Eelgrass Measurement Studies in Island County

IC Marine Resource Committee

Island County Department of Health

Gregg Ridder 4/1/2014

Ecology of Eelgrass

SUBMERGED
Subtidal and
Intertidal

MARINE
Low Salinity to
Ocean Water

FLOWERING
Pollination, Fruits, Seeds

DISTRIBUTION
Temperate to Arctic

NUTRIENT CYCLING
In Sediment and
In Water Column

ESTUARINE FILTRATION
Nutrients and
Sediments

FOOD RESOURCE
Waterfowl
Invertebrates

HABITAT
Breeding
Nursery
Feeding
Protection

INDICATOR
Ecosystem Stress
Pollution
Environmental Health

WASHINGTON STATE DEPARTMENT OF
Natural Resources
www.dnr.wa.gov

The Eelgrass Meadow
A World of Microhabitats

1. zooplankton
2. dwarf crab
3. salmon
4. herring
5. epiphytic macroalgae
6. epiphytic microalgae, hydroids and bryozoa
7. sea cucumber
8. dungeness crab
9. octopus
10. sand dollars
11. clams and cockles
12. pacific spiny lumpsucker
13. opalescent amphipod
14. stalked jellyfish
15. eelgrass isopod
16. juvenile salmon
17. bubble shell
18. opalescent nudibranch
19. perch
20. juvenile kelp crab
21. alabaster nudibranch
22. scallop
23. gunnel
24. bay pipefish
25. sea urchin
26. juvenile sculpin
27. decorator crab
28. juvenile clams
29. juvenile flounder and sole
30. juvenile crab
31. geoduck
32. sediment microfauna
33. snail and snail eggs
34. juvenile cod, tomcod and walleyed pollock
35. herring eggs
36. jellyfish
37. larval fish
38. melibe - hooded nudibranch
39. tubesnout
40. shrimp
41. brooding anemone
42. prickleback
43. sculpin
44. bacteria on detritus
45. mosshell
46. sunflower sea star
47. sea pen
48. red rock crab
49. hermit crab
50. worms
51. ghost shrimp
52. sand lance
53. brant
54. Canada goose
55. bufflehead

This is a reproduction from the interpretive display at the Port Townsend Marine Science Center's Eelgrass Exhibit.
For more information, call, write or visit the Port Townsend Marine Science Center, Fort Worden State Park, Port Townsend, WA 98368 - (206) 385-5582.

Background

- Jeff Gaeckle (WADNR) > Fred Short - Submerged Vegetation Monitoring Program 2003 - 2014; Methods for underwater videography; Scope is all of Puget Sound

- Sandy Wyllie-Echeverria (Friday Harbor Labs) - Eelgrass plant physiology, Population relationships, History, Underwater Videography

- Suzanne Shull (Padilla Bay) - Aerial Photography and GPS Ground-Truthing

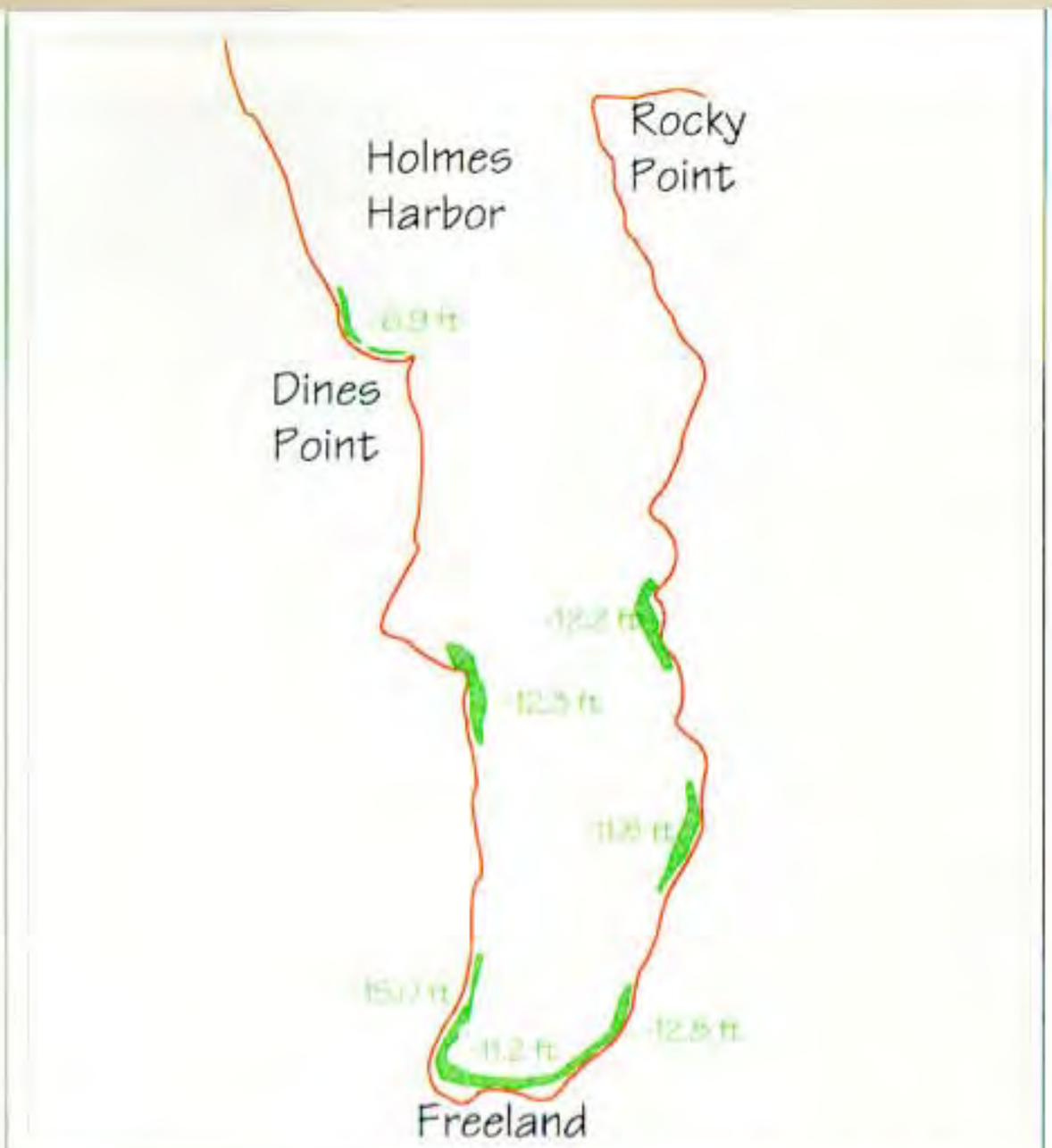
- Jan Holmes and Don Meehan: 2000 Survey by Land Owners

- IC MRC: 2001 Contracted Studies for Island County to Jim Norris and Sandy Wyllie-Echeverria

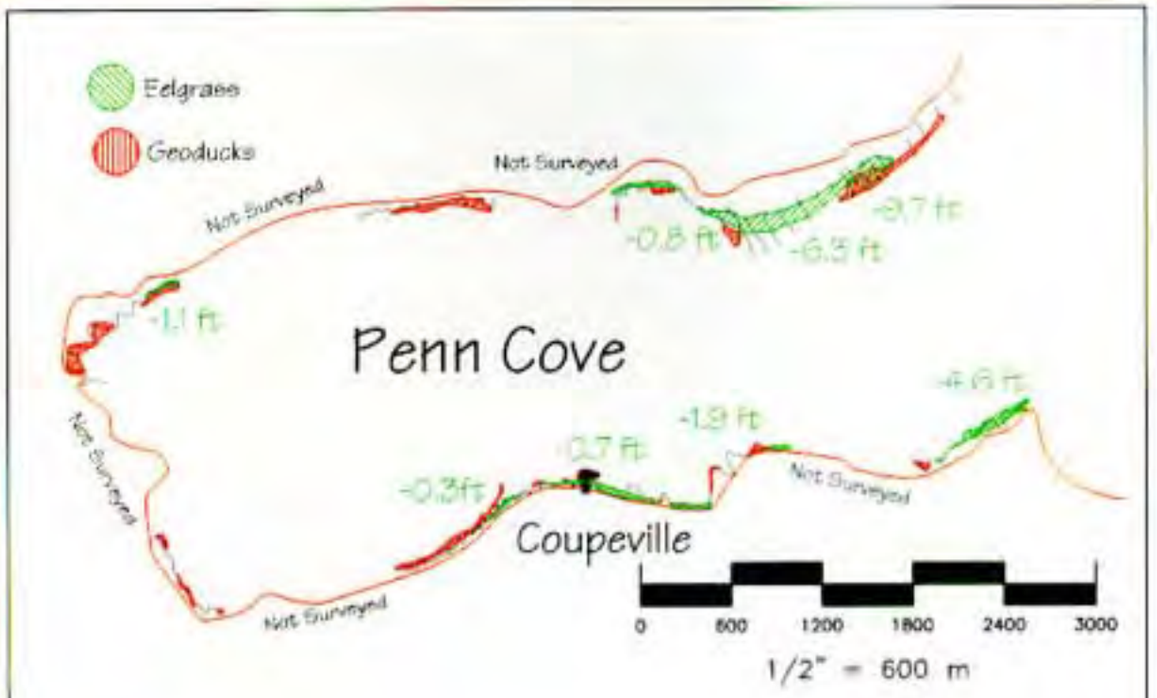
- Loss of Eelgrass in Holmes Harbor in 2007

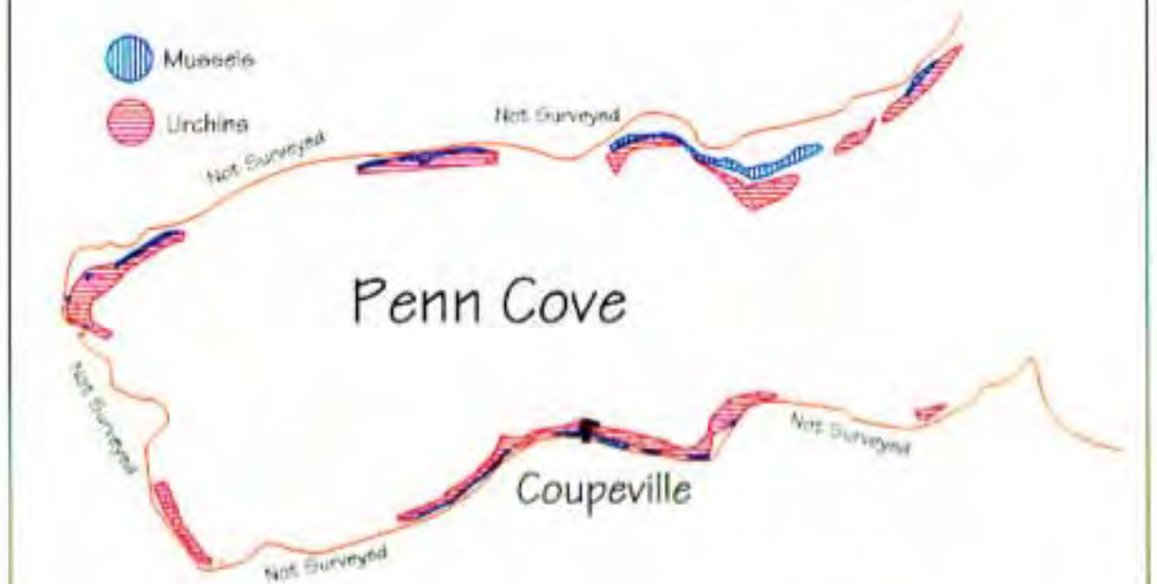
- NWStraits/NOAA/MRC Funded our eelgrass studies in 2008

2000 Survey of IC Eelgrass



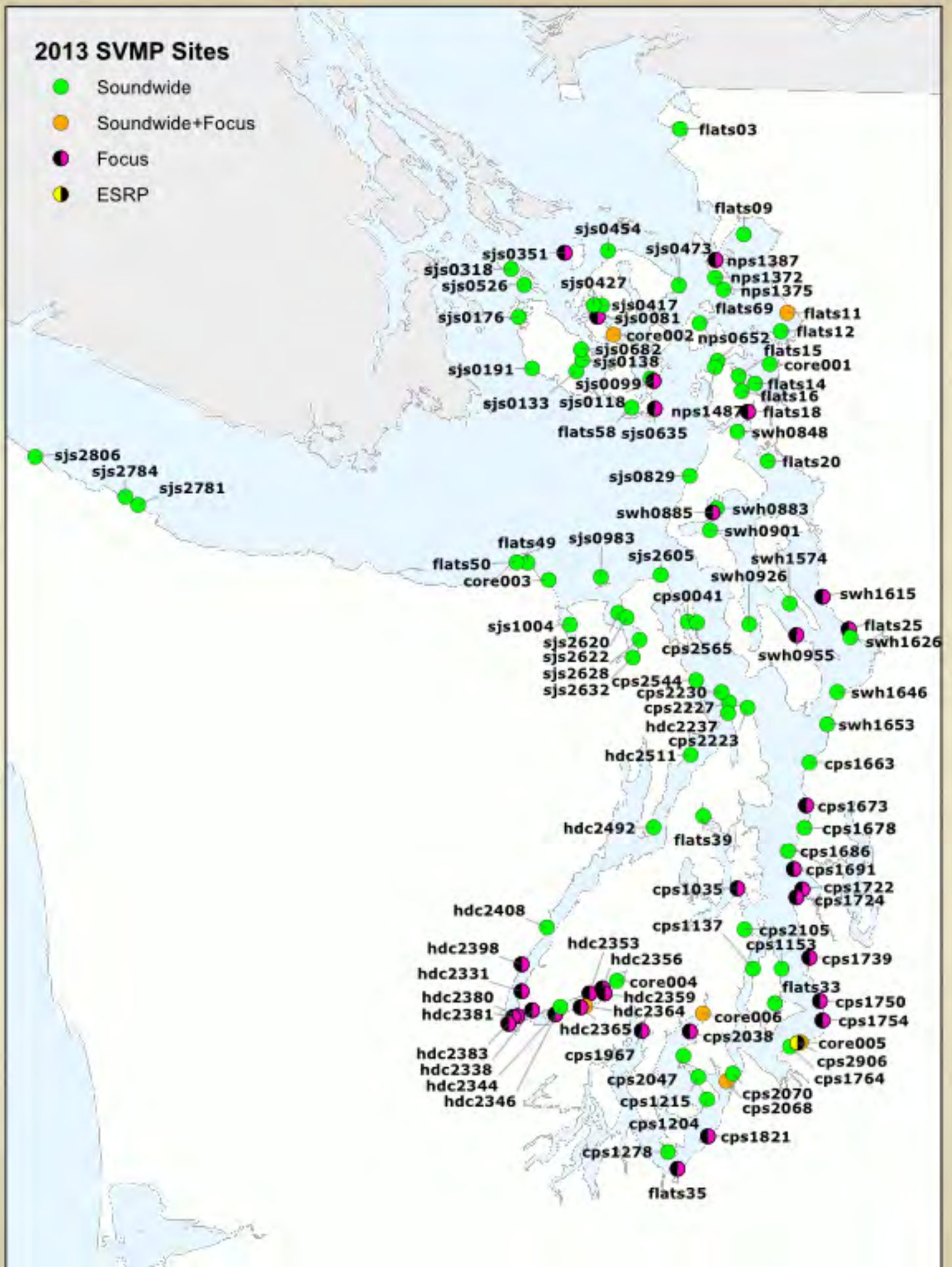
Plotting Offsets	Marine Resources Consultants	Survey: Island County
Easting: 371687	PO Box 816 Port Townsend, WA 98368 (360) 385-4486	Site: Holmes Harbor
Northing: 114424		Survey Dates: 12/14/00





Plotting Offsets	Marine Resources Consultants	Survey: Island County
Easting: 358776	PO Box 816 Port Townsend, WA 98368 (360) 385-4486	Site: Penn Cove
Northing: 136688		Survey Dates: 12/7-8/00

DNR Sampling Sites for 2013



Eelgrass Measurement Methods

- Plant Characteristics
- Underwater Videography
- Aerial Photography

Fun-In-the-Mud

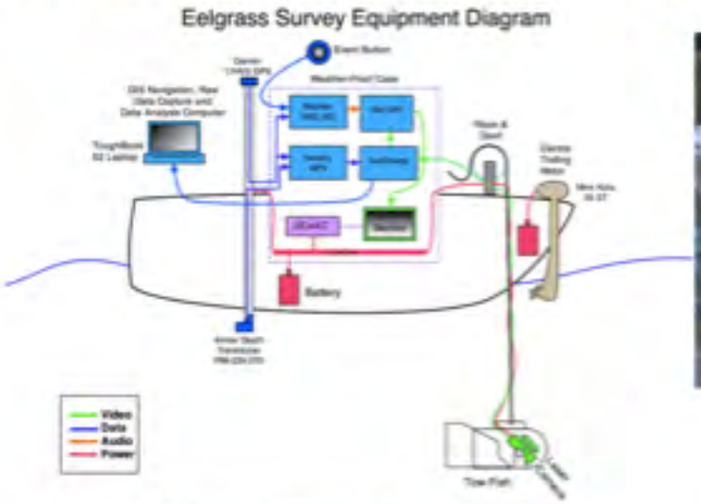
Scope of the Problem

- Measurement: presence/absence, position, depth
- Detection Limit: one plant per square meter
- Specificity: seagrass; Z_{MARINA} vs $Z_{JAPONICA}$
- Capacity: 10 DNR sites (1000 meter) per year; IC has 300 DNR sites (230 on Whidbey; 70 on Camano)
- Sensitivity: Z_{MARINA} Bed Area or localized Feature
- Interpretation: Biological vs statistical Significance
- Useage: Qualitative, Quantitative; Advisory or Regulatory

Methods for Eelgrass Surveys

UNDERWATER VIDEO

Beach Watchers follow the Washington State Department of Natural Resources Submerged Vegetation Project's video mapping protocols using portable mapping and power components on volunteer owned and operated skiffs. A crew is made up of three volunteers: boat captain, towfish operator, and electronics technician.



Text File of GPS, Depth

MPEG2 Movies

AERIAL PHOTOGRAPHY

Vertical photographs of shorelines at extremely low tides were collected from 2000' using a remote controlled, wing-mounted camera that transmitted images to an iPad in the cockpit of a Cessna 177RG.

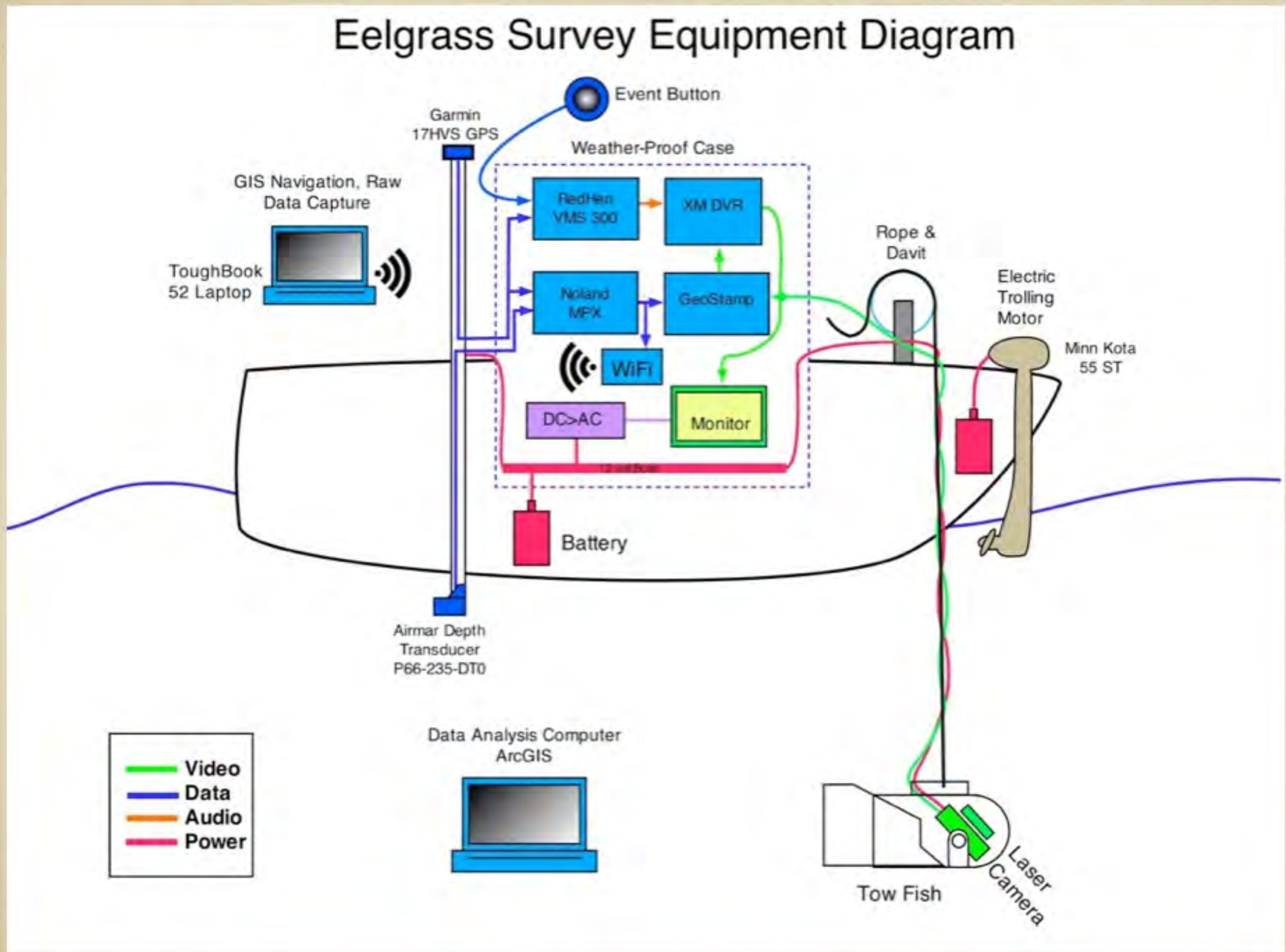
Our Boat Team

- Boat: Cap'n Ken Urstad
- Equipment: Neal Clark, Gregg Ridder, Bob Gentz, Tom Vos, Mark Kennedy, Don Meehan
- Volunteer Coordinator: Bob Gentz
- camera: Steve Shattuck, Joanne McMillen, Kathy Fritts, Virginia Walton, Russ Holmes, Finn Gatewood, Noel Nic'Fergusson
- Video Analysis: Gregg, Neal, Mark
- Data Processing: Gregg, Neal
- DNR Data & Analysis: Fred Short, Lisa Ferrier, Jeff Gaeckle
- Archives/SoundIQ: Suzanne Shull, Sasha Horst
- Manager: Kristen Stavros

Ken's Boat

Boat Envy

Underwater Videography



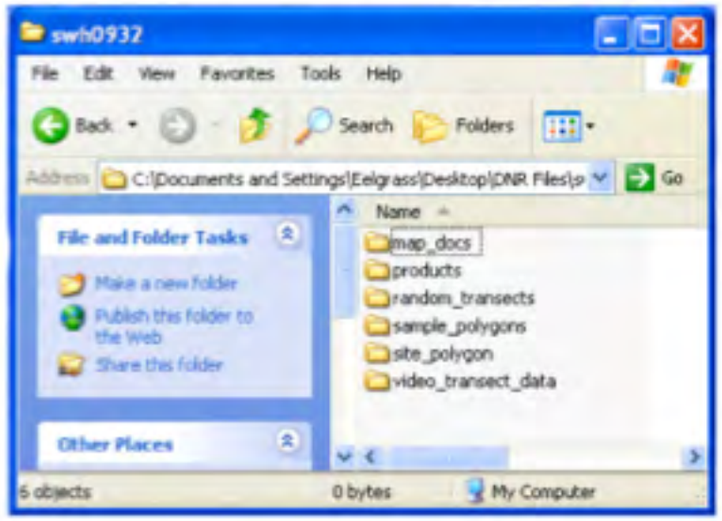
Underwater Videography Tasks

(Gregg Ridder 6/2/13)

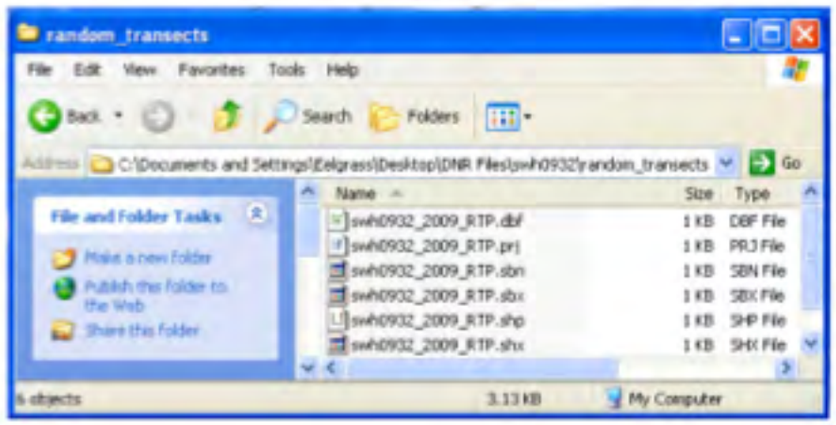
V1. Importing DNR Transect Points and sampling polygons

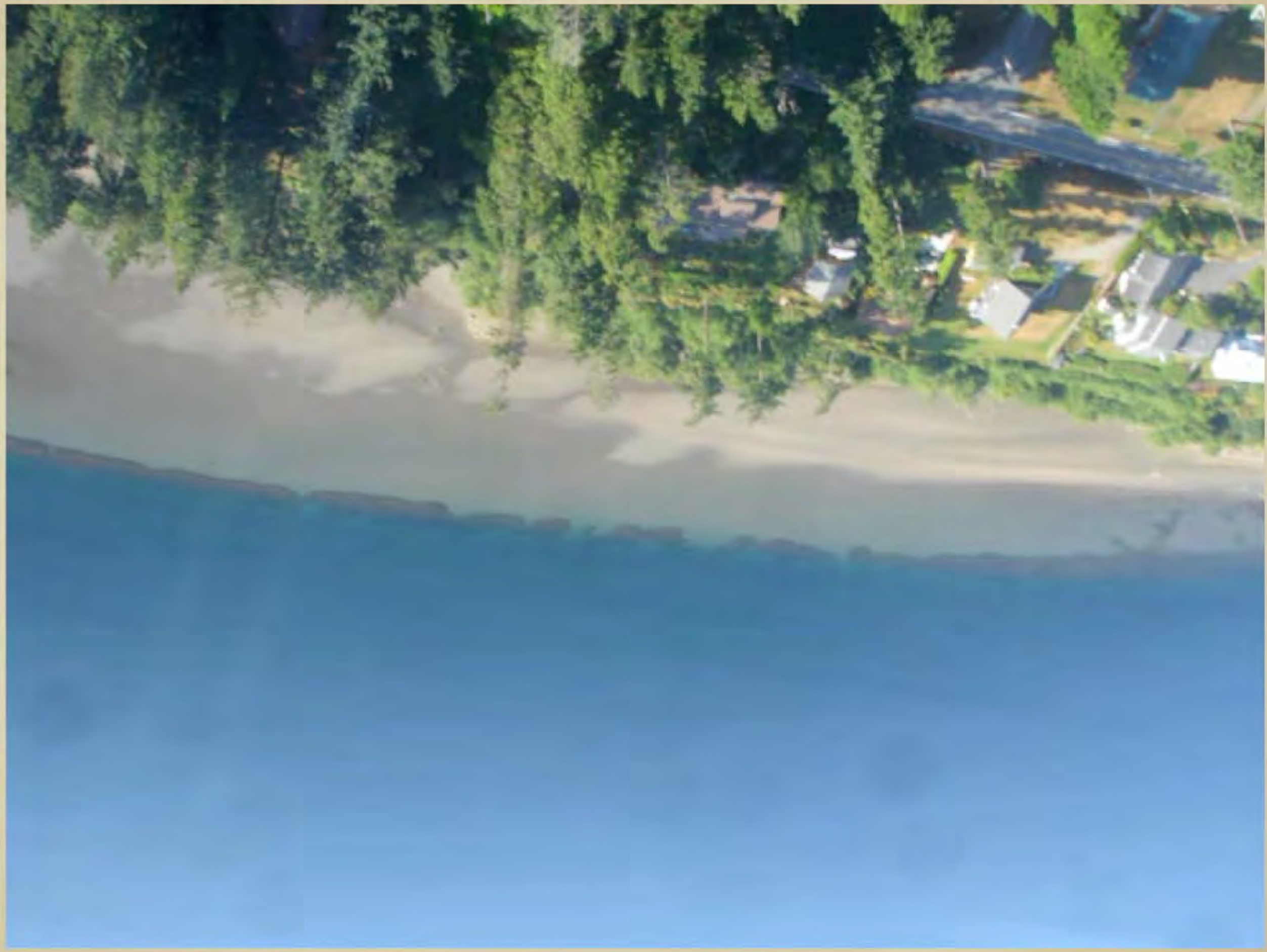
The goal of this task is to take random transect points defined by DNR and import them to Mediamapper so we can plan our transect tracts and provide live GPS guidance to the boat captain using the laptop as a moving map. The problem is that DNR supplies the data as an ArcMap projected coordinate system (NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet; Projection: Lambert_Conformal_Conic) and Mediamapper is set to a geographic projection. This transformation can be done in ArcMap by changing the coordinate system to geographic, exporting the data and opening the file in Mediamapper. The instructions below will accomplish this task.

Our transect points have been defined and prepared by Jeff Gaeckle and Dolores Sare at DNR. Dolores put the files up on the DNR server and we download them as the following files for each site:



The data we need is in the folder we want are in the "random_transects" and "site polygon" folders.





Process/Timeline

- March - May
  - Present last year's data to MRC; Discuss Sites for this year
  - Upgrade / Repair Equipment & Software
  - Get Transect point coordinates from DNR
  - Create Navigation Maps and transect lines
  - Schedule Crew and Volunteers
  - Do a Shake-down Run
- June - August
  - Collect Underwater Video (weather, tides, Crew)
  - Store tracklog and video data
  - Map tracklog and record notes in Quick Report
  - Collect Aerial Photos at low tide days
  - Create final MRC/NOAA report on last year's Results
- September - November
  - Make Spreadsheets from Tracklog; Burn video DVDs
  - Analyze video for eelgrass presence/absence
  - Map results of analysis and edit sample polygons
  - Georeference aerials onto maps
  - Send spreadsheets to DNR for Bed Area Measurments
- December - February
  - Create interim report for MRC/NOAA of this Year's Data
  - Present Results at Conferences/Meetings
  - Transfer results to MRC Archive; SoundIQ

Put Crews together

Crew Schedule for 2013 Eelgrass Monitoring				
Date	**Site**	**Captain**	**Equipment**	**Camera** ***
5/31/13	swh0932	Ken Urstad	Gregg, Mark (Neal, Bob)*	Gregg, Mark
6/14/13	flats29	Ken Urstad	Mark Kennedy	Mark Kennedy
6/15/13	flats29	Ken Urstad	Mark Kennedy	Steve Shattack
6/28/13	swh0885	Ken Urstad	Mark Kennedy	Joanne McMillen
6/29/13	swh0875	Ken Urstad	Bob Gentz	Joanne McMillen
7/12/13	swh0900	Ken Urstad	Tom Vos**	Kathy Fritts
7/13/13	swh0898	Ken Urstad	Neal Clark	Virginia Walton
7/26/13	swh1570	Ken Urstad	Neal Clark	Russ Holmes
7/27/13	swh0888	Ken Urstad	Mark Kennedy	Finn Gatewood
7/28/13	swh0899	Ken Urstad	Neal Clark	Bob Gentz
7/29/13	swh0893	Ken Urstad	Bob Gentz	Noel Nic'Fergusson

* Training for equipment operators and equipment check; completed swh0932

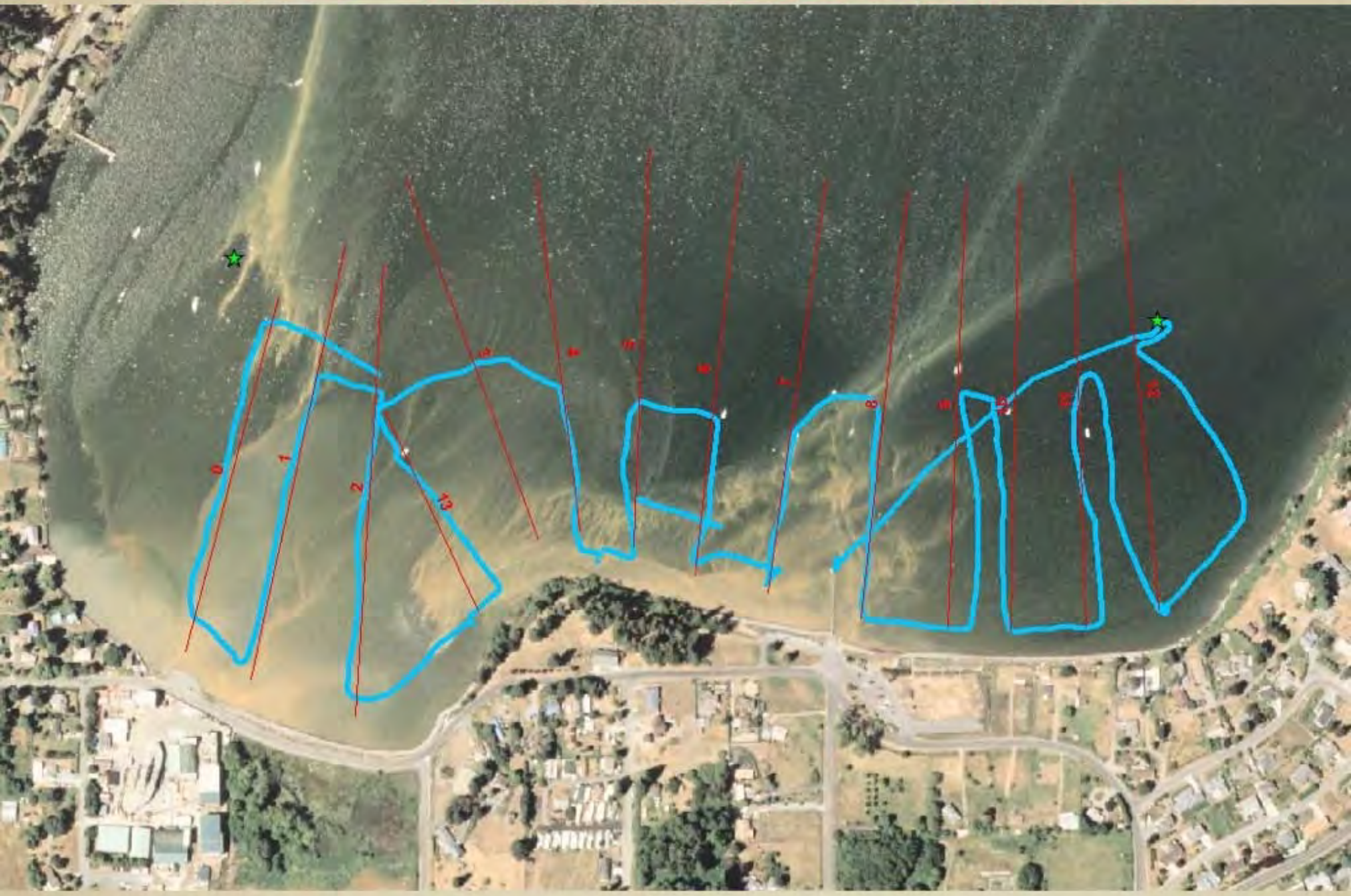
** Tom Vos trained at Gregg's shop on 7/11/13

*** Camera operators were trained by equipment operators on the boat

Identify DNR Site

Create Transect Lines

Collect Video Data along Transects



Data

Tracklog

$GPRMC,201633,A,4800.9851,N,12231.8702,W
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$SDDPT,1.1,*79
$SDDBT,3.8,F,1.1,M,0.6,F*0B
$YXMTW,20.3,C*13
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$GPGGA,2
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$GPRMC,2
$GPGGA,2
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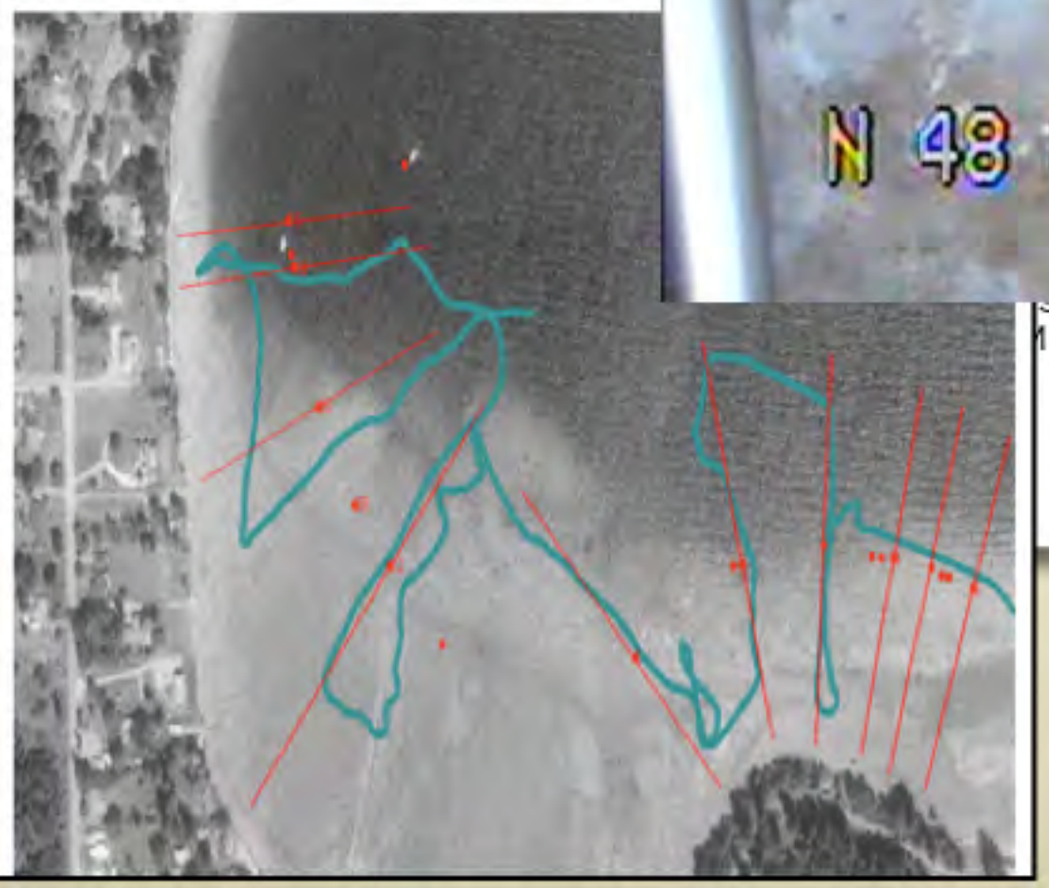
$SDDBT,4.
$YXMTW,2
$GPRMC,2
$GPGGA,2
$SDDPT,1.2
$SDDBT,4.
$YXMTW,2

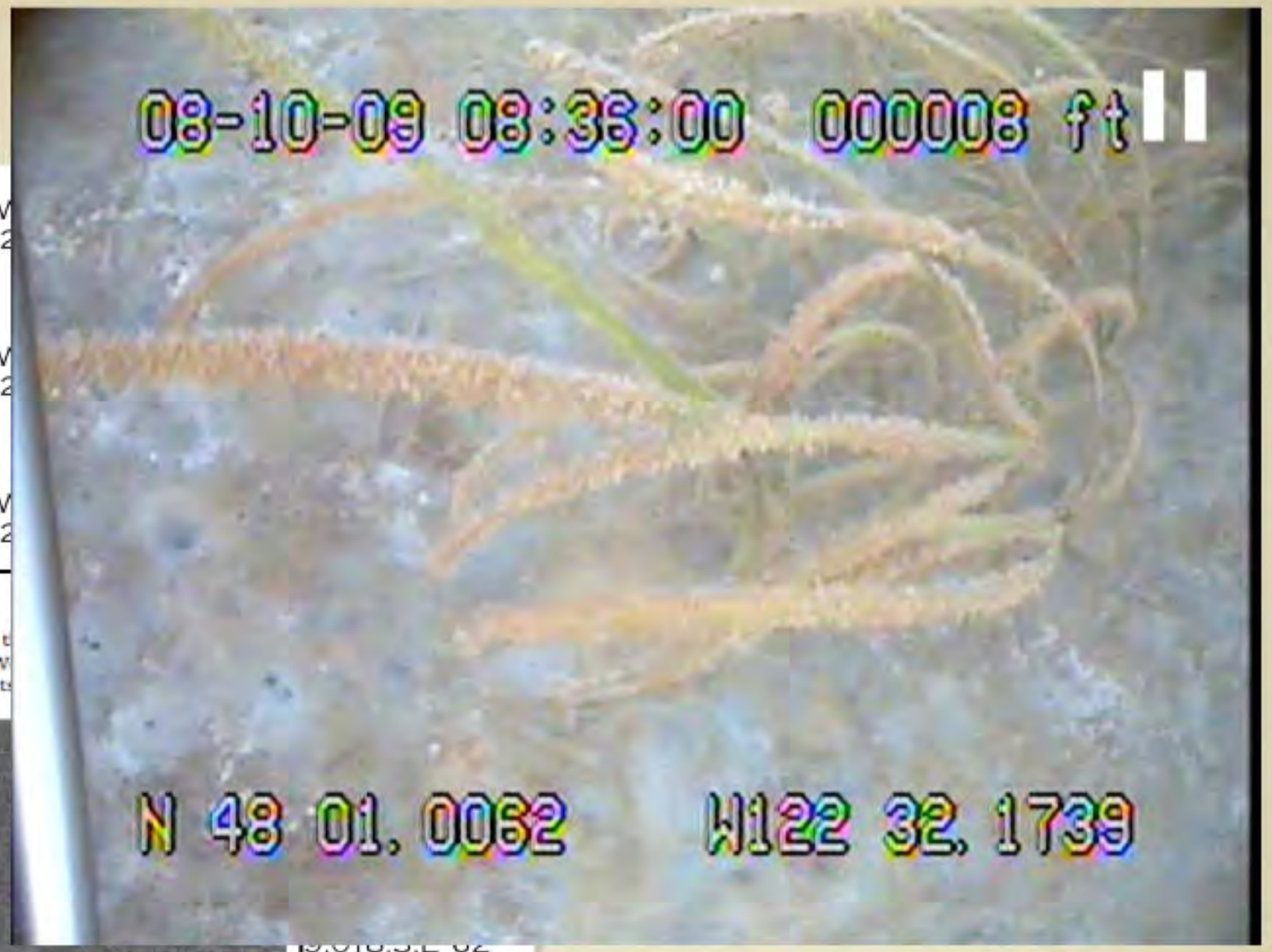
Notes

8/10/09 – swh0932 (Freeland Park)

Ken, Bob Buck and Gregg finished the Freeland Park site. All t
made staying on course difficult, but the rain stayed away. W
from 6/19/08) and finished with #19 for a total of 6 transects



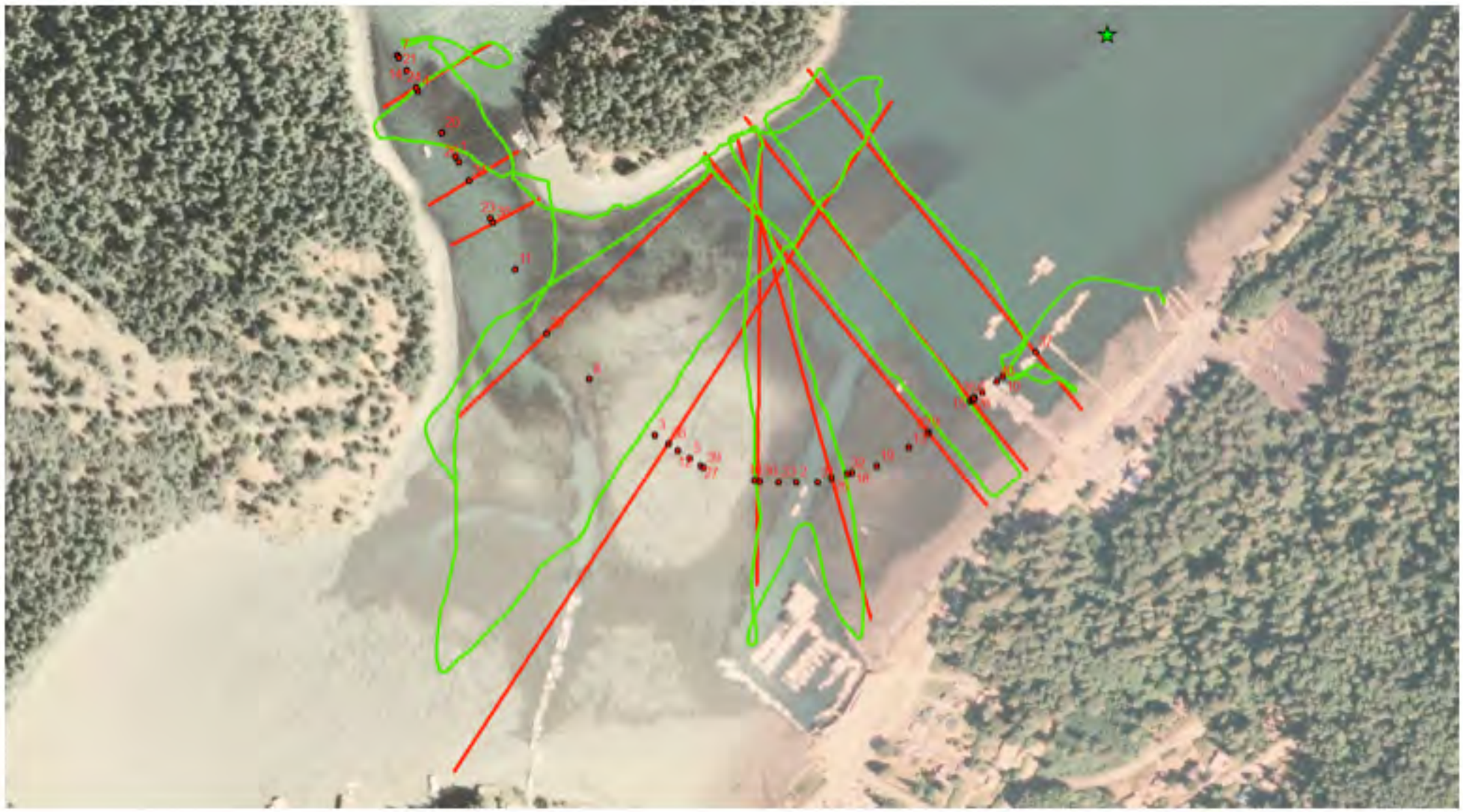
Video



Quick Report

060911 Cornet Bay (flats029)

Ken Urstad, Russ Holmes and Gregg Ridder and met at the Cornet Bay Park at 8:30 AM. The weather was cloudy and cool, but no rain and very light winds. The data capture failed on first try, but worked on the second. We completed 7 transects and then tried to navigate the small channel near the island. We were able to do one transect at the north end of the channel, but the currents were so strong in the channel that all we could do is a reconnaissance survey by using the gas motor. Before we quit we repeated one transect where we drifted off course earlier.



Underwater Videography
Create Spreadsheets

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27	48.01766	-122.52907	1	1	1	1
28	48.01765	-122.52906	1	1	1	1

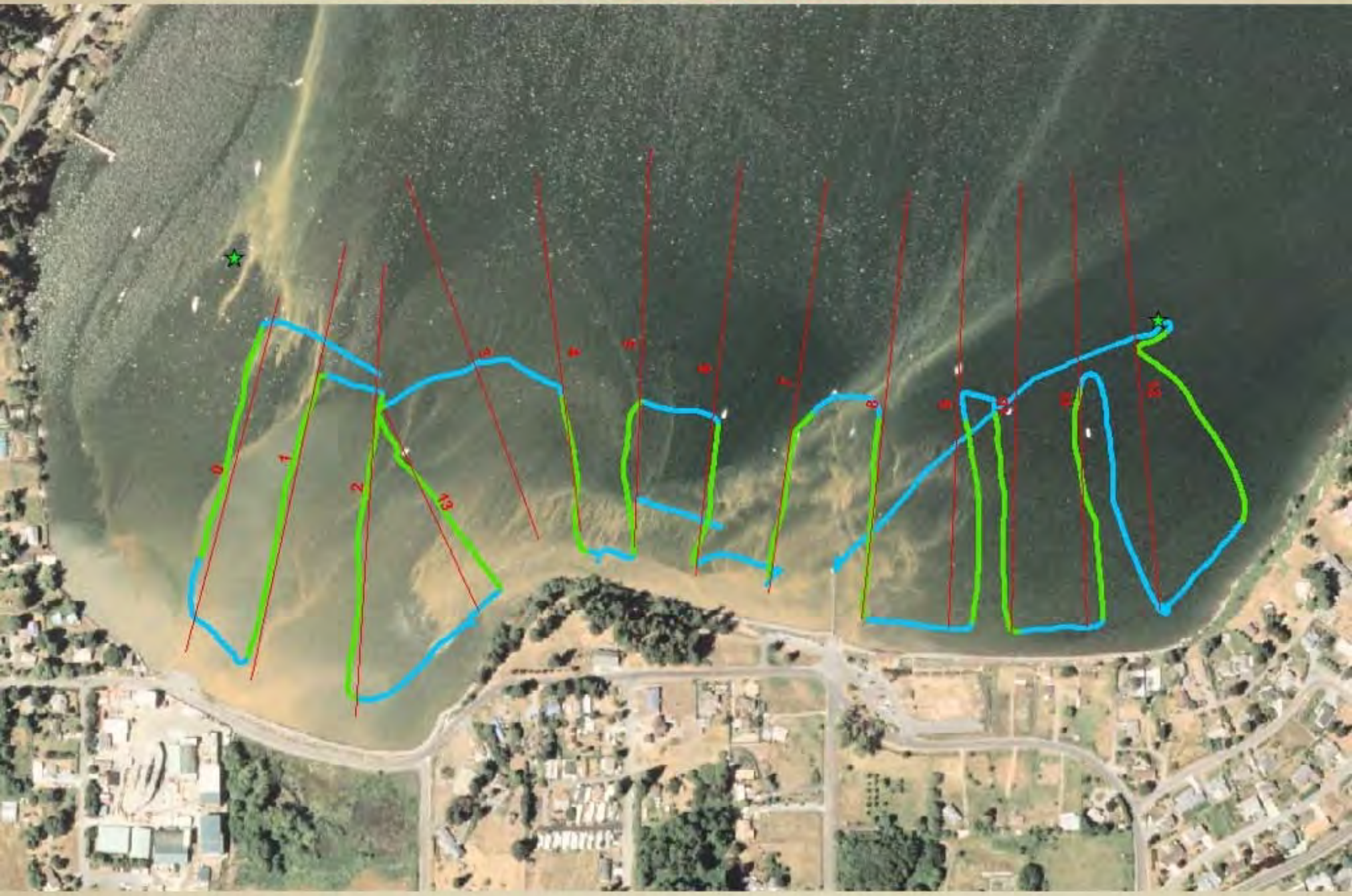
Codec	Elapsed	h:m:s GMT	depth	temp
0:21:27	0:00:00	20:49:51	22.4	20
0:21:28	0:00:01	20:49:52	22.4	20
0:21:29	0:00:02	20:49:53	22.4	20
0:21:30	0:00:03	20:49:54	21.9	20
0:21:31	0:00:04	20:49:55	21.8	20
0:21:32	0:00:05	20:49:56	21.5	20
0:21:33	0:00:06	20:49:57	21.3	20
0:21:34	0:00:07	20:49:58	21	20
0:21:35	0:00:08	20:49:59	20.6	20
0:21:36	0:00:09	20:50:00	20.6	20
0:21:37	0:00:10	20:50:01	20.6	20
0:21:38	0:00:11	20:50:02	20.2	20
0:21:39	0:00:12	20:50:03	20.1	20
0:21:40	0:00:13	20:50:04	19.4	20
0:21:41	0:00:14	20:50:05	19.6	20
0:21:42	0:00:15	20:50:06	18.9	20
0:21:43	0:00:16	20:50:07	18.6	20
0:21:44	0:00:17	20:50:08	18.5	20
0:21:45	0:00:18	20:50:09	18	20
0:21:46	0:00:19	20:50:10	18	20
0:21:47	0:00:20	20:50:11	18	20
0:21:48	0:00:21	20:50:12	17.7	20
0:21:49	0:00:22	20:50:13	17.5	20
0:21:50	0:00:23	20:50:14	17.3	20
0:21:51	0:00:24	20:50:15	17.2	20
0:21:52	0:00:25	20:50:16	16.6	20
0:21:53	0:00:26	20:50:17	16.7	20
0:21:54	0:00:27	20:50:18	16.8	20

Edit Video to match transects

Video Log for 2013 Eelgrass Files

Site	MDY	Video File	Transect (FID)	Start	Duration	Notes	Analyst
swh0932	053113	0900		8:27:32	0:00:02	Not a Transect	
swh0932	053113	0926	12	8:53:46	0:08:02		GMR
swh0932	053113	0937		9:05:15	0:07:39		
swh0932	053113	0946	11	9:14:14	0:07:43	Tomato Soup	
swh0932	053113	0957	10	9:24:39	0:09:08		
swh0932	053113	1010M	9	9:37:34	0:07:20	Merge 1010 & 1015	
swh0932	053113	1020	8	9:48:01	0:05:13		
swh0932	053113	1028	7	9:55:48	0:05:05		
swh0932	053113	1037	6	10:04:33	0:04:29		
swh0932	053113	1044	5	10:11:39	0:06:09		
swh0932	053113	1052	4	10:19:46	0:05:07		
swh0932	053113	1102	13	10:30:04	0:09:03		
swh0932	053113	1115	2	10:43:27	0:07:54		
swh0932	053113	1125	1	10:53:09	0:08:36		
swh0932	053113	1139	0	11:06:54	0:14:52		
Total Time			1:38:41				
flats29	061413	0921A	10	9:20:36	0:06:48	Clip 0921	GMR
flats29	061513	0750		7:49:16	0:00:10	Not a Transect	GMR
flats29	061513	0752		7:51:47	0:08:13	No Tracklog	
flats29	061513	0803		8:02:03	0:18:49	No Tracklog	
flats29	061513	0828A	3	8:27:26	0:13:51	Clip 0828	
flats29	061513	0828B	4	8:41:18	0:16:33	Clip 0828	
flats29	061513	0907A	5	9:06:03	0:19:23	Clip 0907	
flats29	061513	0907B	6	9:25:28	0:19:20	Clip 0907	
flats29	061513	0952	7	9:50:53	0:22:55		
flats29	061513	1016	8	10:15:25	0:12:44		
flats29	061513	1034	1	10:32:58	0:06:11		
flats29	061513	1040A	0	10:39:11	0:06:52	Clip 1040	
flats29	061513	1040B	9	10:48:33	0:05:31	Clip 1040	
Total Time			2:10:08				
swh0885	062813	0828	1	8:26:22	0:15:34		MK
swh0885	062813	0845	9	8:43:02	0:16:01		
swh0885	062813	0903	8	9:01:26	0:15:41		
swh0885	062813	0920	7	9:18:15	0:14:16		
swh0885	062813	0937	6	9:34:47	0:14:53		
swh0885	062813	0954	2	9:52:01	0:15:03		
swh0885	062813	1012	5	10:09:44	0:14:13		
swh0885	062813	1029	4	10:27:13	0:08:59		
swh0885	062813	1041	3	10:39:02	0:10:38		
swh0885	062813	1053	0	10:51:33	0:09:13		
Total Time			2:14:31				

Clip Spreadsheets



Match Spreadsheets with Video

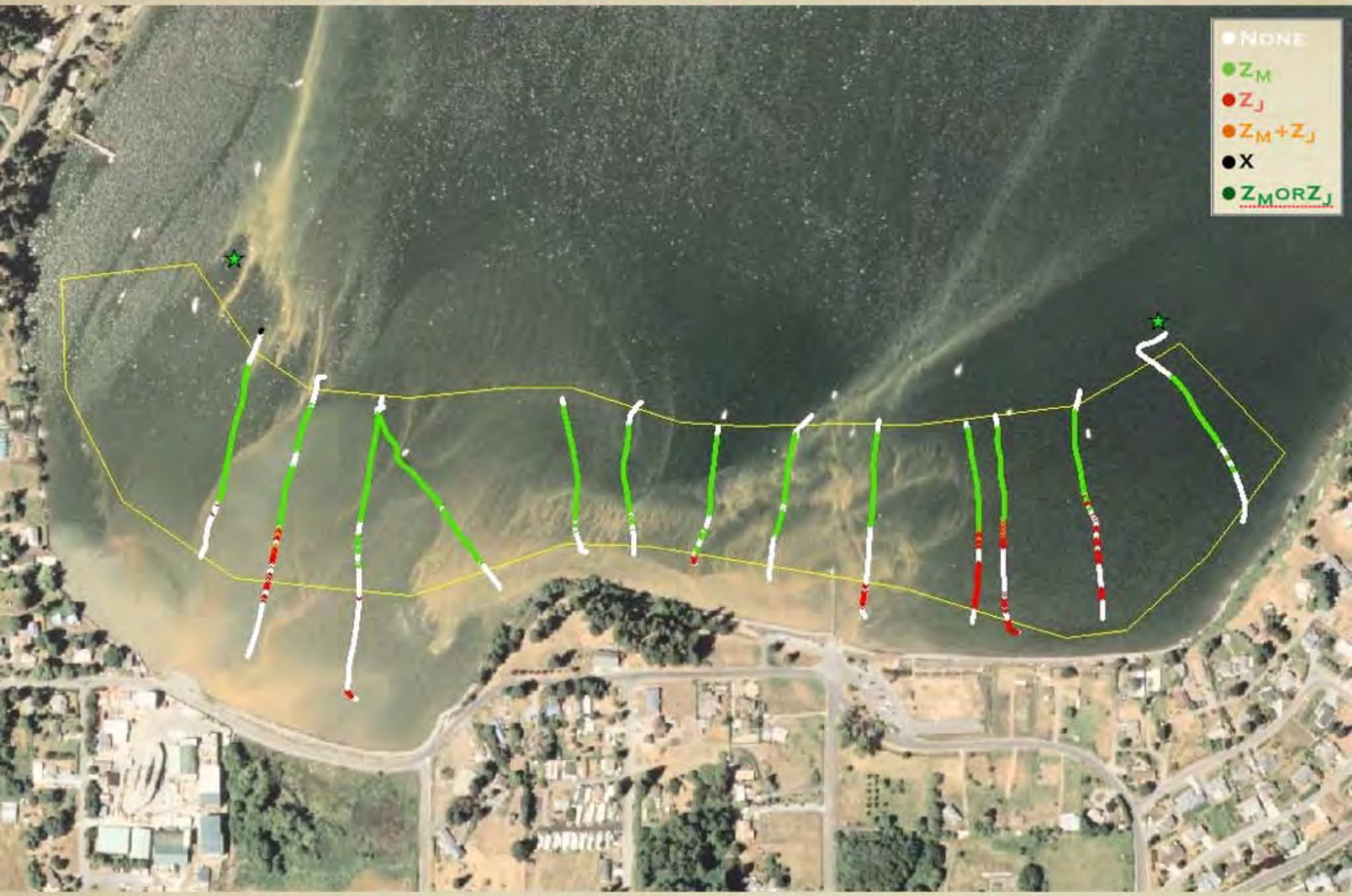
Video Analysis

Site	Name	Date(s)	Transects	Disk(s)	Size (Gb)	Analyst	Complete
flats29	Cornet Bay	061413 & 061514	8	flats29A,B	6.8	Gregg Ridder	Y
swh0875	Midway Blvd, OH	062913	12	swh0875	4.4	Mark Kennedy*	Y
swh0885	Blower's Bluff	062813	10	swh0885A,B	7.2	Mark Kennedy/Gregg Ridder	Y
swh0888	E. Monroe Landing	072713	13	swh0888A,B	7.3	Gregg Ridder	Y
swh0893	Kennedy's Lagoon	072913	12	swh0893A,B	5.9	Gregg Ridder	Y
swh0898	Coupeville	071313	11	swh0898	3.2	Neal Clark	Y
swh0899	Lovejoy Pt.	072813	10	swh0899A,B	5.1	Neal Clark	Y
swh0900	Mineral Spring	071213	13	swh0900	2.5	Mark Kennedy	Y
swh0932	Freeland Park	053113	13	swh0932A,B	6.8	Gregg Ridder	Y
swh1570	Elger Bay	072613	11	swh1570A,B	9.3	Neal Clark/Gregg Ridder	Y
Totals			113		58.5		

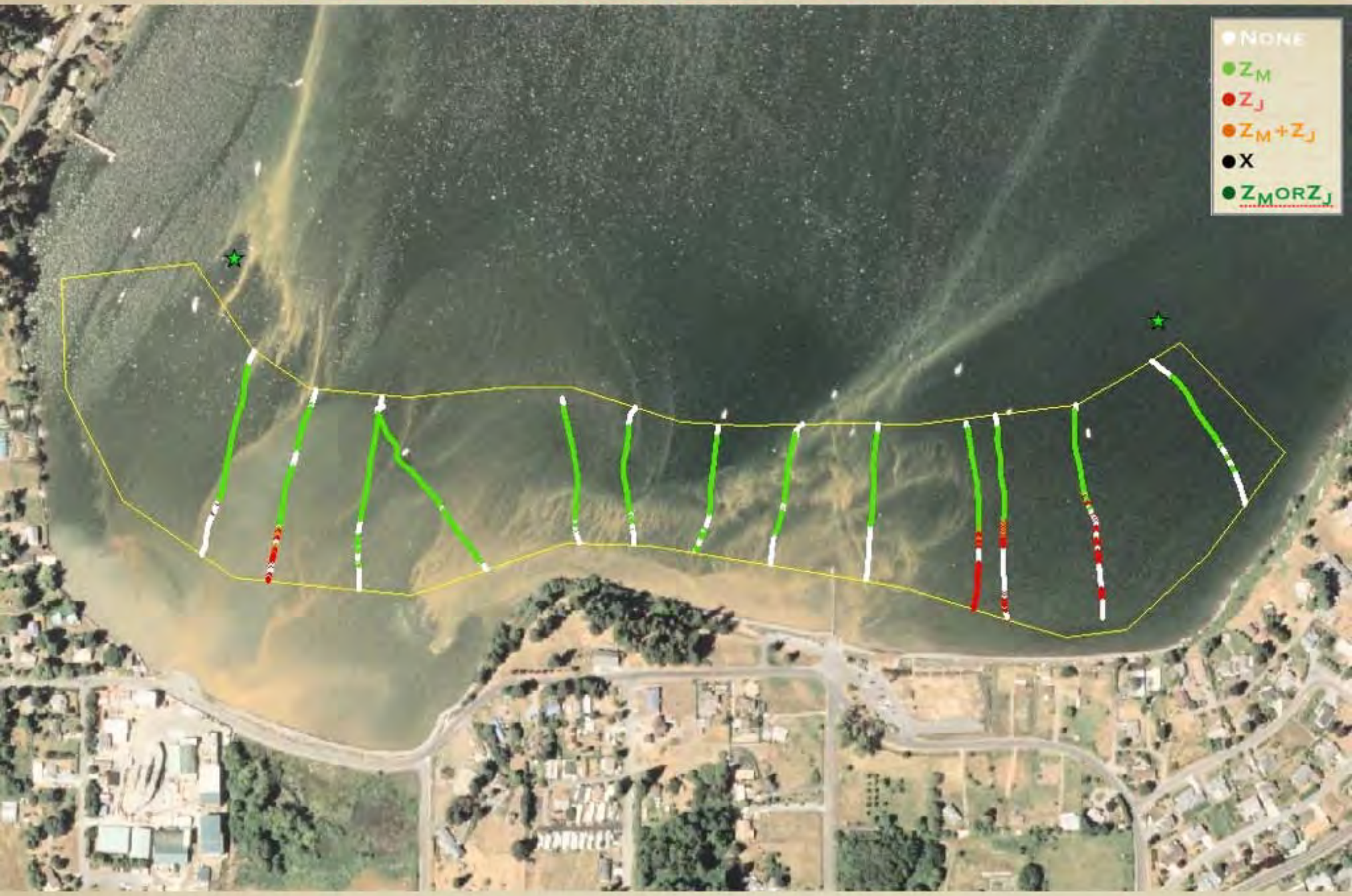
* first year - trained by Gregg and Neal on Jan 13, 2014

Display Z Scores

Overlay Sampling Polygon

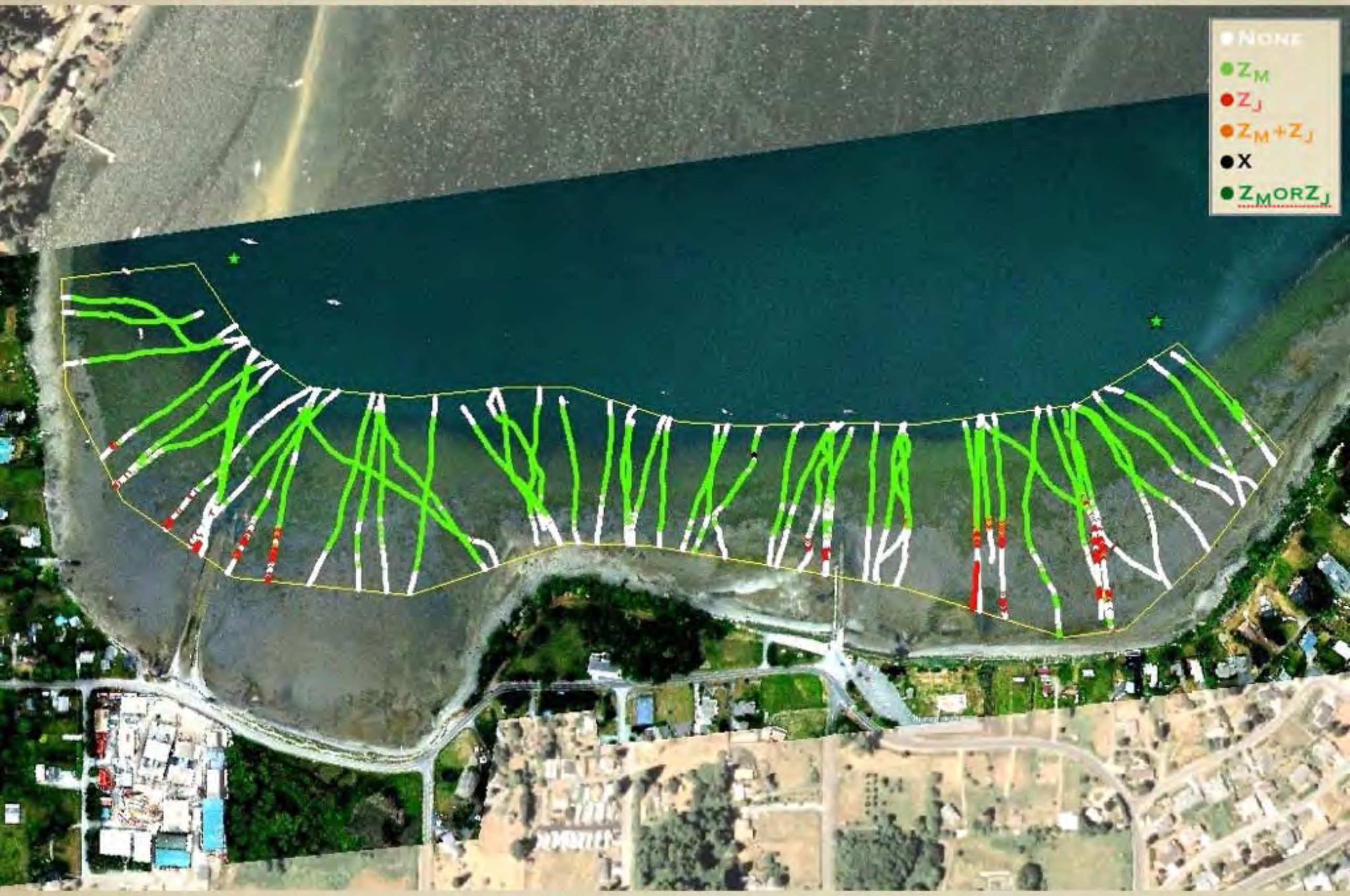


Clip Transect data to SP Boundary



Add Geo-referenced Aerial

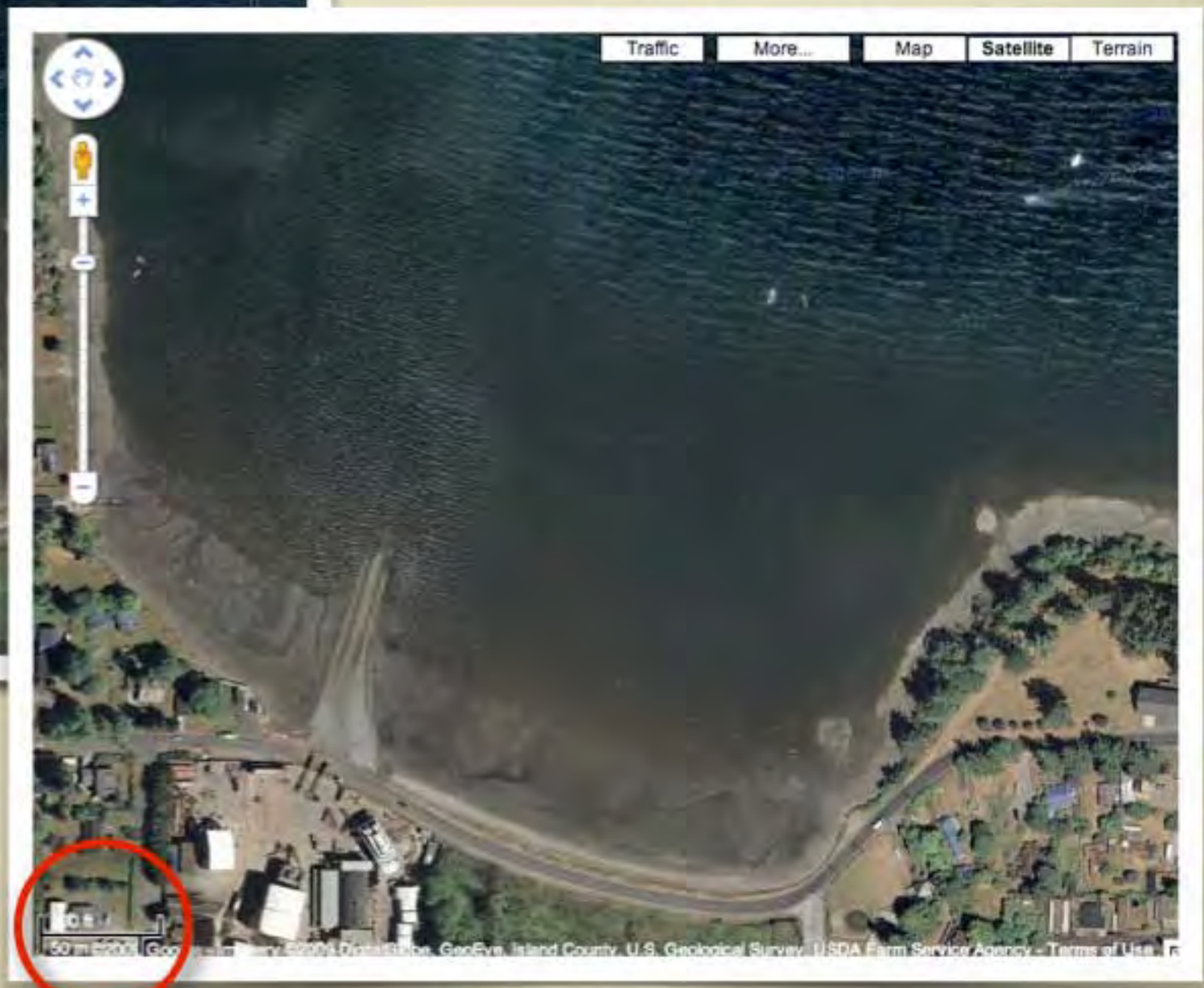
Include Data from Previous Years



Aerial Photography

Camera

Oblique vs Vertical



Photographic Resolution

Stitching Images

Geo-Registering Images

Holmes Harbor - Freeland Park

Aerial Photography Tasks

(Gregg Ridder 6/8/11)

A1. Taking Aerial Photographs

I developed a system to acquire aerial images using a small private plane with a remotely controlled camera mounted under the wing (see images below). The camera (Canon G10) was mounted to be as vertical as possible during flight. All images were taken within 30 minutes of lowest tides. The airplane (Cessna 177RG Cardinal) was flown at 2500 feet at 100 knots along the entire shoreline of all regions while taking pictures at an interval of approximately 4 seconds using a remote radio-controlled trigger (Optika) to provide overlap between successive images. The wings were kept level for all photographs.

Figure 1. Aerial Camera at 2500'

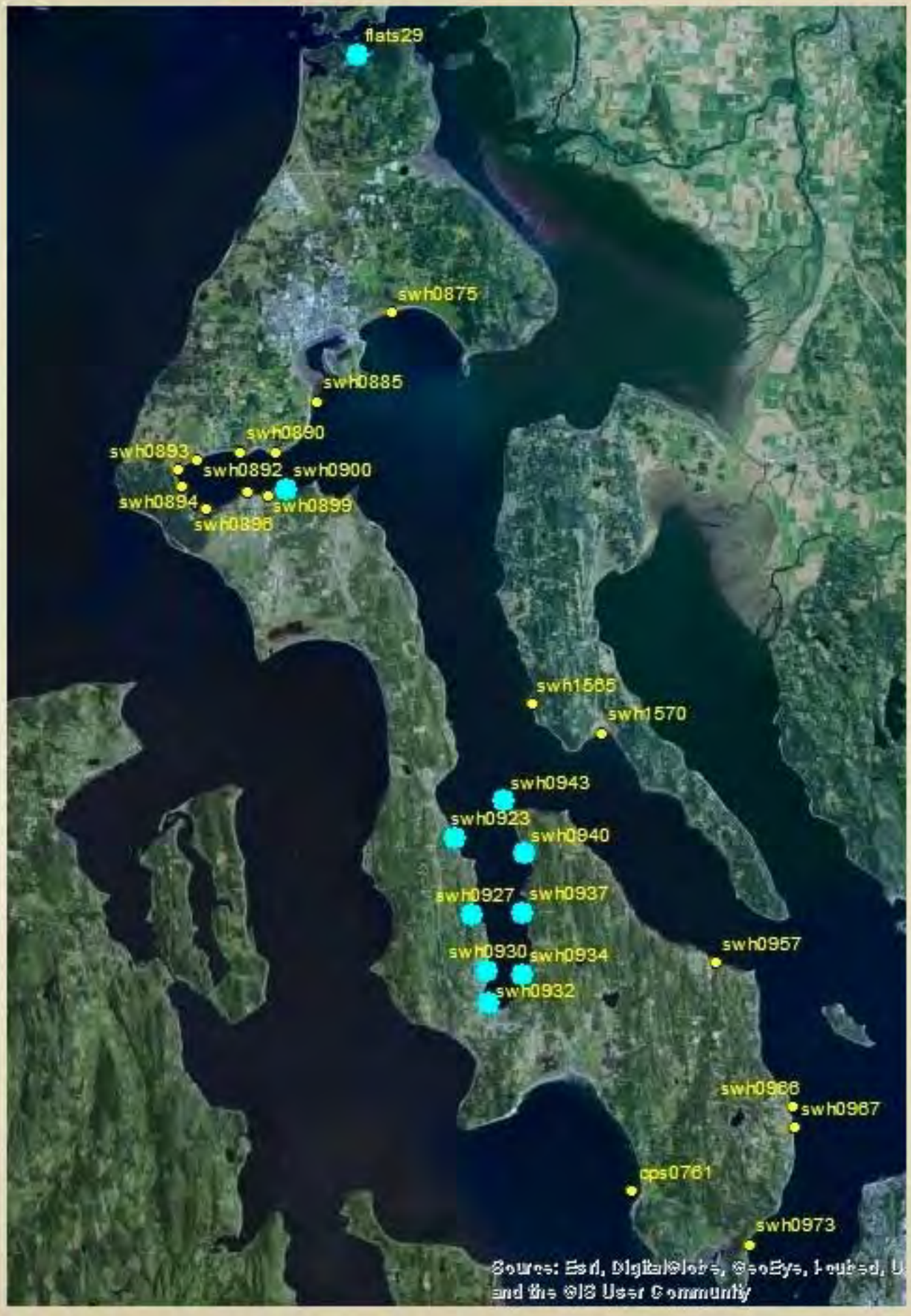
Figure 2. Camera mounted under wing

The camera was set at a fixed exposure time of 1/500 sec, a resolution of 14 megapixels, highest quality JPEG compression, image stabilization, and fixed focus (infinity). Complete details of the photographic parameters are recorded in the EXIF information within each image.

Figure 3. Details about the photograph is stored in the picture information.

Sampling Sites for Underwater Videography

2009 Sites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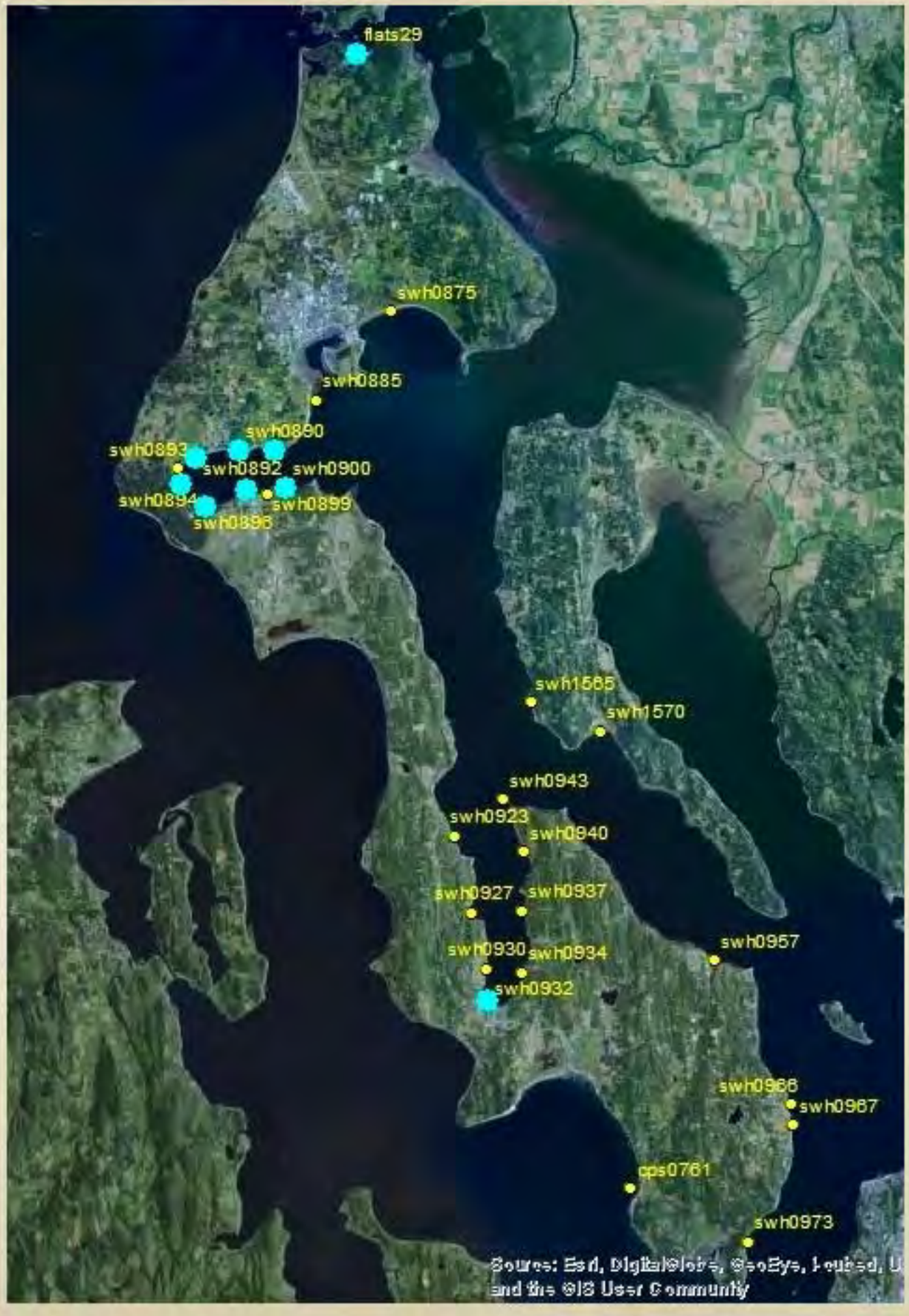
swh0875
swh0885
swh0890
swh0893
swh0892
swh0900
swh0894
swh0899
swh0896
swh1565
swh1570
swh0943
swh0923
swh0940
swh0927
swh0937
swh0930
swh0934
swh0957
swh0932
swh0966
swh0967
cps0761
swh0973
Source: Esri, DigitalGlobe, GeoEye, Earthstar, U
and the GIS User Community

2010 Sites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swh0900
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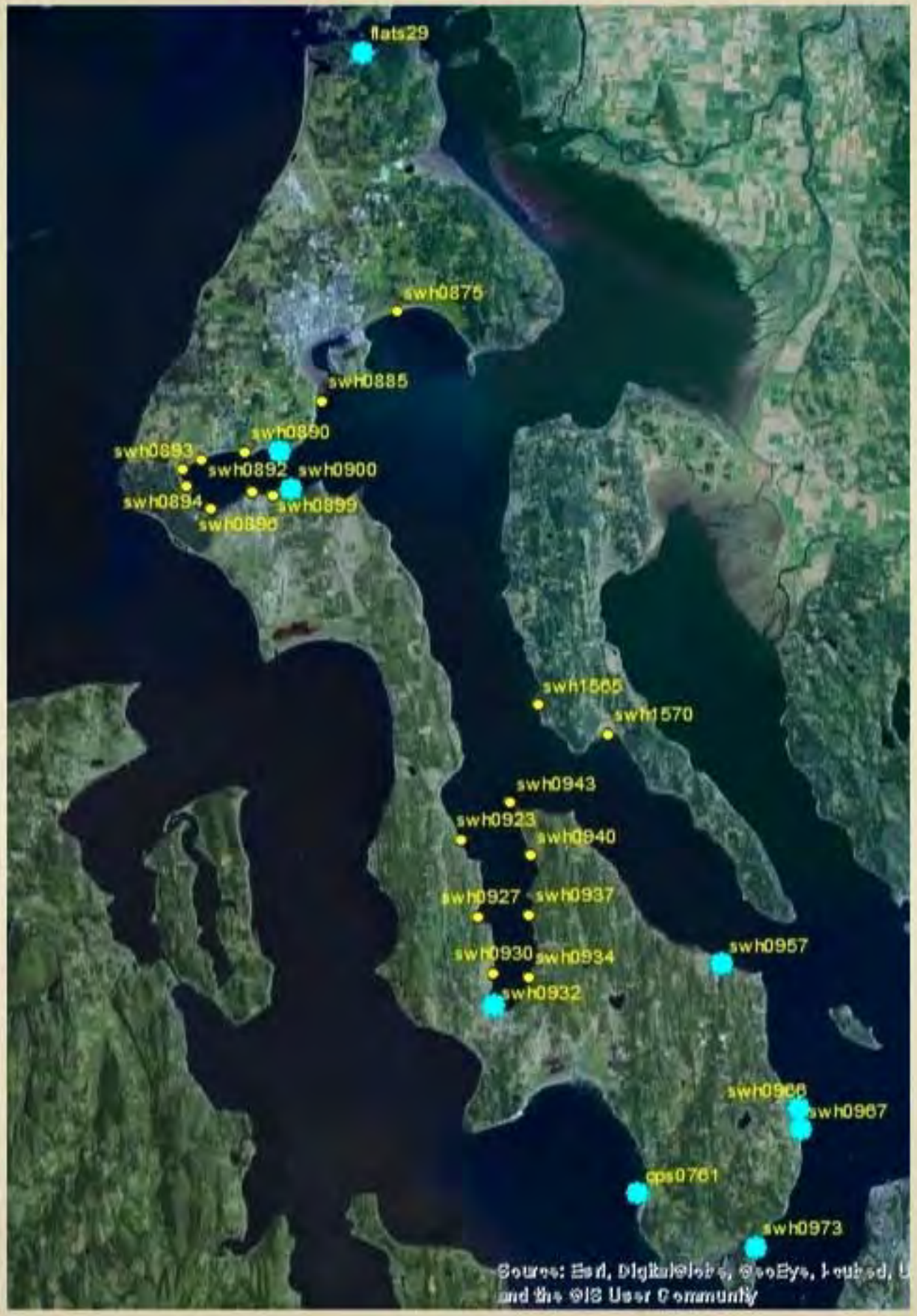
swh1570
swh0943
swh0923
swh0940
swh0927
swh0937
swh0957
swh0930
swh0934
swh0932
swh0966
swh0967
cps0761
swh0973
Sources: Esri, DigitalGlobe, GeoEye, Earthstar, U
and the GIS User Community

2011 Sites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swh0875
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swh0890
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swh1570
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swh0930
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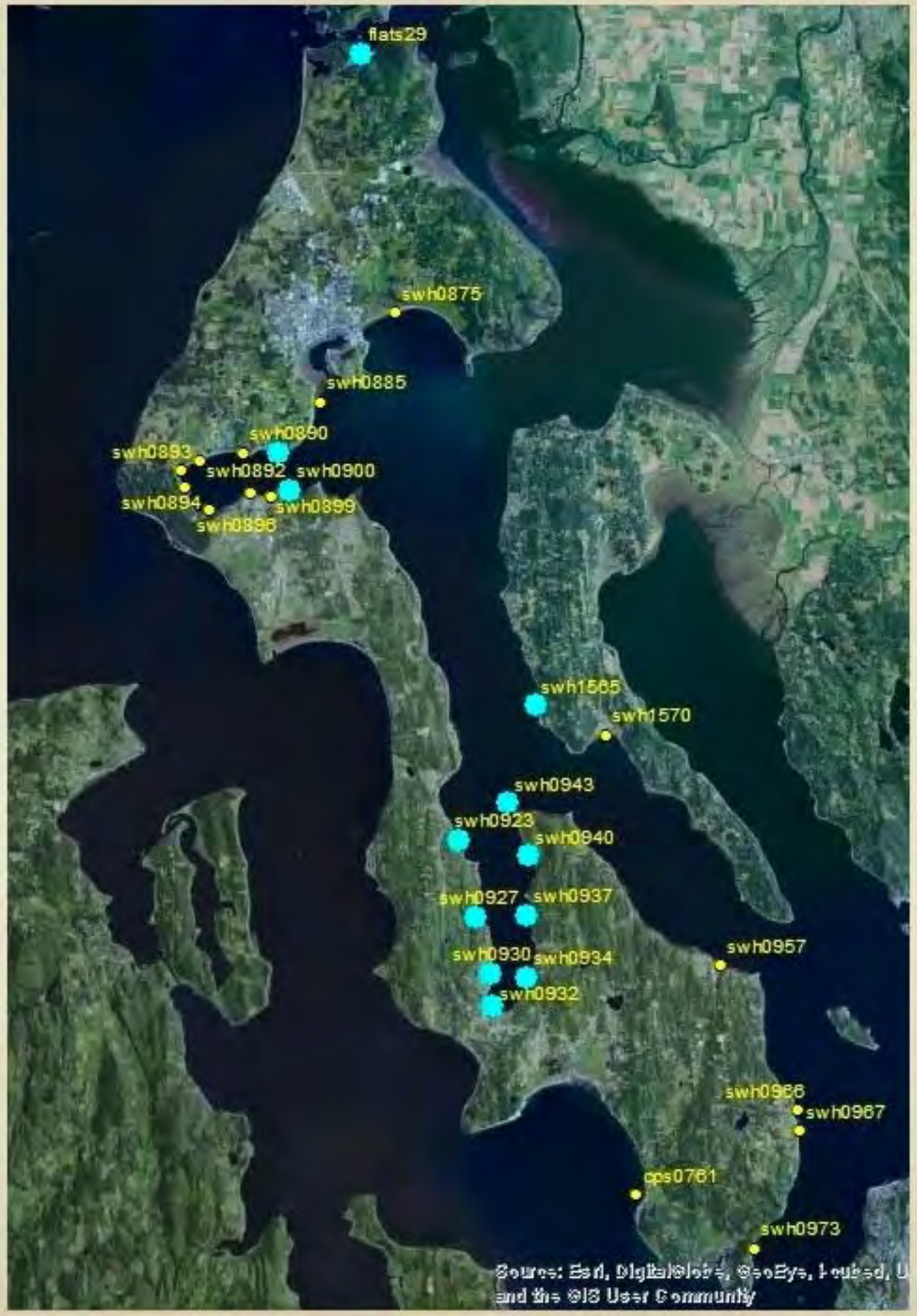
gps0761
swh0973
Source: Esri, DigitalGlobe, GeoEye, Earthstar, and the GIS User Community

2012 Sites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swh1570
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swh0923
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swh0927
swh0937
swh0957
swh0930
swh0934
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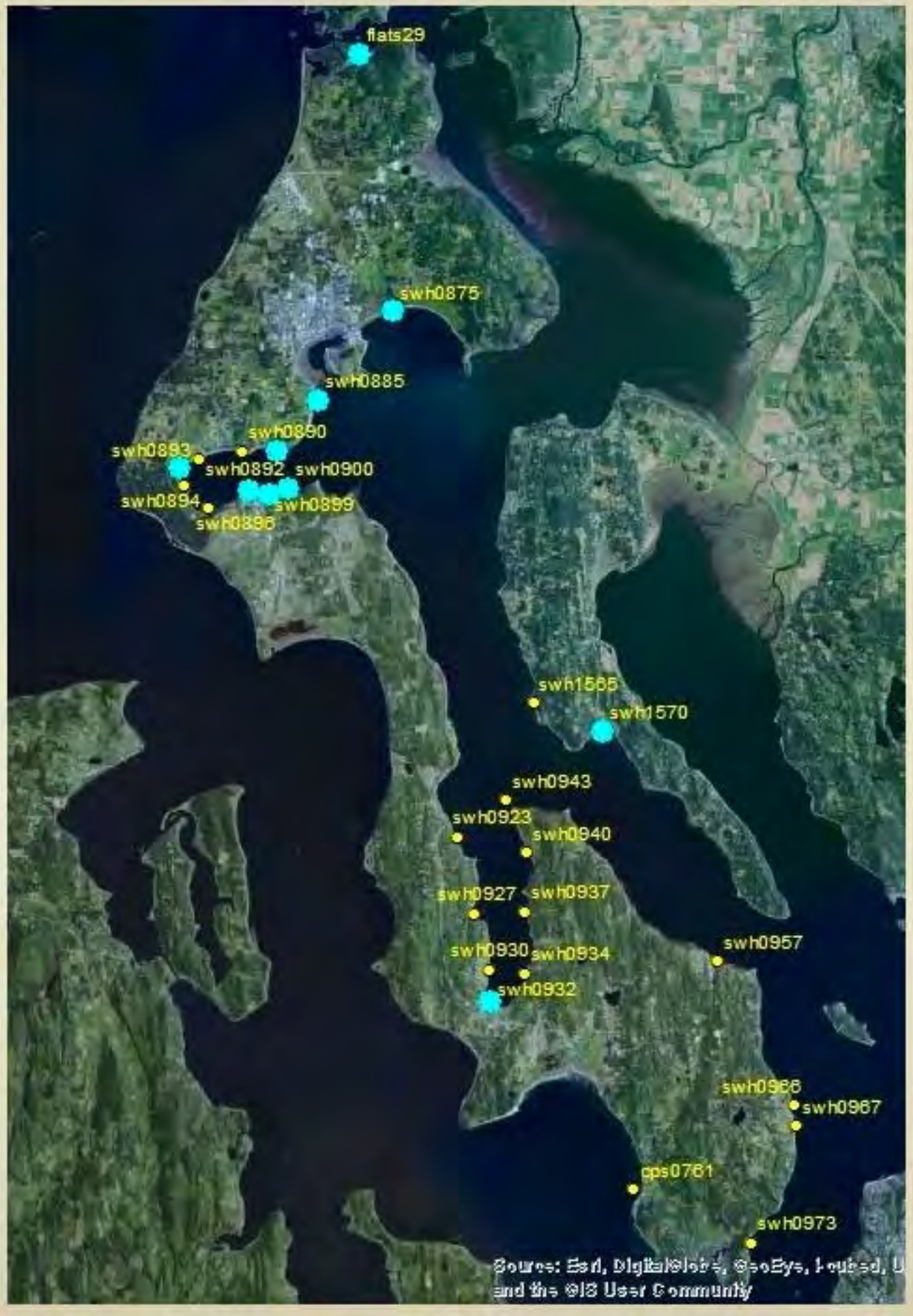
swh0967
cps0761
swh0973
Sources: Esri, DigitalGlobe, GeoEye, Earthstar, U
and the GIS User Community

2013 Sites


flats29
swh0875
swh0885
swh0890
swh0893
swh0892
swh0900
swh0894
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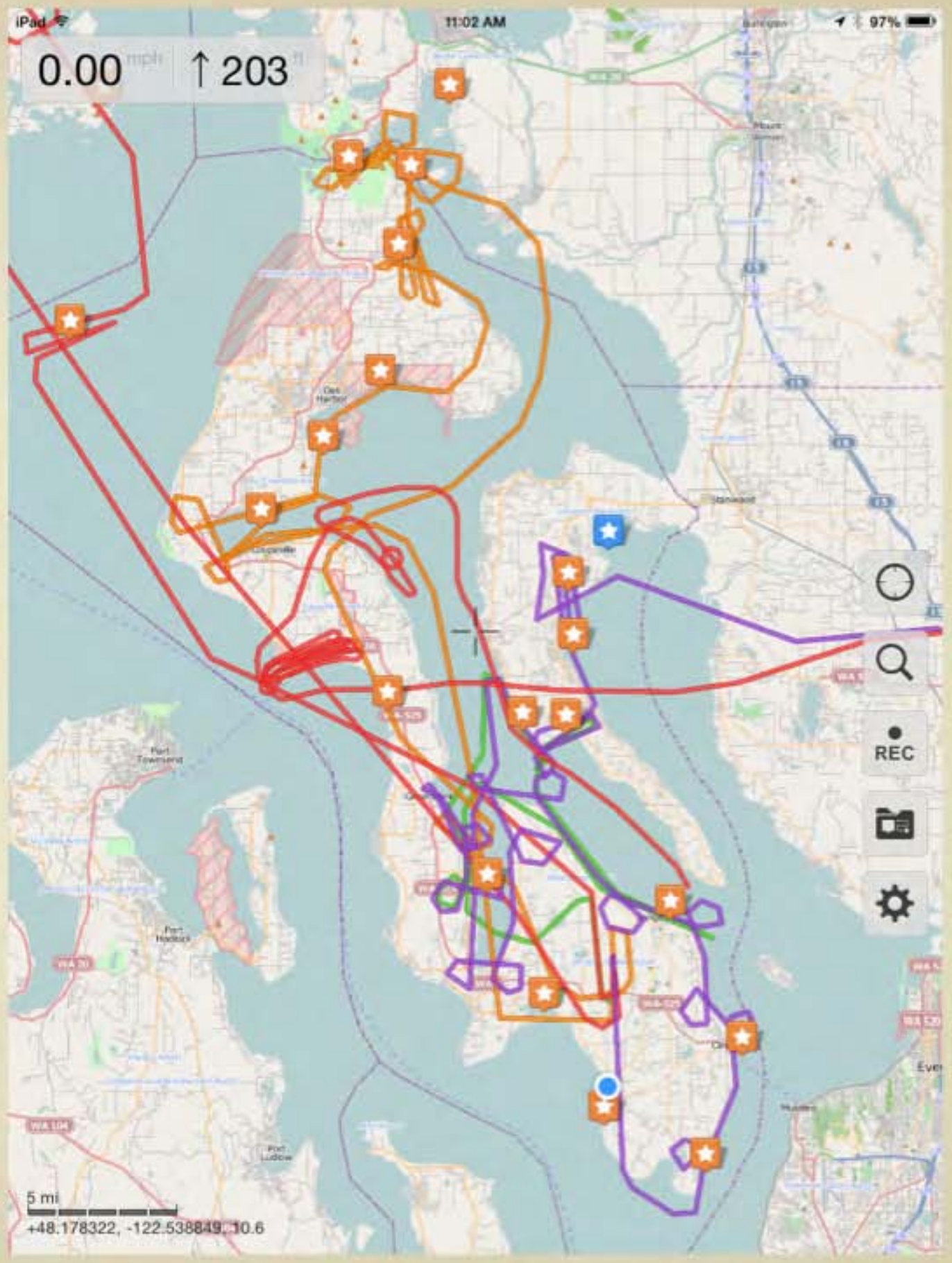
swh1570
swh0943
swh0923
swh0940
swh0927
swh0937
swh0957
swh0930
swh0934
swh0932
swh0966
swh0967
cps0761
swh0973
Sources: Esri, DigitalGlobe, GeoEye, Earthstar, U
and the GIS User Community

2013 Aerial Flight Log Island County

4 Flights

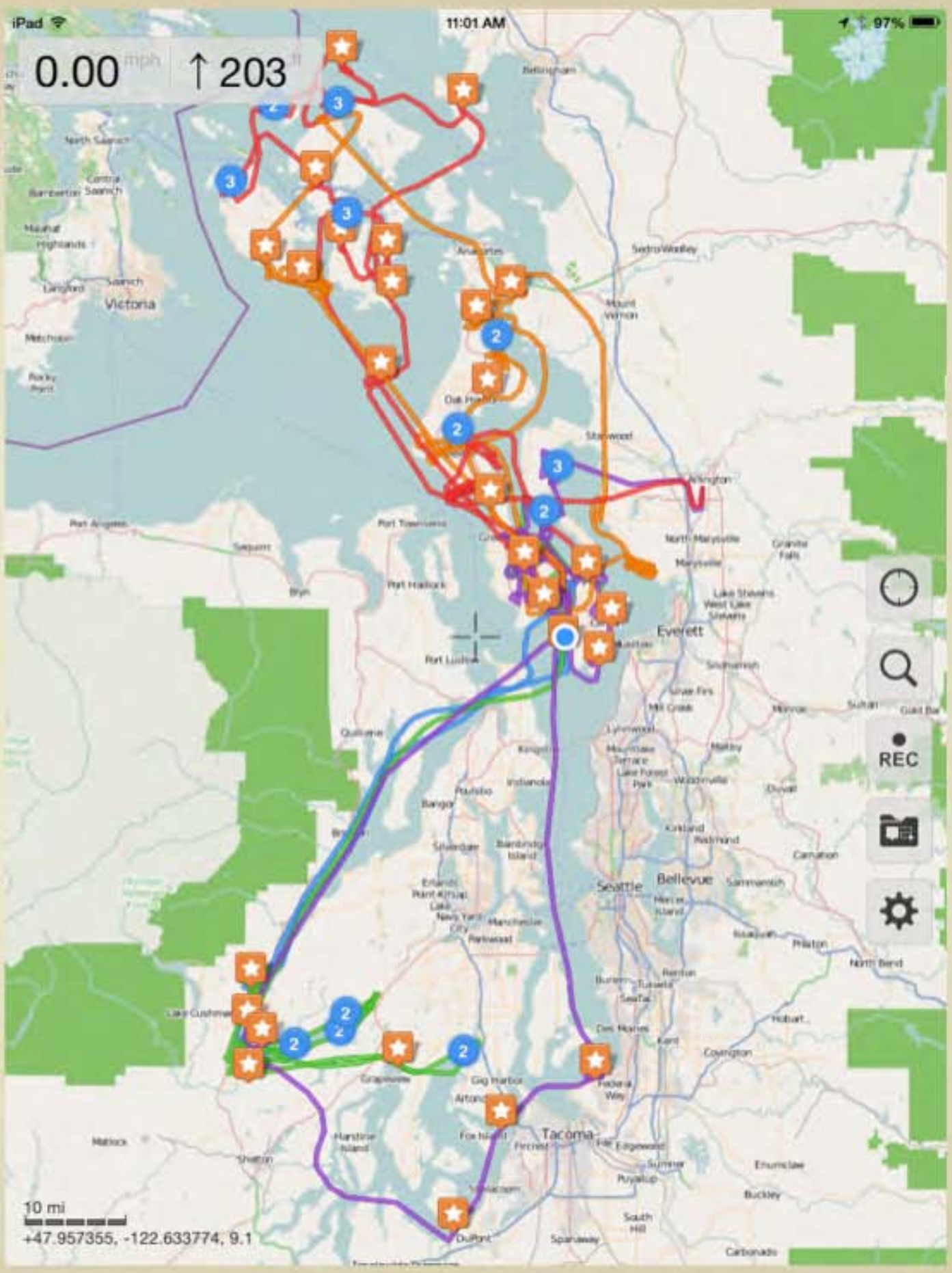
2500 Photos

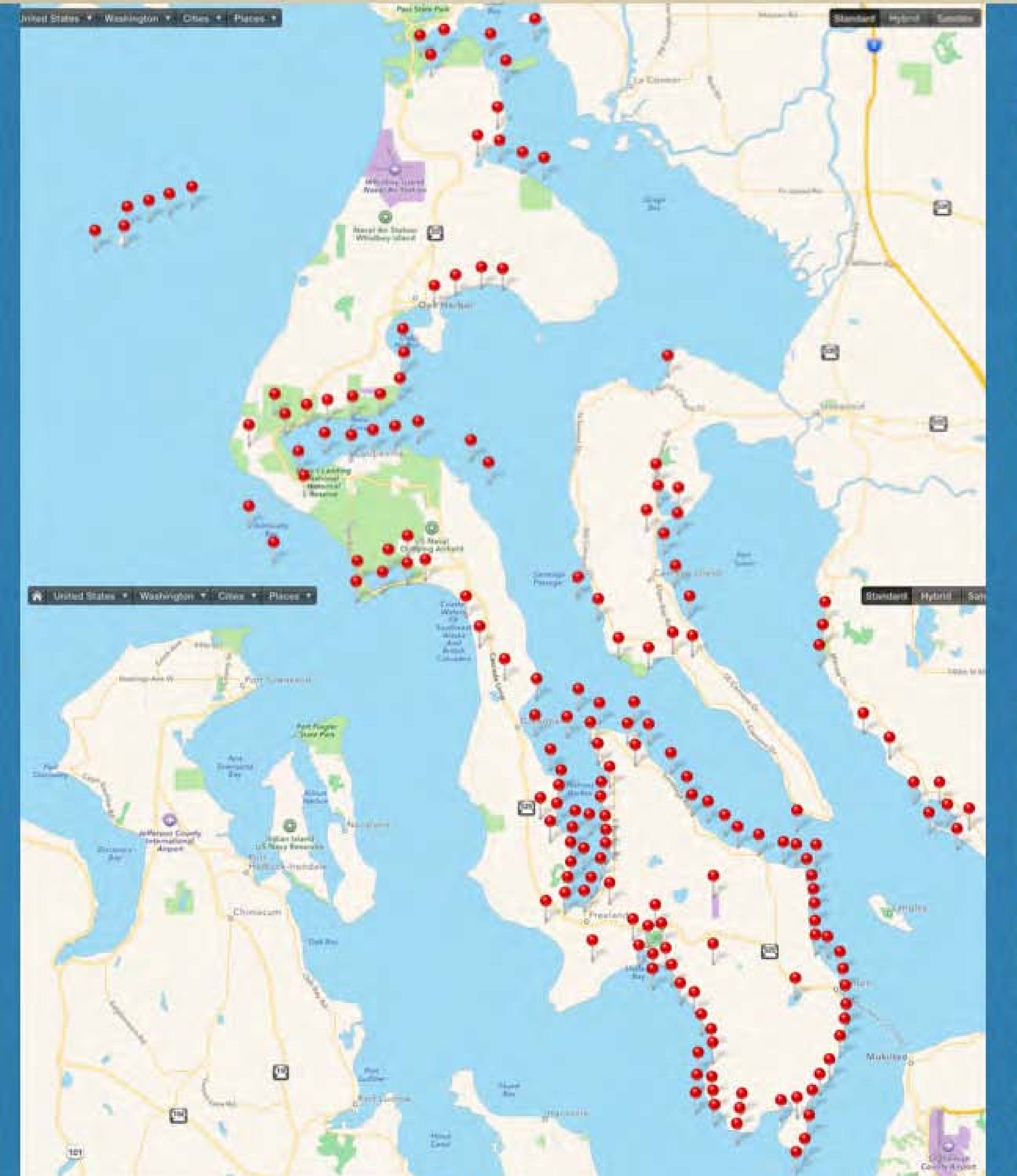


2013 Aerial Flight Log Puget Sound

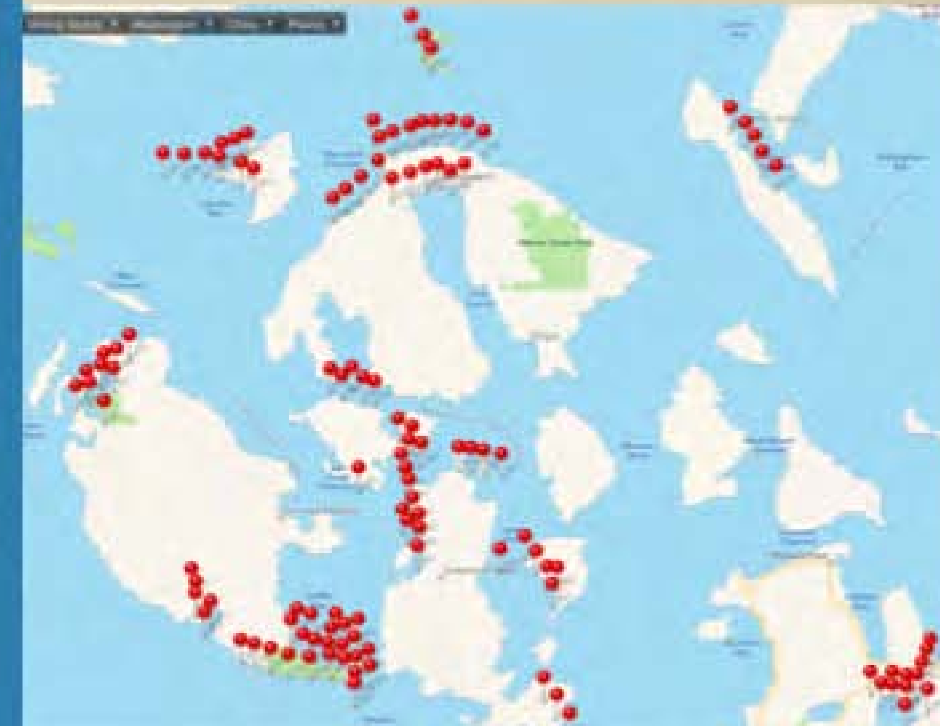
9 Flights

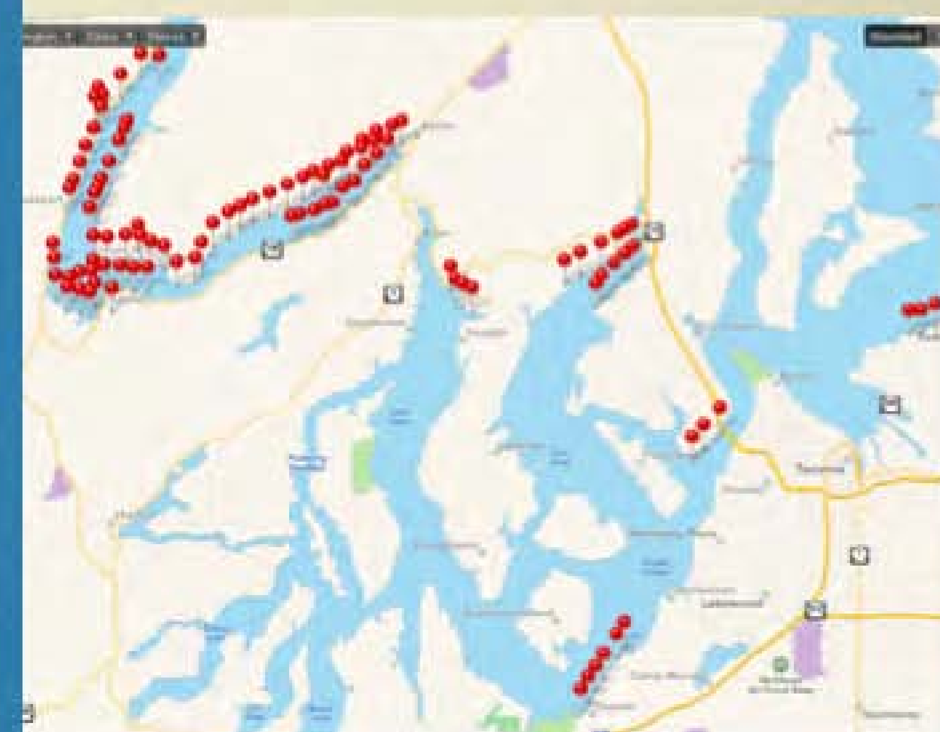
4500 Photos





United States
Washington
Cities
Places
Standard
Hybrid
Satellite
Oak Harbor
Freeland
Mukilteo
Langley
Port Townsend
Chimacum



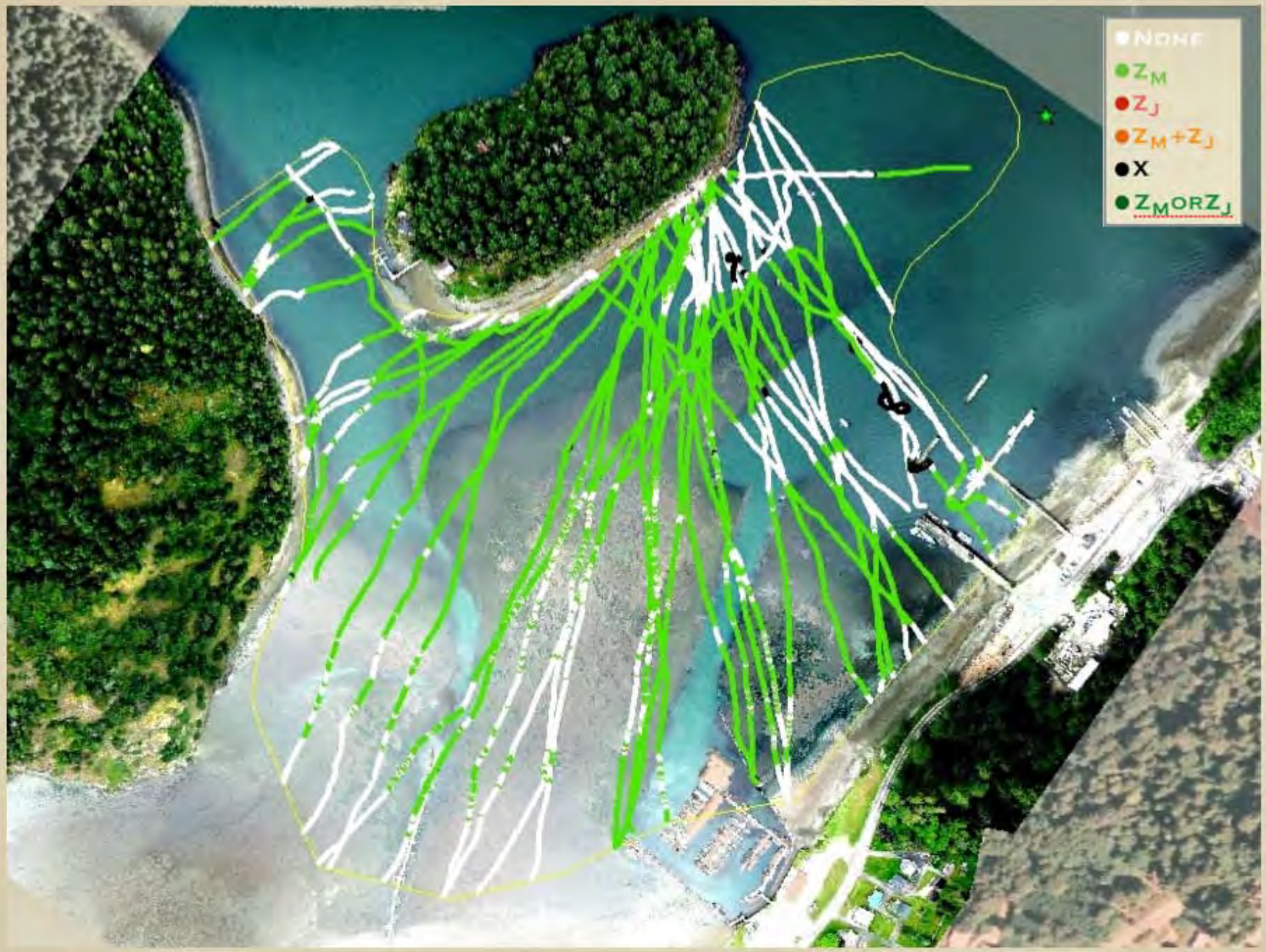


Results for 2013

Flats29 2013

Flats29 2009-2013

Flats29 2009-2013



Boating Activity

flats029

Flats29 2012

Flats29 2013

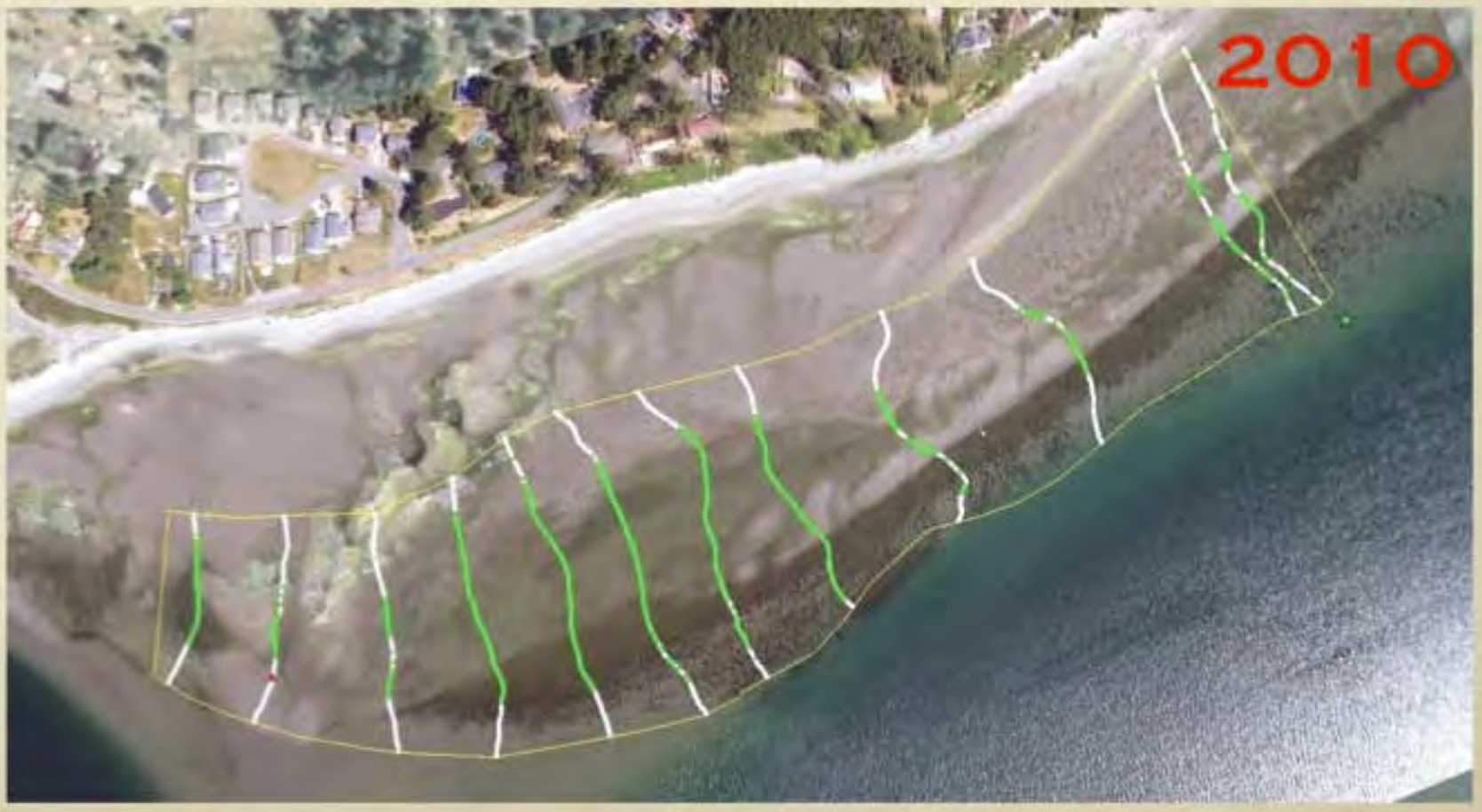
Flats29

SWH0875 (6/29/13)

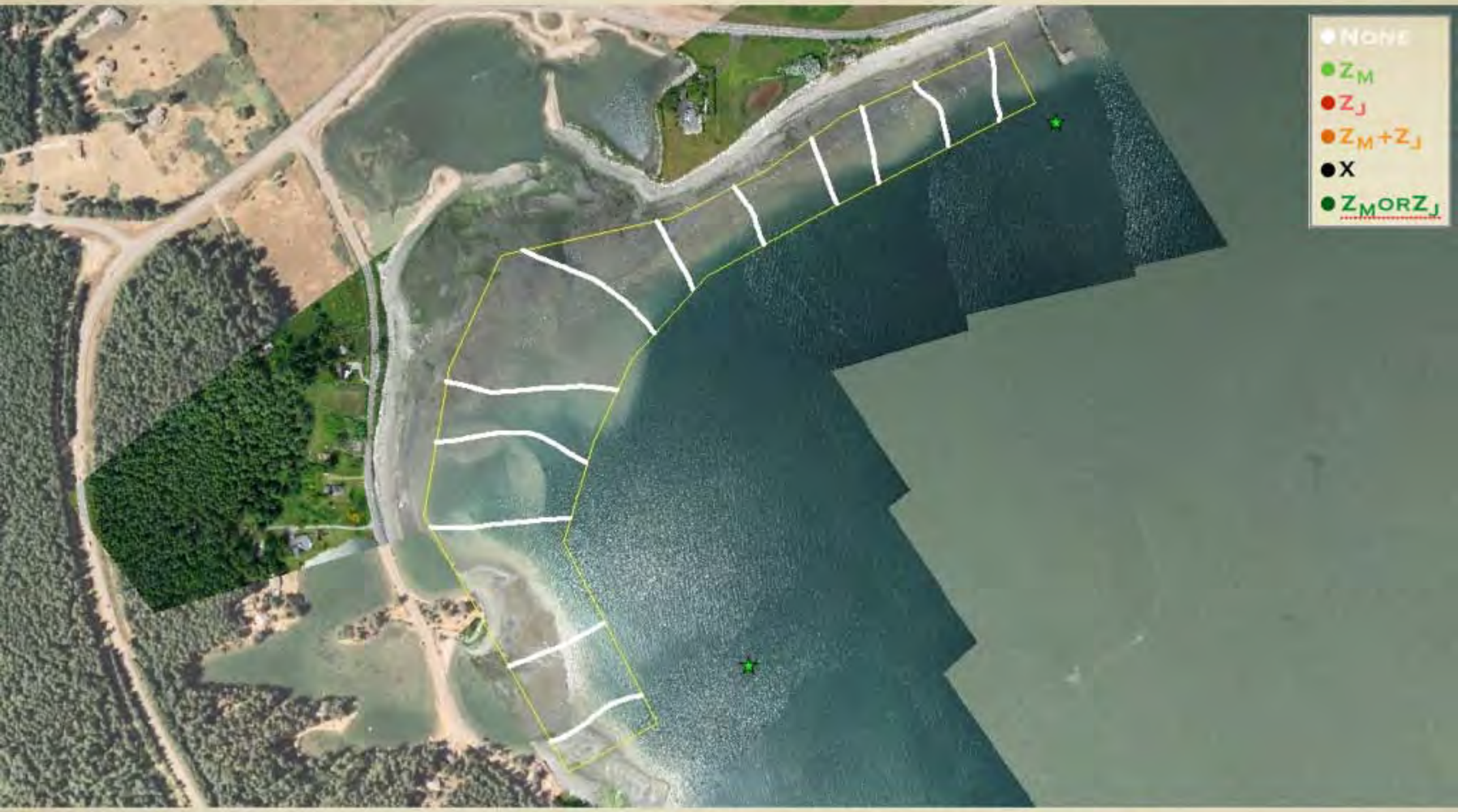
5/28/13


swh0885
SVMP Video 6/28/13
Aerial 5/28/13
Zm Bed Area (ha):
19.4 ± 3.2
None
Z_M
Z_J
$Z_M + Z_J$
X
Z_M or Z_J
FLATS29 (6/28/13)
5/28/13

SWH0888




None
Z_M
Z_J
Z_M+Z_J
X
Z_M OR Z_J



SWH0893 (7/29/13)

5/28/13

SWH0898 (7/13/13)

5/28/13


NONE
Z_M
Z_J
Z_M+Z_J
X
Z_M OR Z_J

SWH0899 (7/28/13)

5/28/13

SWH0900

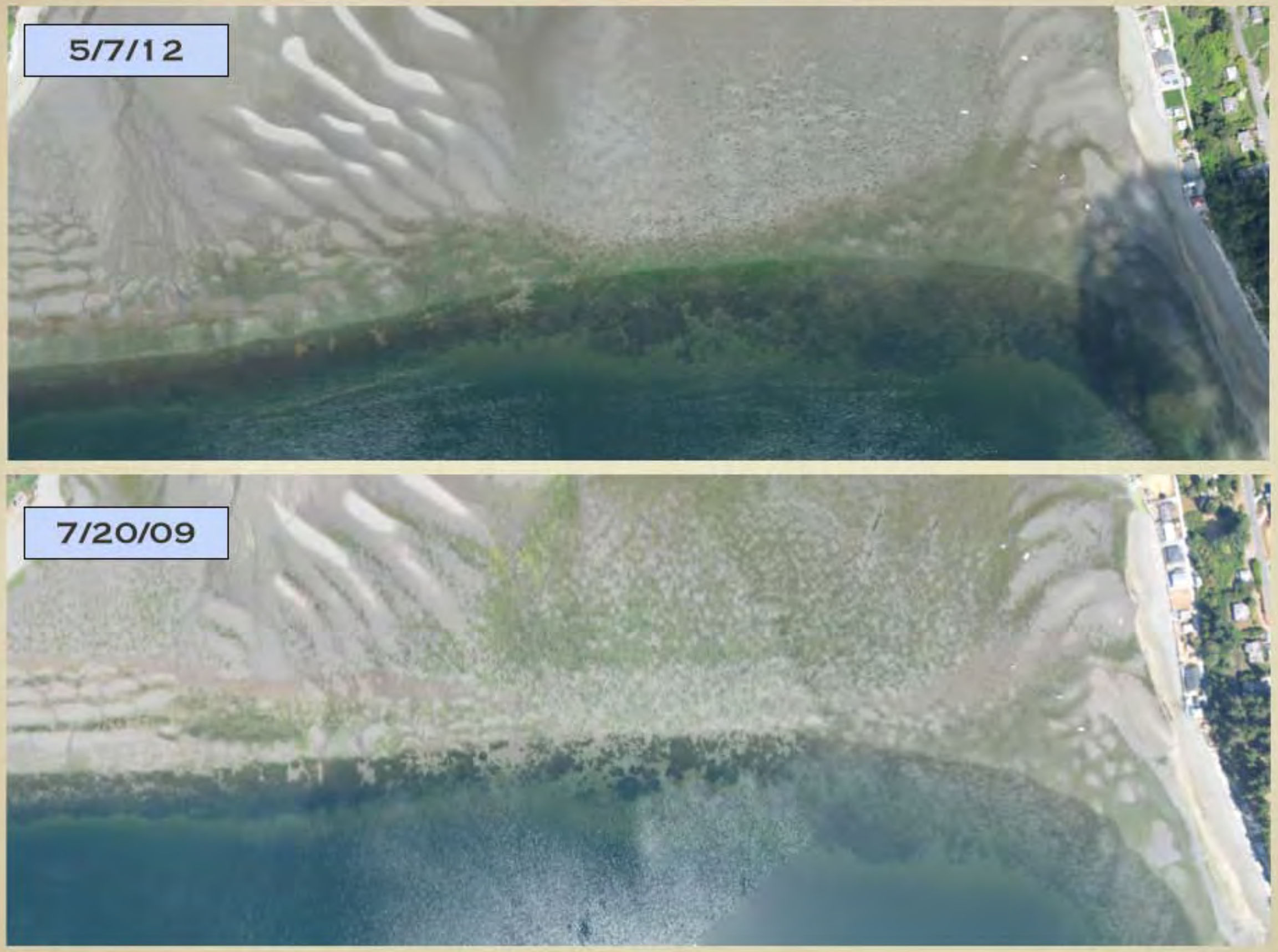
SWH0900


2013
SWH0932 (5/31/13)
5/28/13
2009

SWH0932

Holmes Harbor

Elger Bay



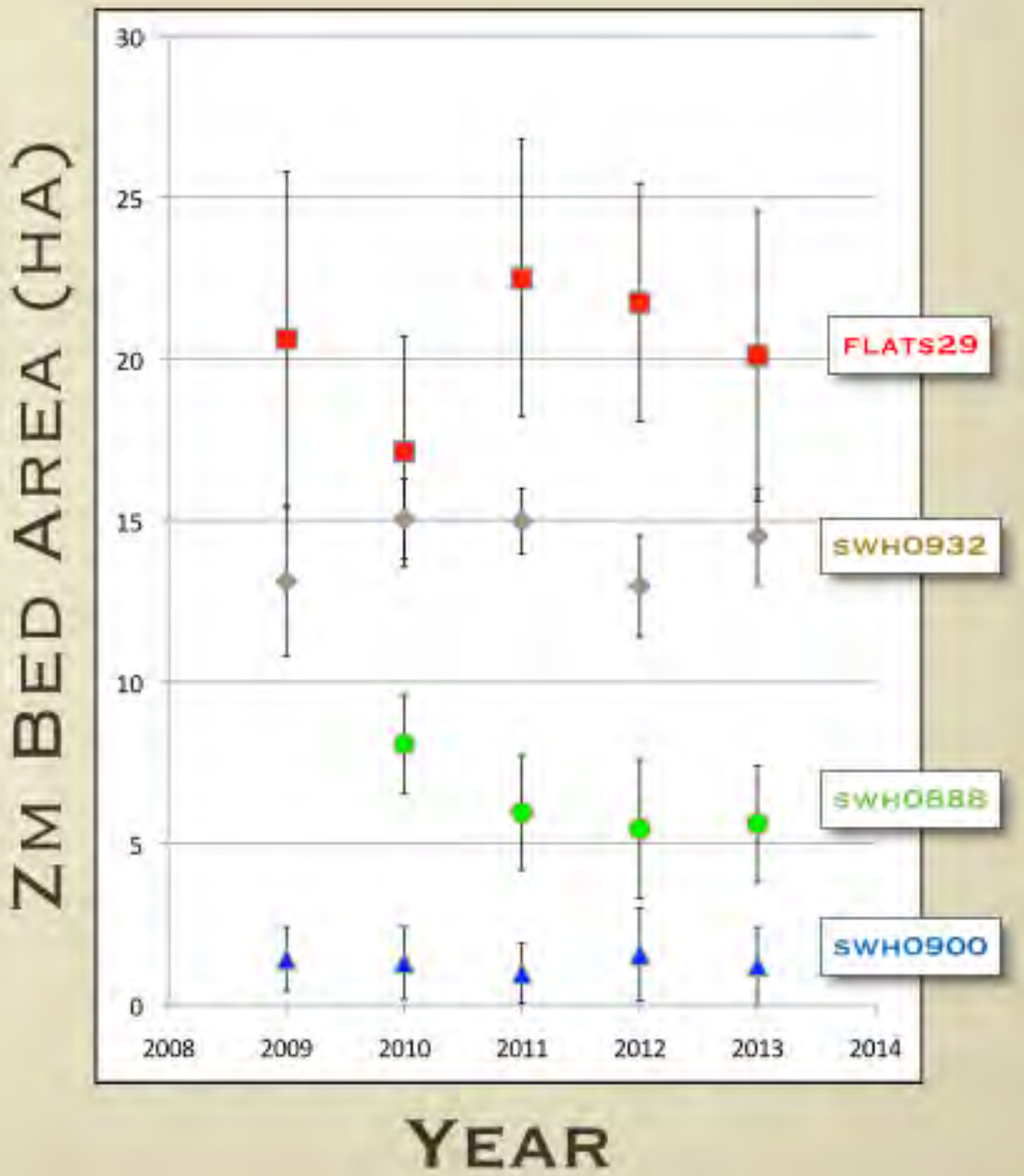
Elger Bay

Zostra marina Bed Area Measurements 2009-2013

Site Code	Site Name	Date	N	Zm area (ha)		95% CI
cps0761	Dave Macke County Park, Maxwelton	23-Jun-11	12	3.6	±	0.7
flats29	Cornet Bay, Whidbey*	27-Aug-09	7	20.6	±	5.2
flats29	Cornet Bay, Whidbey	03-Aug-10	10	17.1	±	3.6
flats29	Cornet Bay, Whidbey	09-Jun-11	8	22.5	±	4.3
flats29	Cornet Bay, Whidbey	11-Jul-12	9	21.7	±	3.7
flats29	Cornet Bay, Whidbey*	15-Jun-13	8	20.1	±	4.5
swh0875	Midway Blvd, Oak Harbor*	29-Jun-13	12	5.9	±	2.1
swh0885	Blower's Bluff North, Whidbey*	28-Jun-13	10	19.4	±	2.1
swh0888	E of Monroe Landing	17-Jul-10	12	8.1	±	1.5
swh0888	E of Monroe Landing	06-Jul-11	10	6.0	±	1.8
swh0888	E of Monroe Landing	21-Aug-12	10	5.4	±	2.2
swh0888	E of Monroe Landing*	27-Jul-13	13	5.6	±	1.8
swh0890	W of Monroe Landing	16-Jul-10	12	0.0	±	0.0
swh0892	San de Fuca, Whidbey	30-Jul-10	9	0.0	±	0.1
swh0893	Kennedy's Lagoon, Whidbey*	29-Jul-13	12	0.0	±	0.0
swh0894	Mueller Park, Whidbey	30-Jul-10	12	0.0	±	0.0
swh0896	Carriage Heights Ln	19-Jul-10	0	0.0	±	0.0
swh0898	W of Lovejoy Point, Coupeville	02-Jul-10	12	1.0	±	0.6
swh0898	W of Lovejoy Point, Coupeville*	13-Jul-13	11	1.2	±	0.6
swh0899	Lovejoy Point, Coupeville*	28-Jul-13	10	1.0	±	0.7
swh0900	Mineral Spring, Coupeville*	26-Aug-09	14	1.4	±	1.0
swh0900	Mineral Spring, Coupeville	17-Jun-10	11	1.3	±	1.1
swh0900	Mineral Spring, Coupeville	10-Jun-11	14	1.0	±	0.9
swh0900	Mineral Spring, Coupeville	23-Jul-12	10	1.6	±	1.4
swh0900	Mineral Spring, Coupeville*	12-Jul-13	13	1.2	±	1.2
swh0923	N of Dines Pt North, Whidbey	09-Aug-12	10	3.6	±	0.7
swh0927	Honeymoon Bay, Whidbey*	17-Aug-09	14	10.9	±	1.0
swh0927	Honeymoon Bay, Whidbey	07-Jul-12	12	10.2	±	1.1
swh0930	S Harbor Hills Dr, Whidbey*	17-Jun-09	12	3.8	±	0.8
swh0930	S Harbor Hills Dr, Whidbey	26-Jun-12	11	3.8	±	0.8
swh0932	Freeland Park, Whidbey*	19-Jun-09	10	13.1	±	2.3
swh0932	Freeland Park, Whidbey	31-Jul-10	12	15.0	±	1.2
swh0932	Freeland Park, Whidbey	07-Jun-11	11	15.0	±	1.0
swh0932	Freeland Park, Whidbey	09-Jun-12	10	13.0	±	1.6
swh0932	Freeland Park, Whidbey*	31-May-13	13	14.5	±	1.5
swh0934	NW of Lone Lake, Whidbey*	18-Jun-09	18	4.9	±	0.5
swh0934	NW of Lone Lake, Whidbey	06-Aug-12	9	5.5	±	1.4
swh0937	East of Honeymoon Bay, Whidbey*	12-Aug-09	10	9.0	±	1.0
swh0937	East of Honeymoon Bay, Whidbey	07-Aug-12	12	9.1	±	0.6
swh0940	East of Dine's Point, Whidbey*	04-Jun-09	10	6.8	±	1.5
swh0940	East of Dine's Point, Whidbey	10-Aug-12	11	8.2	±	1.1
swh0943	Baby Island, SE Whidbey*	19-Aug-09	13	17.7	±	2.0
swh0943	Baby Island, SE Whidbey	11-Aug-12	13	18.2	±	1.2
swh0957	Port of South Whidbey Harbor, SE Whidbey	20-Jun-11	10	9.0	±	1.5
swh0966	Clinton Ferry Terminal North, SE Whidbey	21-Jun-11	11	7.5	±	1.2
swh0967	Clinton Ferry Terminal South, SE Whidbey	22-Jun-11	13	2.7	±	1.0
swh0973	Possession, SE Whidbey	19-Jul-11	12	13.7	±	2.4
swh1565	Cama Beach, Camano Island	08-Aug-12	12	3.6	±	1.0
swh1570	Elger Bay, South Camano*	26-Jul-13	11	17.7	±	1.9

* Zm Area not calculated by DNR method

1 ha = 2.47 Acres

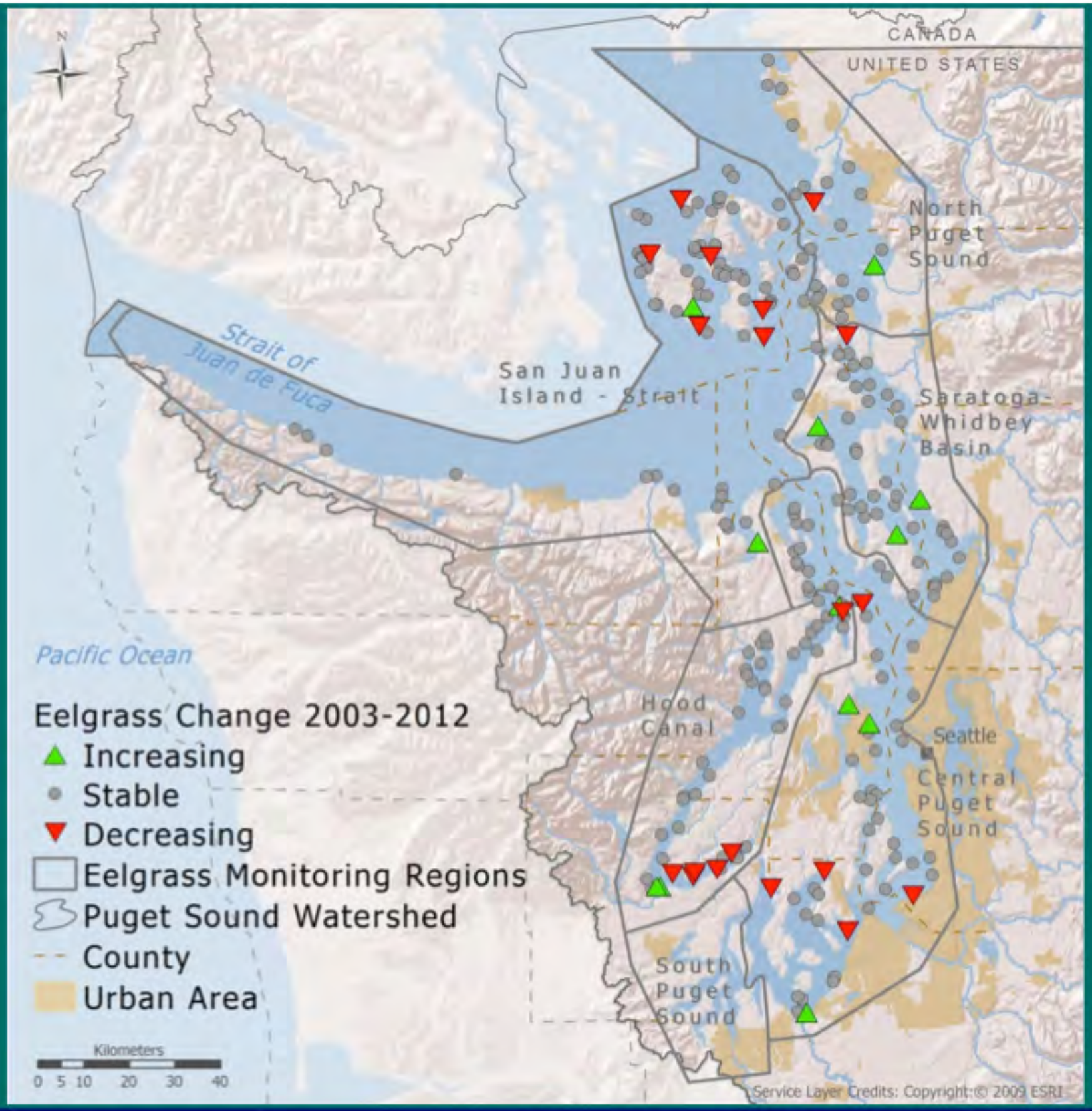


Site	Date	Track	N	Sum of GPS Speed Values					SP Area	Zm	Zm Area	± 95% CI
Comparison to DNR 2012 Results												
flats29	**11-Jul-12**	28	305	104.8	140.3	0	15.4	260.5	31.918	0.572	18.3	
		3	825	302.3	501.1	0	109.2	913.9	31.918	0.623	19.9	
		34	412	194.1	256	0	0	450.1	31.918	0.569	18.2	
		35	1248	386.3	409.9	0	154.8	1006	31.918	0.482	15.4	
		5	504	184.1	113.3	0	0	297.4	31.918	0.381	12.2	
		1	837	193.4	751.1	0	0	945.4	31.918	0.794	25.4	
		18	1756	313.3	828.3	0	0	1141.6	31.918	0.726	23.2	
		2	969	134	944.9	0	0	1078.9	31.918	0.876	28.0	
		32	1014	541.6	609.8	0	0	1152.4	31.918	0.529	16.9	
	Totals		7870.0	2353.9	4554.7	0.0	279.4	7246.2	31.918	0.654	**20.9**	**± 3.3**
								DNR	33.820	0.643	**21.7**	**± 3.7**
swh0888	**21-Aug-12**	10	293	253.3	45	0	0	298.3	14.151	0.151	2.1	
		11	409	241	166.3	0	0	407.3	14.151	0.408	5.8	
		12	384	88.2	280.2	0	0	368.4	14.151	0.761	10.8	
		13	280	72.1	221	0	0	293.1	14.151	0.754	10.7	
		14	395	197.6	184.9	0	0	382.5	14.151	0.483	6.8	
		16	294	126.2	156.8	0	0	283	14.151	0.554	7.8	
		26	258	217.8	36.3	0	0	254.1	14.151	0.143	2.0	
		3	334	292.4	39.9	0	0	332.3	14.151	0.120	1.7	
		5	313	326.6	32.8	0	0	359.4	14.151	0.091	1.3	
		8	430	277.6	146.3	40.3	0	439.2	14.151	0.333	4.7	
	Totals		3390.0	2092.8	1309.5	40.3	0.0	3417.6	14.151	0.383	**5.4**	**± 2.3**
								DNR	14.180	0.383	**5.4**	**± 2.2**
swh0932	**9-Jun-12**	11	440	144.1	238.4	0	0	382.5	22.262	0.623	13.9	
		12	284	89.7	227	0	0	316.7	22.262	0.717	16.0	
		13	340	111.5	158.9	20.7	0.9	292	22.262	0.546	12.2	
		15	275	47.4	187.8	0	0	235.2	22.262	0.798	17.8	
		19	375	140.9	201.2	94	4	379.7	22.262	0.536	11.9	
		23	151	74.5	66	0	0	140.5	22.262	0.470	10.5	
		8	301	116.7	173.8	0	1.6	292.1	22.262	0.598	13.3	
		28	397	202	186.3	10.4	0	398.7	22.262	0.467	10.4	
		6	540	151.8	182	72.1	3.5	406.7	22.262	0.451	10.0	
		9	539	97	286.4	9.4	0.8	393.6	22.262	0.729	16.2	
	Totals		3642.0	1175.6	1907.8	206.6	10.8	3237.7	22.262	0.591	**13.2**	**± 1.7**
								DNR	21.830	0.594	**13.0**	**± 1.6**

1 ha = 2.47 Acres

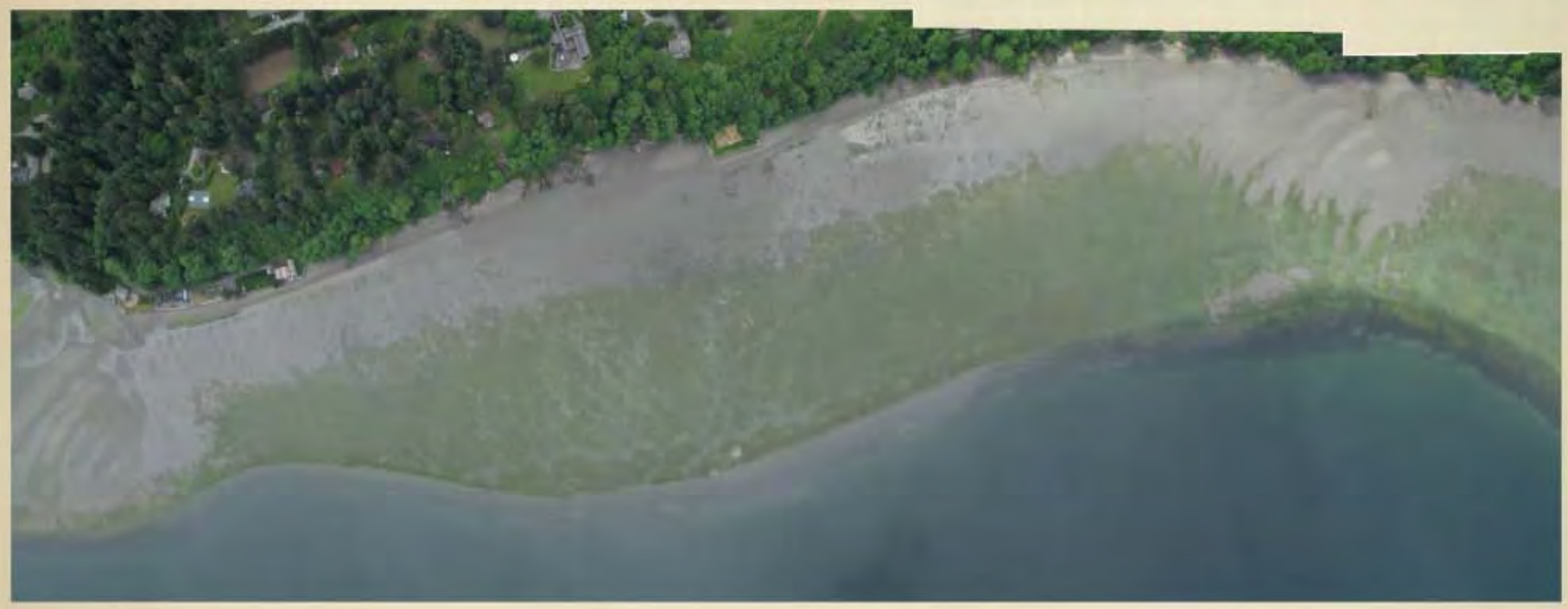
SVMP Monitoring Sites with Declining and Increasing Eelgrass

State of the Sound
Puget Sound Partnership



WASHINGTON STATE DEPARTMENT OF
Natural Resources
www.dnr.wa.gov

SWH0955
Langley DNR Site



SWH0954
Langley
Shrimping Site

SWH0927
SPOT

Smith & Minor Islands

Ala Spit

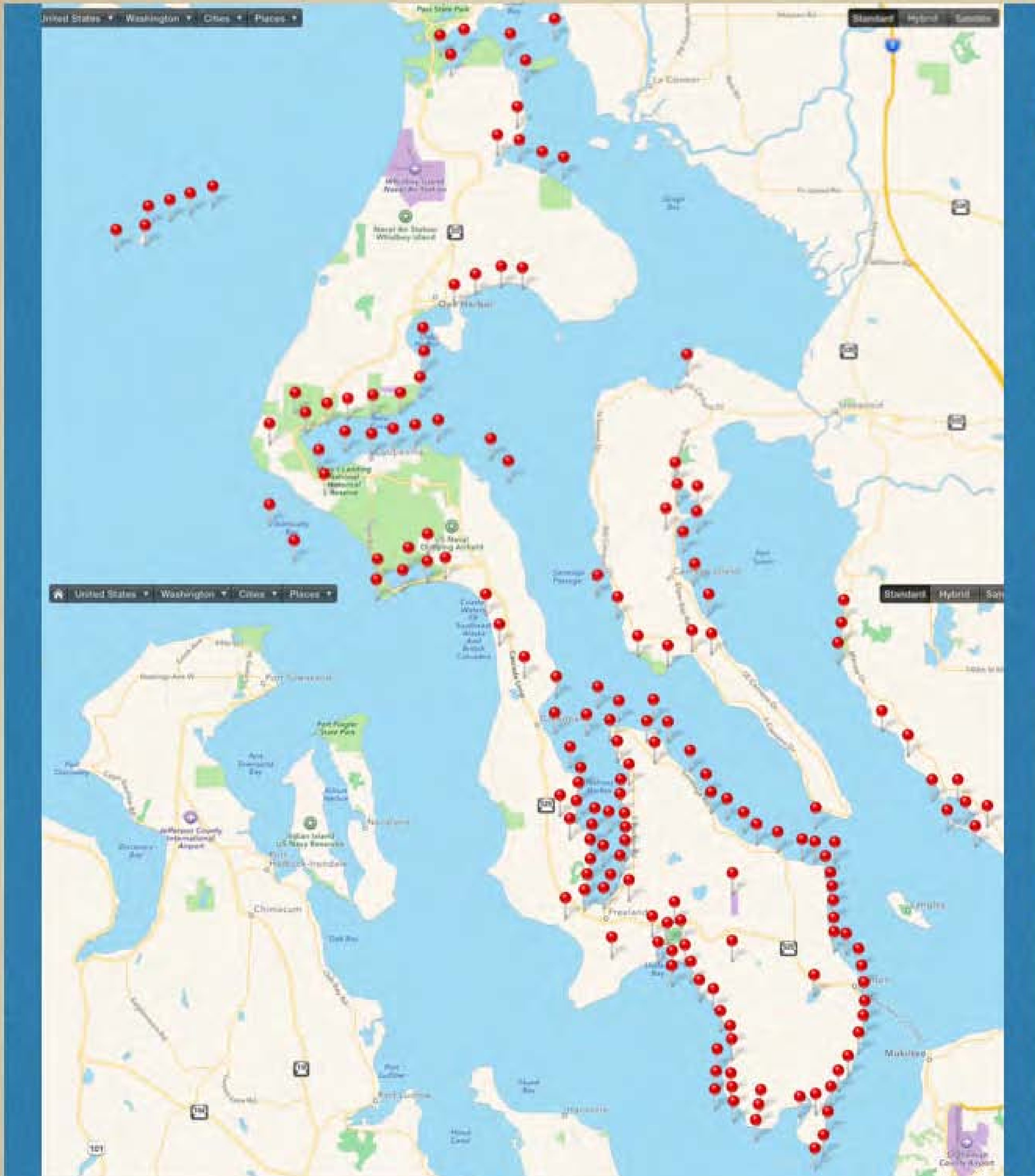
Ledgewood

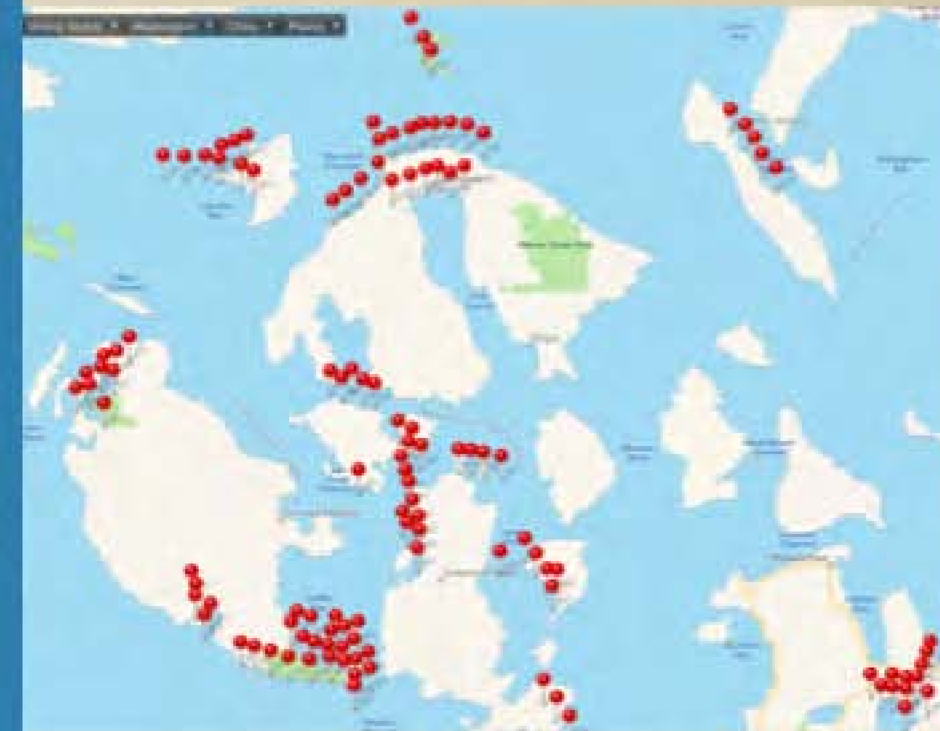
Triangle Cove

Gerdes Road

Crocket Lake

Deer Lagoon


United States
Washington
Cities
Places
Standard
Hybrid
Satellite
Oak Harbor
Freeland
Mukilteo
Port Townsend
Chimacum
Port Ludlow
Port Hadlock-Irondale
Coupeville
Camano Island
Stanwood
La Conner
Whidbey Island Naval Air Station
Naval Air Station Whidbey Island
Jefferson County International Airport
Fort Flagler State Park
Indian Island US Navy Reservation
US Naval Outlying Airfield
Saratoga Passage
Port Susan
Discovery Bay
Oak Bay
Hansville
101




Tacoma
Lakewood

Genetic Structure and Diversity of Zostera marina (Eelgrass) in the San Juan Archipelago, Washington, USA
Estuaries and Coasts, 04 Dec, 2009
Sandy Wyllie-Echeverria & Sandra Looman Talbot & Jolene Rae Rearick

Orcas Island

Orcas Island - near Ship Bay

Amy Henry
Committee on Evolutionary Biology
University of Chicago

Dumas Bay

Quality Assurance Project Plan

A. Problem Definition/ Background
B. Project Task Description
C. Measurement Quality Objectives
D. Training & Certification
E. Documentation & Records
F. Sampling Process Design
G. Sampling Method Requirements
H. Sample Handling & Custody Procedures
I. Analytical Methods Requirements
J. Quality Control Requirements
K. Equipment Testing, Inspection and Maintenance Req's
L. Instrument Calibration & Frequency
M. Inspection / Acceptance Requirements
N. Data Acquisition Requirements
O. Data Management
P. Assessment & Response Actions
Q. Reports
R. Data Review, Validation and Verification
S. Validation and Verification Methods
T. Reconciliation with DQO's

Use of Underwater Video and Aerial Data

- Groups
  - MRC
  - NWStraits
  - IC DOH, DNR, PW
  - WA DNR
  - Research Projects
- Formats
  - SoundIQ
  - Marine Vegetation Atlas
  - Grant Proposals
  - Raw Geo-tagged photos, tables, charts
  - Presentations, Reports, Posters
- Data Storage
  - Local
  - Public Access
- Endpoints
  - Eelgrass
  - Kelp
  - other organisms...sea stars, jellies,..

Summary

- Completed Analyses for Five years
- Few changes in Eelgrass Bed Areas
- Penn Cove << Other Regions
- Notable Damage due to Human Activity
- 2014 Data Collection is Starting in June

Questions to MRC

- Are there sites of interest for 2014?
- How will our data Be Used?
- Reports?
- Addressing QAPP Issues?
- Other uses of underwater video or aerials?

End