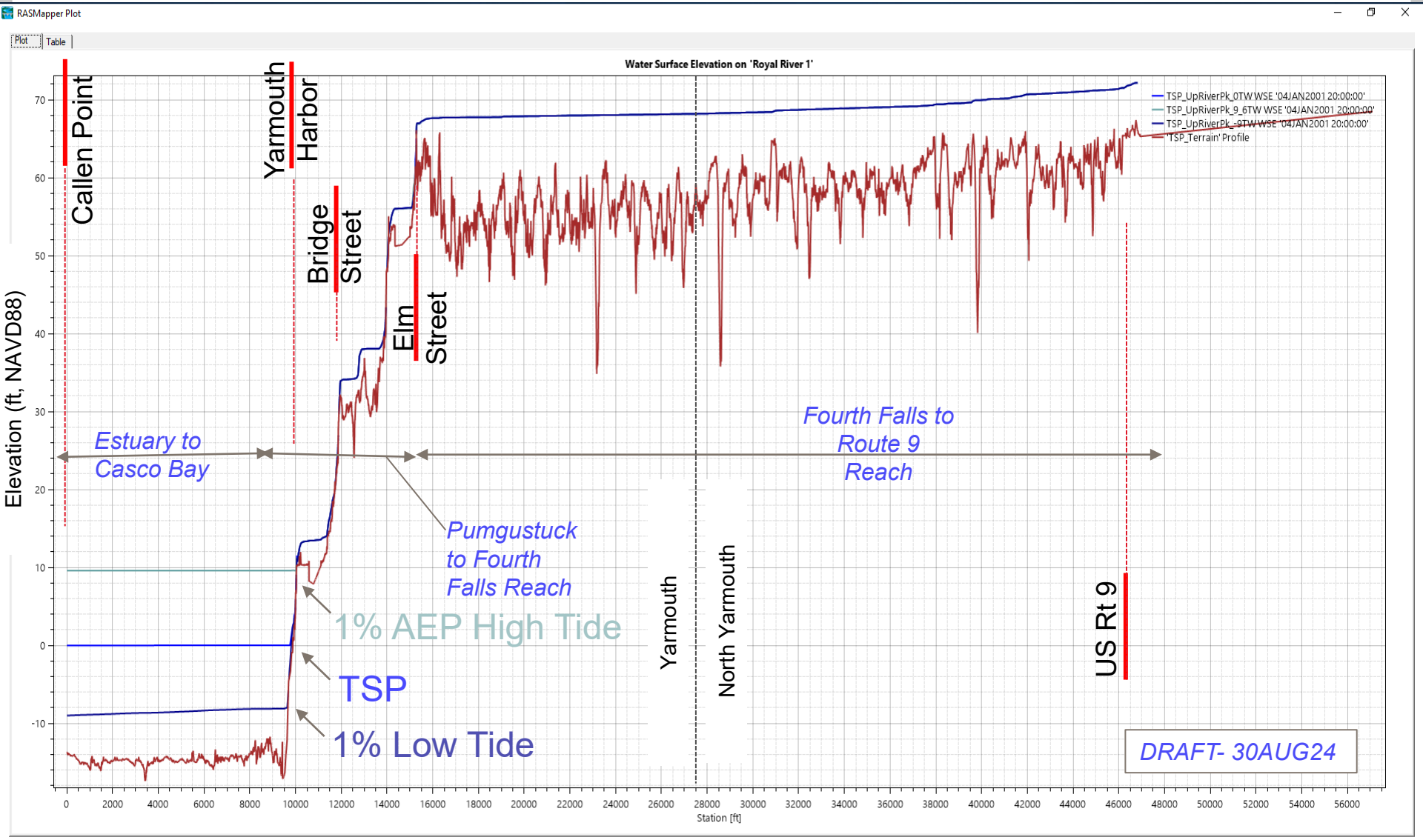
Upriver Peak Migration 95% Exceedance Tailwater Sensitivity Results

- 1% AEP Downstream High Tide (9.6 ft NAVD88)
- TSP (0 ft NAVD88)
- 1% AEP Downstream Low Tide (-9 ft NAVD88)

Location	Station (feet)	TSP 9.6 TW - TSP 0 TW	TSP -9 TW - TSP 0 TW	TSP_UpRiverPk_0TW WSE '02JAN2001 12:00:00' (ft, NAVD88)	TSP_UpRiverPk_9_6TW WSE '02JAN2001 12:00:00' (ft, NAVD88)	TSP_UpRiverPk_-9TW WSE '02JAN2001 12:00:00' (ft, NAVD88)
U/s end of model	46,822	0.0	0.0	68.1	68.1	68.1
Toddy Brook	38,266	0.0	0.0	65.9	65.9	65.9
Elm Street	15,500	0.0	0.0	65.1	65.1	65.1
US Rt 1	12,600	0.0	0.0	32.5	32.5	32.5
u/s Bridge Street Dam	11,962	0.0	0.0	32.3	32.3	32.3
USGS Gage	10,133	0.0	0.0	11.0	11.0	11.0
D/S end of model	0	9.6	-9.0	0.0	9.6	-9.0

DRAFT- 30AUG24

WATER SURFACE PROFILE COMPARISON – UPRIVER PEAK MIGRATION - 5% EXCEEDANCE – TAILWATER SENSITIVITY



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Upriver Peak Migration 5% Exceedance Tailwater Sensitivity Results

- 1% AEP Downstream High Tide (9.6 ft NAVD88)
- TSP (0 ft NAVD88)
- 1% AEP Downstream Low Tide (-9 ft NAVD88)

Location	Station (ft)	TSP_UpRiverPk_9_6TW - TSP_UpRiverPk_0TW (ft)	TSP_UpRiverPk_-9TW - TSP_UpRiverPk_0TW (ft)	TSP_UpRiverPk_0TW WSE '04JAN2001 20:00:00' (ft, NAVD88)	TSP_UpRiverPk_9_6TW WSE '04JAN2001 20:00:00' (ft, NAVD88)	TSP_UpRiverPk_-9TW WSE '04JAN2001 20:00:00' (ft, NAVD88)
U/s end of model	46,822	0.0	0.0	72.2	72.2	72.2
Toddy Brook	38,266	0.0	0.0	69.4	69.4	69.4
Elm Street	15,500	0.0	0.0	67.2	67.2	67.2
US Rt 1	12,600	0.0	0.0	34.3	34.2	34.2
u/s Bridge Street Dam	11,962	0.0	0.0	33.9	33.9	33.9
USGS Gage	10,133	-0.1	-0.1	11.6	11.5	11.5
D/S end of model	0	9.6	-9.0	0.0	9.6	-9.0

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Sensitivity Review

- Manning's n Roughness Low/High
- Water Surface centerline profiles

Modeled Event	Results Time	Peak Discharge (cfs)
7Q10	04JAN2001 20:00:00	25
Annual Median Flows	Max	120
95% Exceedance MidMay-MidJune	02JAN2001 12:00:00	62
5% Exceedance MidMay-MidJune	04JAN2001 20:00:00	641
50% AEP	04JAN2001 20:00:00	3,643
10% AEP	04JAN2001 20:00:00	6,480
1%AEP	15DEC2019 12:00:00	10,419
10-22DEC2019 Validation	15DEC2019 12:00:00	4,300

- Geometry:
  - Existing
  - TSP

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Manning's n Roughness Typical Ranges (HEC-RAS 2D User's Manual)

NLCD Value	n Value Range	Description	NLCD Value	n Value Range	Description
11	0.025 - 0.05	**Open Water-** areas of open water, generally with less than 25% cover of vegetation or soil. This is for natural streams on mild to moderate slopes.	42	0.08 - 0.16	**Evergreen Forest-** areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
12	n/a	**Perennial Ice/Snow-** areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.	43	0.08 - 0.20	**Mixed Forest-** areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
21	0.03 - 0.05	**Developed, Open Space-** areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	52	0.07 - 0.16	**Shrub/Scrub-** areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
22	0.06 - 0.12	**Developed, Low Intensity-** areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	71	0.025 - 0.05	**Grassland/Herbaceous-** areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
23	0.08 - 0.16	**Developed, Medium Intensity** -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	81	0.025 - 0.05	**Pasture/Hay**-areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
24	0.12 - 0.20	**Developed High Intensity**-highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.	82	0.020 - 0.05	**Cultivated Crops** -areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
31	0.023 - 0.030	**Barren Land (Rock/Sand/Clay)** - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	90	0.045 - 0.15	**Woody Wetlands-** areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
41	0.10 - 0.20	**Deciduous Forest-** areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	95	0.05 - 0.085	**Emergent Herbaceous Wetlands-** Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Typical Manning's n Roughness values for very shallow, sheet flow (≤0.1-ft depth) (from NRCS TR-55)

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover 20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information compiled by Engman (1986).

[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

[3] When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Manning's n Roughness Sensitivity

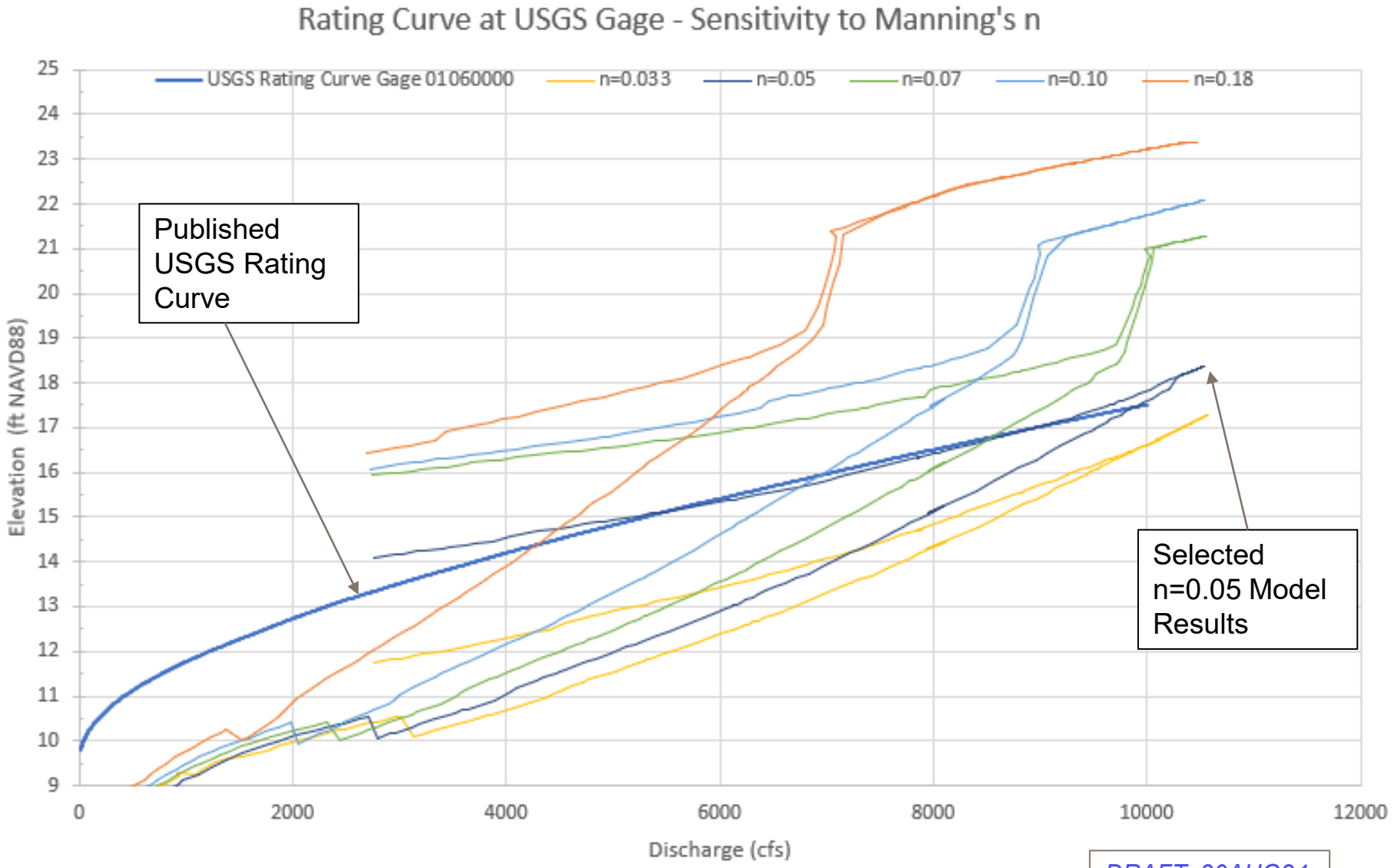
- Existing n values = TSP n values
- High end of range n values x 1.5
- Low end of range n values

FEMA Effective Model Roughness

Flooding Source	Channel "n"	Overbank "n"
Royal River (Downstream) (At Yarmouth)	0.032 - 0.045	0.060 - 0.150

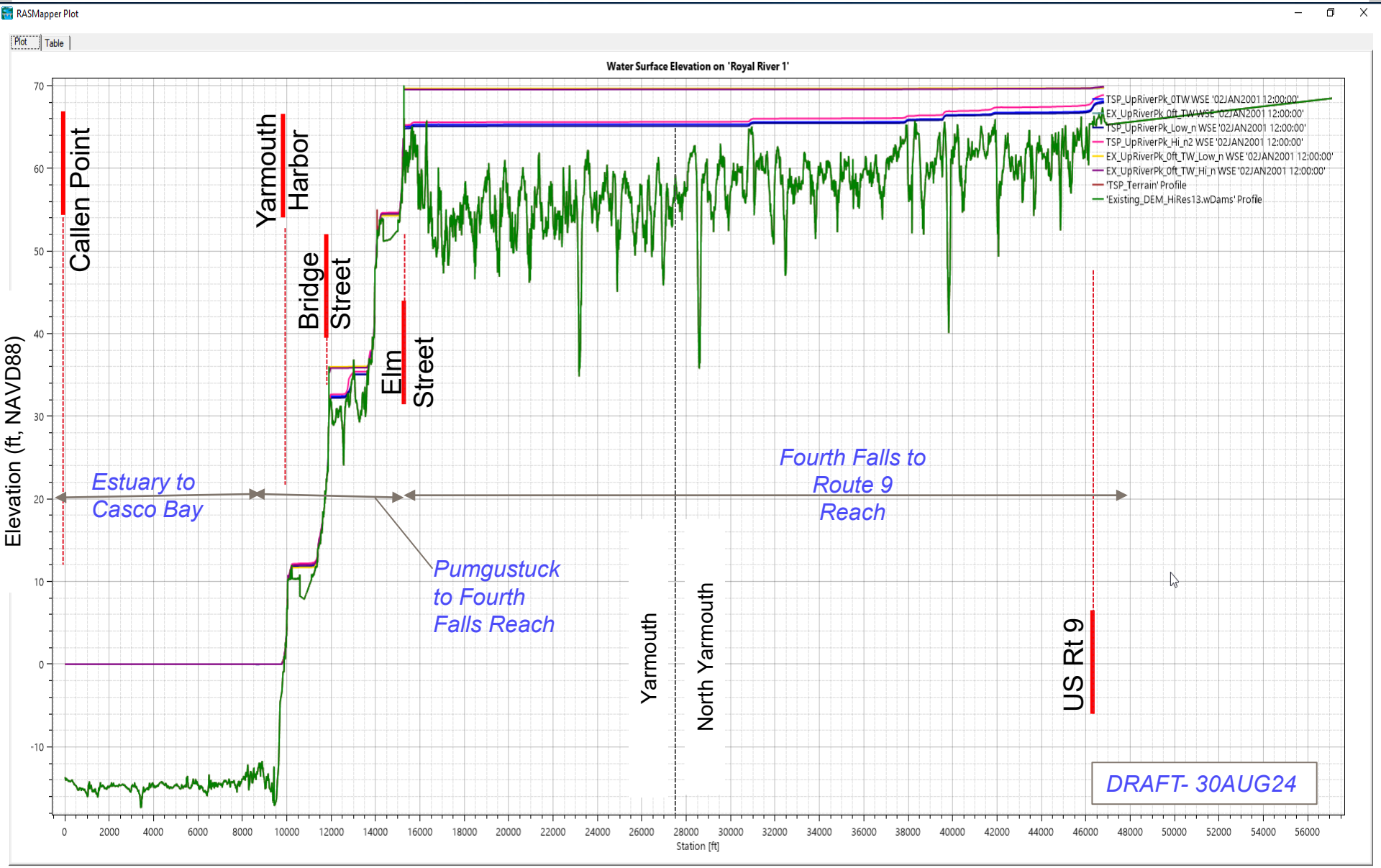
			EX	TSP	EX-Hi	TSP-Hi	EX-Lo	TSP-Lo
		Geometry Name>	Existing_2D_19JUL24	TSP_2D_19JUL24	EX_High_n_sensitivity	TSP_High_n_Sensitivity	EX_Low_n_sensitivity	TSP_Low_n_sensitivity
NLCD Value	Land Use Description	Default	G57	G58	G03	G01	G02	G60
	No Data	0.066						
43	Mixed Forest	0.16	0.16	0.16	0.3	0.3	0.08	0.08
21	Developed, Open Space	0.016	0.016	0.016	0.075	0.075	0.03	0.03
81	Pasture-Hay	0.05	0.05	0.05	0.075	0.075	0.025	0.025
22	Developed, Low Intensity	0.063	0.063	0.063	0.18	0.18	0.06	0.06
23	Developed, Medium Intensity	0.094	0.094	0.094	0.24	0.24	0.08	0.08
90	Woody Wetlands	0.12	0.12	0.12	0.225	0.225	0.045	0.045
42	Evergreen Forest	0.16	0.16	0.16	0.24	0.24	0.08	0.08
41	Deciduous Forest	0.16	0.16	0.16	0.3	0.3	0.1	0.1
31	Barren Land Rock-Sand-Cla6y	0.035	0.035	0.035	0.045	0.045	0.023	0.023
71	Grassland-Herbaceous	0.035	0.035	0.035	0.075	0.075	0.025	0.025
82	Cultivated Crops	0.045	0.045	0.045	0.075	0.075	0.02	0.02
95	Emergent Herbaceeous Wetland	0.15	0.15	0.15	0.225	0.225	0.05	0.05
11	Open Water	0.033	0.033	0.033	0.075	0.075	0.025	0.025
24	Develop, High Intensity	0.125	0.125	0.125	0.3	0.3	0.12	0.12
52	Shrub-Scrub	0.07	0.07	0.07	0.24	0.24	0.07	0.07
	openwater (custom channel / calibration regions)	0.033	0.033/0.05	0.033/0.05	0.075	0.075	0.025	0.025

INITIAL CALIBRATION – MANNING'S N CALIBRATION ZONES



DRAFT- 30AUG24

WATER SURFACE PROFILE COMPARISON – UPRIVER PEAK MIGRATION - 95% EXCEEDANCE – MANNING'S N SENSITIVITY



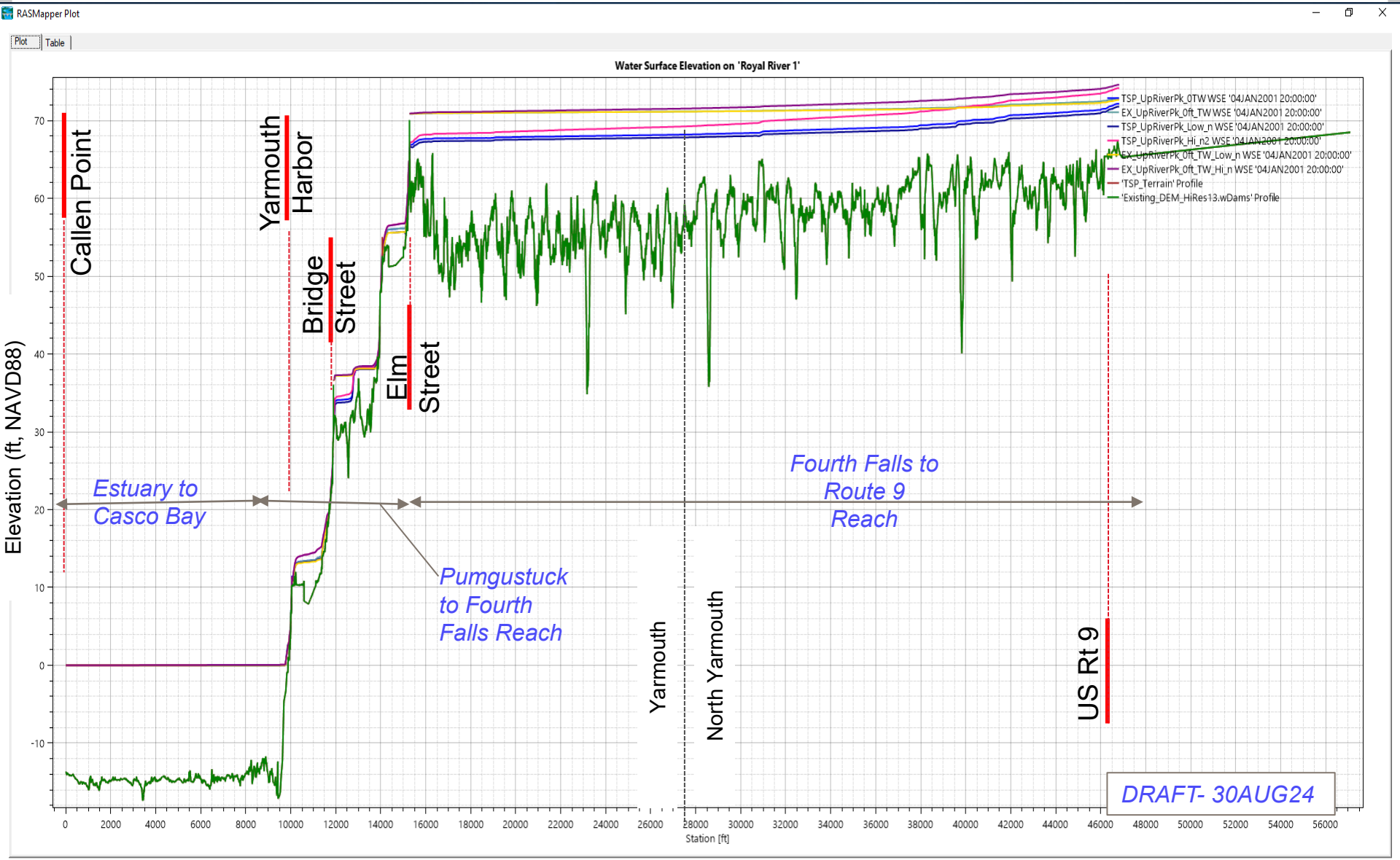
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Upriver Peak Migration 95% Exceedance Manning's n Roughness Sensitivity Results

- Existing n values = TSP n values
- High end of range n values x 1.5
- Low end of range n values

Location	Station (ft)	TSP High n - TSP (ft)	TSP Low n - TSP (ft)	EX Hi n - EX (ft)	Ex Low n – EX (ft)	TSP-EX (ft)	TSP Hi - EX Hi (Departure) (ft)	TSP Lo - EX Lo (Departure) (ft)
U/s end of model	46,822	**0.8**	**-0.2**	**0.2**	0.0	-1.6	-1.0 (+0.6)	-1.8 (-0.2)
Toddy Brook	38,266	0.4	-0.1	0.0	0.1	-3.7	-3.2 (+0.5)	-3.9 (-0.2)
Elm Street	15,500	0.2	-0.2	-0.1	0.1	-4.5	-4.3 (+0.2)	-4.8 (-0.3)
US Rt 1	12,600	0.3	-0.2	-0.1	0.0	-3.5	-3.1 (+0.4)	-3.7 (-0.2)
u/s Bridge Street Dam	11,962	0.2	-0.2	-0.1	0.0	-3.7	-3.3 (+0.4)	-3.9 (-0.2)
USGS Gage	10,133	0.2	-0.1	0.2	-0.1	0.1	0.1 (0)	0.1 (0)
D/S end of model	0	0.0	0.0	0.0	0.0	0.0	0.0 (0)	0.0 (0)

WATER SURFACE PROFILE COMPARISON – UPRIVER PEAK MIGRATION - 5% EXCEEDANCE – MANNING'S N SENSITIVITY



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Upriver Peak Migration 5% Exceedance Manning's n Roughness Sensitivity Results

- Existing n values = TSP n values
- High end of range n values x 1.5
- Low end of range n values

Location	Station (ft)	TSP High n - TSP (ft)	TSP Low n - TSP (ft)	EX Hi n - EX (ft)	Ex Low n – EX (ft)	TSP-EX (ft)	TSP Hi - EX Hi (Departure) (ft)	TSP Lo - EX Lo (Departure) (ft)
U/s end of model	46,822	**2.0**	-0.4	**1.7**	**-0.2**	-0.7	-0.4 (+0.3)	-0.8 (-0.1)
Toddy Brook	38,266	1.8	-0.4	0.9	-0.1	-2.2	-1.4 (+0.8)	-2.5 (-0.3)
Elm Street	15,500	0.3	-0.4	0.1	0.0	-3.6	-3.4 (+0.2)	-4.1 (-0.5)
US Rt 1	12,600	0.6	-0.3	0.1	-0.1	-3.0	-2.5 (+0.5)	-3.3 (-0.3)
u/s Bridge Street Dam	11,962	0.4	**-0.5**	0.0	-0.1	-3.3	-3.0 (+0.3)	-3.8 (-0.5)
USGS Gage	10,133	0.2	-0.1	0.3	0.0	0.1	0.0 (-0.1)	0.1 (0)
D/S end of model	0	0.0	0.0	0.0	0.0	0.0	0.0 (0)	0.0 (0)

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SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

"All Muck" Sensitivity Review – Uncertainty in Bottom Conditions Immediately Upstream/Under Elm Street Dam

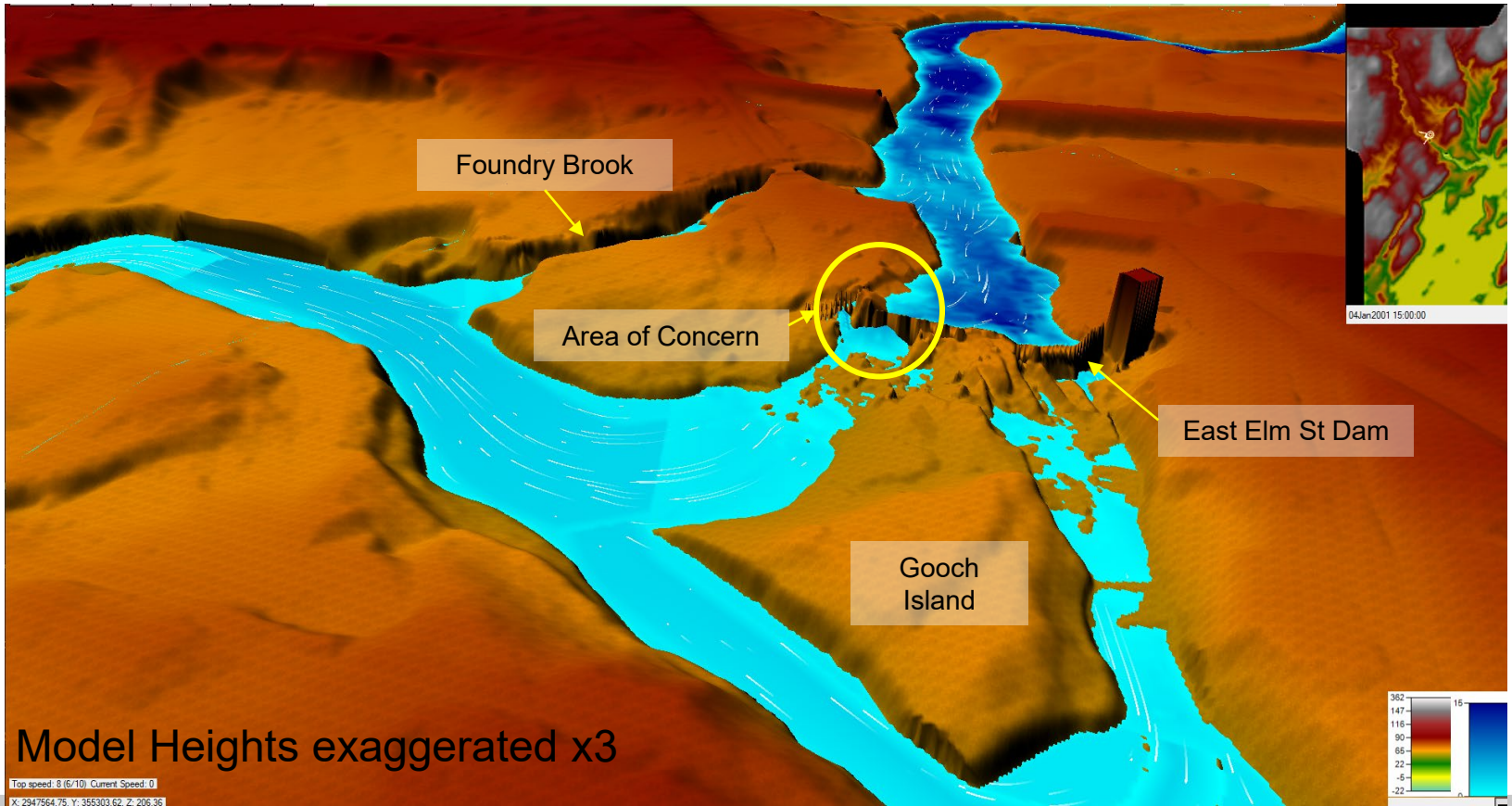
- Water Surface centerline profiles
- Depth/Inundation Comparisons

Modeled Event	Results Time	Peak Discharge (cfs)
7Q10	04JAN2001 20:00:00	25
Annual Median Flows	Max	120
95% Exceedance MidMay-MidJune	02JAN2001 12:00:00	62
5% Exceedance MidMay-MidJune	04JAN2001 20:00:00	641
50% AEP	04JAN2001 20:00:00	3,643
10% AEP	04JAN2001 20:00:00	6,480
1%AEP	15DEC2019 12:00:00	10,419
10-22DEC2019 Validation	15DEC2019 12:00:00	4,300

- Geometry:
  - Existing
  - TSP
  - "All Muck"

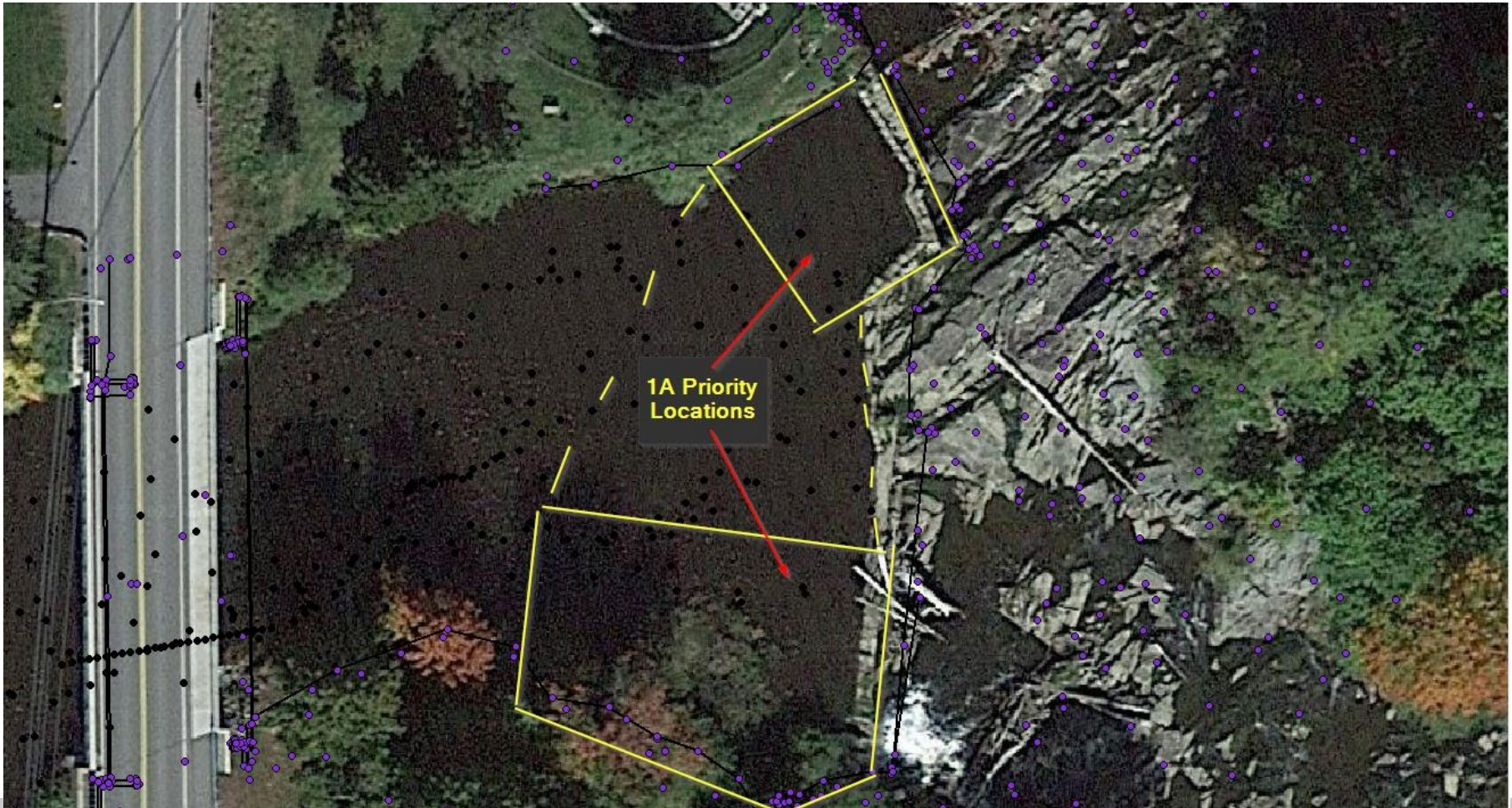
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

"All Muck" Sensitivity Review – Uncertainty in Bottom Conditions Immediately Upstream/Under Elm Street Dam



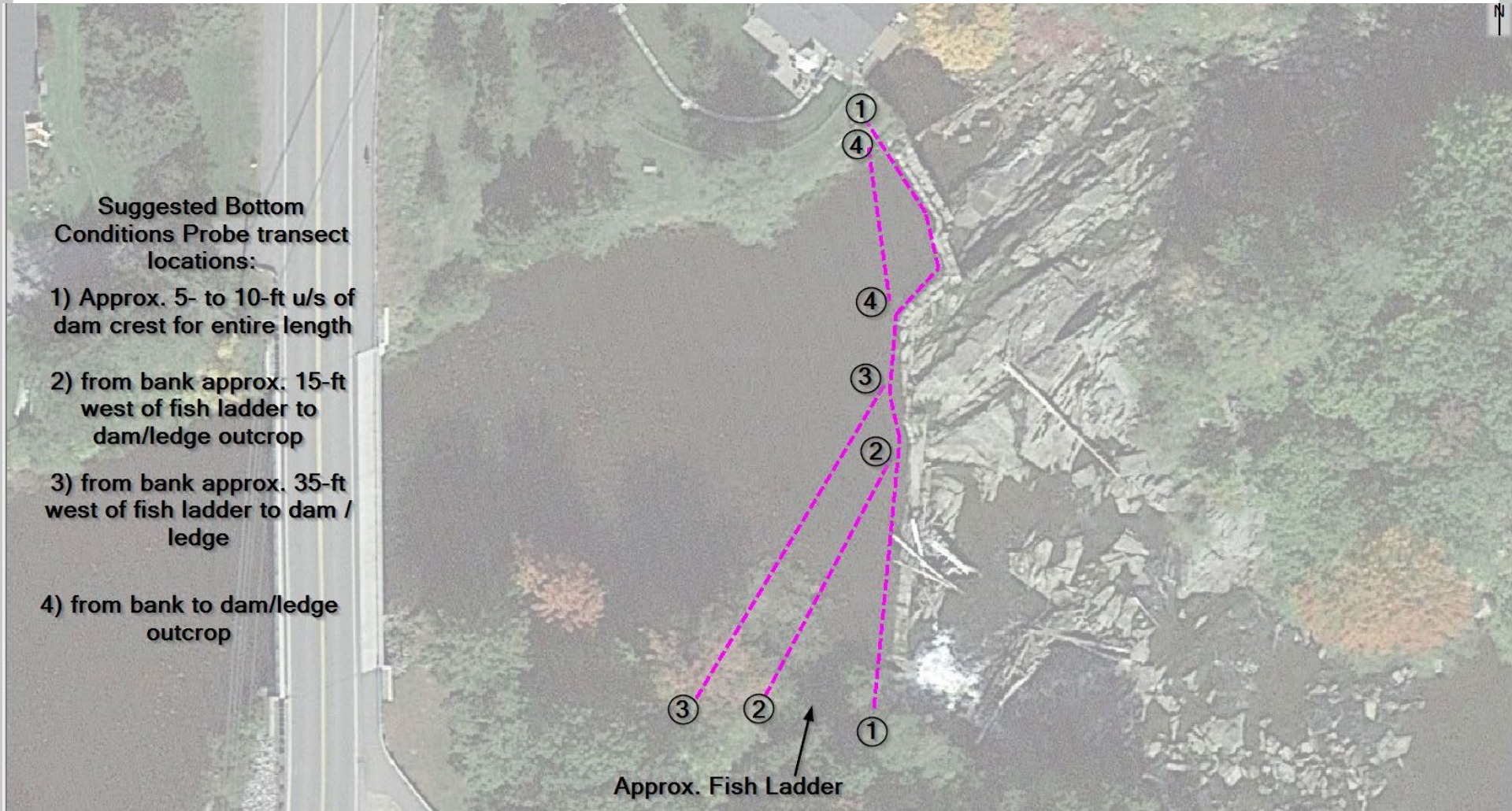
SENSITIVITY REVIEW – BOTTOM CONDITIONS IMMEDIATELY UPSTREAM / UNDER ELM STREET DAM "ALL MUCK"

Limited Bathymetry & Unknown Bottom Conditions



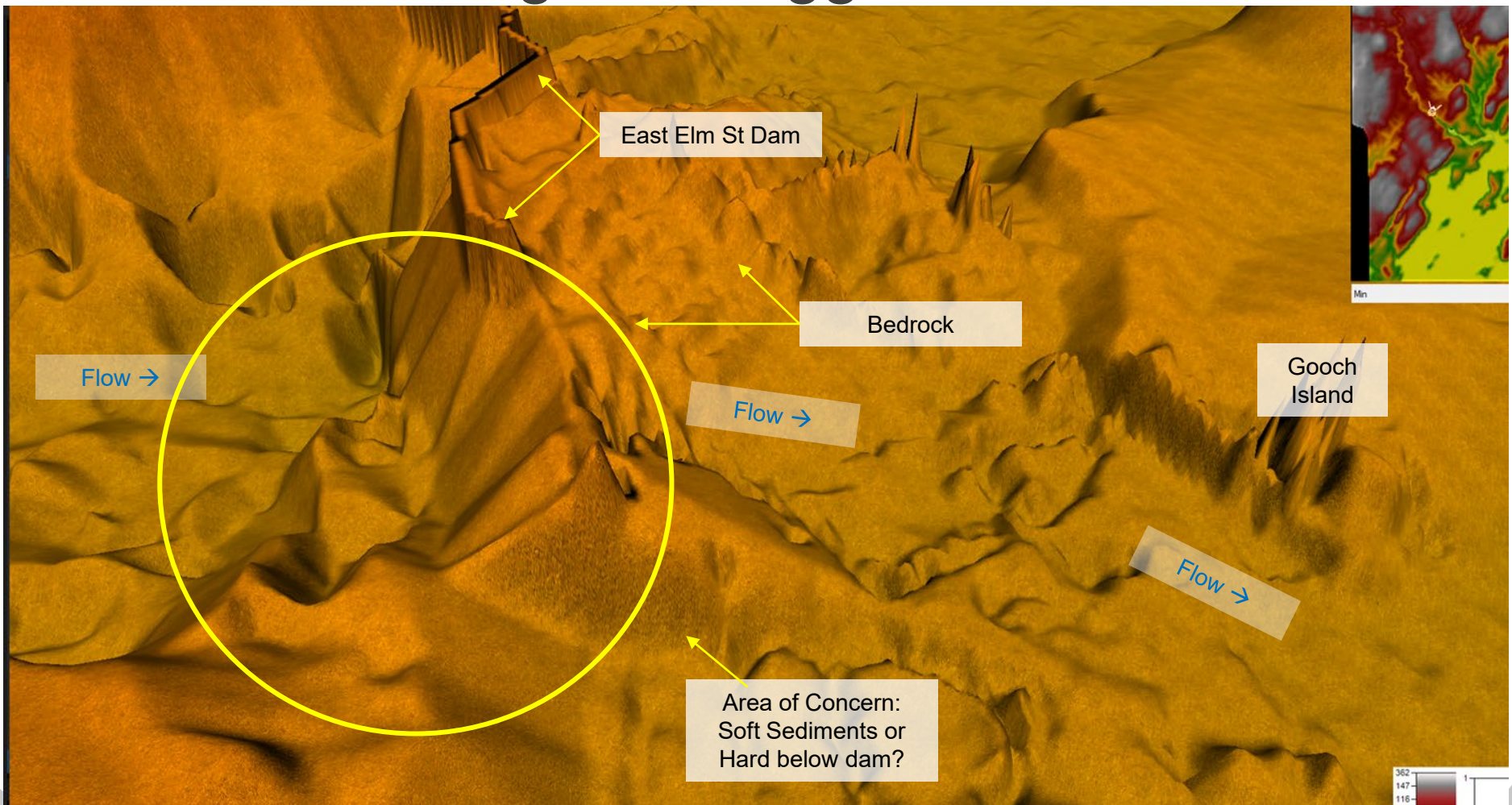
SENSITIVITY REVIEW – BOTTOM CONDITIONS IMMEDIATELY UPSTREAM / UNDER ELM STREET DAM "ALL MUCK"

Requested Probe Transects – Contracted but Unable to be collected safely during this study

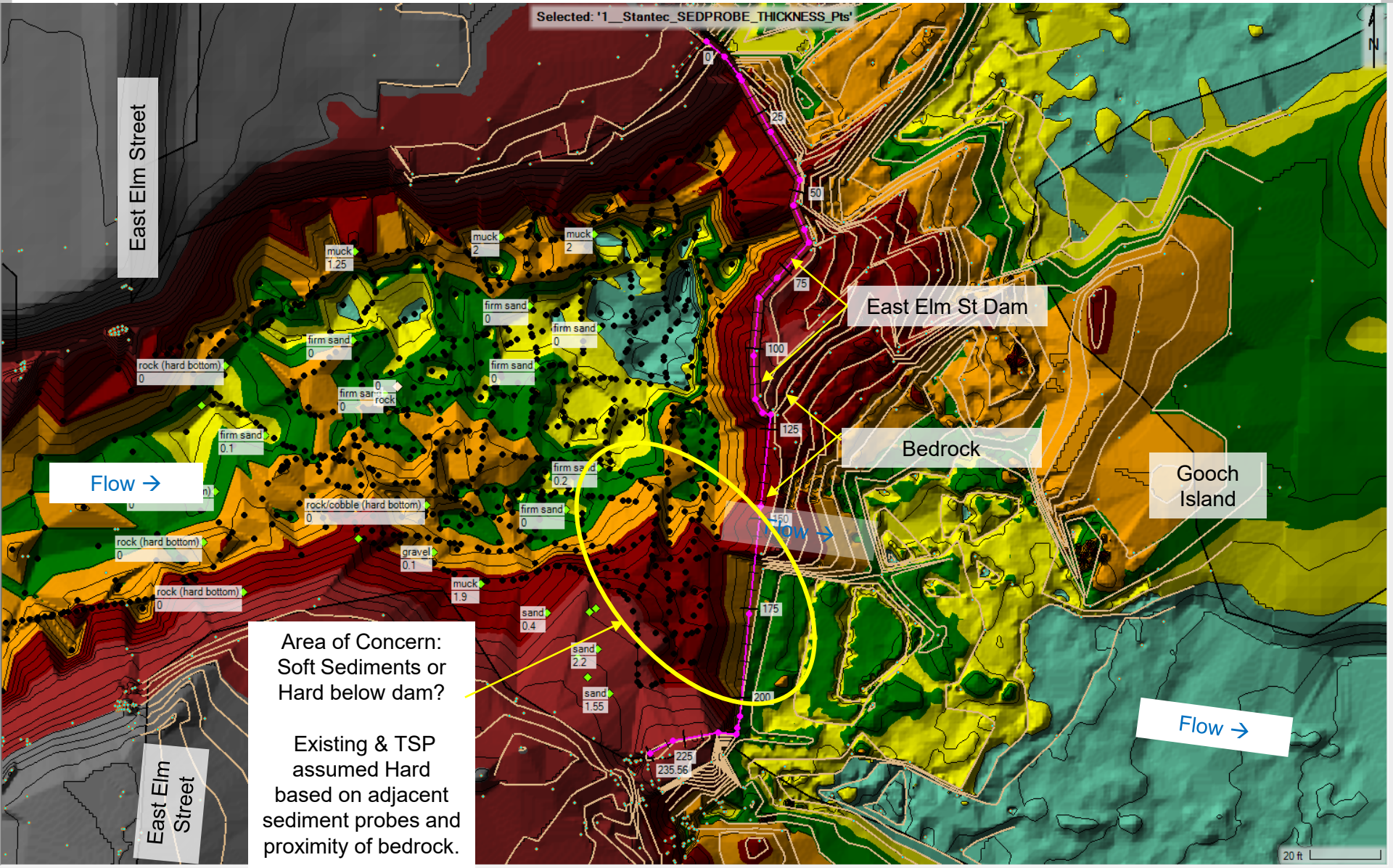


SENSITIVITY REVIEW – 3D VIEW OF TERRAIN IMMEDIATELY UPSTREAM/UNDER ELM STREET DAM

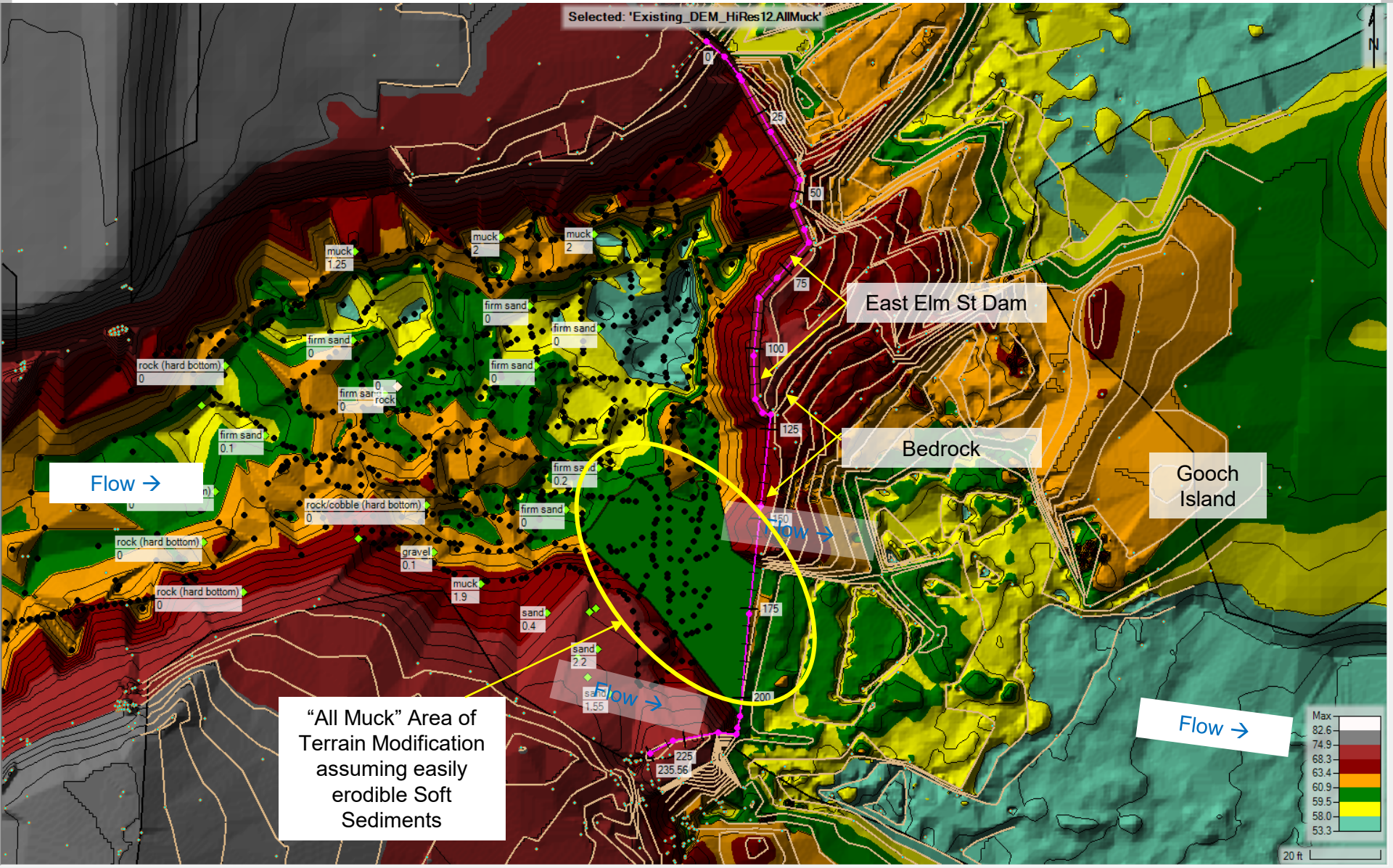
TSP Model Heights Exaggerated x3



SENSITIVITY REVIEW –TERRAIN IMMEDIATELY UPSTREAM/UNDER ELM STREET DAM – EX & TSP TERRAIN

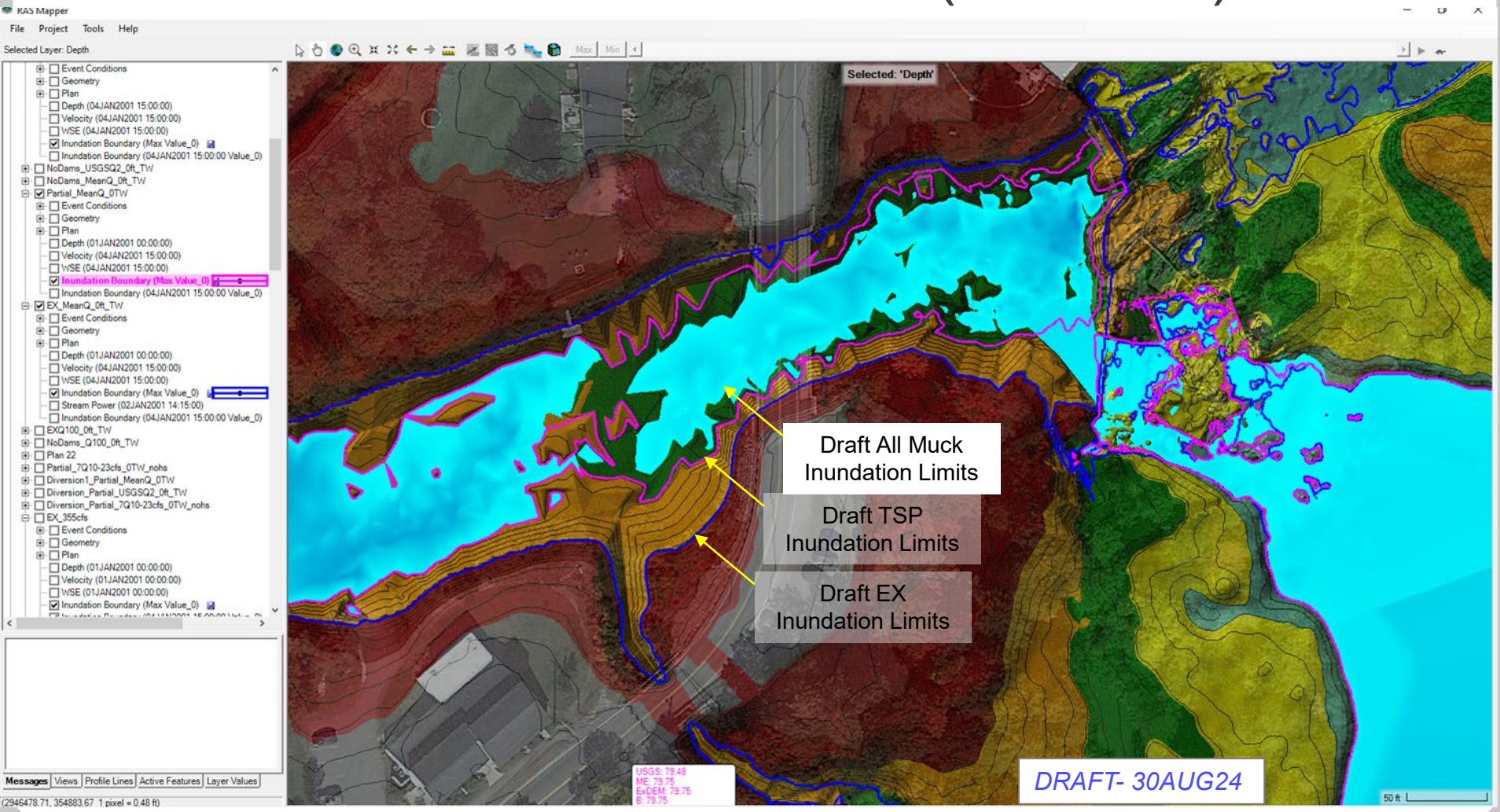


SENSITIVITY REVIEW –TERRAIN IMMEDIATELY UPSTREAM/UNDER ELM STREET DAM – “ALL MUCK” TERRAIN MODIFICATION



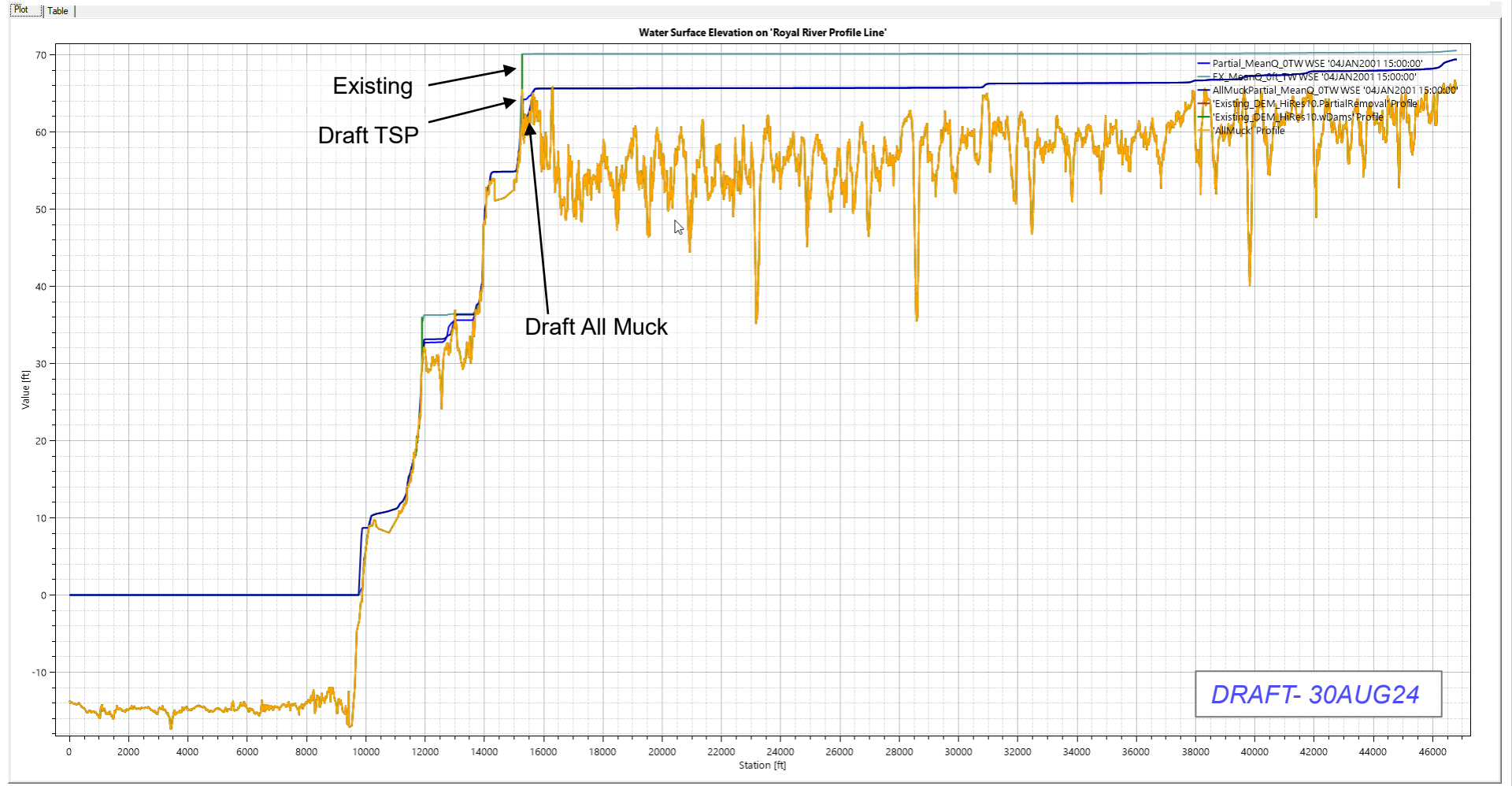
SENSITIVITY REVIEW – BOTTOM CONDITIONS IMMEDIATELY UPSTREAM/UNDER ELM STREET DAM "ALL MUCK"

Depth/Inundation Comparisons
- Annual Median - "All Muck" (archived)



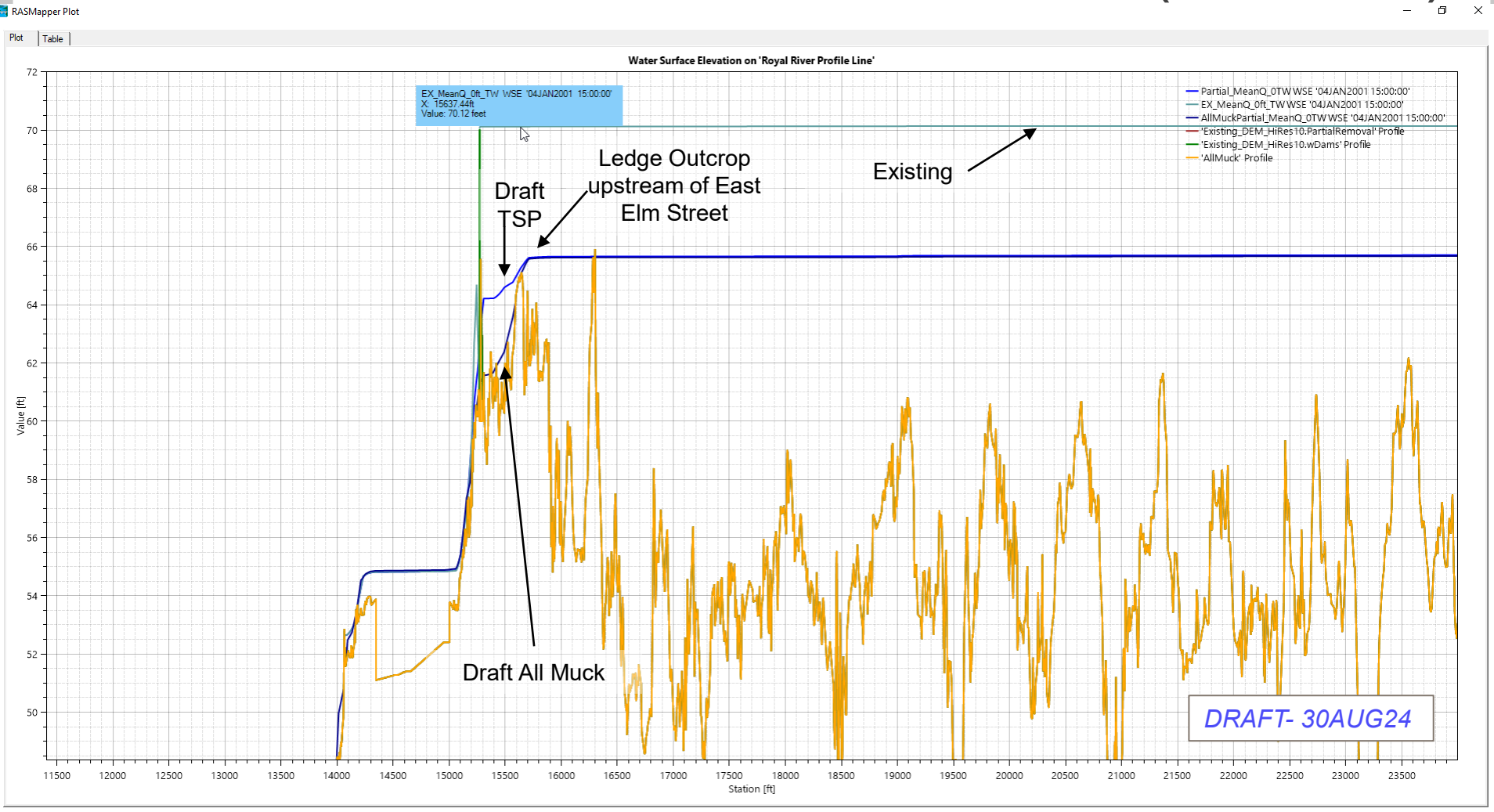
SENSITIVITY REVIEW – BOTTOM CONDITIONS IMMEDIATELY UPSTREAM/UNDER ELM STREET DAM "ALL MUCK"

DRAFT "All Muck" Water Surface Profile Comparisons - Annual Median (archived)



SENSITIVITY REVIEW – BOTTOM CONDITIONS IMMEDIATELY UPSTREAM/UNDER ELM STREET DAM "ALL MUCK"

DRAFT Water Surface Profile Comparisons - Annual Median – Elm Street Detail (archived)



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development

- 6 Concepts; first presented (MF5) integrated into TSP
- Depth/Inundation Comparisons
- Velocity/Inundation Comparisons

Modeled Event	Results Time	Peak Discharge (cfs)
7Q10	04JAN2001 20:00:00	25
Annual Median Flows	Max	120
95% Exceedance MidMay-MidJune	02JAN2001 12:00:00	62
5% Exceedance MidMay-MidJune	04JAN2001 20:00:00	641
50% AEP	04JAN2001 20:00:00	3,643
10% AEP	04JAN2001 20:00:00	6,480
1%AEP	15DEC2019 12:00:00	10,419
10-22DEC2019 Validation	15DEC2019 12:00:00	4,300

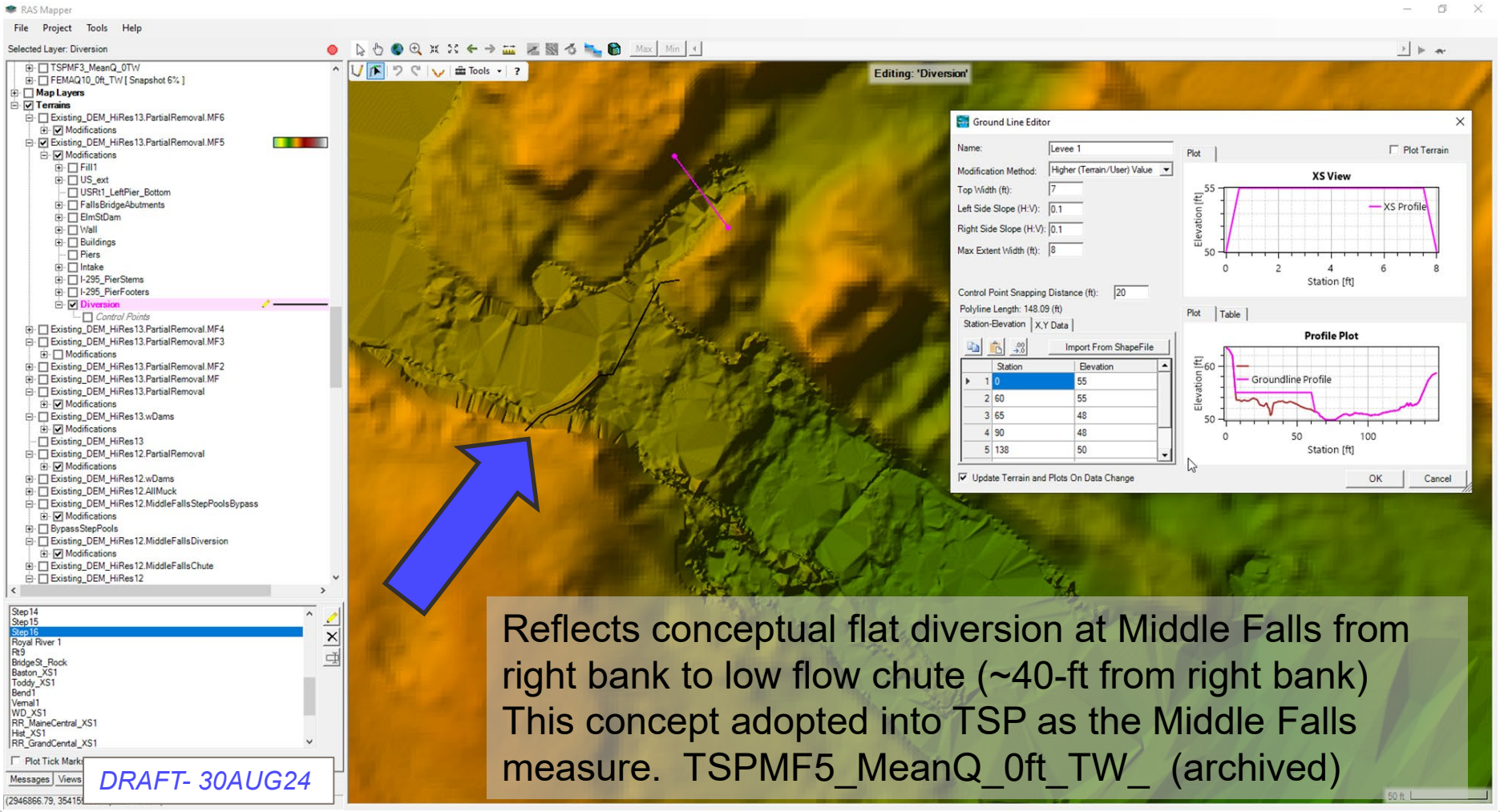
- Geometry:
  - MF Concepts
  - Existing
  - TSP


View from Factory Island, looking up middle falls
Diversion Structure
Larry (for scale)


Crane Pad Area
Drop off makes access challenging
Diversion Strucure
View from Factory Island, looking toward right-descending bank at top of middle falls

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



Reflects conceptual flat diversion at Middle Falls from right bank to low flow chute (~40-ft from right bank) This concept adopted into TSP as the Middle Falls measure. TSPMF5_MeanQ_0ft_TW_ (archived)

Middle Falls – Flow Diversion Concept Development

Depth Check

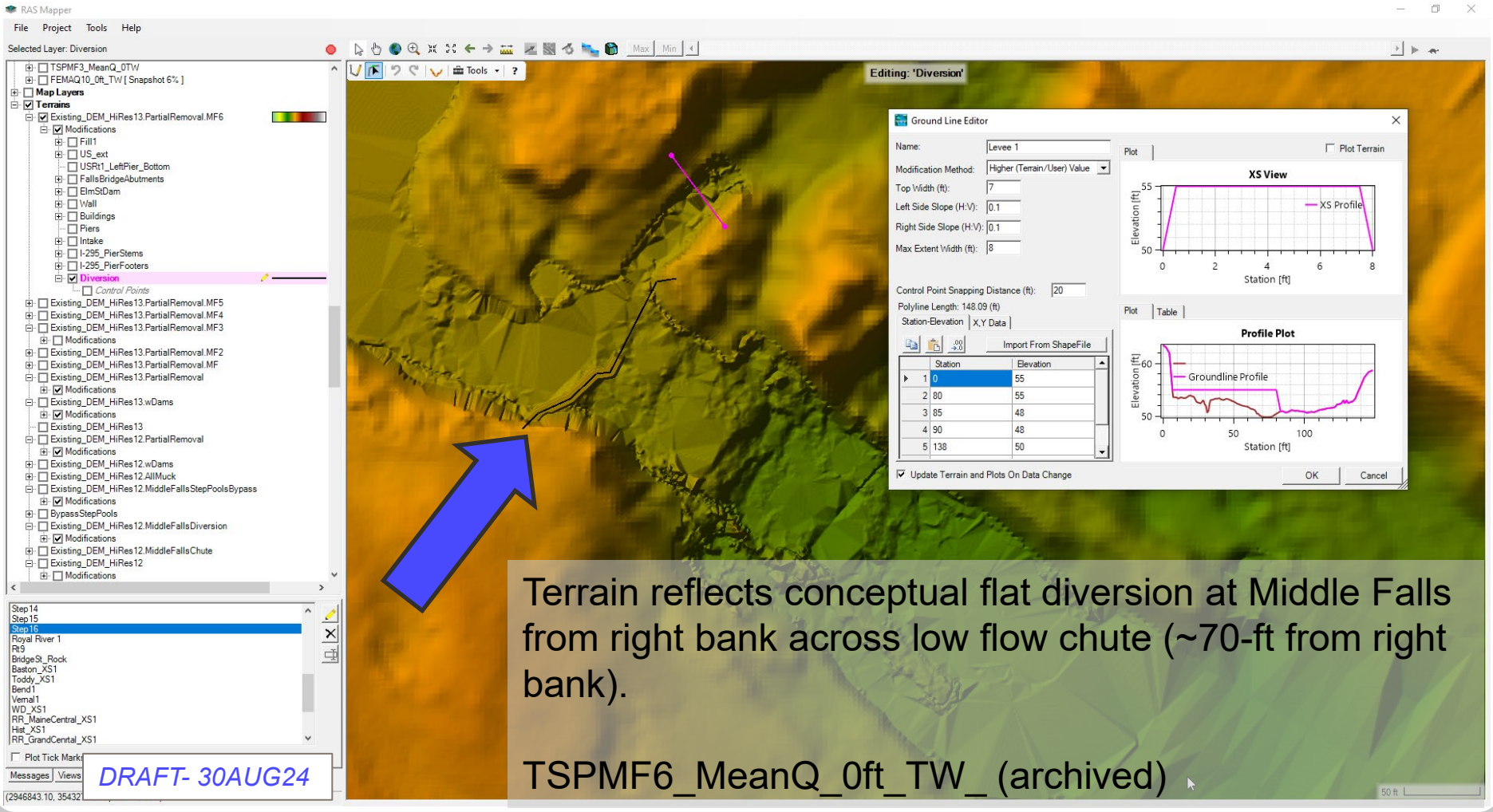
Reflects conceptual flat diversion at Middle Falls from right bank to low flow chute (~40-ft from right bank) This concept adopted into TSP as the Middle Falls measure.

TSPMF5_MeanQ_0ft_TW_ (archived)

Peak Migration 95% Exceedance = 62 cfs total Royal River flow

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development

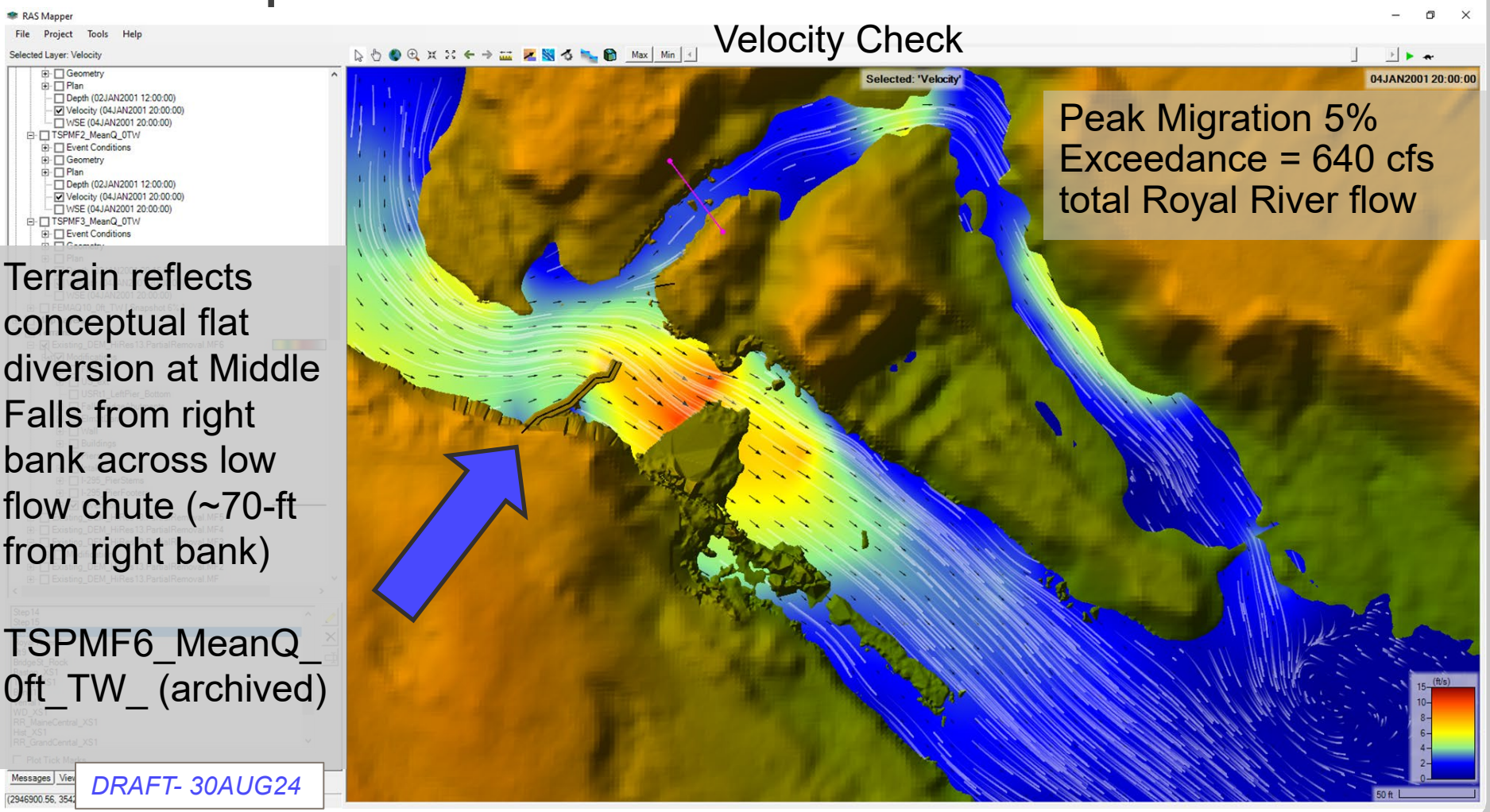


Terrain reflects conceptual flat diversion at Middle Falls from right bank across low flow chute (~70-ft from right bank).

TSPMF6_MeanQ_0ft_TW_ (archived)

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



Velocity Check

Peak Migration 5% Exceedance = 640 cfs total Royal River flow

Terrain reflects conceptual flat diversion at Middle Falls from right bank across low flow chute (~70-ft from right bank)

TSPMF6_MeanQ_0ft_TW_ (archived)

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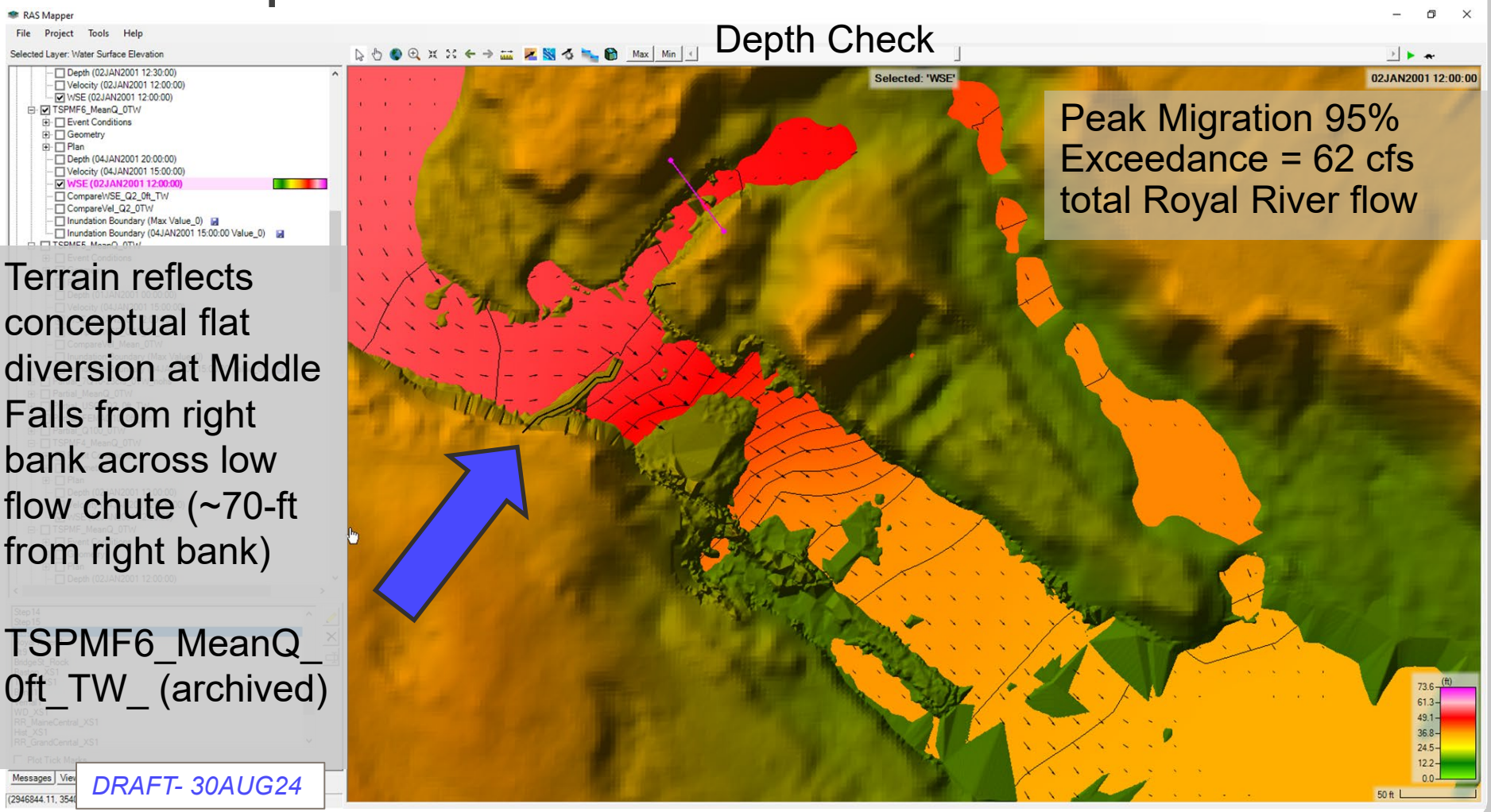
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



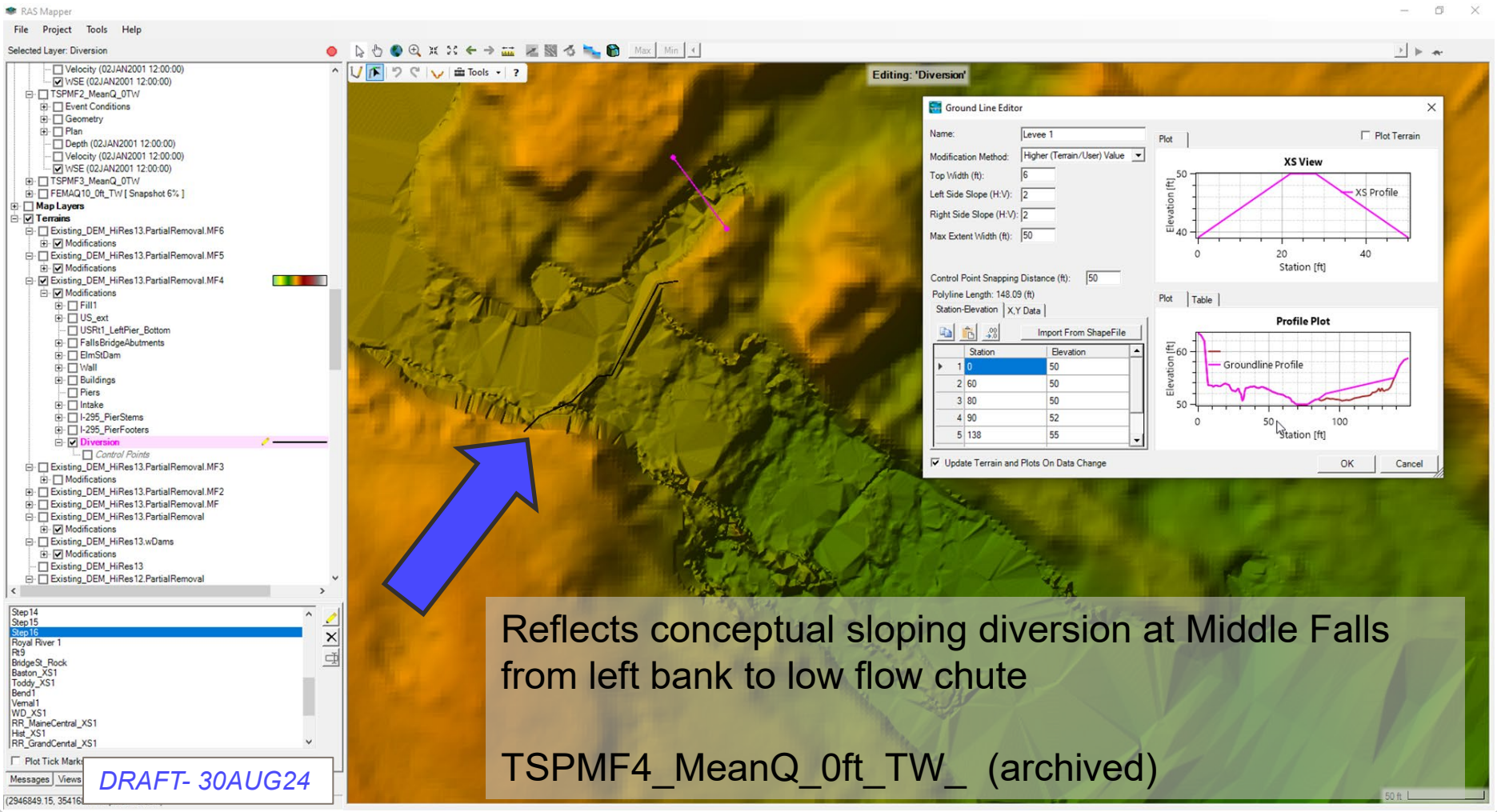
Terrain reflects conceptual flat diversion at Middle Falls from right bank across low flow chute (~70-ft from right bank)

TSPMF6_MeanQ_0ft_TW_ (archived)

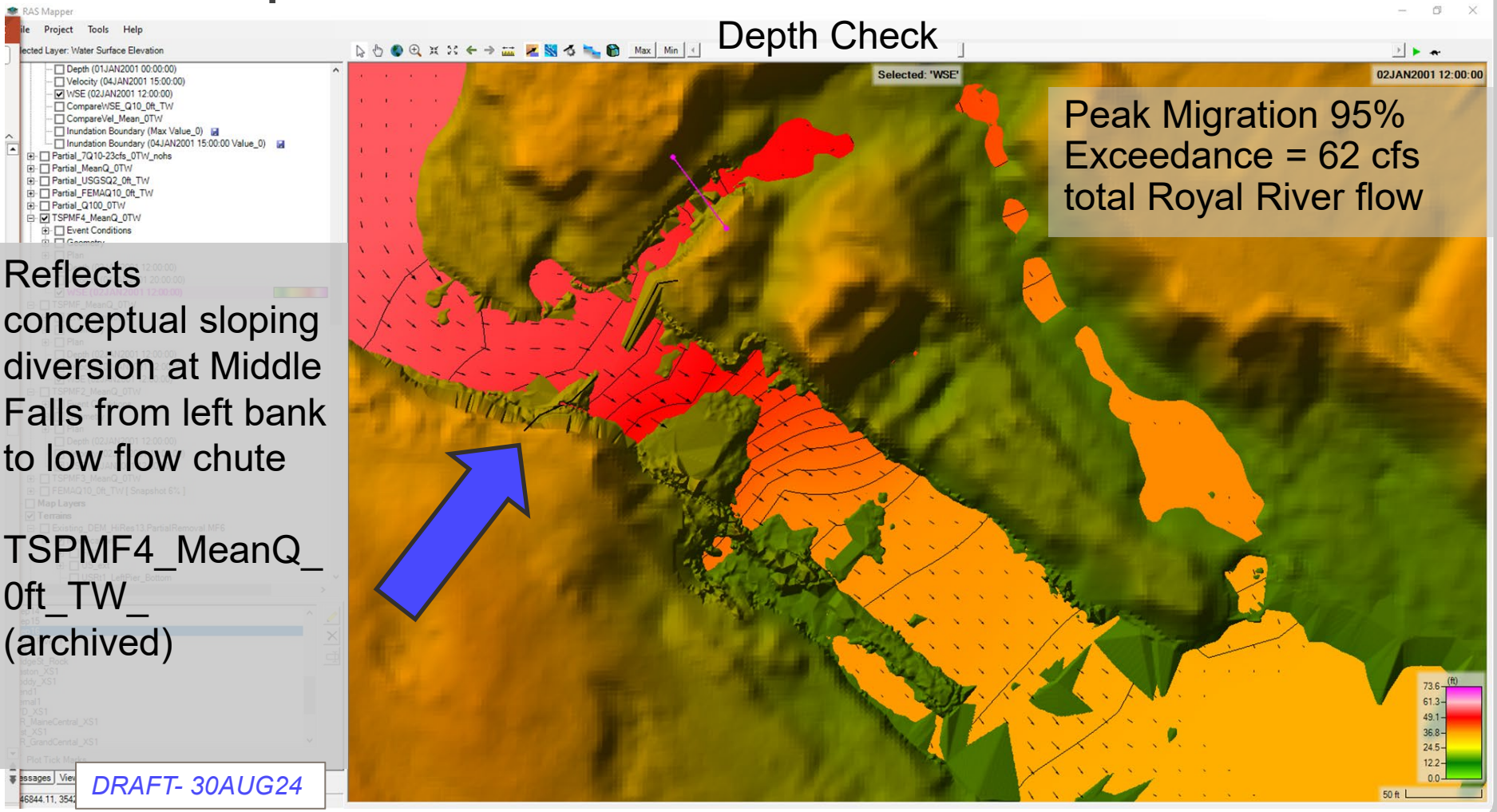
DRAFT- 30AUG24

SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

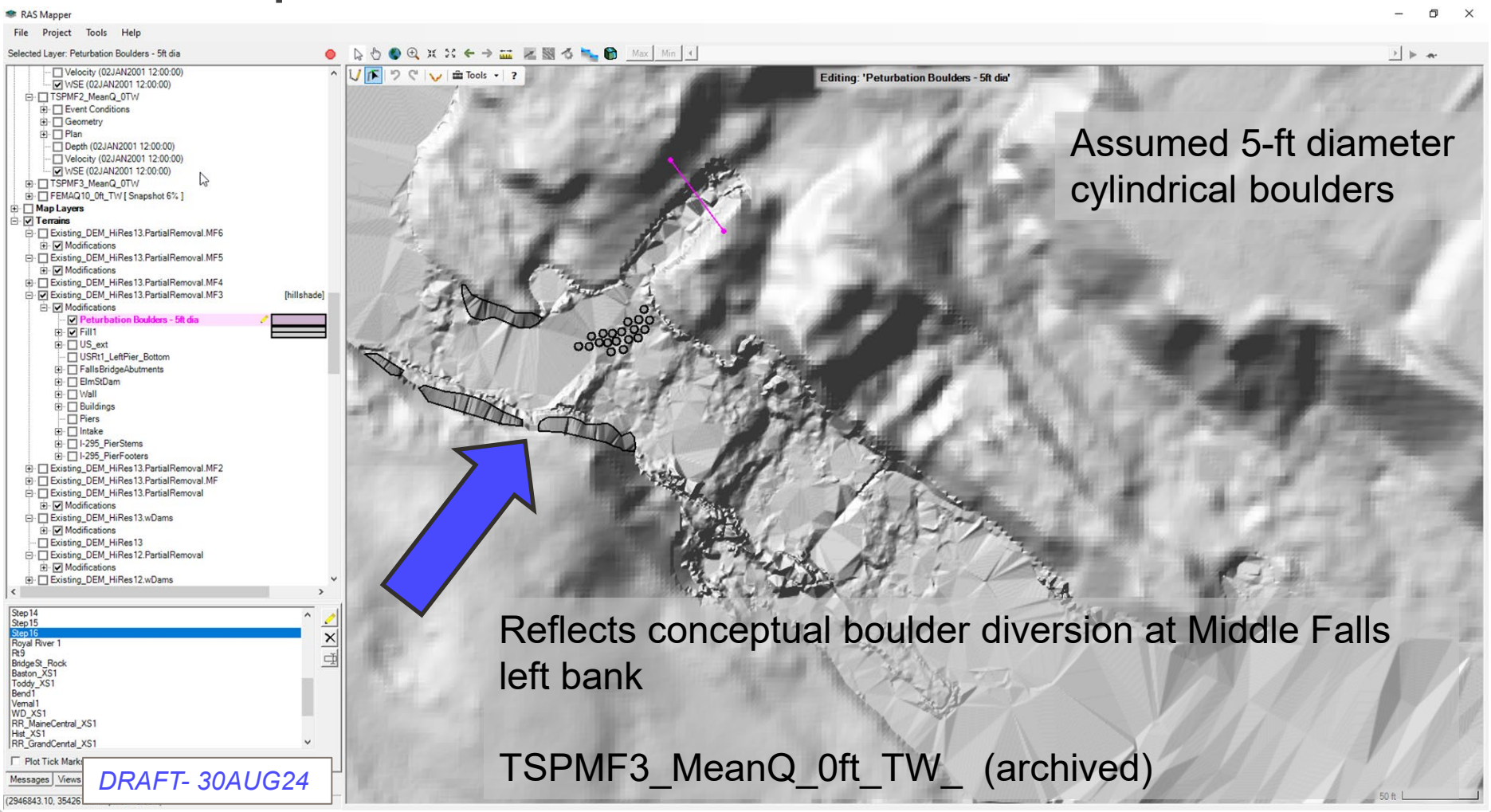
Middle Falls – Flow Diversion Concept Development



Middle Falls – Flow Diversion Concept Development

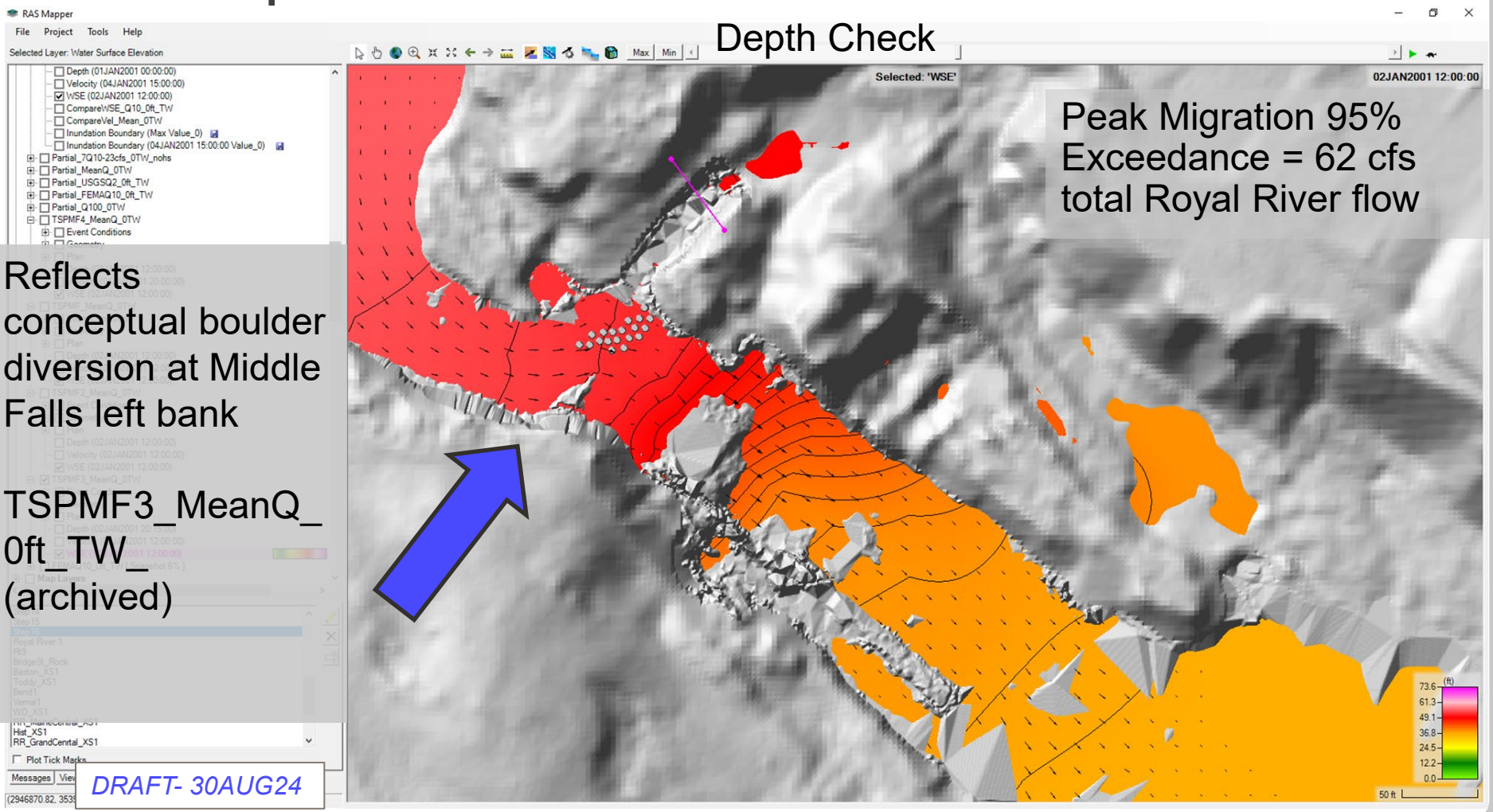


Middle Falls – Flow Diversion Concept Development



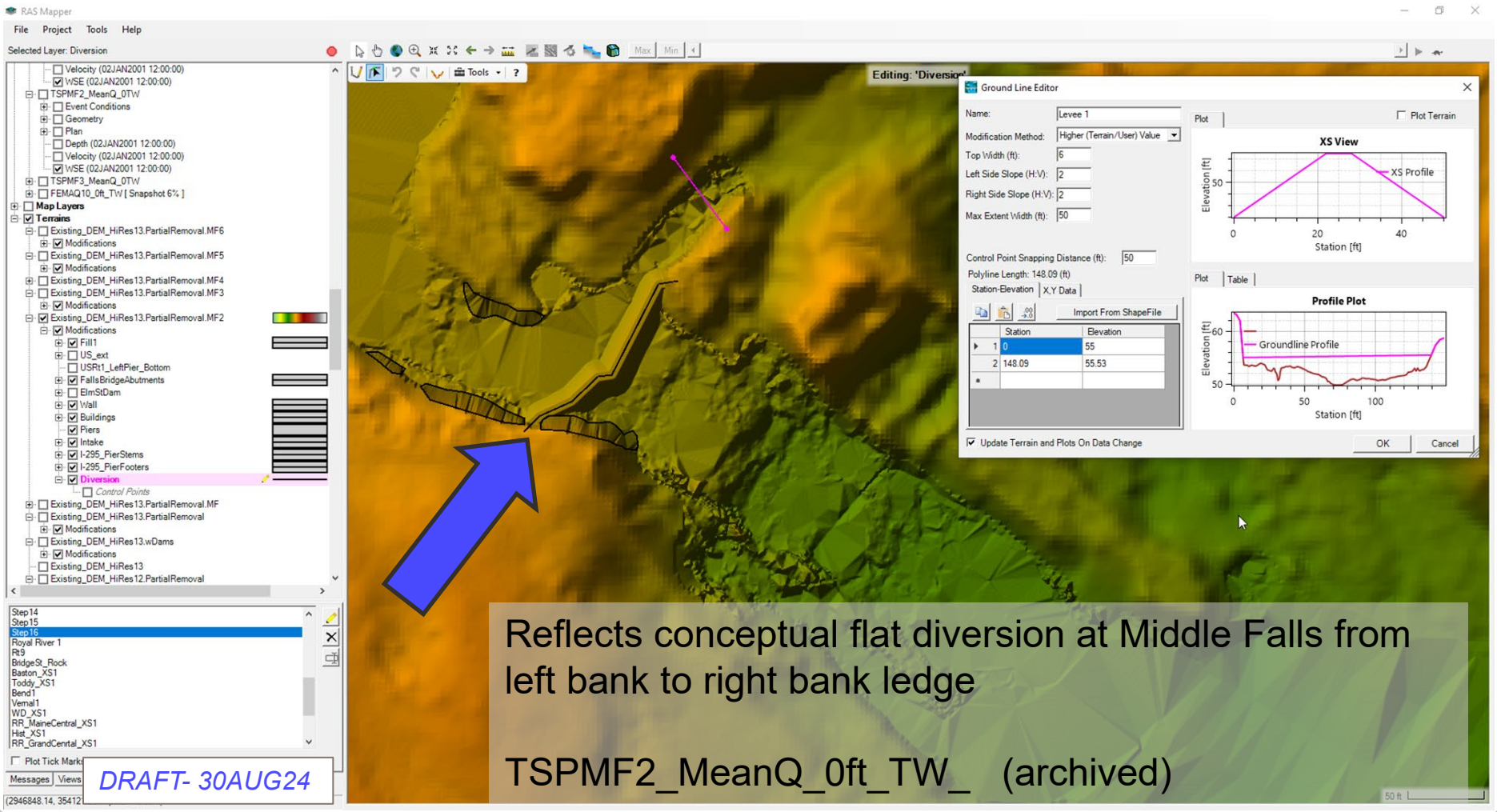
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

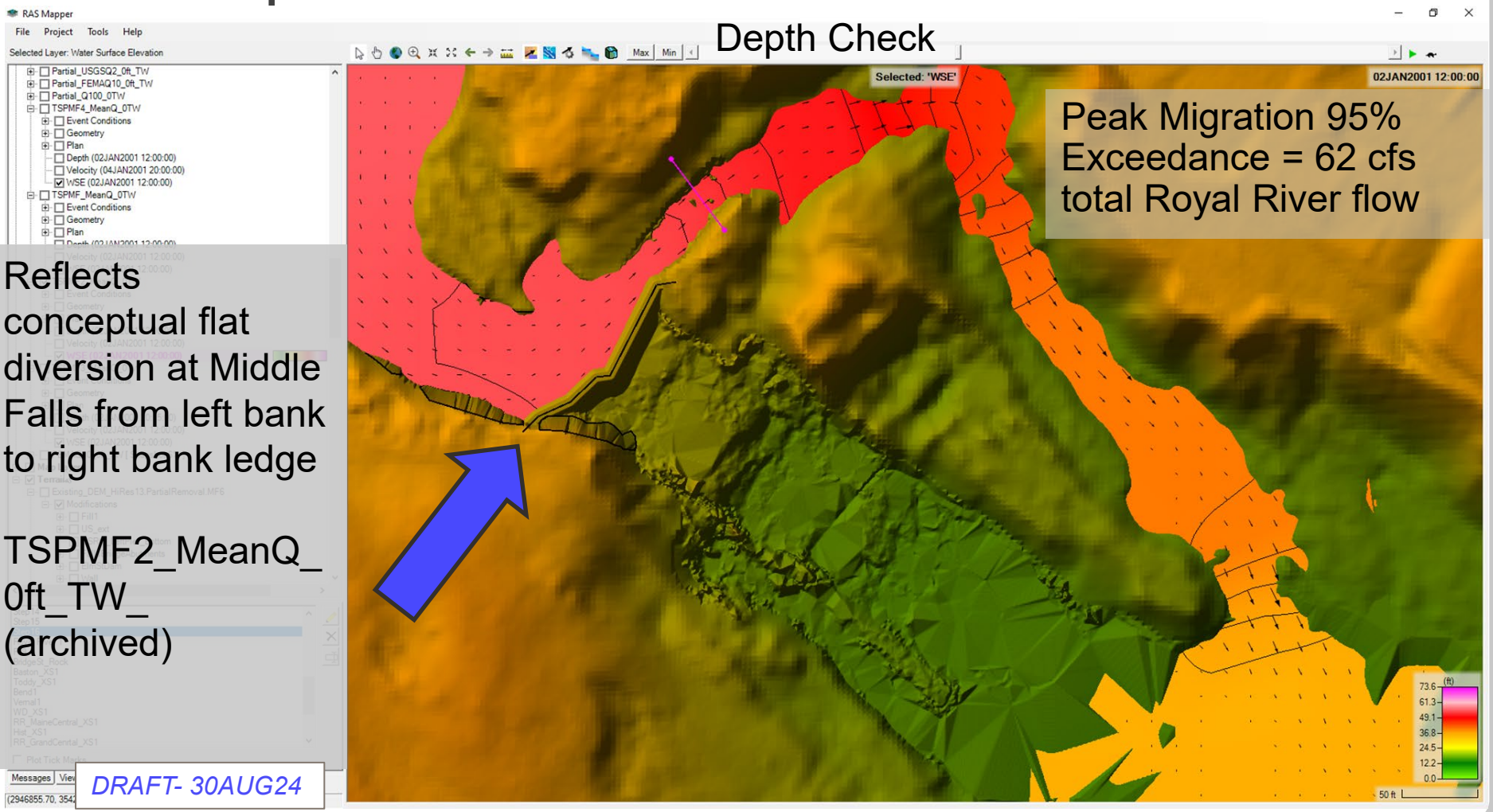
Middle Falls – Flow Diversion Concept Development

Depth Check

Peak Migration 95% Exceedance = 62 cfs total Royal River flow

Reflects conceptual flat diversion at Middle Falls from left bank to right bank ledge

TSPMF2_MeanQ_0ft_TW_ (archived)



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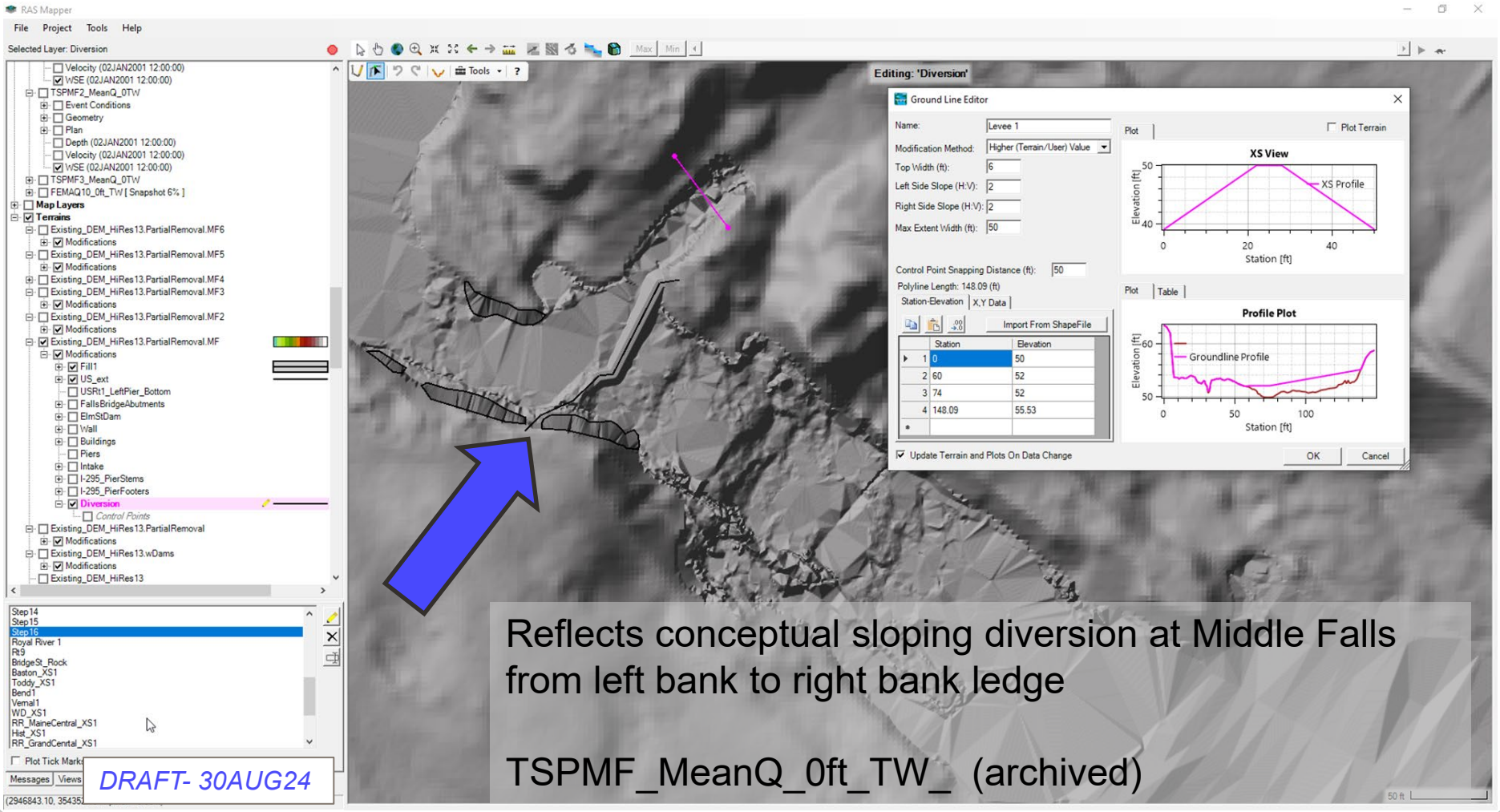
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

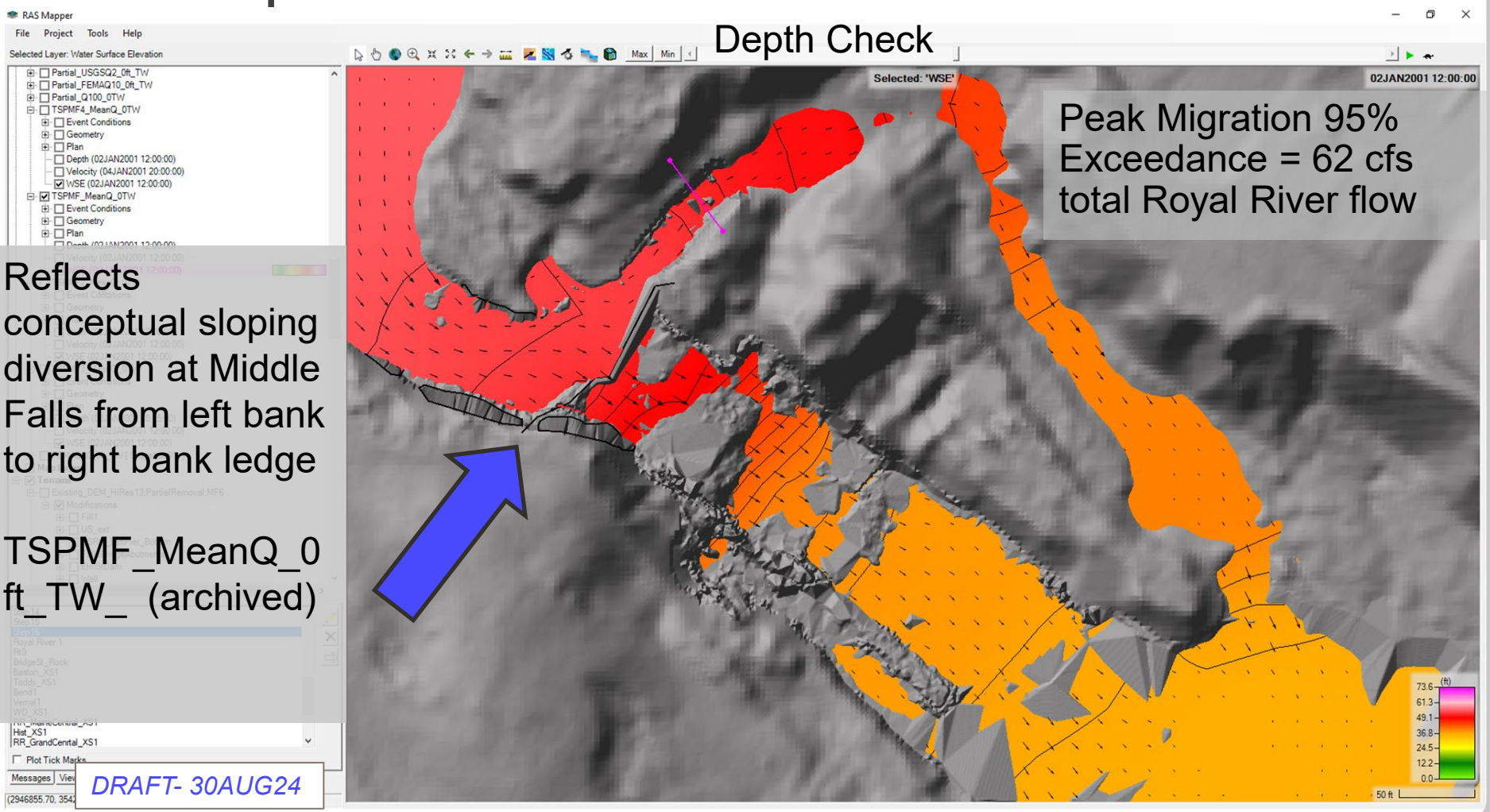
Middle Falls – Flow Diversion Concept Development

Depth Check

Peak Migration 95% Exceedance = 62 cfs total Royal River flow

Reflects conceptual sloping diversion at Middle Falls from left bank to right bank ledge

TSPMF_MeanQ_0ft_TW_ (archived)



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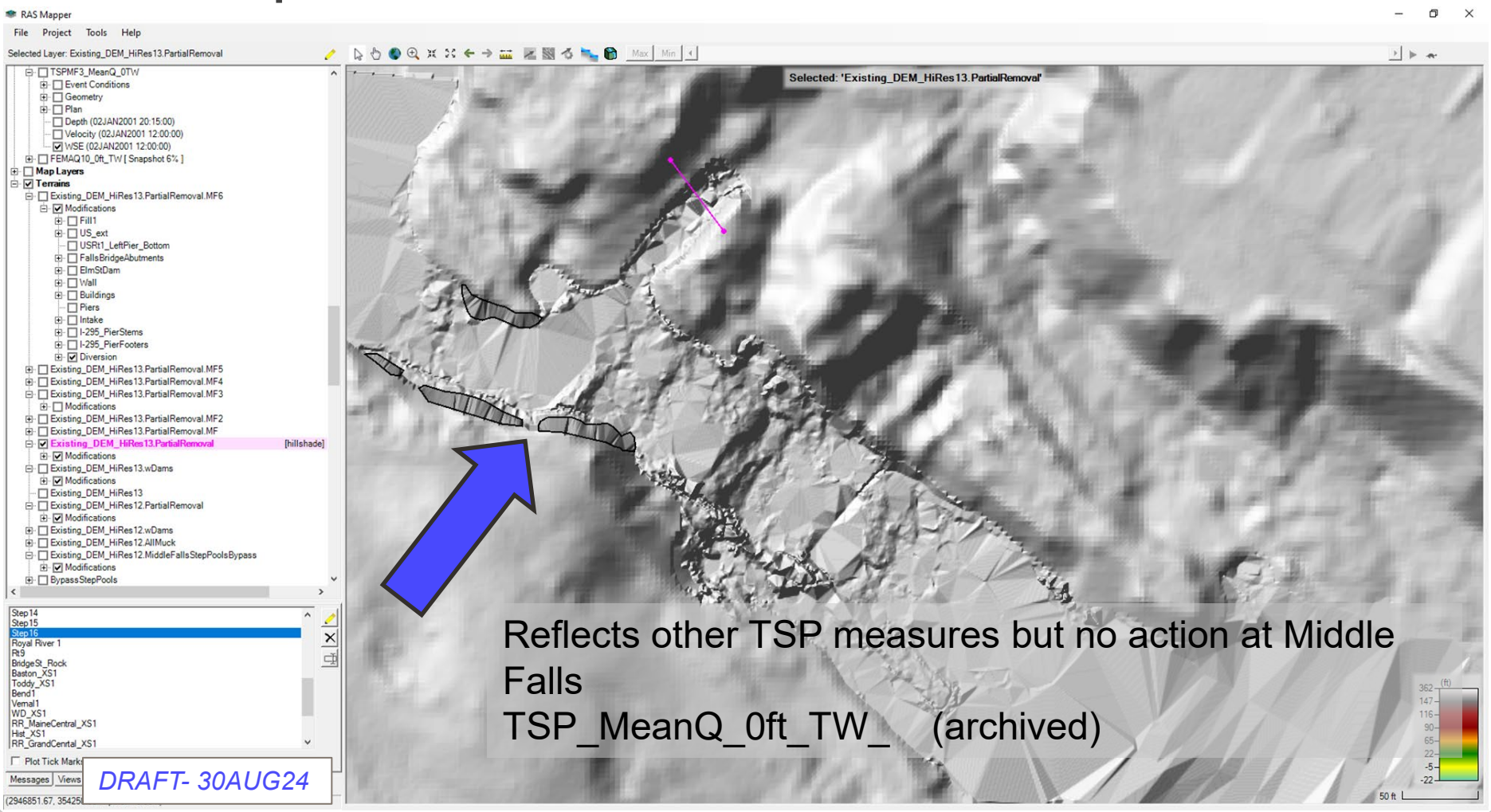
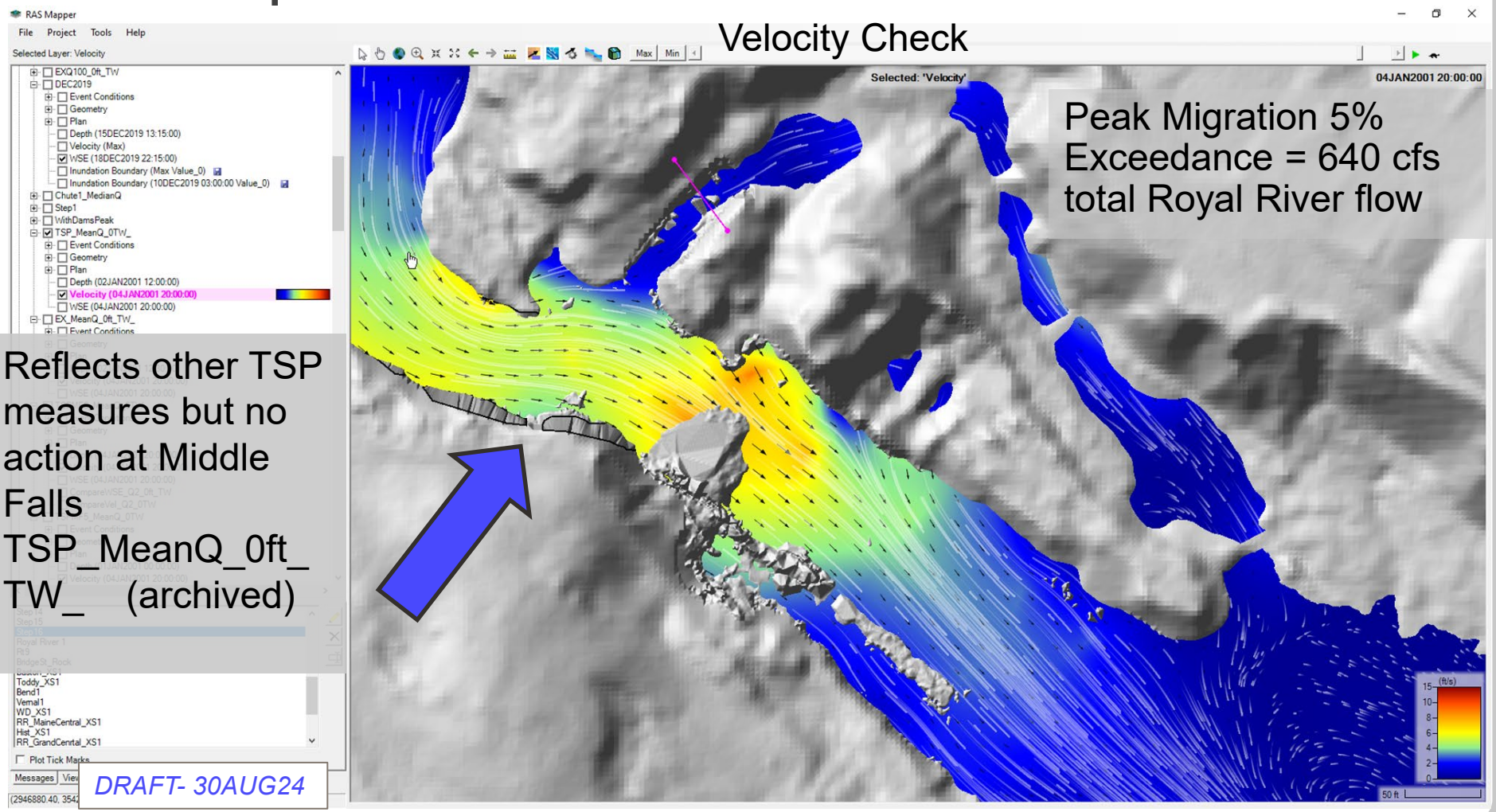
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



Reflects other TSP measures but no action at Middle Falls TSP_MeanQ_0ft_TW_ (archived)

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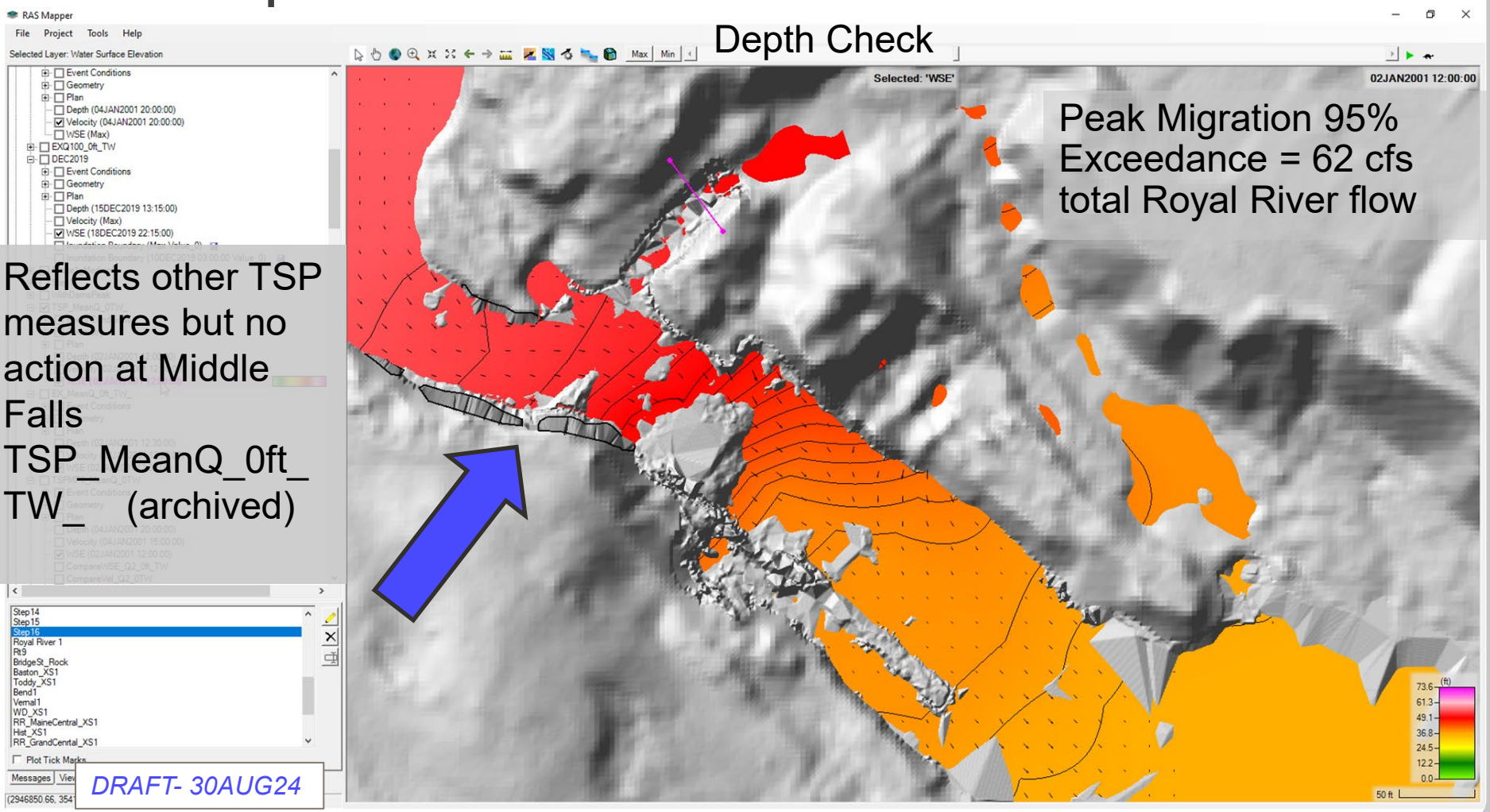
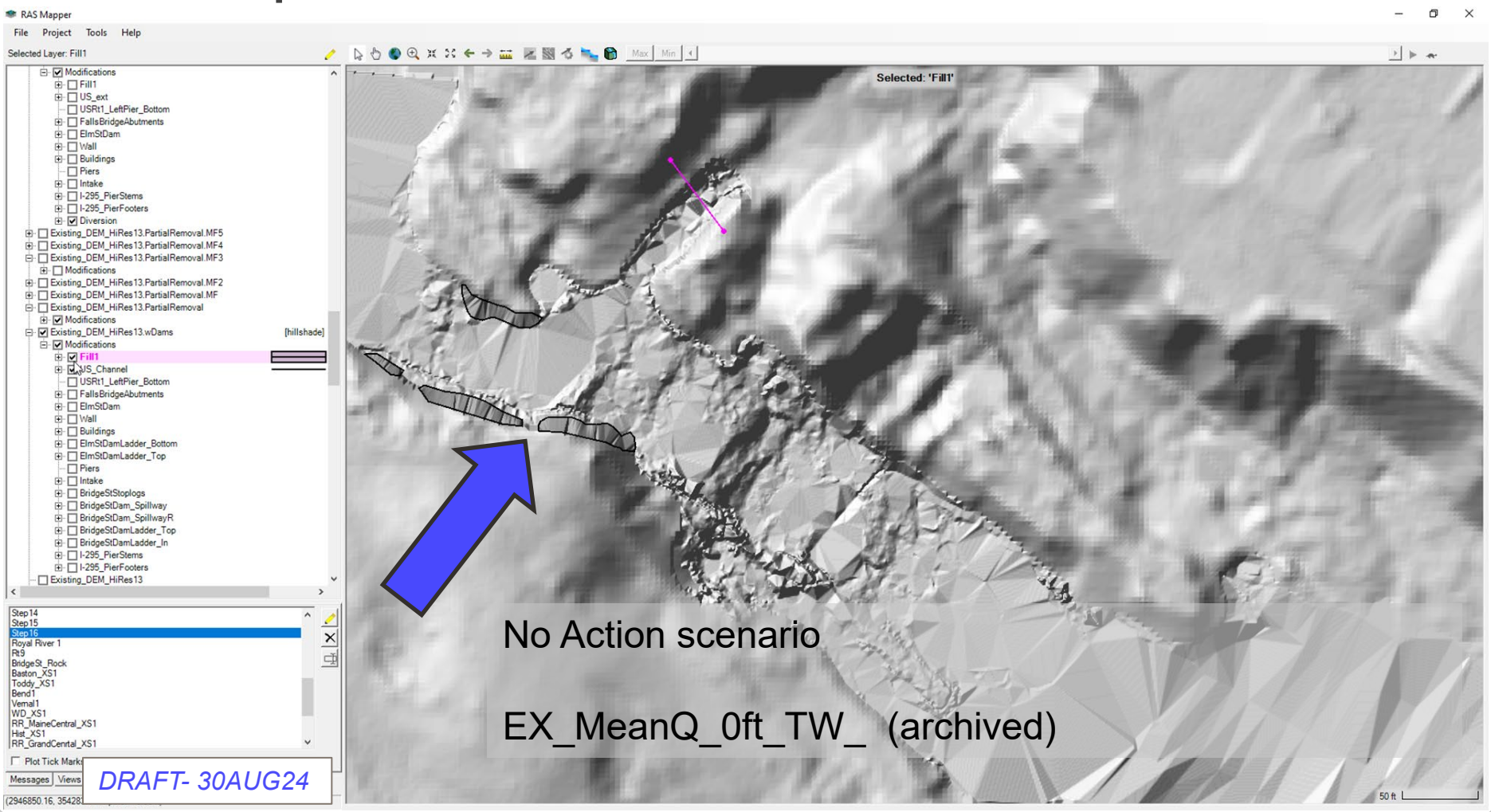
SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



SECTION 206 ROYAL RIVER FISH PASSAGE
DRAFT TSP HEC-RAS RESULTS – 30AUG24

Middle Falls – Flow Diversion Concept Development



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Middle Falls – Flow Diversion Concept Development