CSAT / EHYDRO Update and New Research Directions in Decision Support

Michael Hartman

Lauren Dunkin,

Ned Mitchell, Jeff Swallow (NAO), Andrew Keith (OP-J)

CIRP Technical Discussion

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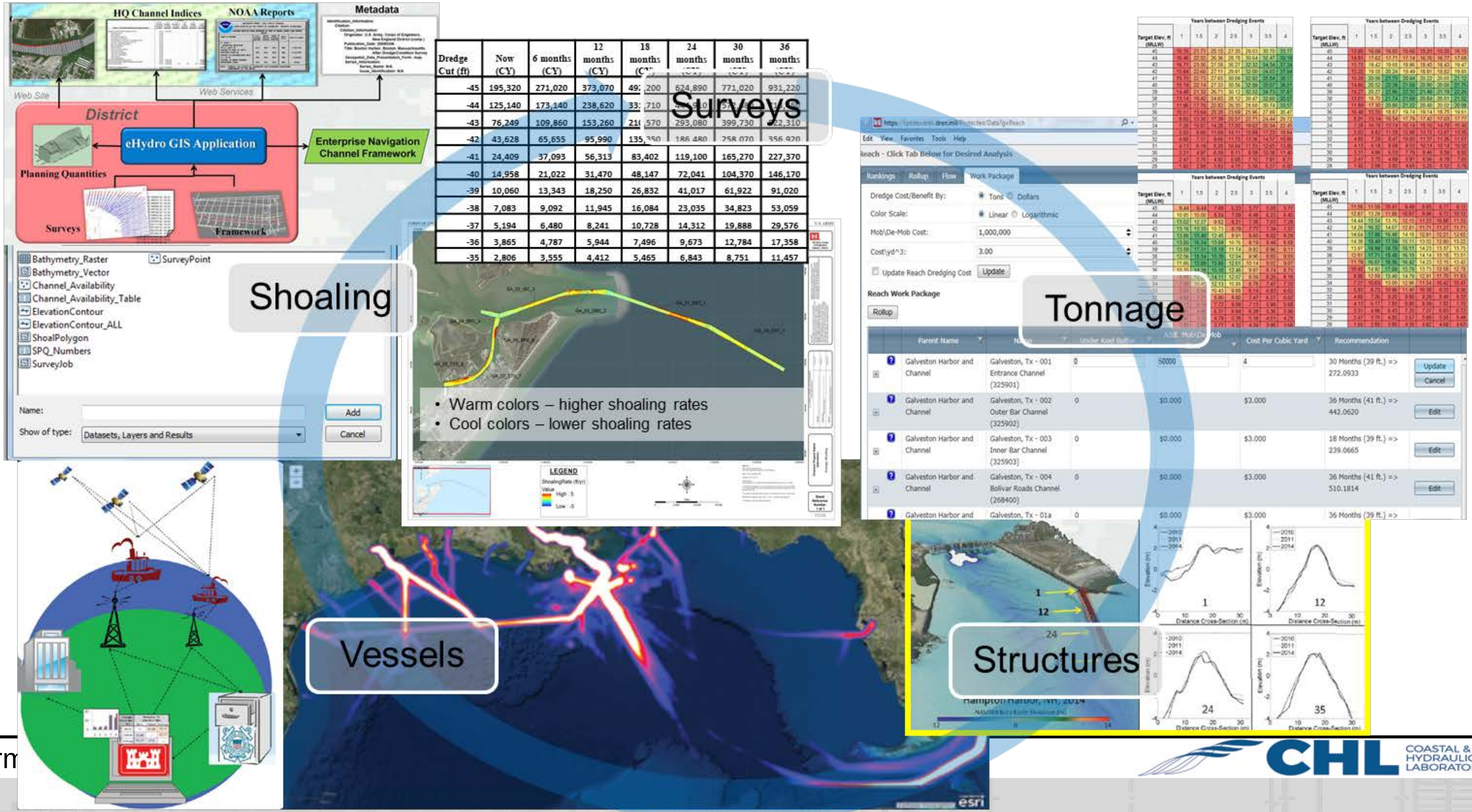
US Army Corps of Engineers®

CHL COASTAL & HYDRAULICS LABORATORY

ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

Coastal Navigation Portfolio Management

Advance objective, quantitative, and systems-based approaches to management of the Corps' large coastal navigation portfolio of projects.


HQ Channel Indices
NOAA Reports
Metadata
Web Site
Web Services
District
eHydro GIS Application
Enterprise Navigation Channel Framework
Planning Quantities
Surveys
Framework
Bathymetry_Raster
SurveyPoint
Bathymetry_Vector
Channel_Availability
Channel_Availability_Table
ElevationContour
ElevationContour_ALL
ShoalPolygon
SPQ_Numbers
SurveyJob
Add
Cancel
Surveys
Shoaling
Tonnage
Vessels
Structures
Years between Dredging Events
Target Elev. ft (MLLW)
LEGEND
1
12
24
35
Distance Cross-Section (m)
Elevation (m)
2010
2011
2014
esri

Name:

Show of type: Datasets, Layers and Results

Dredge Cut (ft)	Now (CY)	6 months (CY)	12 months (CY)	18 months (CY)	24 months (CY)	30 months (CY)	36 months (CY)
-45	195,320	271,020	373,070	[illegible]	624,890	771,020	931,220
-44	125,140	173,140	238,620	[illegible]	[illegible]	[illegible]	[illegible]
-43	76,249	109,860	153,260	[illegible]	293,080	399,730	[illegible]
-42	43,628	65,655	95,990	[illegible]	186,480	258,070	356,920
-41	24,409	37,093	56,313	83,402	119,100	165,270	227,370
-40	14,958	21,022	31,470	48,147	72,041	104,370	146,170
-39	10,060	13,343	18,250	26,832	41,017	61,922	91,020
-38	7,083	9,092	11,945	16,084	23,035	34,823	53,059
-37	5,194	6,480	8,241	10,728	14,312	19,888	29,576
-36	3,865	4,787	5,944	7,496	9,673	12,784	17,358
-35	2,806	3,555	4,412	5,465	6,843	8,751	11,457

- Warm colors – higher shoaling rates
- Cool colors – lower shoaling rates

Reach - Click Tab Below for Desired Analysis

Rankings | Rollup | Flow | Work Package

Dredge Cost/Benefit By: ● Tons ○ Dollars

Color Scale: ● Linear ○ Logarithmic

Mob\De-Mob Cost: 1,000,000

Cost\yd^3: 3.00

☐ Update Reach Dredging Cost [Update]

Reach Work Package

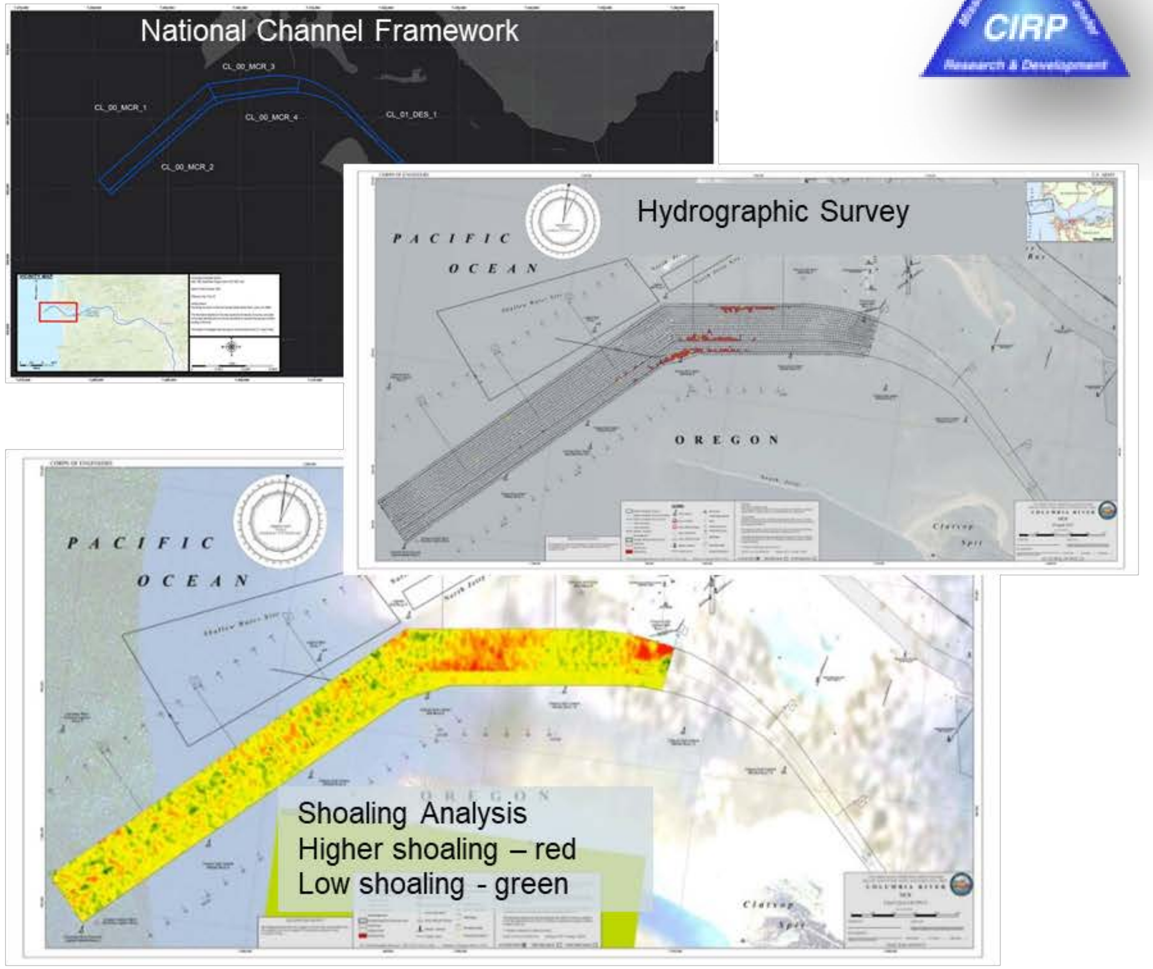
[Rollup]

Parent Name	Name	Under Keel Buffer	Mob\De-Mob	Cost Per Cubic Yard	Recommendation	
Galveston Harbor and Channel	Galveston, Tx - 001 Entrance Channel (325901)	0	50000	4	30 Months (39 ft.) => 272.0933	Update Cancel
Galveston Harbor and Channel	Galveston, Tx - 002 Outer Bar Channel (325902)	0	$0.000	$3.000	36 Months (41 ft.) => 442.0620	Edit
Galveston Harbor and Channel	Galveston, Tx - 003 Inner Bar Channel (325903)	0	$0.000	$3.000	18 Months (39 ft.) => 239.0665	Edit
Galveston Harbor and Channel	Galveston, Tx - 004 Bolivar Roads Channel (268400)	0	$0.000	$3.000	36 Months (41 ft.) => 510.1814	Edit
Galveston Harbor and	Galveston, Tx - 01a	0	$0.000	$3.000	36 Months (39 ft.) =>	

Corps Shoaling Analysis Tool (CSAT)

Description

- CSAT estimates shoaling rates using hydrographic surveys within the boundary of the National Channel Framework.
- CSAT uses the historical shoaling rates to predict future dredging volumes at various channel depth intervals.
- Where are shoaling ‘hot spots’ within the navigation channel?
- How has shoaling changed as a result of meteorological events (extratropical storm, rainfall or drought periods), dredge schedule change or dredge type change?


National Channel Framework
CL_00_MCR_3
CL_00_MCR_1
CL_00_MCR_4
CL_01_DES_1
CL_00_MCR_2
Hydrographic Survey
PACIFIC
OCEAN
OREGON
PACIFIC
OCEAN
Shoaling Analysis
Higher shoaling – red
Low shoaling - green

National Channel Framework, hydrographic survey map sheet from eHydro, and the shoaling rate prediction for Columbia River, OR.

CSAT Survey Workflow

eHydro Surveys

Uniform Grid per Reach

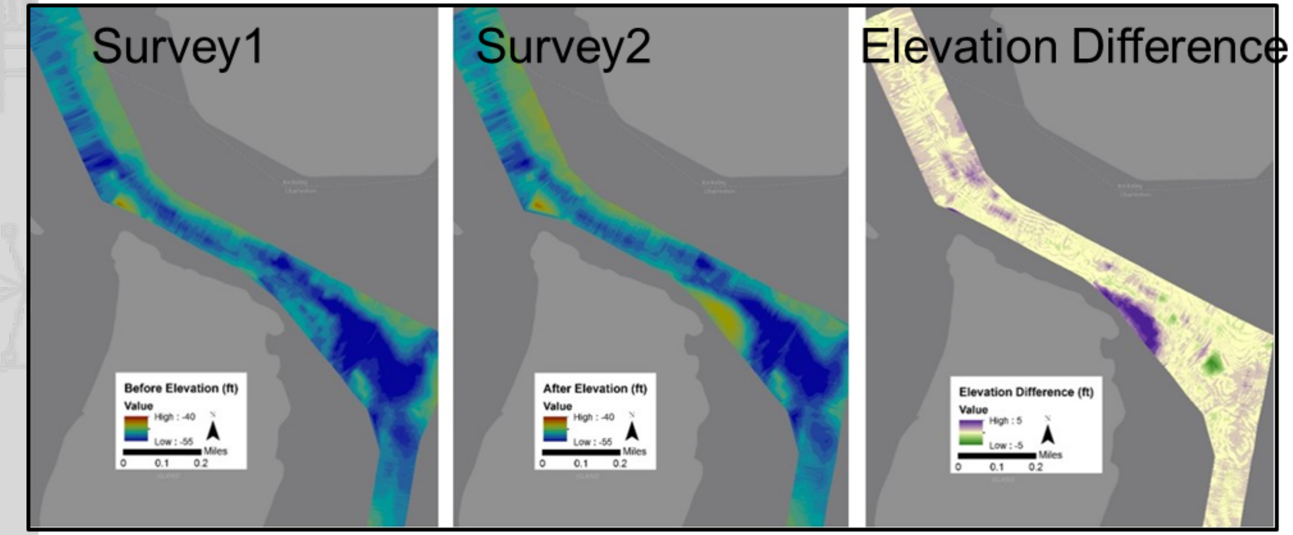
Survey check

Survey Type (After-dredge, Before dredge, Condition)

Partial coverage

Duplicate surveys

User Classification



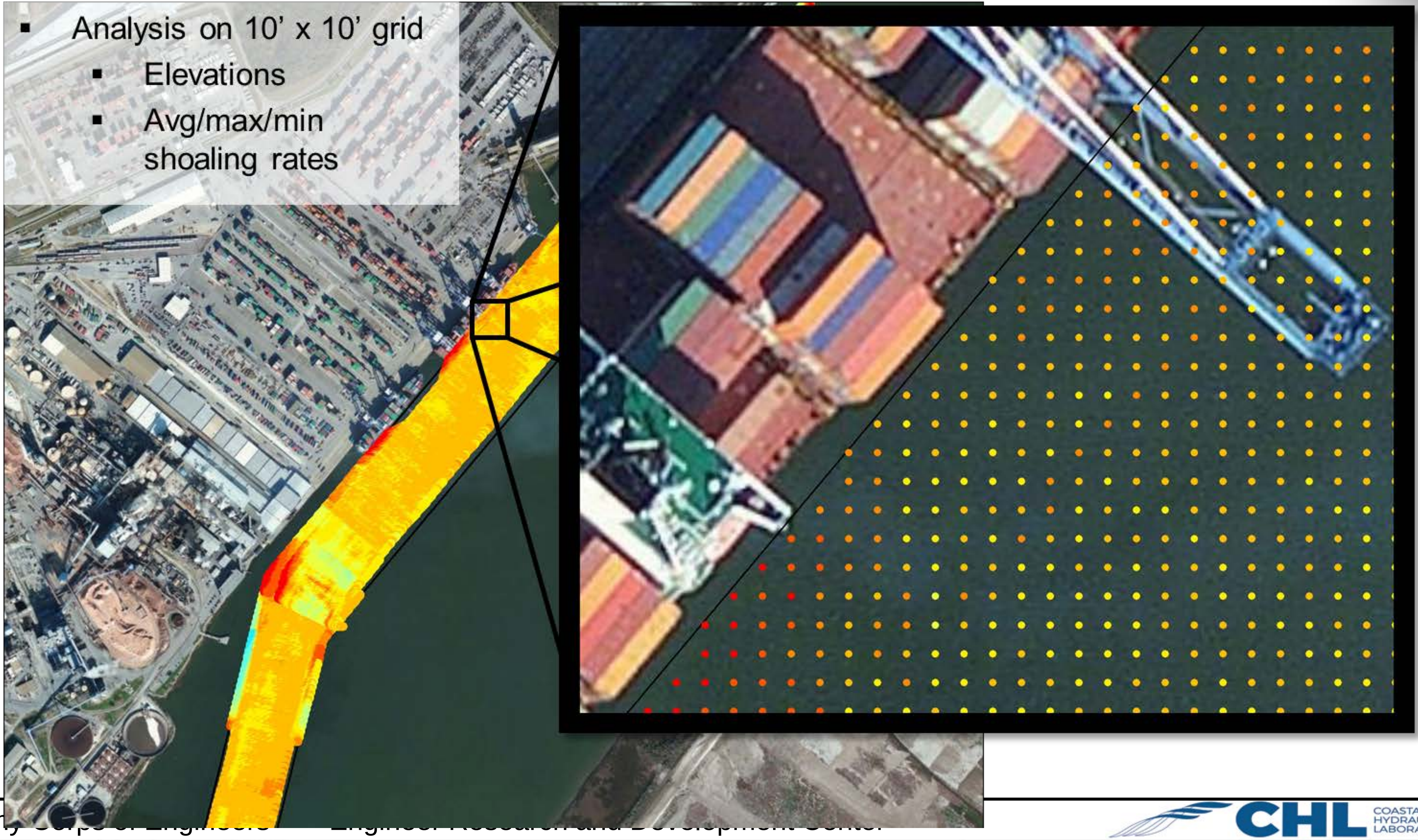
Survey1

Survey2

Elevation Difference

Before Elevation (ft)
Value
High : -40
Low : -55
N
Miles
0
0.1
0.2
After Elevation (ft)
Value
High : -40
Low : -55
N
Miles
0
0.1
0.2
Elevation Difference (ft)
Value
High : 5
Low : -5
N
Miles
0
0.1
0.2

Shoaling Analysis on 10ft x 10ft grid

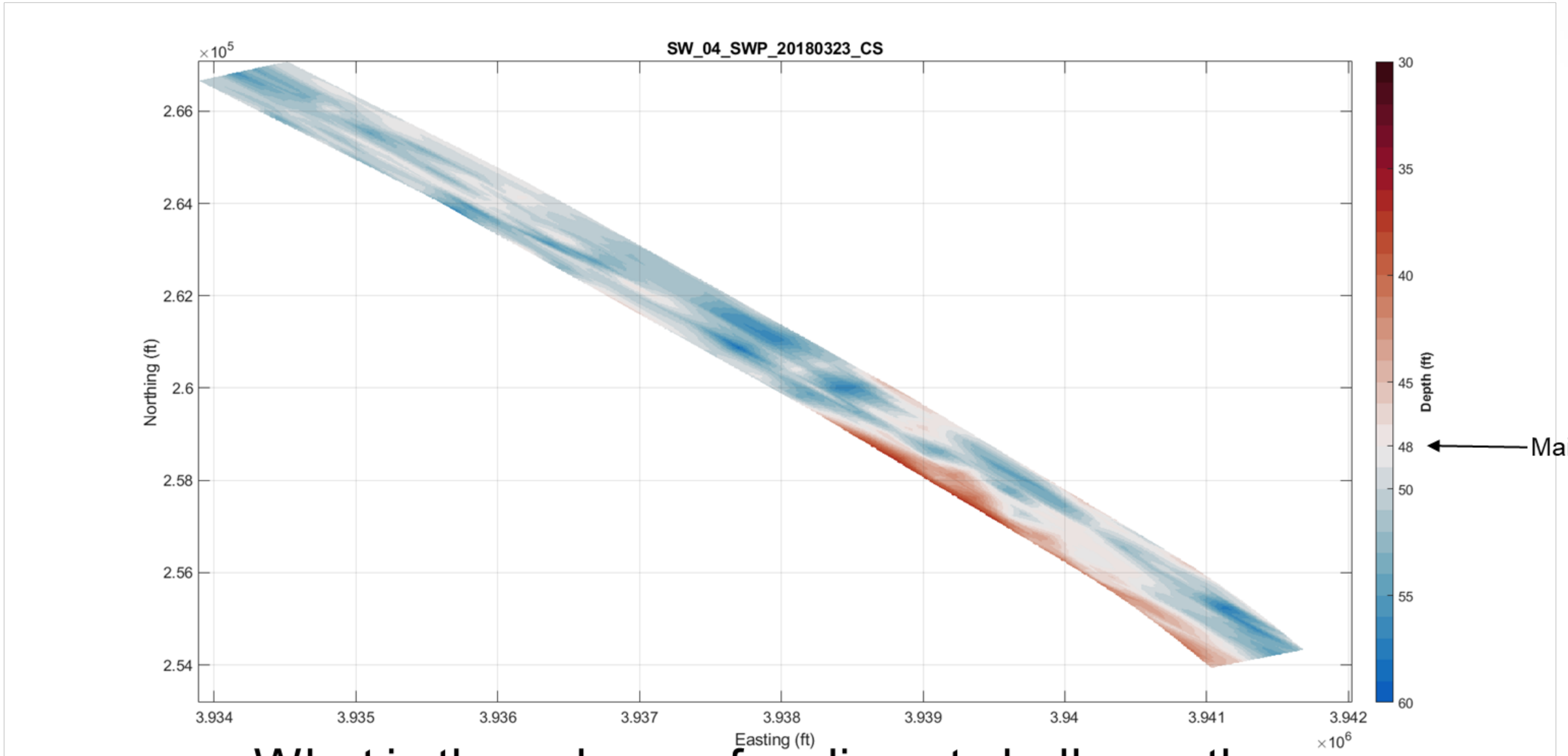


- Analysis on 10’ x 10’ grid
  - Elevations
  - Avg/max/min shoaling rates

So What's New?

- New CSAT Product
  - Example application of CSAT shoaling forecast
- New Animations from eHydro data
- Improvements of Channel Availability

Survey Planning Quantities (SPQ)

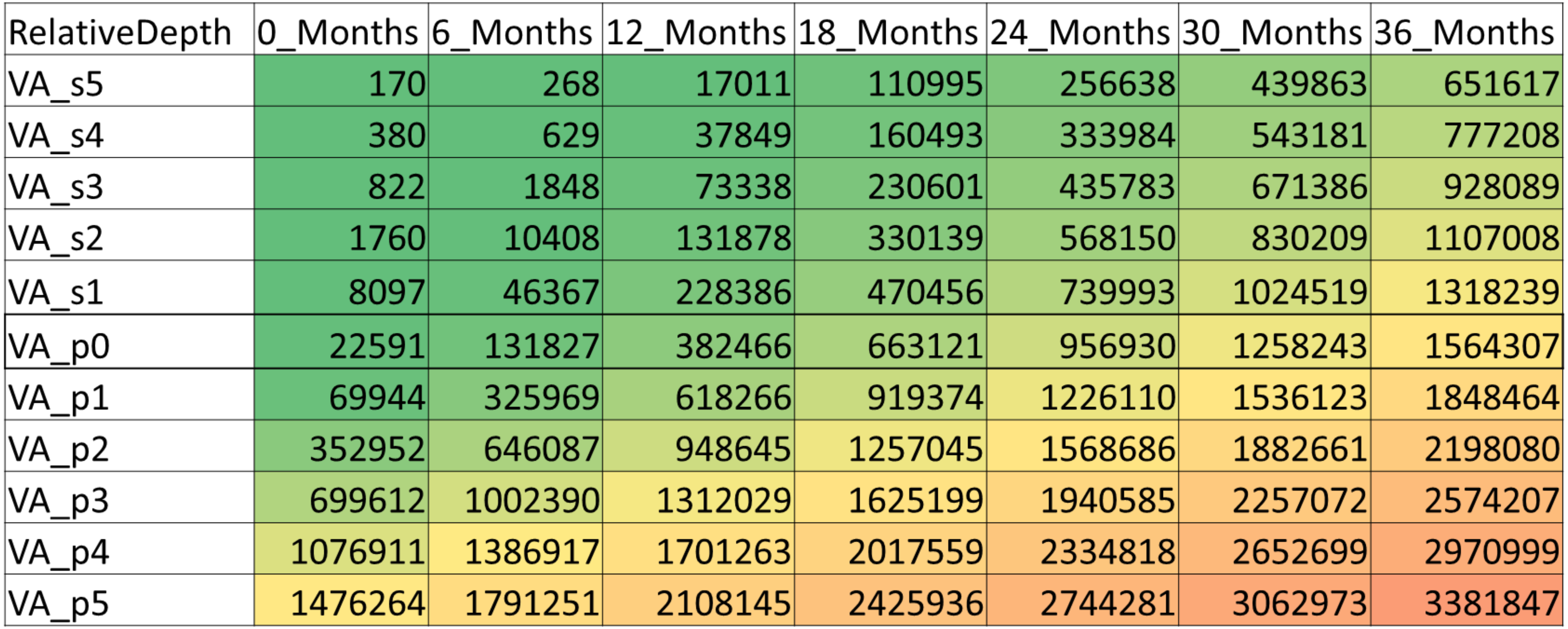


Maintained Depth

What is the volume of sediment shallower than Maintained Depth?

CSAT Output – Reach Level or CWIS level Rollup – Volume Tables

- Report volumes at different depth/time intervals and shoaling rates



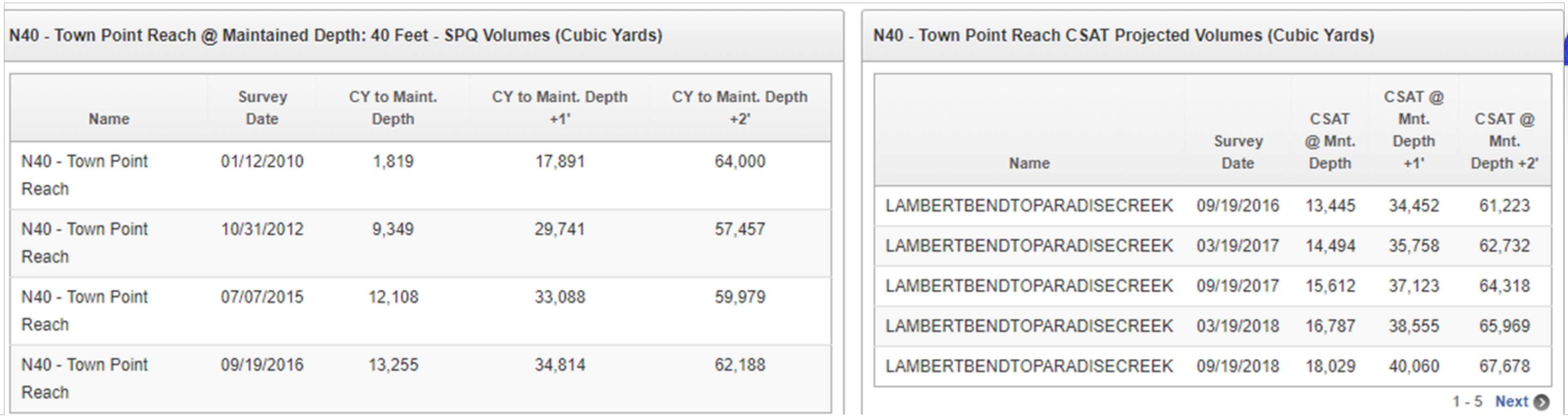
Oakland Harbor (12990)

RelativeDepth	0_Months	6_Months	12_Months	18_Months	24_Months	30_Months	36_Months
VA_s5	170	268	17011	110995	256638	439863	651617
VA_s4	380	629	37849	160493	333984	543181	777208
VA_s3	822	1848	73338	230601	435783	671386	928089
VA_s2	1760	10408	131878	330139	568150	830209	1107008
VA_s1	8097	46367	228386	470456	739993	1024519	1318239
VA_p0	22591	131827	382466	663121	956930	1258243	1564307
VA_p1	69944	325969	618266	919374	1226110	1536123	1848464
VA_p2	352952	646087	948645	1257045	1568686	1882661	2198080
VA_p3	699612	1002390	1312029	1625199	1940585	2257072	2574207
VA_p4	1076911	1386917	1701263	2017559	2334818	2652699	2970999
VA_p5	1476264	1791251	2108145	2425936	2744281	3062973	3381847

0_months column is equivalent to Summary Planning Quantities (SPQs)

CSAT Example Viewer - NAO

Jeff Swallow – NAO – FiNDeR

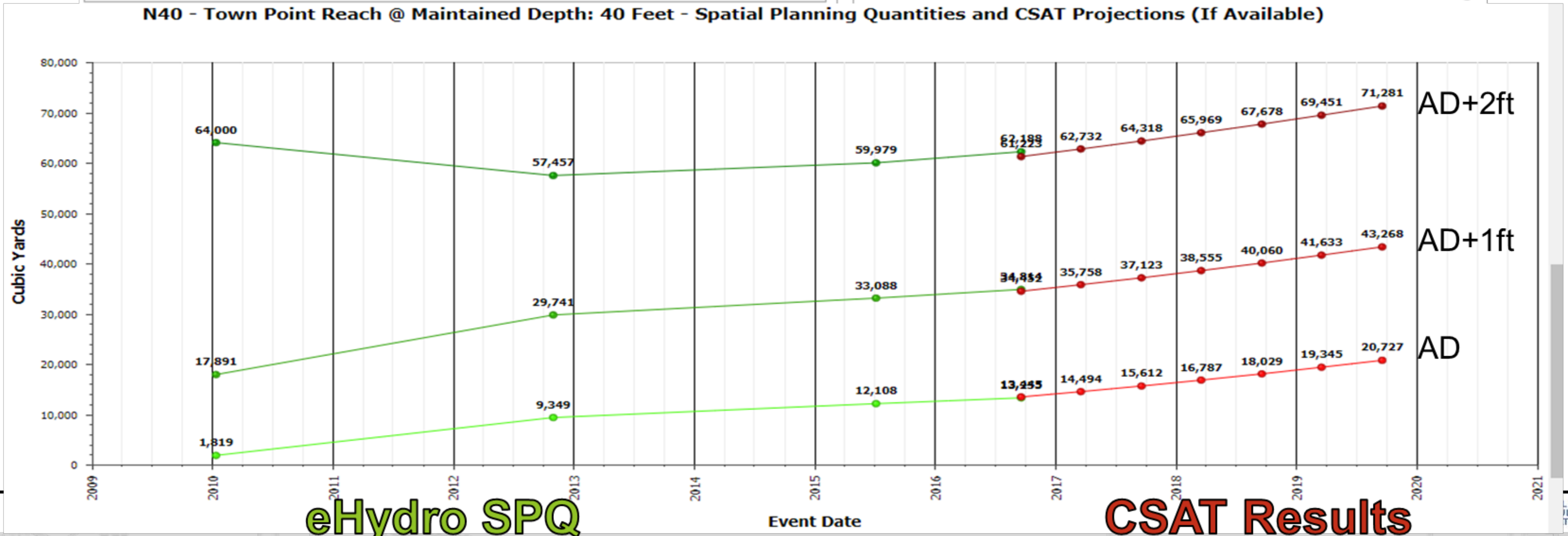


N40 - Town Point Reach @ Maintained Depth: 40 Feet - SPQ Volumes (Cubic Yards)

Name	Survey Date	CY to Maint. Depth	CY to Maint. Depth +1'	CY to Maint. Depth +2'
N40 - Town Point Reach	01/12/2010	1,819	17,891	64,000
N40 - Town Point Reach	10/31/2012	9,349	29,741	57,457
N40 - Town Point Reach	07/07/2015	12,108	33,088	59,979
N40 - Town Point Reach	09/19/2016	13,255	34,814	62,188

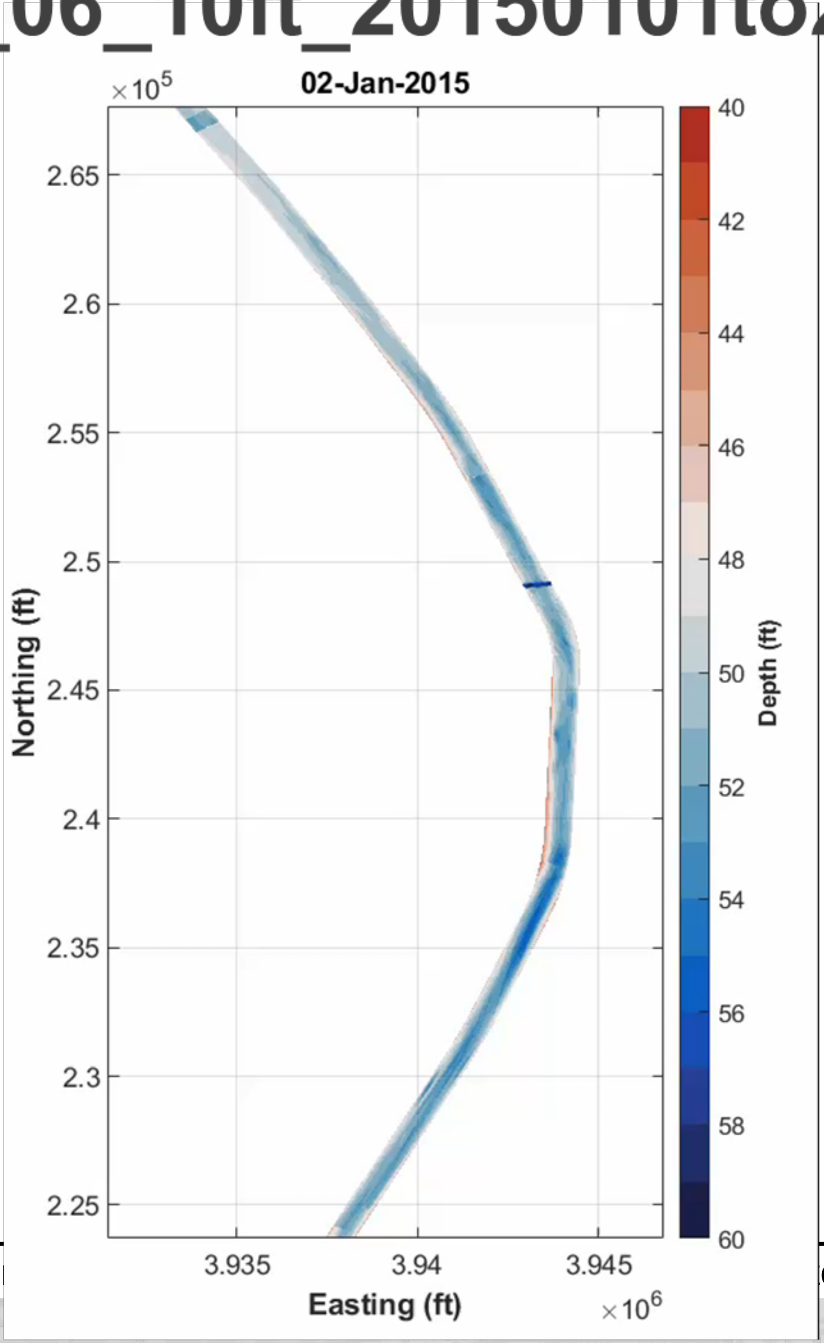
N40 - Town Point Reach CSAT Projected Volumes (Cubic Yards)

Name	Survey Date	CSAT @ Mnt. Depth	CSAT @ Mnt. Depth +1'	CSAT @ Mnt. Depth +2'
LAMBERTBENDTOPARADISECREEK	09/19/2016	13,445	34,452	61,223
LAMBERTBENDTOPARADISECREEK	03/19/2017	14,494	35,758	62,732
LAMBERTBENDTOPARADISECREEK	09/19/2017	15,612	37,123	64,318
LAMBERTBENDTOPARADISECREEK	03/19/2018	16,787	38,555	65,969
LAMBERTBENDTOPARADISECREEK	09/19/2018	18,029	40,060	67,678



N40 - Town Point Reach @ Maintained Depth: 40 Feet - Spatial Planning Quantities and CSAT Projections (If Available)

SWP_04_05_06_10ft_20150101to20161231



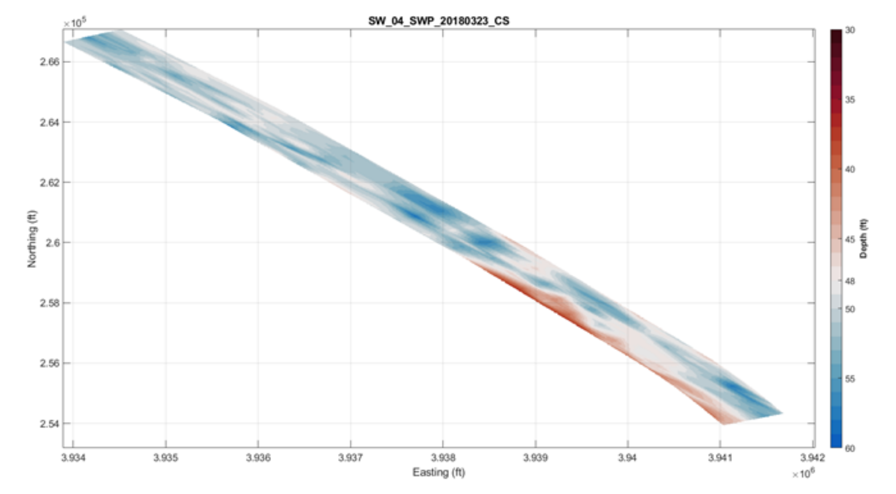
New approach for defining channel availability

How good of a job are we doing maintaining our channels? Historically evaluated using "channel availability".

Controlling Depth is the minimum depth in a channel quarter

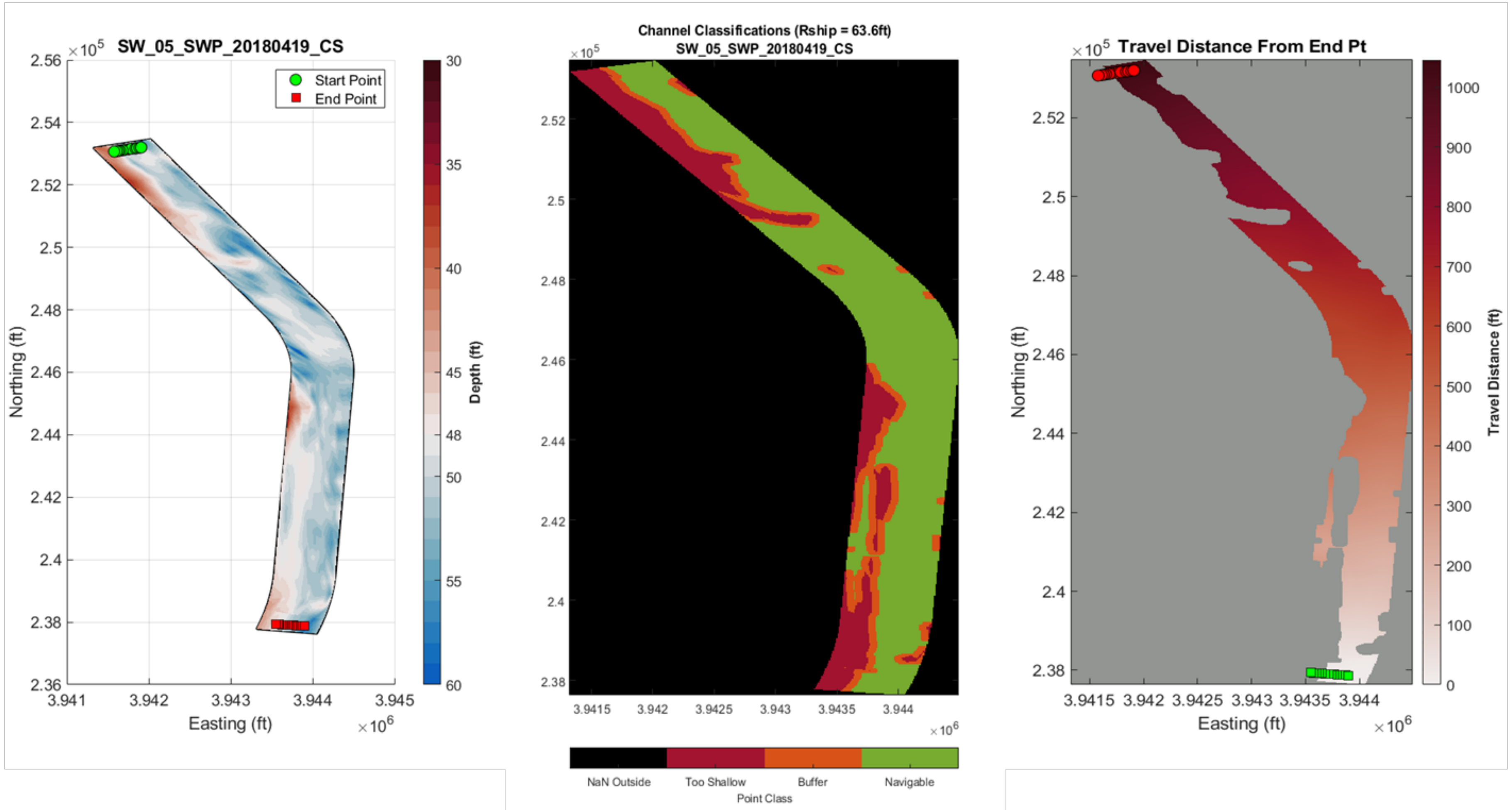
Currently testing Controlling Depth vs Project Depth:

```
if controllingDepth < projectDepth
        channelAvailable = false;
else
        channelAvailable = true;
end
```



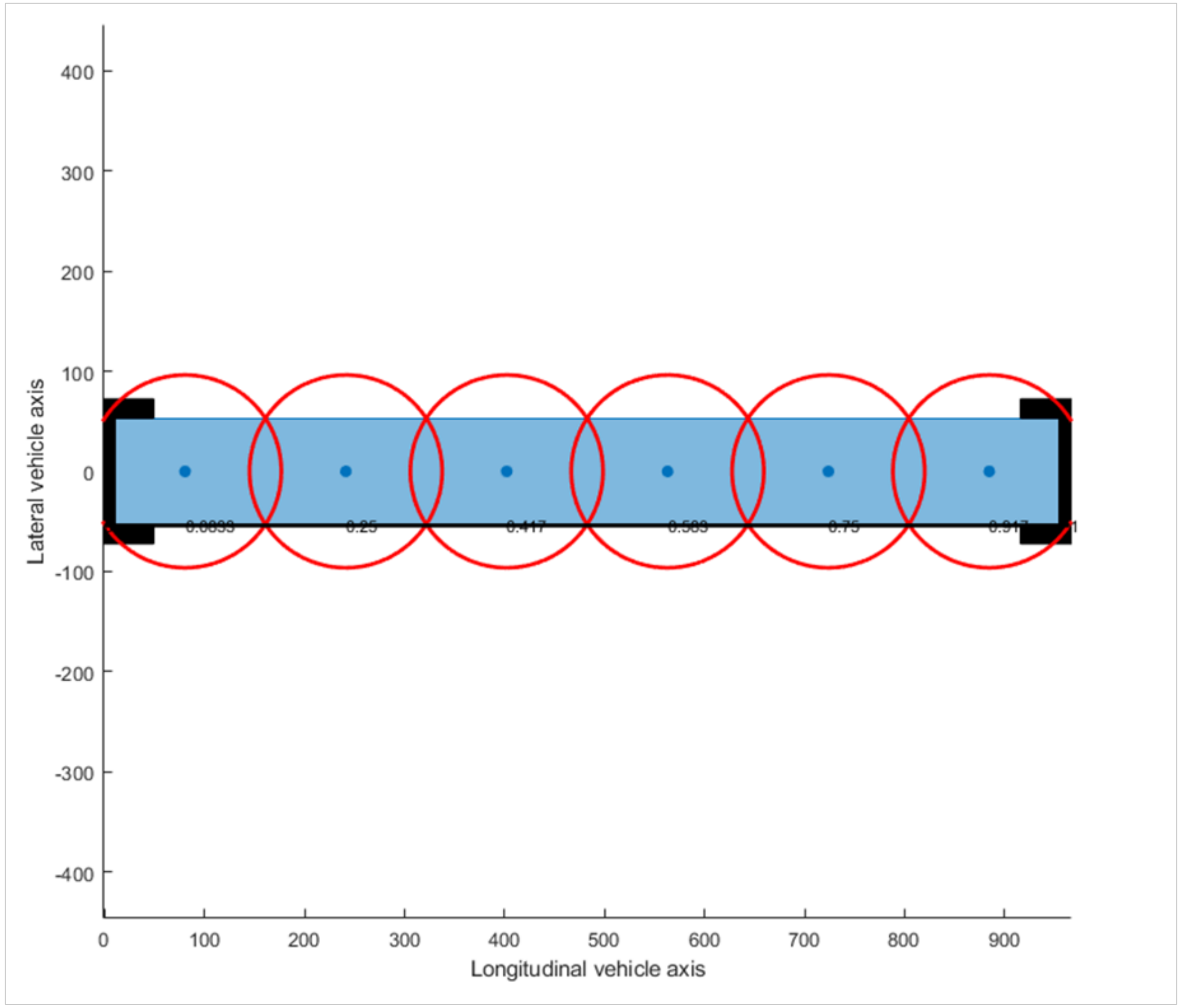
This definition means that it is possible for a single survey point to declare the entire channel as unavailable. Does that single point actually impact the vessel traffic though?

Channel Navigability

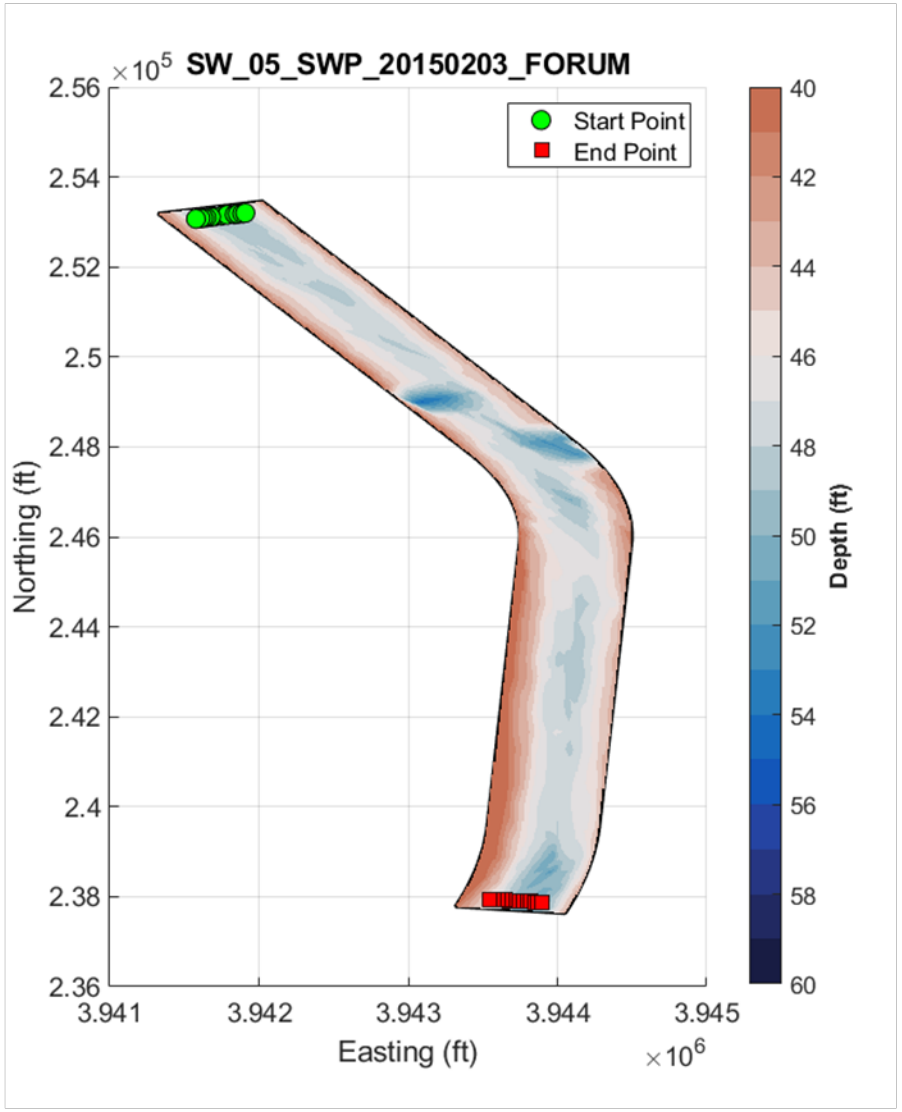


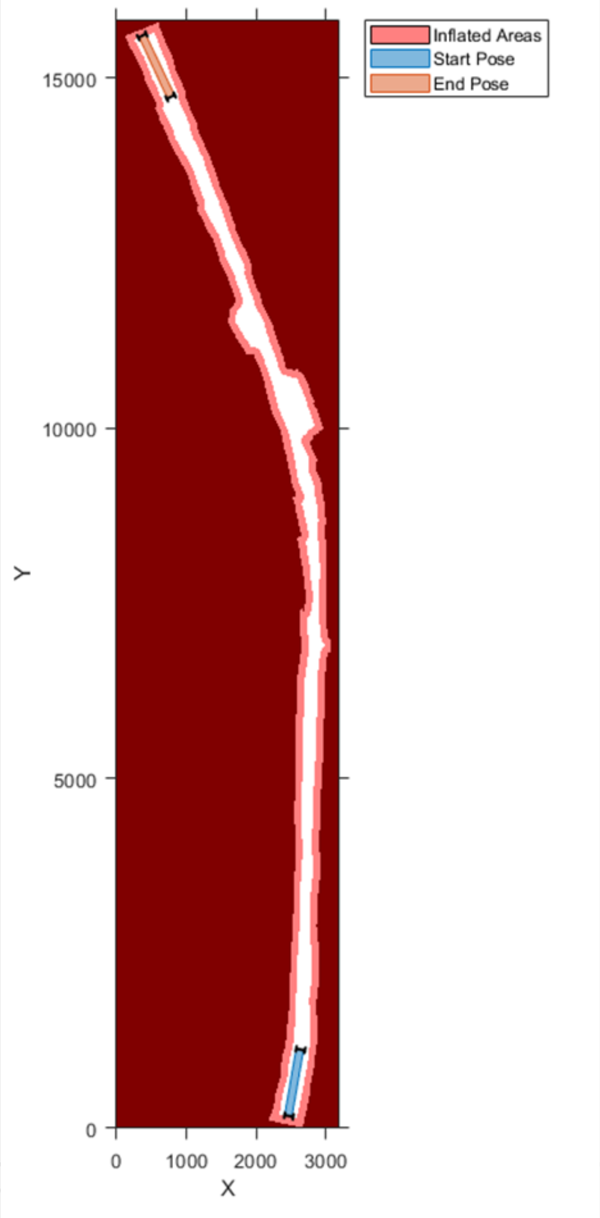
Channel Navigability

- Representative Vessel
  - Panamax
    - Length: 965 ft
    - Beam: 106 ft

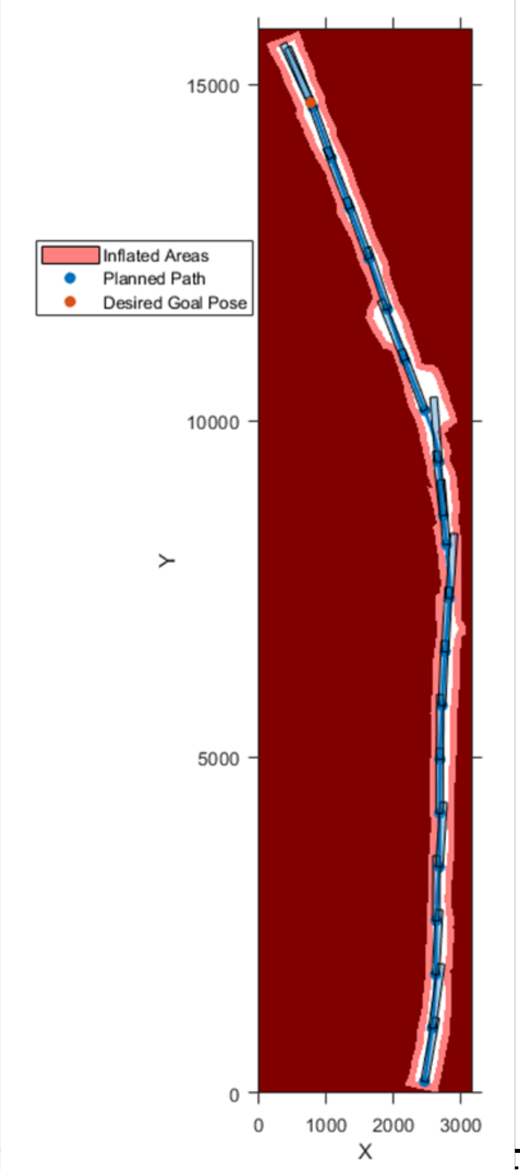


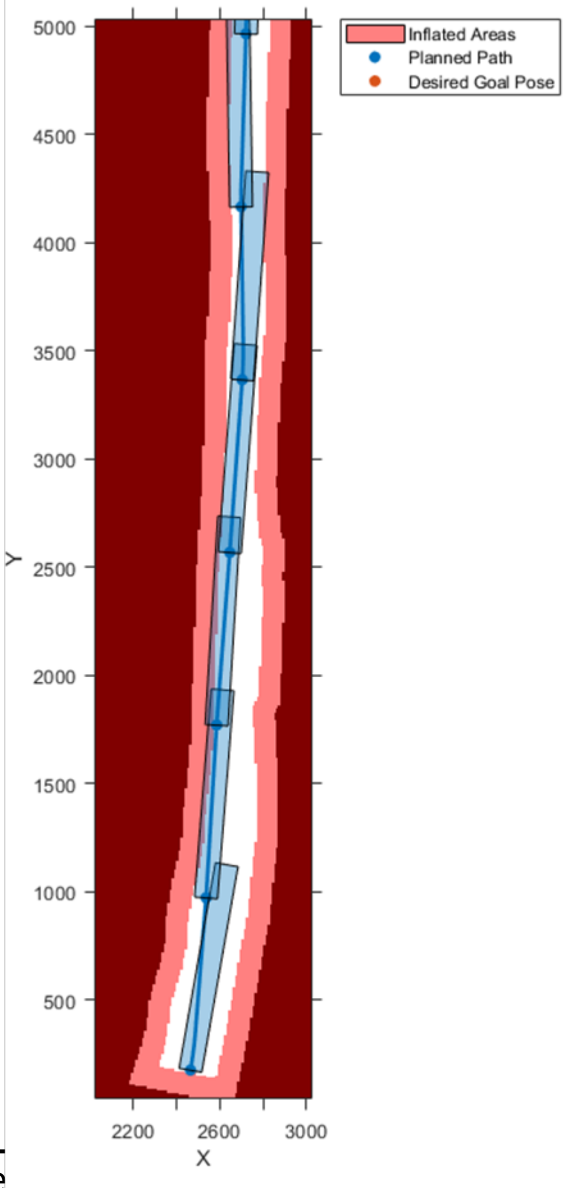
Automated Navigation from Start to End Pose

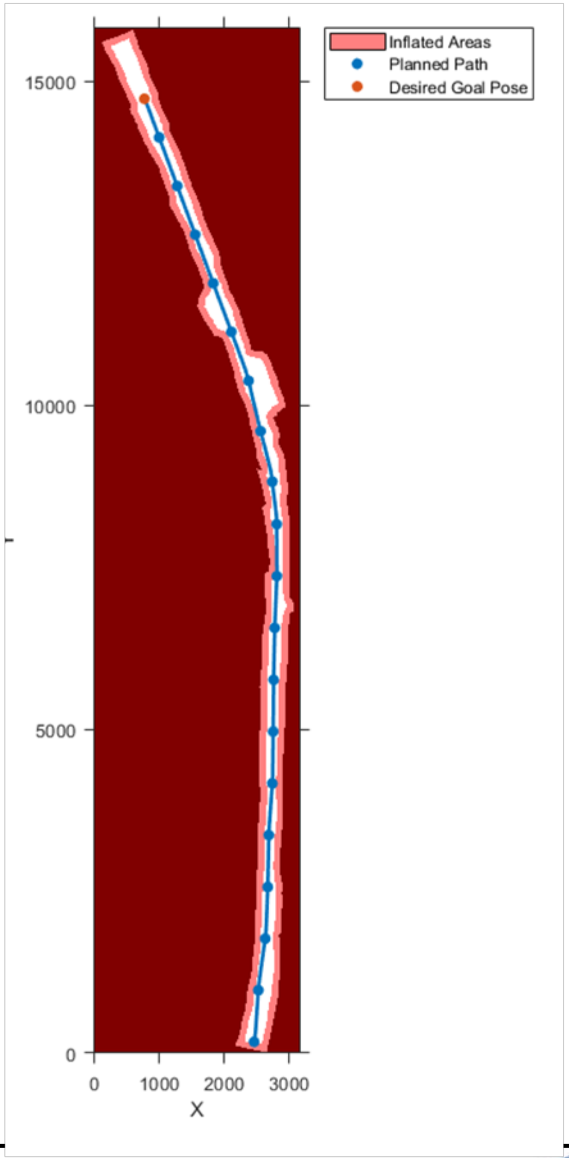




Routing Successfully!



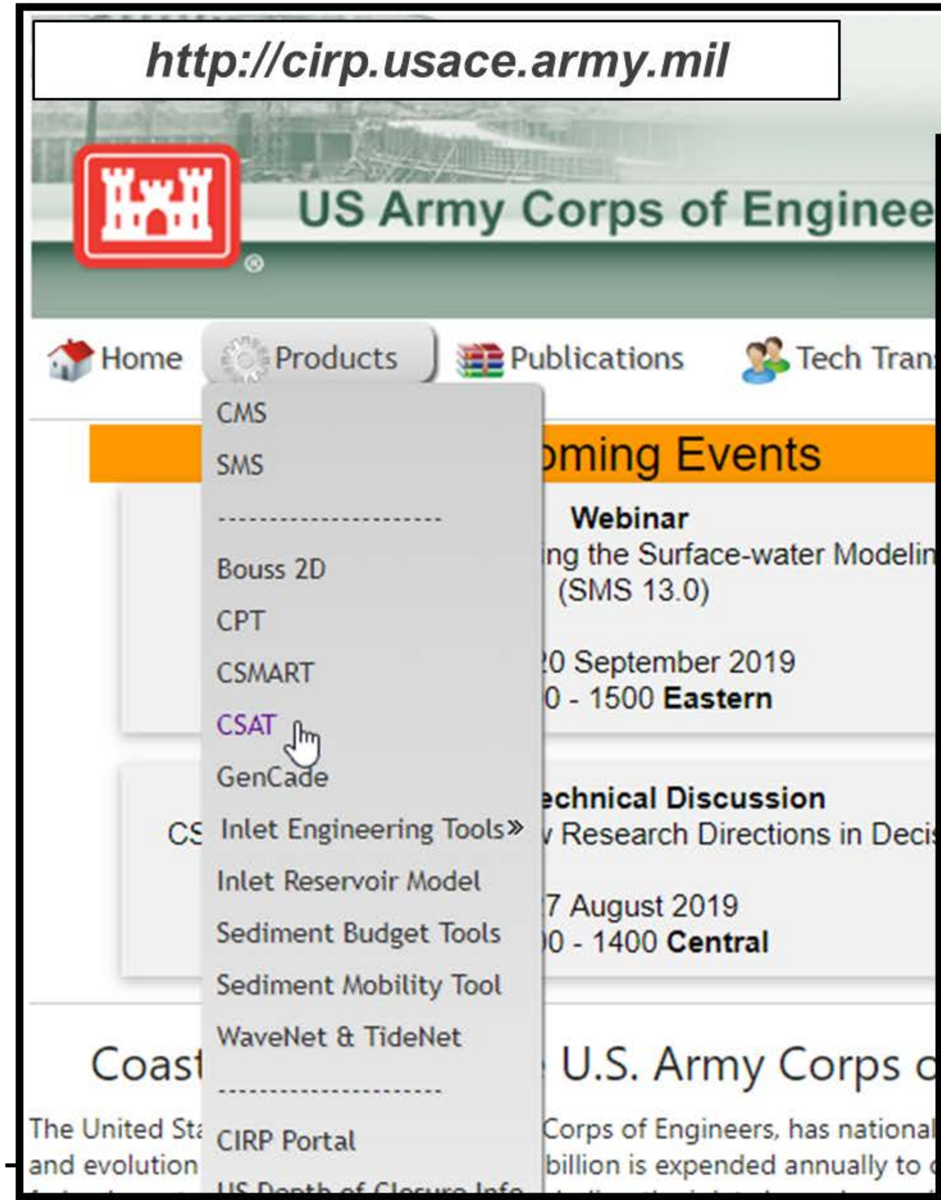




CSAT Access

http://cirp.usace.army.mil

StoryMap: https://arcg.is/094Lur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Webinar
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(SMS 13.0)
20 September 2019
0 - 1500 Eastern
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Research Directions in Deci
7 August 2019
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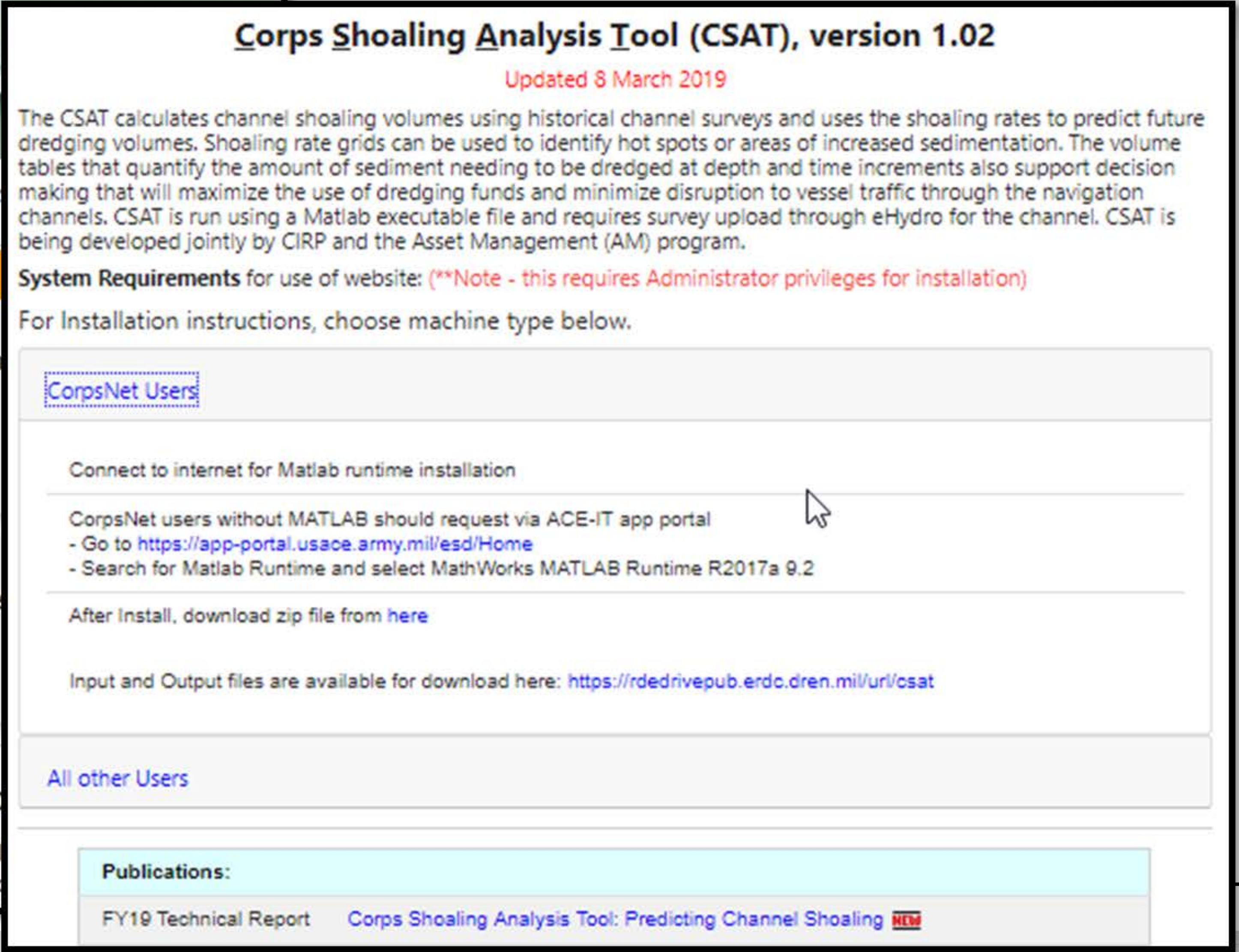

Corps Shoaling Analysis Tool (CSAT), version 1.02

Updated 8 March 2019

The CSAT calculates channel shoaling volumes using historical channel surveys and uses the shoaling rates to predict future dredging volumes. Shoaling rate grids can be used to identify hot spots or areas of increased sedimentation. The volume tables that quantify the amount of sediment needing to be dredged at depth and time increments also support decision making that will maximize the use of dredging funds and minimize disruption to vessel traffic through the navigation channels. CSAT is run using a Matlab executable file and requires survey upload through eHydro for the channel. CSAT is being developed jointly by CIRP and the Asset Management (AM) program.

System Requirements for use of website: (**Note - this requires Administrator privileges for installation)

For Installation instructions, choose machine type below.

CorpsNet Users

Connect to internet for Matlab runtime installation

CorpsNet users without MATLAB should request via ACE-IT app portal
- Go to https://app-portal.usace.army.mil/esd/Home
- Search for Matlab Runtime and select MathWorks MATLAB Runtime R2017a 9.2

After Install, download zip file from here

Input and Output files are available for download here: https://rdedrivepub.erdc.dren.mil/url/csat

All other Users

Publications:

FY19 Technical Report Corps Shoaling Analysis Tool: Predicting Channel Shoaling NEW

Future Work

- Continue improving Routing
  - Apply in other locations
- CSAT in Python (beta testing)
- CSAT on Microsoft Azure
  - (migration of production process almost complete)

Questions?