Supplementary Material

S1. Part 1 – Full water chemistry and light data

Table S1. Water chemistry and light data by site and by collection date

Collection Sites	Date	TSS (g/L)	Chl-a (mg/m^3)	DOC mgC/L	CDOM (r.u.)	k ext. coeff. (m-1)
Breezeswept South	7/19/2017	0.0081	2.960	6.106	NA	1.6671
Breezeswept South	8/24/2017	0.0030	2.072	7.885	NA	1.4503
Breezeswept North	7/19/2017	0.0024	1.480	7.360	NA	1.0286
Breezeswept North	8/23/2017	0.0023	1.184	8.673	1.672	0.8155
Court Dock	7/14/2016	0.0183	0.888	4.310	NA	2.5358
Court Dock	8/26/2016	NA	NA	6.407	14.497	1.8561
Court East	7/14/2016	NA	NA	NA	NA	2.1743
Court East	8/26/2016	NA	0.592	NA	NA	NA
Court East	6/20/2017	0.0076	0.888	7.630	3.012	1.4040
Court East	7/19/2017	0.0014	2.664	7.977	NA	0.9664
Court East	8/23/2017	0.0020	0.296	15.140	3.851	1.9298
Court West	7/19/2017	0.0006	0.592	9.960	NA	1.5512
Court West	8/23/2017	0.0024	0.888	15.500	NA	2.2242
CRAMP	8/20/2018	0.0072	4.973	5.059	1.171	1.2256
FDS	7/15/2016	0.0019	0.000	3.210	NA	0.8675
FDS	8/25/2016	NA	0.592	4.248	6.835	2.2194
FDS	6/22/2017	0.0044	1.776	3.634	0.967	0.8526
FDS	7/18/2017	-0.0021	1.480	7.553	NA	1.3591
FDS	8/22/2017	0.0004	3.552	7.227	1.765	1.2589
Chappell	6/21/2017	0.0144	0.296	3.635	0.252	0.4460
Chappell	8/24/2017	0.0006	0.000	2.176	0.848	0.5560
Hessel Marina	7/20/2017	-0.0008	1.184	2.805	NA	0.3103
Hessel Marina	8/24/2017	0.0020	0.296	3.476	1.460	1.1400
Hessel Marina	8/23/2018	0.0003	1.430	2.344	0.393	0.4079
Neil	6/23/2017	0.0011	0.000	2.348	0.251	0.3786
Neil	7/20/2017	-0.0001	0.888	2.321	NA	0.2198
Neil	8/24/2017	0.0015	0.888	3.096	0.612	0.2341
Neil	8/23/2018	0.0024	0.847	2.505	0.292	1.2782
Howells Dock	8/26/2016	NA	0.592	2.919	1.614	0.5199
Howells Dock	6/21/2017	0.0073	NA	2.738	0.464	0.4836
Howells Dock	8/25/2017	0.0007	0.592	3.690	0.435	0.5769
Howells Dock	8/22/2018	0.0015	3.276	2.711	0.438	1.3893

Urie Point	8/22/2018	0.0011	1.993	2.710	0.311	0.4396

Table S2 Water chemistry, light, depth to vegetation, and percent open water data for all sites by date.

Collection Sites with Date	TSS (g/L)	TSS (mg/L)	Chl-a (mg/m^3)	DOC (mgC/L)	Kd(PAR) (m-1)	SDT	Depth to bottom (m)	Depth to 10% light remaining (m)	Depth to 1% light remaining (photic zone)	1/kpar	Percent light at depth	Depth to EWM (range, in m)	% Open water (avg.)
Breezeswept South 7/19/17	0.0081	8.1	2.960	6.106	1.667	0.9	1.5	1.38	2.76	0.60	8.2%	0 - 0.5	87.0%
Breezeswept South 8/24/17	0.0030	3.0	2.072	7.885	1.450	NA	0.9	1.59	3.18	0.69	27.1%	0 - 0.75	51.2%
Breezeswept North 7/19/17	0.0024	2.4	1.480	7.360	1.029	NA	0.8	2.24	4.48	0.97	46.2%	0 - 0.5	11.4%
Breezeswept North 8/23/17	0.0023	2.3	1.184	8.673	0.816	NA	1.4	2.82	5.65	1.23	31.9%	0 - 0.75	23.1%
Court East 6/20/17	0.0076	7.6	0.888	7.630	1.404	1.5	1.5	1.64	3.28	0.71	12.2%	0	0.0%
Court East 7/19/17	0.0014	1.4	2.664	7.977	0.966	1.5	1.5	2.38	4.77	1.03	23.5%	0 - 1.6	27.6%
Court East 8/23/17	0.0020	2.0	0.296	15.140	1.930	1.5	1.5	1.19	2.39	0.52	5.5%	0 - 0.75	30.0%
Court West 7/19/17	0.0006	0.6	0.592	9.960	1.551	1.5	1.5	1.48	2.97	0.64	9.8%	0.1 - 0.75	9.2%
Court West 8/23/17	0.0024	2.4	0.888	15.500	2.224	2.0	2.5	1.03	2.07	0.45	0.4%	0 - 0.75	63.8%
CRAMP 8/20/18	0.0072	7.2	4.973	5.059	1.226	2.5	2.6	1.88	3.76	0.82	4.1%	0 - 0.5	77.2%
FDS 6/22/17	0.0044	4.4	1.776	3.634	0.853	NA	1.5	2.70	5.40	1.17	27.8%	NA	11.3%
FDS 7/18/17	-0.0021	-2.1	1.480	7.553	1.359	1.9	2.0	1.69	3.39	0.74	6.6%	0 - 1.5	73.4%
FDS 8/22/17	0.0004	0.4	3.552	7.227	1.259	1.5	2.5	1.83	3.66	0.79	4.3%	0	21.5%
Chappell 6/21/17	0.0144	14.4	0.296	3.635	0.446	2.2	2.2	5.16	10.33	2.24	37.5%	NA	57.5%
Chappell 8/24/17	0.0006	0.6	0.000	2.176	0.556	2.5	2.5	4.14	8.28	1.80	24.9%	0.25 - 1.9	3.1%
Hessel Marina 7/20/17	-0.0008	-0.8	1.184	2.805	0.310	4.0	4.0	7.41	14.84	3.22	28.9%	1.0 - 2.0	24.3%
Hessel Marina 8/24/17	0.0020	2.0	0.296	3.476	1.140	2.8	2.8	2.02	4.04	0.88	4.1%	0 - 2.5	50.6%
Hessel Marina 8/23/18	0.0003	0.3	1.430	2.344	0.408	2.1	2.8	5.64	11.29	2.45	32.6%	0.5 - 1.0	53.6%
Neil 6/23/17	0.0011	1.1	0.000	2.348	0.379	1.9	1.9	6.08	12.16	2.64	48.7%	1.4 - 1.8	16.4%
Neil 7/20/17	-0.0001	-0.1	0.888	2.321	0.220	2.0	2.0	10.46	20.95	4.55	64.4%	1.5 - 1.75	53.8%
Neil 8/24/17	0.0015	1.5	0.888	3.096	0.234	1.8	1.8	9.82	19.67	4.27	65.6%	0.75 - 1.25	11.7%
Neil 8/23/18	0.0024	2.4	0.847	2.505	1.278	1.5	2.0	1.80	3.60	0.78	7.8%	1.25	28.9%
Howells Dock 8/25/17	0.0007	0.7	0.592	3.690	0.577	2.8	2.8	3.99	7.98	1.73	19.9%	0.75 - 2.0	25.0%
Howells Dock 8/22/18	0.0015	1.5	2.520	2.711	1.389	2.5	2.5	1.66	3.31	0.72	3.1%	0.5 - 1.5	32.7%
Urie Point 8/22/18	0.0011	1.1	1.733	2.710	0.440	3.2	3.2	5.23	10.48	2.27	24.5%	1.0 - 1.25	70.0%

S2. Part 2 – All error matrix results.

Table S3 Error matrices for all classifications, with scale parameter = 25 and = 50 results.

Breezeswept North July 2017
Tetracam Scale
Parameter 25

		Reference Data							
		Open water	Flatstem Pondweed	EWM	Elodea	Shadow	Detached Surface Veg	Row Total	User's Accuracy
Classified Data	Open water	25	1	0	7	0	0	33	75.8%
	Flatstem Pondweed	0	0	0	0	0	1	1	0.0%
	EWM	0	0	0	0	1	0	1	0.0%
	Elodea	1	0	2	12	0	0	15	80.0%
	Shadow	0	0	0	0	1	0	1	100.0%
	Detached Surface Veg	0	0	0	0	0	0	0	n/a
	Column Total	26	1	2	19	2	1	51	
	Producer's Accuracy	96.2%	0.0%	0.0%	63.2%	50.0%	0.0%		OVERALL ACCURACY= 38/51=74.5%

Breezeswept North July 2017
Tetracam Scale
Parameter 50

		Reference Data						
		Open water	Flatstem Pondweed	EWM	Elodea	Detached Surface Veg	Row Total	User's Accuracy
Classified Data	Open water	21	0	2	8	0	31	67.7%
	Flatstem Pondweed	0	1	0	0	0	1	100.0%
	EWM	0	0	1	0	0	1	100.0%
	Elodea	1	0	1	10	0	12	83.3%
	Detached Surface Veg	1	0	0	0	0	1	0.0%
	Column Total	23	1	4	18	0	46	
	Producer's Accuracy	91.3%	100.0%	25.0%	55.6%	n/a		OVERALL ACCURACY= 33/46=71.7%

Court East August 2016
Tetracam Scale Parameter 25

		Reference Data					
		EWM	Open Water	Spatterdock	Surface Veg	Row Total	User's Accuracy
Classified Data	EWM	14	5	0	0	19	73.7%
	Open Water	1	24	0	0	25	96.0%
	Spatterdock	0	0	1	0	1	100.0%
	Surface Veg	0	0	2	1	3	33.3%
	Column Total	15	29	3	1	48	
	Producer's Accuracy	93.3%	82.8%	33.3%	100.0%		OVERALL ACCURACY= 40/48=83.3%

Court East August 2016
Tetracam Scale Parameter 50

		Reference Data					
		EWM	Open Water	Spatterdock	Surface Veg	Row Total	User's Accuracy
Classified Data	EWM	9	7	0	0	16	56.3%
	Open Water	1	25	0	0	26	96.2%
	Spatterdock	0	0	4	0	4	100.0%
	Surface Veg	0	0	1	0	1	0.0%
	Column Total	10	32	5	0	47	
	Producer's Accuracy	90.0%	78.1%	80.0%	n/a		OVERALL ACCURACY= 38/47=80.9%

Court East June 2017
VISNIR Scale Parameter 25

		Reference Data					
		Open Water	Detached Surface Veg	EWM	Small Leaf Pondweed	Row Total	User's Accuracy
Classified Data	Open Water	19	0	10	0	29	65.52%
	Detached Surface Veg	0	3	0	0	3	100.00%
	EWM	6	0	14	1	21	66.67%
	Small Leaf Pondweed	0	0	1	2	3	66.67%
	Column Total	25	3	25	3	56	
	Producer's Accuracy	76.00%	100.00%	56.00%	66.67%		OVERALL ACCURACY= 38/56=67.9%

Court East June 2017
VISNIR Scale Parameter 50

		Reference Data					
		Open Water	Detached Surface Veg	EWM	Small Leaf Pondweed	Row Total	User's Accuracy
Classified Data	Open Water	20	0	3	0	23	87.0%
	Detached Surface Veg	0	4	0	0	4	100.0%
	EWM	10	3	14	0	27	51.9%
	Small Leaf Pondweed	0	0	2	0	2	0.0%
	Column Total	30	7	19	0	56	
	Producer's Accuracy	66.7%	57.1%	73.7%	n/a		OVERALL ACCURACY= 38/56=67.9%

Court East July 2017
Tetracam Scale Parameter 25

		Reference Data				
		Open Water	EWM/Elodea Mix	Detached Surface Veg	Row Total	User's Accuracy
Classified Data	Open Water	13	0	0	13	100.0%
	EWM/Elodea Mix	0	14	1	15	93.3%
	Detached Surface Veg	0	0	16	16	100.0%
	Column Total	13	14	17	44	
	Producer's Accuracy	100.0%	100.0%	94.1%	OVERALL ACCURACY= 43/44=97.7%	

Court East July 2017
Tetracam Scale Parameter 50

		Reference Data				
		Open Water	EWM/Elodea Mix	Detached Surface Veg	Row Total	User's Accuracy
Classified Data	Open Water	11	3	0	14	78.6%
	EWM/Elodea Mix	1	12	1	14	85.7%
	Detached Surface Veg	0	0	17	17	100.0%
	Column Total	12	15	18	45	
	Producer's Accuracy	91.7%	80.0%	94.4%	OVERALL ACCURACY= 40/45=88.9%	

Hessel Tetracam July 2017
Tetracam Scale Parameter 25

		Reference Data						
		Curlyleaf Pondweed	EWM	Deeper Water	Dock	Visible Bottom	Row Total	User's Accuracy
Classified Data	Curlyleaf Pondweed	2	0	0	0	0	2	100.0%
	EWM	4	11	0	1	3	19	57.9%
	Deeper Water	7	4	11	1	1	24	45.8%
	Dock	0	0	0	1	0	1	100.0%
	Visible Bottom	0	0	0	0	7	7	100.0%
	Column Total	13	15	11	3	11	53	
	Producer's Accuracy	15.38%	73.33%	100.0%	33.3%	63.6%		OVERALL ACCURACY= 32/53=60.4 %

Hessel Tetracam July 2017
Tetracam Scale Parameter 50

		Reference Data						
		Curlyleaf Pondweed	EWM	Deeper Water	Dock	Visible Bottom	Row Total	User's Accuracy
Classified Data	Curlyleaf Pondweed	1	1	0	0	0	2	50.0%
	EWM	3	12	1	0	4	20	60.0%
	Deeper Water	2	6	12	0	2	22	54.5%
	Dock	0	0	0	0	0	0	n/a
	Visible Bottom	0	1	0	0	5	6	83.3%
	Column Total	6	20	13	0	11	50	
	Producer's Accuracy	16.67%	60.00%	92.3%	n/a	45.5%		OVERALL ACCURACY= 30/50=60.0 %

Howells Dock August 2016
Tetracam Scale Parameter 25

		Reference Data				
		Northern Watermilfoil	EWM	Open	Row Total	User's Accuracy
Classified Data	Northern Watermilfoil	0	0	1	1	0.00%
	EWM	0	19	1	20	95.00%
	Open	1	0	21	22	95.45%
	Column Total	1	19	23	43	
	Producer's Accuracy	0.00%	100.00%	91.30%		OVERALL ACCURACY= 40/43=93.0%

Howells Dock August 2016
Tetracam Scale Parameter 50

		Reference Data				
		Northern Watermilfoil	EWM	Open	Row Total	User's Accuracy
Classified Data	Northern Watermilfoil	1	0	0	1	100.00%
	EWM	1	17	2	20	85.00%
	Open	0	2	20	22	90.91%
	Column Total	2	19	22	43	
	Producer's Accuracy	50.00%	89.47%	90.91%		OVERALL ACCURACY= 38/43=88.4%

Howells Dock August 2017
Tetracam Scale Parameter 25 Image 910

		Reference Data				
		Bottom	EWM	Eelgrass	Row Total	User's Accuracy
Classified Data	Bottom	14	5	0	19	73.68%
	EWM	2	21	4	27	77.78%
	Eelgrass	1	0	0	1	0.00%
	Column Total	17	26	4	47	
	Producer's Accuracy	82.35%	80.77%	0.00%		OVERALL ACCURACY= 35/47=74.5 %

Howells Dock August 2017
Tetracam Scale Parameter 50 Image 910

		Reference Data				
		Bottom	EWM	Eelgrass	Row Total	User's Accuracy
Classified Data	Bottom	11	7	0	18	61.11%
	EWM	2	23	2	27	85.19%
	Eelgrass	1	0	1	2	50.00%
	Column Total	14	30	3	47	
	Producer's Accuracy	78.57%	76.67%	33.33%		OVERALL ACCURACY= 35/47=74.5 %

Howells Dock August 2017
Tetracam Scale Parameter 25
Image 916

		Reference Data					
		Visible Bottom	EWM	Eelgrass	Mixed Vegetation	Row Total	User's Accuracy
Classified Data	Visible Bottom	11	8	0	0	19	57.9%
	EWM	1	19	0	0	20	95.0%
	Eelgrass	0	2	2	2	6	33.3%
	Mixed Vegetation	1	0	0	5	6	83.3%
	Column Total	13	29	2	7	51	
	Producer's Accuracy	84.6%	65.5%	100.0%	71.4%		OVERALL ACCURACY= 37/51=72.5%

Howells Dock August 2017
Tetracam Scale Parameter 50
Image 916

		Reference Data					
		Visible Bottom	EWM	Eelgrass	Mixed Vegetation	Row Total	User's Accuracy
Classified Data	Visible Bottom	16	2	0	1	19	84.2%
	EWM	2	19	0	0	21	90.5%
	Eelgrass	0	2	4	0	6	66.7%
	Mixed Vegetation	0	1	0	5	6	83.3%
	Column Total	18	24	4	6	52	
	Producer's Accuracy	88.9%	79.2%	100.0%	83.3%		OVERALL ACCURACY= 44/52=84.6%

Howells Dock August 2018
Tetracam Scale Parameter 25

		Reference Data			
		EWM	Bottom	Row Total	User's Accuracy
Classified Data	EWM	17	4	21	80.95%
	Bottom	0	9	9	100.00%
	Column Total	17	13	30	
	Producer's Accuracy	100.00%	69.23%		OVERALL ACCURACY= 26/30=86.7%

Howells Dock August 2018
Tetracam Scale Parameter 50

		Reference Data			
		EWM	Bottom	Row Total	User's Accuracy
Classified Data	EWM	19	6	25	76.00%
	Bottom	0	9	9	100.00%
	Column Total	19	15	34	
	Producer's Accuracy	100.00%	60.00%		OVERALL ACCURACY= 28/34=82.4%

Neil July 2017
Tetracam Scale Parameter 25

		Reference Data							
		Algae covered rocks	Chara	Deeper rocks	EWM	Exposed rocks	Visible Bottom	Row Total	User's Accuracy
Classified Data	Algae covered rocks	3	0	0	0	0	0	3	100.0%
	Chara	0	18	2	5	0	1	26	69.2%
	Deeper rocks	1	0	1	0	0	0	2	50.0%
	EWM	0	1	0	13	0	0	14	92.9%
	Exposed rocks	0	0	0	0	1	0	1	100.0%
	Visible Bottom	0	4	1	0	0	5	10	50.0%
	Column Total	4	23	4	18	1	6	56	
	Producer's Accuracy	75.0%	78.3%	25.0%	72.2%	100.0%	83.3%		OVERALL ACCURACY= 41/56=73.2%

Neil July 2017
Tetracam Scale Parameter 50

		Reference Data							
		Algae covered rocks	Chara	Deeper rocks	EWM	Exposed rocks	Visible Bottom	Row Total	User's Accuracy
Classified Data	Algae covered rocks	3	0	1	0	0	0	4	75.0%
	Chara	0	20	0	4	0	0	24	83.3%
	Deeper rocks	1	0	4	0	0	0	5	80.0%
	EWM	0	1	0	12	0	0	13	92.3%
	Exposed rocks	0	0	0	0	0	0	0	n/a
	Visible Bottom	0	3	1	0	0	4	8	50.0%
	Column Total	4	24	6	16	0	4	54	
	Producer's Accuracy	75.00%	83.33%	66.7%	75.0%	n/a	100.0%		OVERALL ACCURACY= 43/54=79.6%

S3. Part 3 – Details of every classification site and result

S3.1 Breezeswept North

Figure S1 shows the analyzed Tetracam imagery for Breezeswept North with a CIR band combination in July 2017 (9A) and the classification results with scale parameter = 25 (9B), and with scale parameter = 50 (9C); a Nikon D800 RGB image collected via Bergen Hexacopter forms the background. Breezeswept North has relatively higher DOC and K_d(PAR) extinction values and therefore is in the darker water cluster grouping.

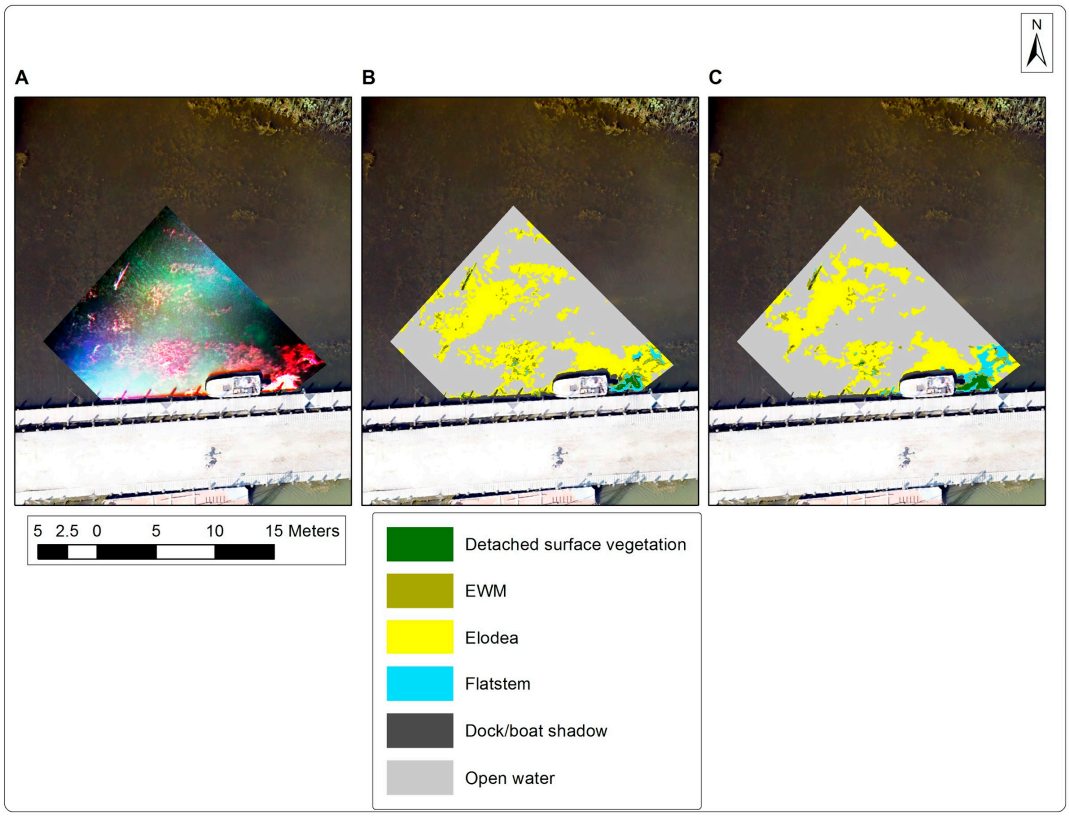

Figure S1. Tetracam multispectral image of Breezeswept North using color-infrared bands (A) and classification results with scale parameter = 25 (B), and with scale parameter = 50 (C).

Visual estimates indicated that three SAV species were prominent at Breezeswept North based on four survey points in or near the Tetracam image area: EWM, *Elodea canadensis* (Canadian waterweed), and *Potamogeton zosteriformis* (flat-stem pondweed). The canopies of EWM and flat-stem pondweed were 0.5 m or less from the water surface, while the tallest *Elodea* was 0.5 to 0.75 m below the surface. Figure S2(a) shows EWM and flat-stem pondweed close to the water's surface at the site, and S2(b) shows mostly flat-stem pondweed beneath the water's surface. S2(c) shows an overview RGB image of the site (taken with the RGB VISNIR camera), and S2(d) shows the mostly sunny conditions on the day of the data collection, which supported greater water penetration by the available sunlight. The densest areas of SAV appear as the

brightest red color in Figure S2(a), just north and northeast of the boat; these areas were mostly *Elodea* just north of the boat but flat-stem pondweed northeast of the boat. EWM was sparser than either of these species and mostly occurred in the northern part of the image, but was a smaller component than *Elodea*, which is reflected in the classification results. The major visible difference in the classification results using the two scales was that flat-stem pondweed formed a larger part of the result with the larger scale parameter. The extent of EWM appears similar with both scale results.

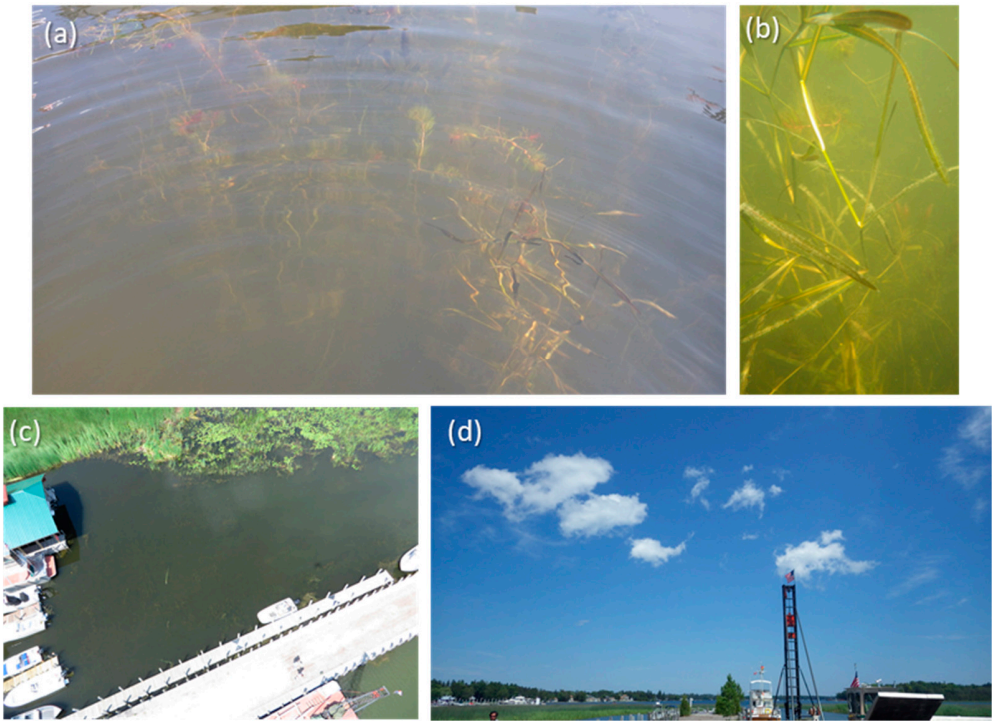

Figure S2. Field photos helping to document conditions at Breezeswept North on the day of data collection in July 2017, including documentation of EWM and flat-stem pondweed near the water's surface (a), flat-stem pondweed as seen underwater (b), an overview RGB image of the site (c), and mostly sunny sky conditions on the day of the data collection (d).

S3.2 Court East

Figure S3 shows the analyzed Tetracam imagery for the Court East site in August 2016 (S3A) and the classification results with scale parameter = 25 (11B), and with scale parameter = 50 (S3C); a Nikon D800 RGB image collected via Bergen Hexacopter forms the background. Court East is in the dark water cluster grouping, close to the mouth of Pearson Creek.

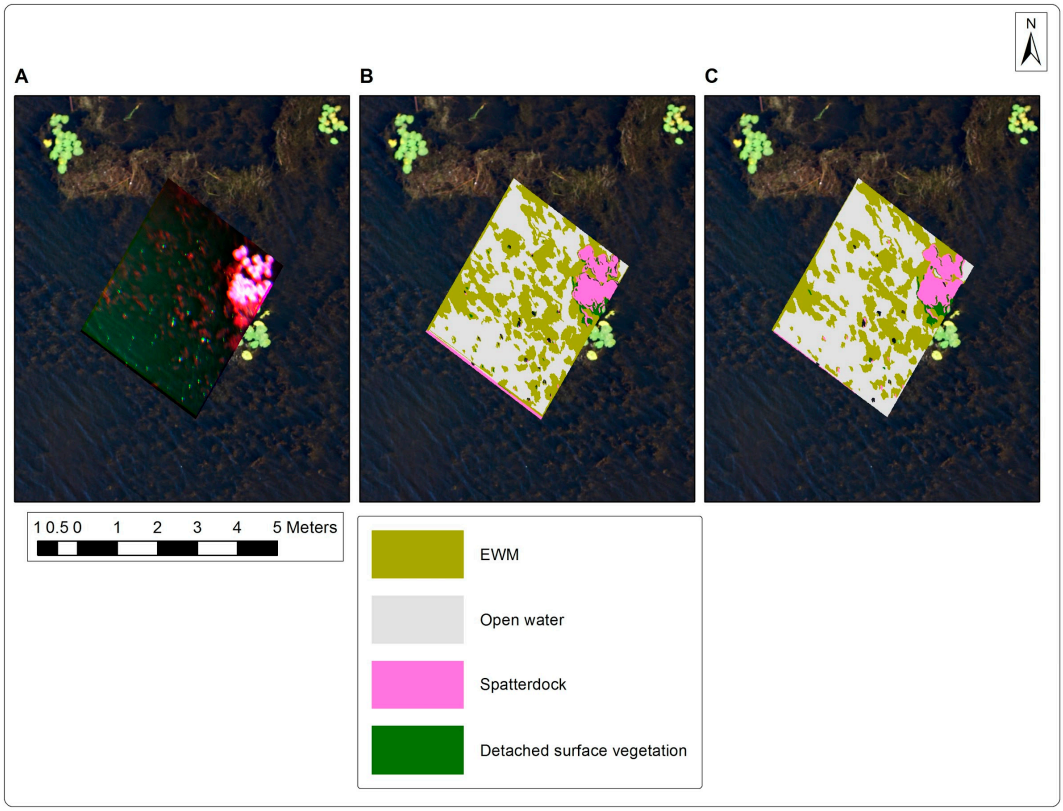

Figure S3. Tetracam multispectral image of Court East from August 2016 using color-infrared bands (A) and classification results with scale parameter = 25 (B) and scale parameter = 50 (C).

With 2016 flights mostly taking place at lower elevations than in later years, the August 2016 Court East classifications in Figure S3 cover a relatively small area of approximately 3x3 m (in contrast, the single Breezeswept North image in S1 from a higher flight elevation covers an area

of approximately 15x15 m). Visual surveys indicated that the surface vegetation showing as the brightest red towards the top right in the NIR view (S3A) was *Nuphar variegata* (spatterdock or bullhead pond lily) and the underwater vegetation was EWM. The field photograph taken on the same survey day in 2016 in Figure S4(a) helps verify this, and also the presence of an area of detached surface vegetation with EWM visible underwater that was able to be classified. Figure S4(b) shows an underwater photograph taken at this site, showing EWM with visible periphytic algae. This EWM shows up as dark red areas underwater in the color-infrared display in A3A due to sufficient penetration by the red edge band (720 nm) of the Tetracam into the water column.

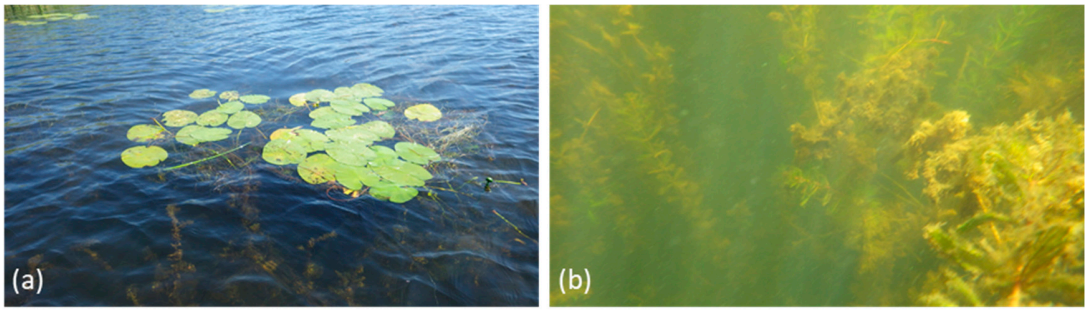

Figure S4. Field photographs showing much of the Court East August 2016 classification area on the same day as UAS imagery was collected, including (a) the presence of spatterdock and some loose surface vegetation at the surface near the spatterdock and (b) EWM underwater.

Figure S5 shows the analyzed Tetracam imagery for the Court East site in June 2017 (S5A) and the classification results with scale parameter = 25 (S5B) and scale parameter = 50 (S5C); a Phantom 3A RGB composite image forms the background.

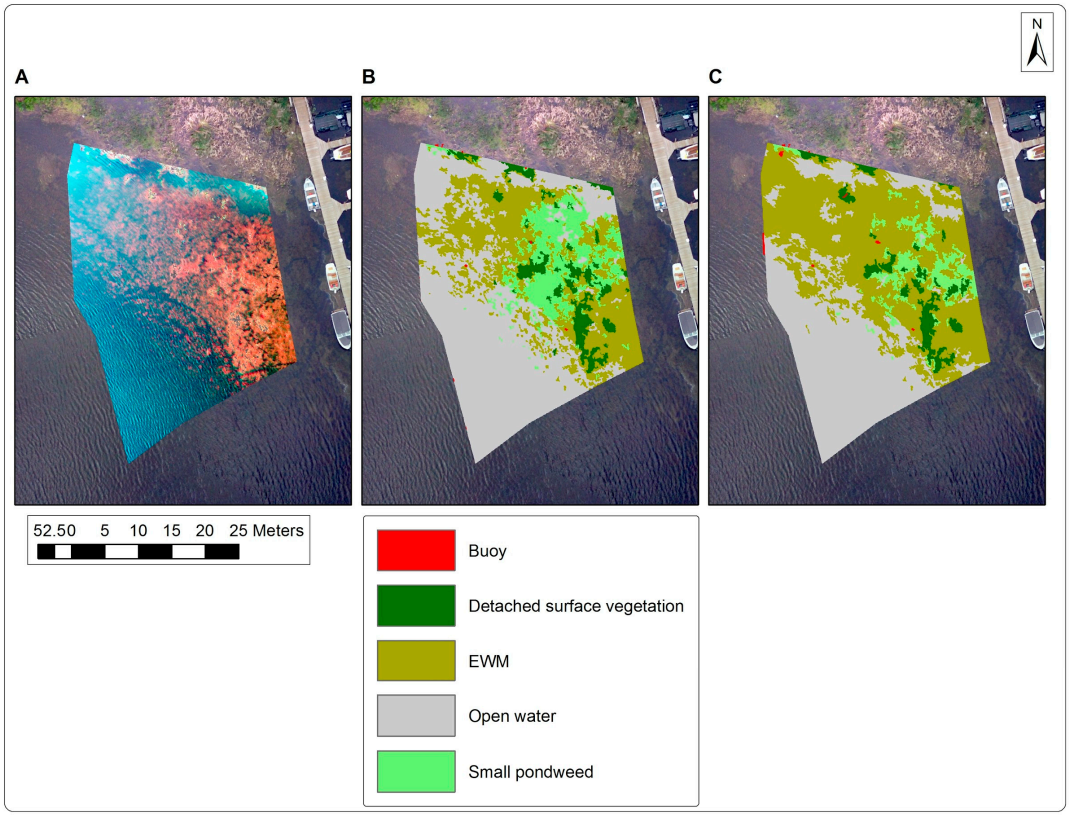

Figure S5. VISNIR multispectral image from June 2017 for Court East using color-infrared bands (A) and classification results with scale parameter = 25 (B) and scale parameter = 50 (C).

At the Court East site in June of 2017, field surveys showed that visible vegetation was primarily EWM near the sampling buoys, with some areas of *Potamogeton pusillus* ssp. *pusillus* (small or small-leaf pondweed), shown out of the water in Figure S6(d), and *Elodea*. During this visit, *Elodea* was mostly beneath the water's surface, while the top of the EWM canopy was at the surface (but not emergent) (Figures S6(a) and S6(b)). Floating spatterdock leaves were distinctly visible, as were areas of detached, floating surface vegetation (S6(c)). We thought it could be possible to differentiate the EWM visible at the surface from small pondweed and selected areas for use in classification that were dominated by those two vegetation types based on the visual estimates that took place near the three sampling buoys deployed here. The dense

EWM shows up prominently in the near-infrared VISNIR imagery (Figure S5A), but training sites for small pondweed were harder to reliably select because the areas were not extensive, and it appeared mostly near the detached surface vegetation in classification results (Figures A5B and A5C). The scale parameter = 25 results (designed for clearer waters) and the scale parameter = 50 results (designed for the darker waters, such as this site) appear different, with small pondweed more extensive with the smaller scale parameter and EWM more extensive with the larger scale parameter. Detached surface vegetation appears similar in both results.

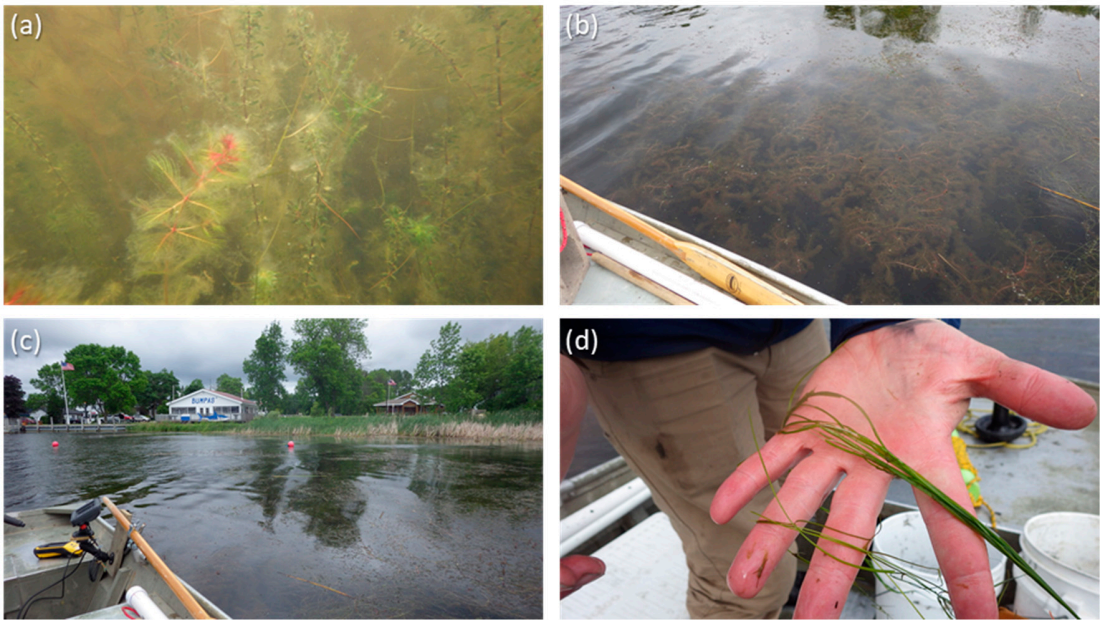

Figure S6. Field photos taken at Court East on the July 2017 survey day, showing a mixture of EWM and *Elodea* beneath the water surface (A), dense EWM at the water surface (B), detached areas of vegetation to the right of the survey vessel with two sampling buoy locations visible in the background (C), and small pondweed removed from the water (D).

Court East in July 2017 was one of the sites we used when initially testing different scale parameters. Figure S7 adds a classification result with a very small scale parameter of 5 (Figure

S7A), zoomed in to the northeast corner of the area shown in Figure 13. The three different scale parameters (5 vs. 25 vs. 50) create classification results with different appearances. The smallest scale parameter allows for more finely divided vegetation polygons and the ability to include a spatterdock class that we were not able to capture with training areas at the two larger scale parameters. Small pondweed appears less extensive with the smallest scale parameter but more extensive with the scale parameter of 25.

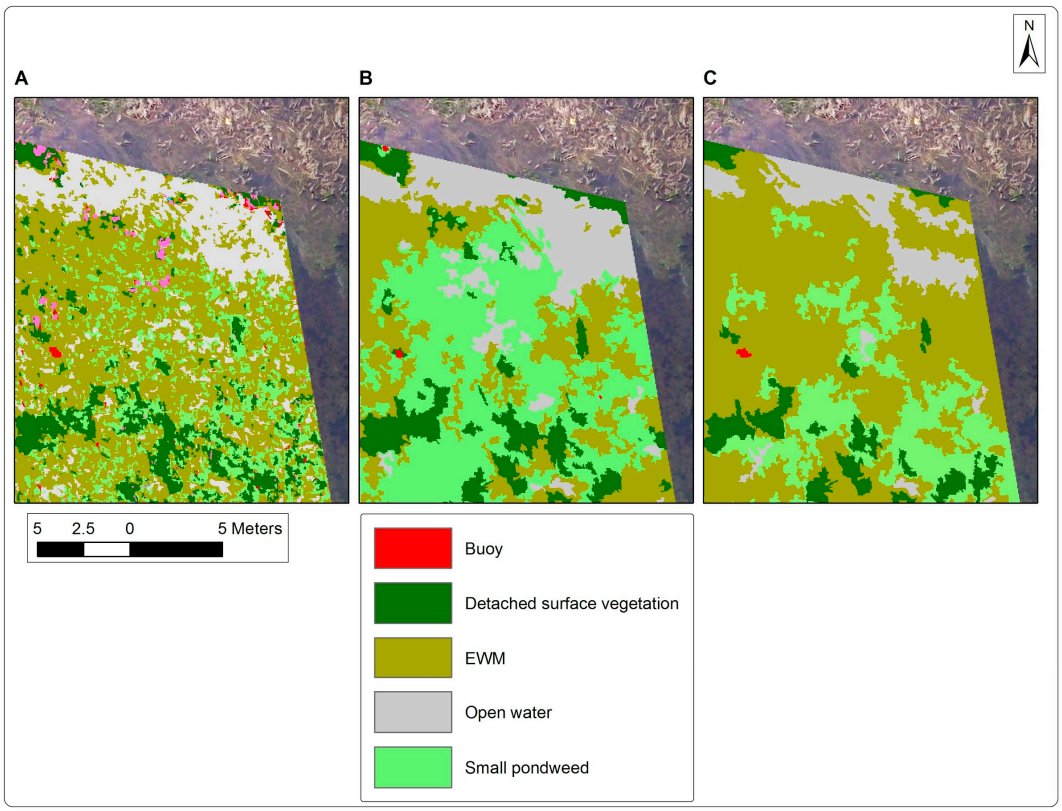

Figure S7. Comparison of June 2017 VISNIR classification results for the northeastern corner of the analyzed image, with scale parameter = 5 (A), 25 (B), and 50 (C).

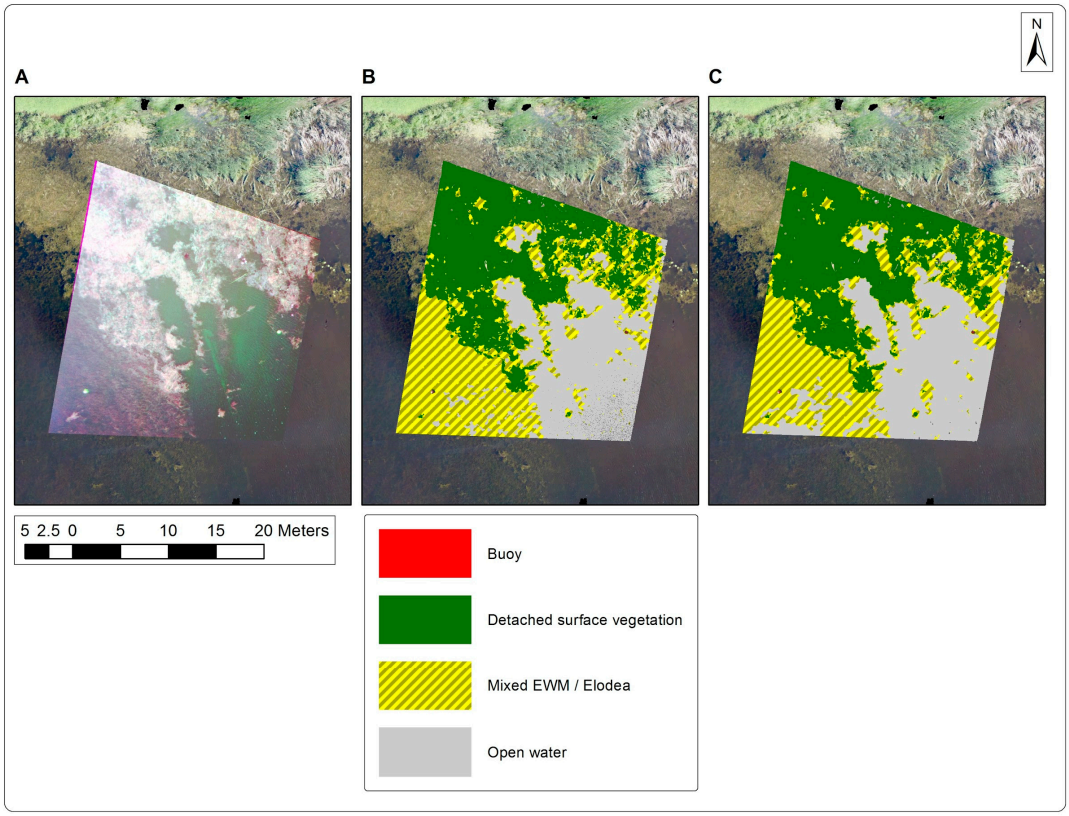

Figure S8. Tetracam multispectral image from July 2017 for Court East using color-infrared bands (A) and classification results with scale parameter = 25 (B) and scale parameter = 50 (C).

Our visit to Court East in July 2017 occurred soon after an aquatic vegetation harvester had been deployed by local marinas to control nuisance growth, leaving behind significant areas of detached surface vegetation. These show up as the brighter white areas in the Tetracam CIR image (Figure S8A), so we created a separate vegetation class for this cover type. Visual estimates for the area around a sampling buoy in the southwest corner showed a dominance of *Elodea* with EWM also being prominent. Underwater photos such as Figure S9 showed EWM and *Elodea* closely mixed together, and inspection of the Tetracam imagery did not show any obvious difference between the two. The tops of the canopies for both species were approximately 0.75 m to 1.0 m below the surface in approximately 1.5 m of water. Because they

were growing so closely together, we created a “mixed EWM/*Elodea*” class for this classification.

Figure S9. Underwater photo taken in the southwest corner of the Court East July 2017 Tetracam image area, showing a matrix of *Elodea* and EWM.

S3.3 Hessel Marina

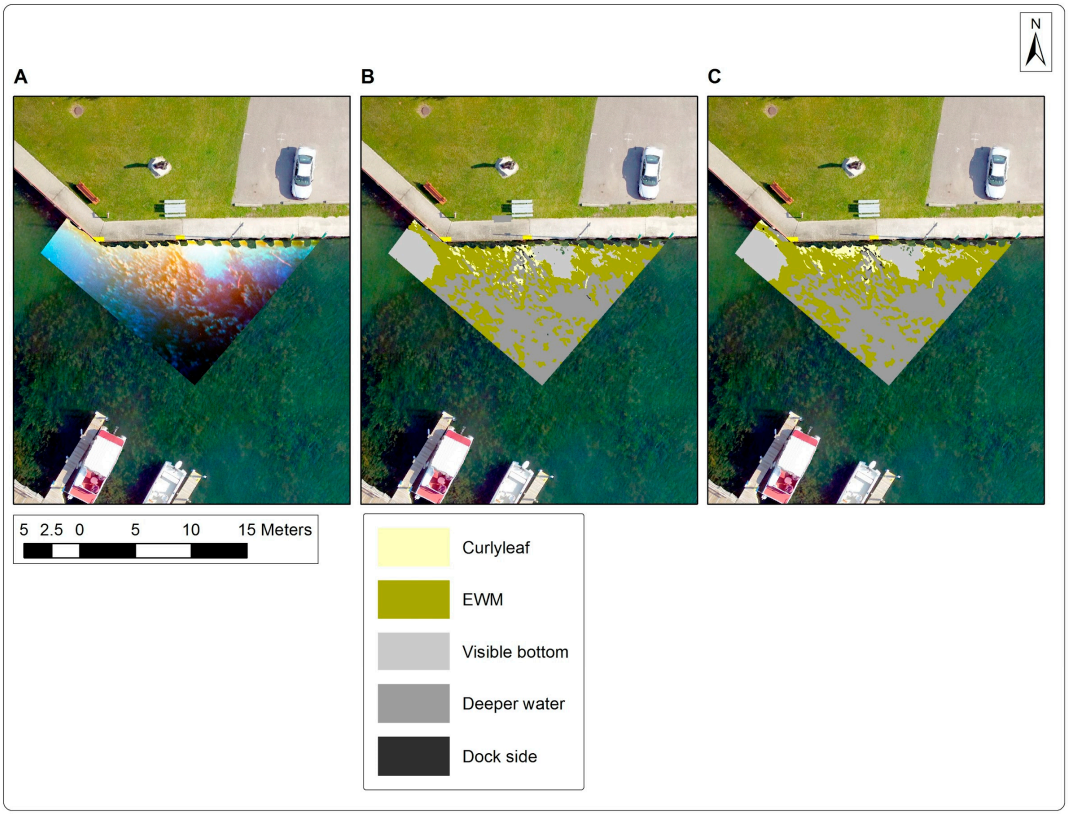

Figure S10. Tetracam multispectral image from July 2017 for Hessel Marina using color-infrared bands (A) and classification results with scale parameter = 25 (B) and scale parameter = 50 (C).

Visual estimates recorded for the Hessel Marina site in July 2017 showed that the predominant vegetation was EWM, with *Potamogeton crispus* (curlyleaf pondweed, another invasive pecies of SAV) also present. Field photos such as Figure S11 show both species present, with curlyleaf having similar heights and appearing generally brighter in this instance than EWM. This observation led us to identify the brightest areas of SAV in the imagery as curlyleaf. The extent of EWM in the July 2017 Hessel Marina classification results (Figs. S10 B and C) appears

similar between the two scale parameters, but curlyleaf covers larger areas in the scale parameter = 50 results (Figure S10C).

Figure S11. Field photo of part of the area covered by the Tetracam image shown in Figure S9, with both EWM and curlyleaf pondweed present.

S3.4 Howells Dock

Three Howells Dock classifications were completed using the six Tetracam bands plus mNDVI, including one for August 2016, two image scenes for August 2017, and one for August 2018. Howells Dock has locally extensive EWM that appears to be growing on the underwater remnants of an old crib dock and has not undergone treatment for EWM removal or reduction since at least 2015. Figure S12 shows the input image and classification results for August 2016; Figure S13 shows the August 2017 result for Tetracam image number 910, Figure S14 shows the August 2017 result for image number 916, and Figure S15 shows the August 2018 image and

results. For August 2017, we found that there was sufficient color variation between neighboring Tetracam images that we analyzed images separately.

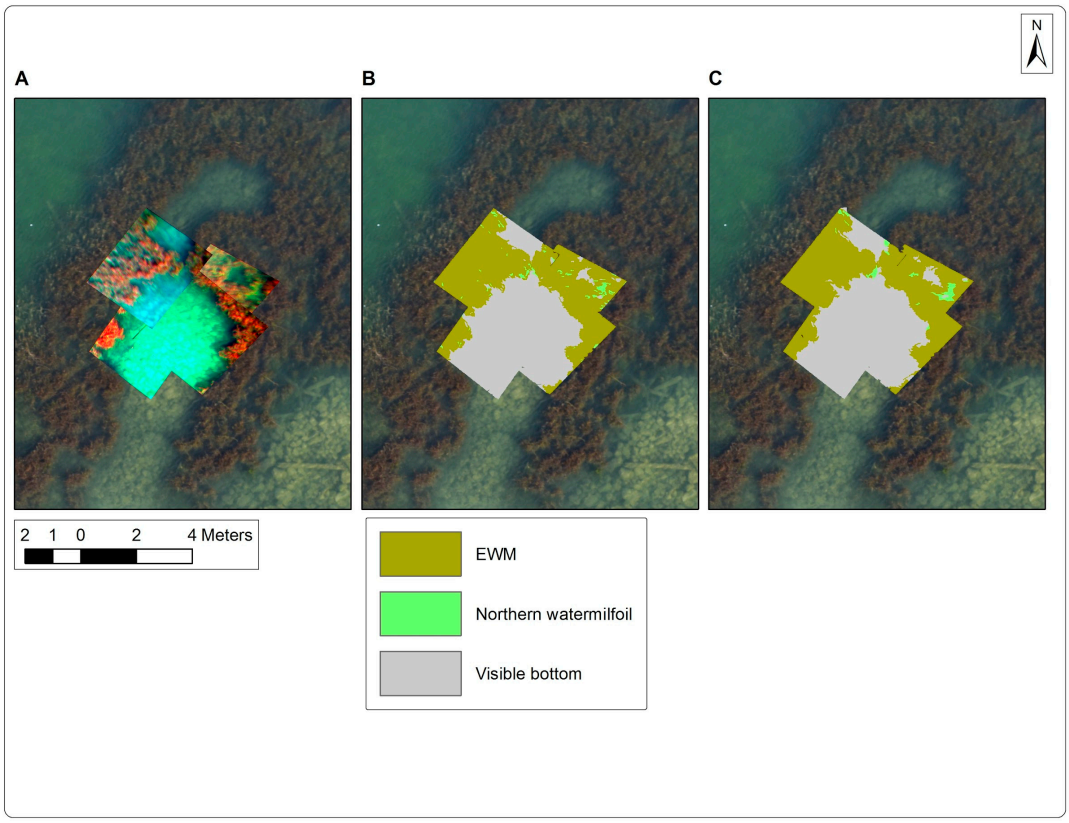

Figure S12. Tetracam multispectral imagery from August 2016 for Howells Dock (A) using color-infrared bands (A) and classification results with scale parameter = 25 (B) and scale parameter = 50 (C).

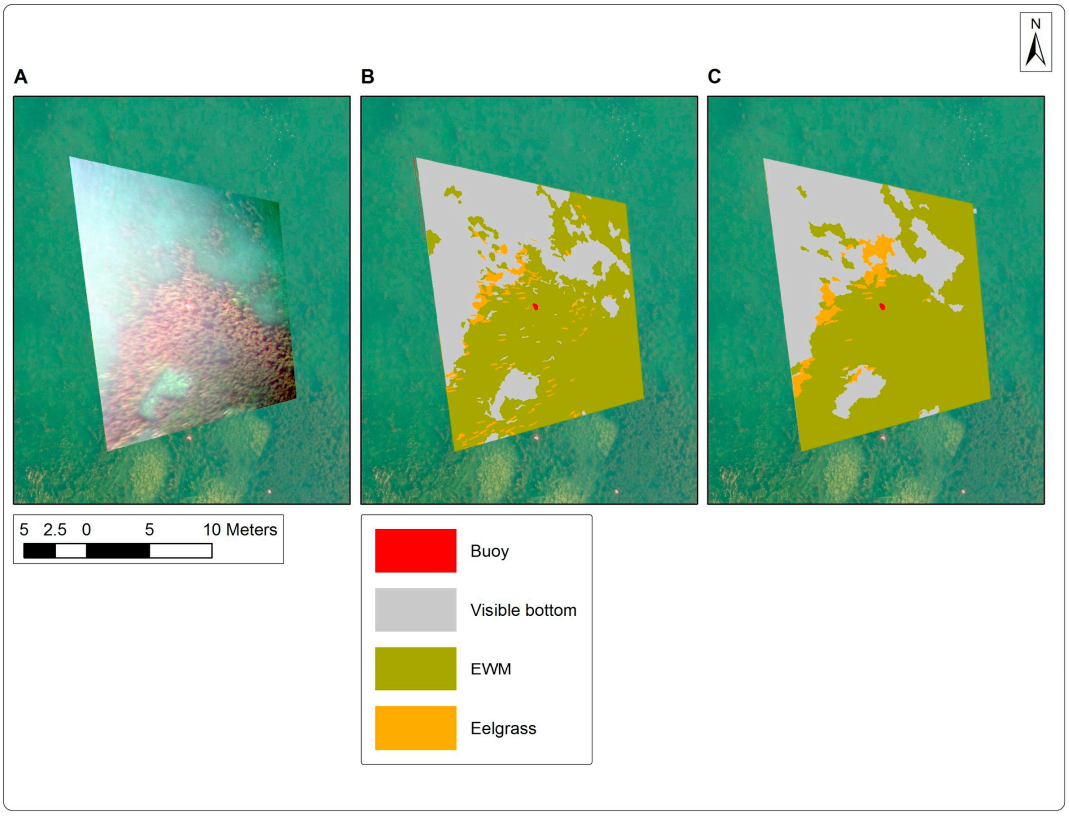

Figure S13. Tetracam multispectral image number 910 from August 2017 for the northern part of Howells Dock (A) using color-infrared bands (A), classification results with scale parameter = 25 (B), and with scale parameter = 50 (C).

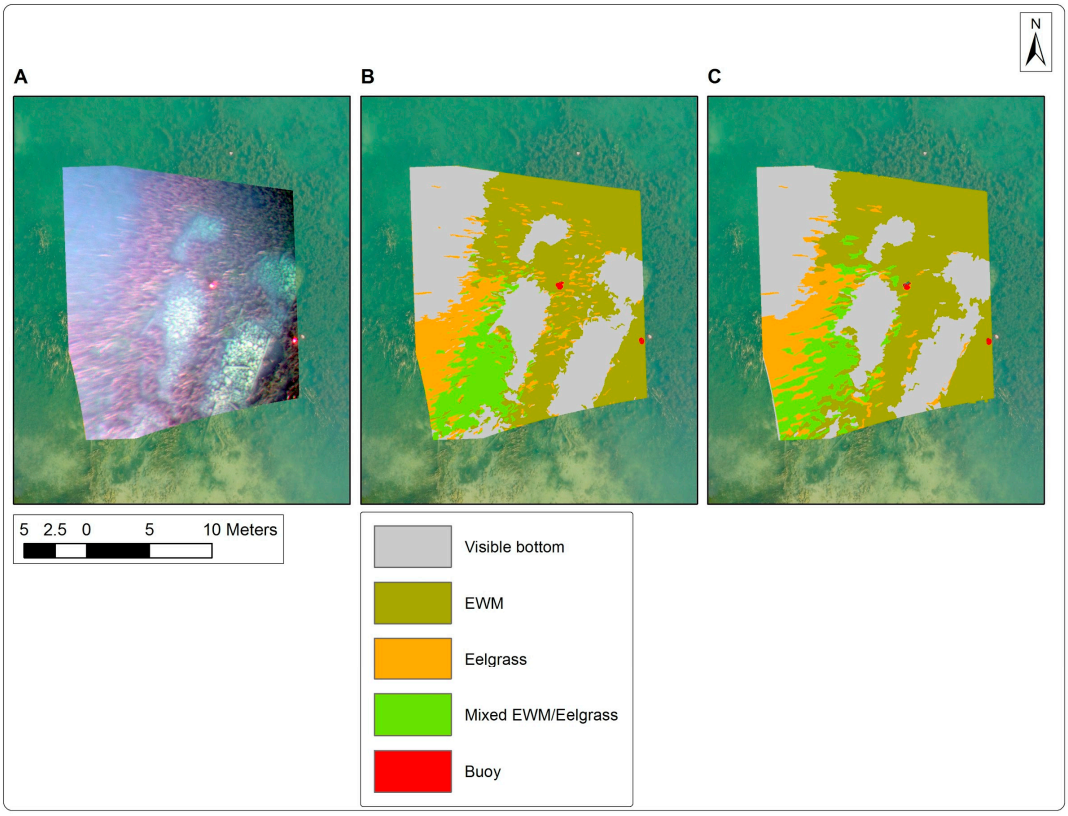

Figure S14. Tetracam multispectral image number 916 from August 2017 for the centre part of Howells Dock using color-infrared bands (A), classification results with scale parameter = 25 (B), and with scale parameter = 50 (C).

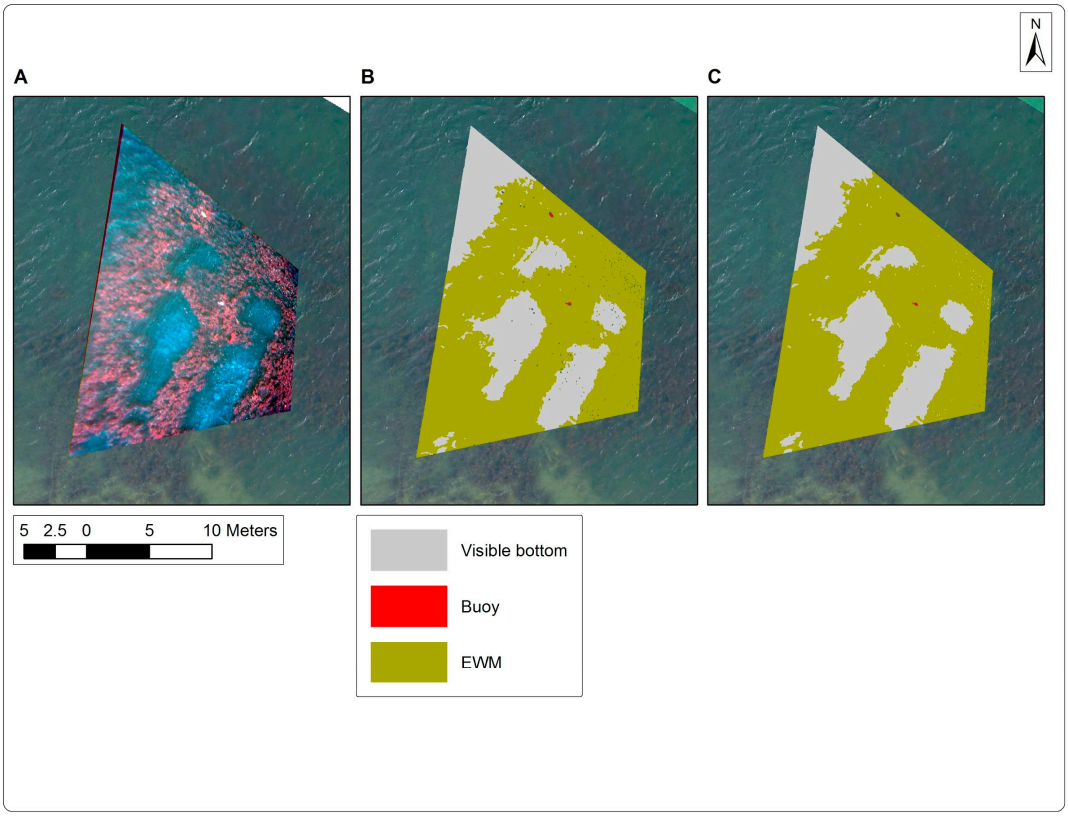

Figure S15. Tetracam multispectral image from August 2018 for Howells Dock using color-infrared bands (A), classification results with scale parameter = 25 (B), and with scale parameter = 50 (C).

The August 2016 Howells Dock classification (Figure S12) used four Tetracam images that were combined into a single image for classification purposes, with each covering approximately at 3x3m area. The visual estimates for this site showed that vegetation was primarily EWM, with nearby areas of eelgrass (*Vallisneria americana*, also known as water celery or tapegrass) not visible in the Tetracam images. While northern watermilfoil (*Myriophyllum sibiricum*), a native species, was not recorded in the visual estimates, it was present in the rake twist data for this site, and it could be seen in field photographs that were inspected more closely after field work was completed (Figure S16).

Figure S16. The bright green vegetation is northern watermilfoil that was visible in the August 2016 Tetracam imagery for Howells Dock, while the darker green/brown vegetation is Eurasian watermilfoil.

The areas visible in the August 2017 image 910 (Figure S13) were predominantly EWM that were one to two meters below the surface, with small areas of eelgrass based on our visual estimates, and the classification results reflect this. The areas in image 916 (Figure S14) were a mix of eelgrass and EWM based on visual estimates. The peduncles (long, coiled flower stalk) of eelgrass were quite distinct in the field (Figure S17) and could be seen in the Tetracam imagery as well, serving to help define training sites for classification. There did not appear to be distinct visually identifiable differences in the Tetracam imagery between EWM and eelgrass for the main stems of the plants when reviewing the aerial imagery that had been collected.

Figure S17. Example of eelgrass peduncles visible at the water's surface near one of the sampling buoys in August 2017 at Howells Dock, with a Trimble GPS unit recording the location in the foreground.

Fieldwork in August 2018 showed that there was almost no eelgrass present at Howells Dock and only EWM could be identified visually, at depths of 0.5 to 1.5 m below the water's surface (Figure S18). This informed our selection of training polygons and the results shown in Figure S15, where only EWM and visible bottom are identified, along with a distinct class for the buoys (one of which can be seen in Figure S17). Areas of EWM vs. the visible lake bottom are distinct in the input imagery and in the classification results.

Figure S18. Example underwater field photo taken on the same day as the August 2018 Tetracam flight showing EWM.

S3.5 Neil

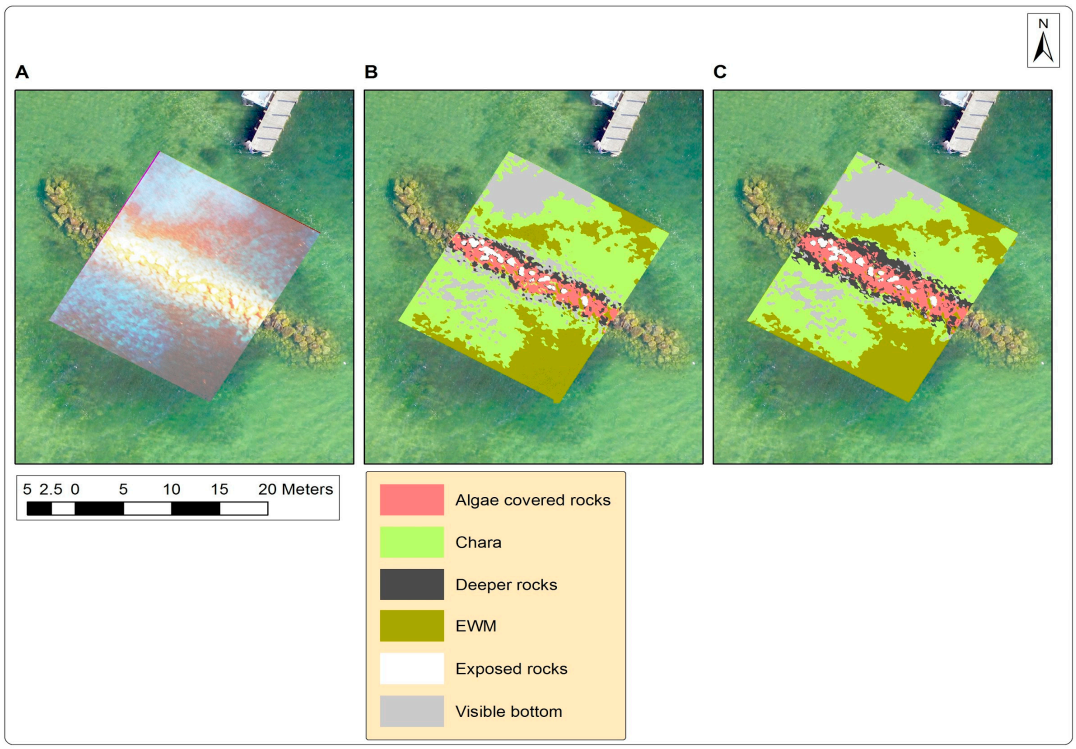

Figure S19. Tetracam multispectral image from August 2018 for Neil using color-infrared bands (A), classification results with scale parameter = 25 (B), and with scale parameter = 50 (C).

Visual estimates showed that the taller vegetation showing up as darker areas in Figure S19A was EWM, especially on the southwest side of the breakwater in the middle of the image. EWM was 1.75 m beneath the surface in approximately 2.4 m of water. There was also a vegetation class we initially called "low vegetation" from visual estimates because it appeared to be at the bottom of the site (in approximately 2.4 m of water). Rake tosses showed this to be *Chara* (both EWM and *Chara* can be seen in Figure S20). The breakwater had three distinct-appearing areas in the Tetracam image of exposed rocks, deeper rocks, and algae covered rocks in between these, so these were all used as training and mapping classes for the classification results, but they could also be combined into a single "rocks" class.

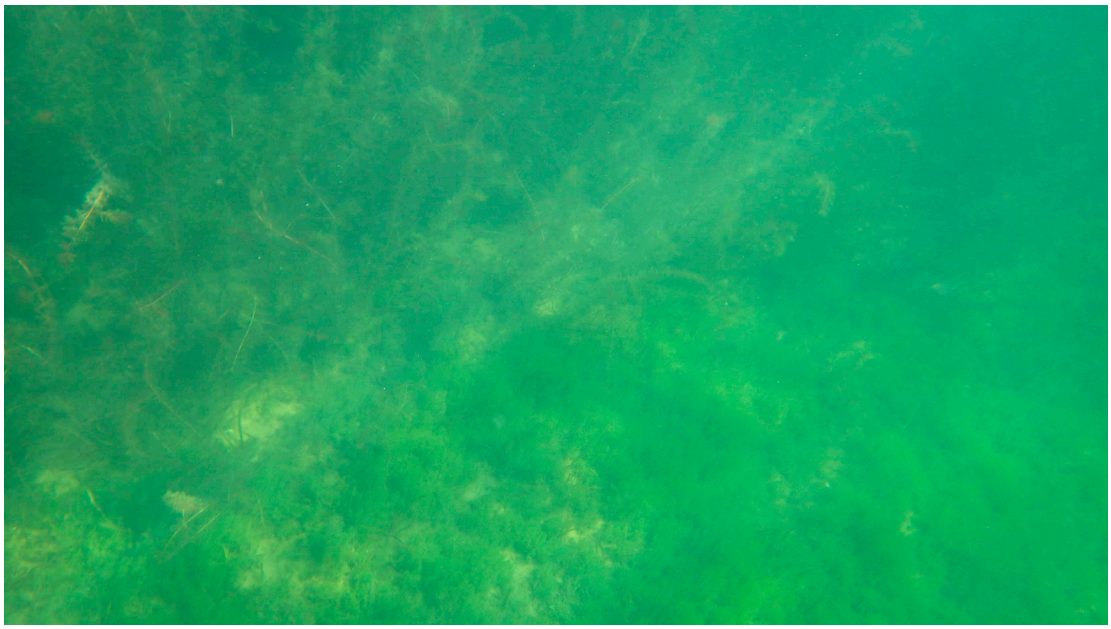

Figure S20. Example underwater photo of Neil area taken at a transition zone between EWM (top left, taller and darker vegetation) and Chara (bottom right, shorter and lighter colored vegetation).