APPENDIX A. FIELD FORMS

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Summer 2018

BIRD SURVEY FORM

Survey Location: BPC1 (Harbor Sq. boardwalk)

Surveyor(s): J. Live

Date: 7.19.18

Begin Time: 05:40

End Time: 05:45

Weather Conditions (circle relevant conditions)

high overcast clouds

Visibility	[✓ clear]	partly-cloudy	[✓ overcast]	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong
Notes: 58°F Sunrise @ 05:30				

Human Activity (Please note any relevant human activity within survey area)

Notes: People coming and going from athletic club @ Harbor Square but little activity along boardwalk.

Species	Seen	Heard	Fly-over	Notes
COYE		2		
MAWR		1		
SOSP		1		
AMCR	1	1		1 seen was fly-by E→W
ANHU	1			fly-by E→W

BIRD SURVEY FORM

Survey Location: BPC2 (marsh Int. adj. to willow cr.)
Surveyor(s): J. Lane
Date: 7.19.18
Begin Time: 05:51
End Time: 05:56

Weather Conditions (circle relevant conditions)

high overcast cover

Visibility	[✓ clear]	partly-cloudy	[✓ overcast]	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong

Notes:
upper 50s °F
sunrise @ 05:30

Human Activity (Please note any relevant human activity within survey area)

Notes:
None w/in point count radius / area

Species	Seen	Heard	Fly-over	Notes
MAWR	~~2~~ 1	1		in hardstem bulrush patch
AMCR	~~3~~ 1		2	in snag above creek, 2 fly-by
TRES	3			(all visual obs.)
BEKI		1		from Unocal site
COYE		1		in hardstem bulrush patch
BCCH		1		
MALL		2		in creek
SOSP		1	~~20~~	
CANG			2	

BIRD SURVEY FORM

Survey Location: BPC5 (off 2nd)
Surveyor(s): J. Love

Date: 7·19·18
Begin Time: 06:35
End Time: 06:40

Weather Conditions (circle relevant conditions)

high overcast

Visibility	[✓ clear]	partly-cloudy	[✓ overcast]	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong
Notes: upper 50s °F Sunrise @ 05:30				

Human Activity (Please note any relevant human activity within survey area)

Notes: None w/in point-count radius / area

Species	Seen	Heard	Fly-over	Notes
RWBL		1		
MAWR		3		from mt. of Shell. Marsh
BEWR		1		Bewick's wren
ANHU			1	also vocalizing
AMCR	1			perched in alder on Shell. N buffer zone
GBHE			1	flying NE→SW
AMGO			2	also vocalizing

BIRD SURVEY FORM

Survey Location: BPC4 - Hatchery Riparian habitat
Surveyor(s): J. Love
Date: 7 · 19 · 18
Begin Time: 06:50
End Time: 06:55

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear]	partly-cloudy	[✓ overcast] high over.	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong

Notes: upper 50s °F
Sunrise @ 05:30

Human Activity (Please note any relevant human activity within survey area)

Notes: None other than traffic on SR104

Species	Seen	Heard	Fly-over	Notes
SPTO	1	2		3 total birds
PSFL		1		
BCCH		1		
SOSP		1		
GCKI		1		
AMCR		1		

BIRD SURVEY FORM

Survey Location: BPC3 – NW of Hatch. in marsh

Surveyor(s): J. Lane

Date: 7.19.18

Begin Time: 07:03

End Time: 07:08

Weather Conditions (circle relevant conditions)

high overcast cover

Visibility	[✓ clear]	partly-cloudy	[✓ overcast]	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong

Notes: upper 50s °F
sunrise @ 05:30

Very quiet here – little bird activity.

Human Activity (Please note any relevant human activity within survey area)

Notes: None w/in point count radius / area

Species	Seen	Heard	Fly-over	Notes
MAWR		2		
BIWR		1		
AMCR			3	ne → SW flight
ANHU			1	

VEGETATION SURVEY FORMS

1 OF 2

Surveyor(s): J LOVE , J RHEUBEN
Date: 7-10-18
Weather: 60s, Sun

Buffer Zone ID: NORTH
Transect No.: N 1
Transect Length: 10.80 m

distance from marker to grass 3 m apart

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	STICKY WILLY , Bedstraw		35 %	
1	GIANT HORSETAIL		50%	
1	him blackberry		10 %	
1	A UNID #4 (Aster/dandelion)		TRACE	
1	UNID #5 (canada bluegrass)		70%	
2	morning glory		10 %	
2	giant horsetail		25 %	
2	nightshade		15%	
3	Waterparsley		100 %	
3	nightshade		15 %	

VEGETATION SURVEY FORMS

2 OF 2

Surveyor(s): J RHEUBEN, J LOVE
Date: 7-10-18
Weather: 60s SUNNY

Buffer Zone ID: NORTH
Transect No.: N1
Transect Length: 10.80m

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
giant horsetail	0.60-1.10	2.40 3.70	6.90-7.25								
Field horsetail	3.6-3.7										
black twinberry	5.75-6.10										
water parsley	8.00-8.30	9.0-9.65									
him. blackberry	8.30-8.40										

VEGETATION SURVEY FORMS

1 OF 3

Surveyor(s): J. RHEUBEN, J. LOVE
Date: 7/10/18
Weather: Sunny 70s

Buffer Zone ID: NORTH
Transect No.: N2
Transect Length: 13.5m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	Fireweed		5%	
1	bittersweet nightshade		5%	
only	one plot available, thick him	black berry		
	inaccessible			

VEGETATION SURVEY FORMS

2 OF 3

Surveyor(s): J. Rheuben & J. Love
Date: 7/10/18
Weather: Sunny, 70s

Buffer Zone ID: north
Transect No.: N2
Transect Length: 13.5 m

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
Typha latifolia	0.00 - 2.65										
bittersweet nightshade	0.65 - 0.70	1.05 - 1.30	2.15 - 2.40								
scoulers willow	2.8 - 4.2										
h.m blackberry	4.0 - 13.5										
lawn area: 4m											
upland of start											
of veg. inventory											

VEGETATION SURVEY FORMS

3 OF 3

Surveyor(s): J. RHEUBEN, J LOVE
Date: 7/10/18
Weather: Sunny 70s

Buffer Zone ID: NORTH
Transect No.: N2
Transect Length: 13.5 m

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm^2)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	
Scoulers willow			13.2						@ 4.0m

VEGETATION SURVEY FORMS

1 OF 4

Surveyor(s): J RHEUBEN | J LOVE
Date: 7-10-18
Weather: 70s, SUNNY

Buffer Zone ID: NORTH
Transect No.: N3
Transect Length: 14.4 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	FIREWEED, Chamelianum angustifol		45	
1	FIELD HORSETAIL		5 %	
2	Fireweed		20 %	
2	lady Fern		15 %	
2	Field horsetail		TRACE	
2	BARE GROUND		50 %	
3	English ivy, hedra helix		15 %	
3	him blackberry		TRACE	
3	downed log		90 %	

3.9m

3.9 m of mowed grass

VEGETATION SURVEY FORMS

2 OF 4

Surveyor(s): J. Rheuben/J. Love
Date: 7-10-18
Weather: 70s, sunny

Buffer Zone ID: North
Transect No.: N3
Transect Length: 14.4 m

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
Scoulers willow	0-10.95	10.2- 10.4	10.1- 6.3	6.5- 14.4							
Alnus rubra	9.8 10.4-										
LADY Fern	8.0- 6.6										
him blackberry	8.0- 7.1	6.4- 5.2									
Scoulers willow											

VEGETATION SURVEY FORMS

3 OF 4

Surveyor(s): J RHEUBEN / J LOVE
Date: 7-10-18
Weather: 70s SUNNY

Buffer Zone ID: NORTH
Transect No.: N3
Transect Length: 14.4m

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm²)	
		< 10	10-20	20-30	30-40	40-60	60-80	80-100		
Scoulers willow			~~12.6~~							@ 0.0
			11.6							
Scoulers willow		9.2								@12.0m
Scoulers willow			10.7							@ 8.0m
" "			10							
" "			14.1							
		9.6								
			16.6							

VEGETATION SURVEY FORMS

4 OF 4

Surveyor(s): J RHEUBEN, J LOVE
Date: 7-10-18
Weather: Sunny, 70s

Buffer Zone ID: NORTH
Transect No.: N3
Transect Length: 14.4m

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments
N3, @ 6.0m	log	2.9	13.7	4	deciduous	No?	

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

VEGETATION SURVEY FORMS

1 OF 3

Surveyor(s): J RHEUBEN / J LOVE
Date: 7-10-18
Weather: 70 sunny

Buffer Zone ID: NORTH
Transect No.: N4
Transect Length: 7.9 m

Herbaceous stratum – Canopy Coverage method

@2.9

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	Water parsley		80 %	
1	Nightshade		15 %	
1	Salix sitka sitchensis		TRACE	
2	Morning glory		~~5~~ TRACE	
2	Pinoak seedling		1 %	
2	Swordfern		TRACE	

VEGETATION SURVEY FORMS

2 OF 3

Surveyor(s): J RHEUBEN, J LOVE

Date: 7-10-18

Weather: 70 SUNNY

Buffer Zone ID: NORTH

Transect No.: N4

Transect Length: 7.9 m

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
~~Red alder~~											
Evergreen huckleberry	4.95 - 4.35										
Sword fern	2.9	1.9 - 1.0									
dandilion sp ID	6.9 - 0.0										
Acer circatum	0.60 - 0.25										

3 OF 3

Surveyor(s): J RHEUBEN
Date: 7-10-18
Weather: 70 sunny

Buffer Zone ID: North
Transect No.: N4
Transect Length: 7.9 m

Tree stratum (belt transect method)

		DBH (cm)							
Species	Indicator status	< 10	10-20	20-30	30-40	40-60	60-80	80-100	Total basal area (cm²)
Red alder			17.1						

VEGETATION SURVEY FORMS

1 OF 4

Surveyor(s): J. Rheuben & N. Maas
Date: 7-11-18
Weather: 60s Sunny

Buffer Zone ID: SHELL. MARSH
Transect No.: SB1
Transect Length: 17.30m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	LADY FERN	~~25~~ JR 7-11-18	25	
1	Night Shade		60	
1	PURPLE LOOSE STRIEF		70	
1	phalaris arundica		10	
2	MORNING GLORY		10	
3	MORNING glory		10	
4	Red alder sapling		5	
	22.10			

VEGETATION SURVEY FORMS

2 OF 4

Surveyor(s): J. Rheubend N. Maas
Date: 7-11-18
Weather: 60s sunny

Buffer Zone ID: Shell. Marsh
Transect No.: SB1
Transect Length: 17.3

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
TYPHA LAT.	17.3 17.0	16.4 – 16.2									
RCG	15.0 16.2 –										
him blackberry	15.4 – 15.1	14.4 – 11.40	10.4 – 6.40								
PURPLE LOOSESTRIEF	16.20 14.5										
MORNING GLORY	10.8 – 9.10	8.90 – 8.50									
LANDSCAPING DETRITUS	6.9 – 3.55										
BARE GROUND	3.80 – 0.0										

VEGETATION SURVEY FORMS

3 OF 4

Surveyor(s): J. Rheuben + n. Maas
Date: 7-11-18
Weather: 60s sunny

Buffer Zone ID: Shell. Marsh
Transect No.: SB1
Transect Length: 17.30 m

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm²)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	
Red ALDER			16.5						

Windward environmental LLC

VEGETATION SURVEY FORMS

4 OF 4

Surveyor(s): J. Rhcuben & N. Maas
Date: 7-11-18
Weather: Sunny 60s

Buffer Zone ID: Shell. Marsh
Transect No.: SB2
Transect Length: 17.30 m

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments
13.7	STUMP	3M	na	1	D	~~Rubus~~ Alder	
10.0	Log	8.75	13.7	1 JR ~~13.7~~	JR ~~Log~~ D	Alder	

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

VEGETATION SURVEY FORMS

1 OF 5

Surveyor(s): J. LOVE, J. RHEUBEN
Date: 7-9-18
Weather: 60s, Sunny

Buffer Zone ID: South
Transect No.: S1
Transect Length: 22.75m

Herbaceous stratum – Canopy Coverage method

	Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category	
22.75	1	oso berry		5		
	1	salmon berry		5		
	1	giant horsetail		1% TRACE		
	1	dead holly		on ground		
17.75	2	salmon beray		5%		
	2	giant horsetal		1% trace		
	2	reed canary grass		1% trace		
	2	trailing blackberry		1%		
	2	him. blackberry		1%		
12.75	2	bareground		85%		
	2	dead holly		on ground		
12.75	3	UNID #1		25%		creek @ edge of plot
	3	giant horsetail		1%		
	3	salmon berry		5		
	3	bare ground		75%		
7.75	4	sword fern		5%		
	4	reed canary grass		15		
	4	horsetail		1% Trace		
	4	bare ground		80%		

VEGETATION SURVEY FORMS

2 OF 5

Surveyor(s): J LOVE, J RHEUBEN
Date: 7-9-18
Weather: 60s Sunny

Buffer Zone ID: South
Transect No.: S1
Transect Length: 77.75m

Herbaceous stratum – Canopy Coverage method

2.75

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
5	LADY Fern		35 %	
5	Urtica, stinging nettle		10 %	
5	giant horsetail		5 %	
5	bare ground		80 %	

VEGETATION SURVEY FORMS

3 OF 5

Surveyor(s): J. Rheuben + J. Love
Date: 7-9-18
Weather: Sunny, 70° F

Buffer Zone ID: South
Transect No.: S1
Transect Length: 22.75

hip height to eye level

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
Salmonberry	22 - 23.35 ~~35~~		21.4 - 20.8	20.15 - 19.80	18.10 - ~~18.8~~	18.1 - 17.8	16.75 - 14.78	14.10 - 12.95	14.25 12.80	12.30 - 11.45	~~+35~~
holly	22.45 - 21.5										
cherry laurel	21.45 - 20.5										
osoberry	20.9 - 20.5		19.75 - 18.4								
him. blackberry	16.45 16.73	16.5 - 15.25									
stink currant	14.97 - 13.55	13.05 - 12.50	10.40 - 11.70.								
trailing blackberry	12.60 - 12.53										
Salmonberry	4.65 - 4.00	3.50 - 3.30	2.40 2.20	2.00 - 0.81							
red osier dogwood	10.0 - 9.45	8.55 8.70									
~~peafruit rose~~ Nootka rose, no flower	8.30 - 8.55										
peafruit rose	7.6 - 5.9										
W. Red cedar Thuja plicata	1.40 - 3.37										

VEGETATION SURVEY FORMS

4 OF 5

Surveyor(s): J. Love and J. Rheuben
Date: 7/9/18
Weather: 60s- Sunny

Buffer Zone ID: S Buffer Zone - Trans. # 1
Transect No.: S1 ~~de~~
Transect Length: ~~25~~ m 22.75 m

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm²)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	
Alnus rubra @ 22.25 m			18.5						
" " @ 20 m					31				
" " @ 19 m				24.4					
" " @ 18.60 m				28.8					
" " @ 17.90 m					34.4				

Densiometer readings:

Plot # 1

1st read
5 Facing N
4 Facing E
4 Facing S

~~2nd read~~
10 Facing W

2nd read
N - 5
E : 4
S : 2
W · 4

Plot # 2

1st Read
N - 3
E - 0
S - 2
W - 1

2nd Read
N 4
E 0
S 2
W 3

VEGETATION SURVEY FORMS

5 OF 5

Surveyor(s): J. Rhcuben & J. Love

Date: 7/19/18

Weather:

Buffer Zone ID: S. Zone

Transect No.: 1

Transect Length:

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments
Trans. 1 @ 10.45m	log	10.54	12.0		D	likely A. rubra	w/in creek channel – S side, woodpecker holes in log

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

VEGETATION SURVEY FORMS

1 OF 4

Surveyor(s): J. RHEUBEN / N MAAS
Date: 7-10-18
Weather: 60s, CLOUDY

Buffer Zone ID: SOUTH
Transect No.: S2
Transect Length: 34.5m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	skunk cabbage		95	
1	renunculus repens		5	
2	lady fern		5	
2	trailing blackberry		5	
2	skunk cabbage		10	
2	pacific willao		10	
2	salmon berry		10	
3	giant horsetail		5	
3	skunk cabbage		10	
3	salmon berry		10	
3	reed canary grass		trace	
3	UNID3		trace	
4	skunk cabbage		50	
4	giant horsetail		5	
4	himalyan blackberry		10	
4	trailing blackberry		5	
5	skunk cabbage		25	
5	horsetail (giant)		5	
5	bracken fern		15	

VEGETATION SURVEY FORMS

2 OF 4

Surveyor(s): J RHEUBEN / N MAAS
Date: 7-10-18
Weather: 60°s, CLOUDY

Buffer Zone ID: SOUTH
Transect No.: S2
Transect Length: 34.5m

7.14 from S2a to flag

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)									Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
rosa pisocarpa	31.9 - 34.4										
glyceria	31.8 - 32.1										
hymalyanan blackberry	30.10 - 31.25	27.9 - 28.0	17.45 - 17.8	16.45 - 17.0	4.0 - 4.9						
reed canary grass	30.7 - 31.1	17.4 - 17.92	14.8 - 16.9	14.30 - 15.45	10.3 - 13.20						
trailing blackberry	30.75 - 31.1	27.25 - 27.5	25 - 24.85	21.7 - 21.8	20.9 - 21.3	10.55 - 11.25	7.3 - 10.40	5.1 - 5.3	0 - 4.3		
carex obnupta	30.6 - 31.4	29.6 - 30.2									
UN ID 2 (highbush cran)*	28.8 - 29.2	28.1 - 28.55	25.6 - 26.3								
salmon berry	28.25 - 28.4	23.70 - 23.8	22.45 - 22.92	~~18.8~~ 17.9 18.75 -	15.6 - 16.6	13.45 - 14.05	11.65 - 12.42	7.3 - 9.8	0 - 5.5		
lady fern	27.9 28.1										
pacific willow	26.70 - 27.0	24.0 - 25.7	22.45 - 23.5	20.05 - 20.45							
~~golden willow~~											
bracken fern	18.7 - 19.8	17.55 - 18.0	13.50 - 14.40								
giant horsetail	17.1 - 17.25	9.5 - 9.6									
Path	5.4 - 7.0										

VEGETATION SURVEY FORMS

3 OF 4

Surveyor(s): J. RHEUBEN/N MAAS
Date: 7-10-18
Weather: 60s, CLOUDY

Buffer Zone ID: SOUTH
Transect No.: S2
Transect Length: 34.5m

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm^2)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	
—									
NONE w/in belt									

JR 7-10-18

VEGETATION SURVEY FORMS

4 OF 4

Surveyor(s): J. RHEUBEN/N MAAS
Date: 7-10-18
Weather: 60s, CLOUDY

Buffer Zone ID: SOUTH
Transect No.: S2
Transect Length: 34.5m

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments
S2	Log	35m	27.5	1	D	A. rubra	

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

VEGETATION SURVEY FORMS

1 OF 4

Surveyor(s): J. Rheuben + N. Maas
Date: 7/12/18
Weather: sunny, 70s°F, no precip.

Buffer Zone ID: SOUTH EAST
Transect No.: SE1
Transect Length:

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	Reed canary grass		5	
2	No HERB STRATUM		0	
3	Salmon berry		5	
3	RCG		10	
3	oso berry		5	
4	reed canary grass		30	
4	him blackberry		10	
4	salmon berry		60	
	After ~ 23m slope + dense blackberry			
	restrict further sampling			

2 OF 4

Surveyor(s): J. Rheuben & N. Maas
Date: 7/12/18
Weather: sunny, 70s°F no precip.

Buffer Zone ID: South East
Transect No.: SE1
Transect Length:

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
him blackberry	0.0 - 1.15	1.50 - 1.75	2.90 - 3.36	15.10 - 15.30	16.1 -						
Salmon berry ⓞ	0.80 - 1.95	2.00 - 11.40	14.25 - 16.5								
Cretegus monogyna	1.30 - 1.45										
oso berry	10.3 - 10.6	12.45 - 12.55	13.4 - 13.65	14.05 - 14.55	15.60 - 16.20	16.30 - 16.85					
reed canary grass	10.7 - 14.15	16.25 - 17.75									
giant horsetail	17.25 - 17.35	17.80 - 18.0									
stinging nettle	18.8 - 19.1	20.10 - 23.1									

VEGETATION SURVEY FORMS

3 OF 4

Surveyor(s): J. Rheuben & N. Maas
Date: 7/12/18
Weather: sunny, 70s°F, no precip.

Buffer Zone ID: South East
Transect No.: SE1
Transect Length:

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm²)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	
none within belt, dense									
overstory present, alder									
mature osoberry									

VEGETATION SURVEY FORMS

4 OF 4

Surveyor(s): J. Rheuben + N. Maas
Date: 7/12/18
Weather: sunny, 70s°F, no precip.

Buffer Zone ID: South East
Transect No.: SE2
Transect Length:

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments
none within	belt						

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

VEGETATION SURVEY FORMS

1 OF 4

Surveyor(s): J. Rheuben
Date: 7/11/18
Weather: 70s, sunny

Buffer Zone ID: SE
Transect No.: SE2
Transect Length: 18.90m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	STING NETTLE		10	
1	him blackberry		90	
1	Trail blackberry		30	
2	Trail blackberry		85	
3	Trailing blackberry		40	
3	giant horsetail		5	
3	him blackberry		70	
3	stinging nettle		10	
4	stinging nettle		5	
4	trailing blackberry		10	
4	detritus		60	
	Rest of "buffer" extends SPAN off of highway			

2 OF 4

Surveyor(s): J. Rheuben
Date: 7/11/18
Weather: 70s, sunny

Buffer Zone ID: SE
Transect No.: SE2
Transect Length: 18.90 m

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
himblackberry	17.3 - 17.4	9.0 - 9.7									
trailing blackberry	4.9 - 5.5										
stinging nettle	4.9 5.3	3.3 - 3.3									

VEGETATION SURVEY FORMS

3 OF 4

Surveyor(s): J. Rheuben
Date: 7/11/18
Weather: Sunny, 70s

Buffer Zone ID: SE
Transect No.: SE2
Transect Length: 18.90m

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm²)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	
CRETAGUS MONOGYNA			19.5						

13.10

VEGETATION SURVEY FORMS

4 OF 4

Surveyor(s): J. Rheuben
Date: 7/11/18
Weather: Sunny, 70s

Buffer Zone ID: SE
Transect No.: SE2
Transect Length: 18.90m

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments
SE2@17.10	Log	7.5	6.3	3	D	ND	
SE2@10	Log	12	11.7	2	D	ND	
SE2@10.4	Log	6	9.7	2	D	ND	

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

1 OF 4

Surveyor(s): J. Shevben
Date: 7/11/18
Weather: 70s, sunny

Buffer Zone ID: SE
Transect No.: SE3
Transect Length: 19.85

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	him blackberry		5	
1	giant horsetail		10	
2	UNID SE3		20	
2	reed canary grass		10	
2	giant horsetail		trace	
3	giant horsetail		10	
4	not accesable due to dense blackberry		–	
"BUFFER" EXTENDS INTO ROAD				

2 OF 4

Surveyor(s): J. Rhouben.
Date: 7/11/18
Weather: 70s, sunny

Buffer Zone ID: SE
Transect No.: SE3
Transect Length: 19.85

Sapling/shrub stratum (line-intercept method)

Species	Line-intercept distance (cm)										Total interception distance (cm)
	1	2	3	4	5	6	7	8	9	10	
him blackberry	0 - 19.85										
giant horsetail	17.25 - 18.25	15.6 - 16.2	12.9 - 13.0	9.6 - 9.9	8.65 - 8.7						
reed canary grass	16.1 - 17.75										
UNID sez	16.8 - 16.9	13.8 - 14.6	10.3 - 11.0								
lady fern	10.7 - 11.75										
sword fern	10.5 - 11.2										

VEGETATION SURVEY FORMS

3 OF 4

Surveyor(s): J, Rheuben
Date: 7/11/18
Weather: 70s, sunny

Buffer Zone ID: SE
Transect No.: SE3
Transect Length: 19.85

Tree stratum (belt transect method)

Species	Indicator status	DBH (cm)							Total basal area (cm²)
		< 10	10-20	20-30	30-40	40-60	60-80	80-100	

VEGETATION SURVEY FORMS

4 OF 4

Surveyor(s): J. Rheuben
Date: 7/11/18
Weather: 70s, sunny

Buffer Zone ID: SE
Transect No.: SE3
Transect Length: 19.85

Large woody debris

Location (e.g., transect and plot no. or Marsh interior)	Type (log, stump or snag)	Length[1] (m)	Diameter at Midpoint[2] (cm)	Decay Class (1-5)	Wood Type (Conifer/ Deciduous)	Species	Comments

[1] Measure (and calculate) height if snag is standing

[2] Measure DBH for standing snag

INVERTEBRATE COLLECTION FORMS

Surveyor(s): N. Mars, J. Rueben
Date: 7/10/18 -
Weather: 60s, partly cloudy -> sunny

Fall-out trap collection

Buffer Zone	Transect	Sample ID	Replicate	Time Deploy	Date Deploy	TIME Retrieve	DATE Retrieve	Notes
(Wil. Cr.) South	S2	Fallout S2-1	1	1100	7/10/18	7/11/18	1300	GPS name S2FT
" "	S2	Fallout S2-2	2	1110	7/10/18	7/11/18	1319	↓
" "	S2	Fallout S2-3	3	1120	7/10/18	7/11/18	1310	
Shellabarger	SB1	SB1-1	1	0830	7.11.18	7/12/18	0845	GPS SB1FT
↓	SB1	↓ SB1-2	2	0840	7.11.18	7/12/18	0855	↓
	SB1	SB1-3	3	0850	7.11.18	7/12/18	0905	
SE	SE2	SE2-1	1	0930	↓	7/12/18	0955	GPS SE2FT
↓	SE2	↓ SE2-2	2	0935		↓	1000	↓
	SE2	SE2-3	3	0940			1002	
N	N1	N -1	1	1340	↓	07.12.18	1455	GPS N FT
↓	N2	↓ N -2	2	1345		↓	1500	↓
	N3	N -3	3	1350			1504	

INVERTEBRATE COLLECTION FORMS

Surveyor(s): N. MAAS, TTW
Date: 07.12.18
Weather: 80°, sunny

Invertebrate core collection

Sample ID	Replicate	Collection Time	Notes
seD4-1	1	1040	
seD4-2	2	1045	
seD4-3	3	1050	
seD3-1	1	1100	
seD3-2	2	1103	
seD3-3	3	1105	
SED 2-1	1	1335	
SED 2-2	2	1340	
SED 2-3	3	1345	
SED 1-1	1	1350	
SED 1-2	2	1352	
SED 1-3	3	1355	

INVERTEBRATE COLLECTION FORMS

Surveyor(s): J. Love
Date: 6·1·19 (last summer sample)

Invertebrate identification

Sample ID	Replicate	Taxonomy[1]	Notes
SBFT2	FT2	globular springtail	<1mm
		aphid	~2 mm, white
		diptera x~~787~~ 14	"eyelash" flies, 3-8 mm
		Crane fly x 1	~25 mm
		Coleopteran x 1	~2 mm, dark
		dipteran x6	"eyelash" flies, ~4-6mm
		" "	" ", ~ 2 mm
		dipteran, midge	~1 mm, tan
		dipteran, non-biting midge x 6	5-7 mm
		~~hymenopteran x 1~~ gz	
		termite (blattodean) x 1	winged, ~ 3mm
		dipteran (thick body) x 1	2-3 mm
		non-biting midge x ~~8~~ 16 gy	4-10 mm
		10 x dipteran [illegible]	"eyelash" flies, ~5 mm
		crane fly	~15 mm
		dipteran x 1	~12 mm, fat, striped, orange-brown
hemipteran –		Philaenus spumarius (meadow spittlebug)	– ~7mm – ID by M. Peterson
		spider	~6 mm, tan
		springtail x 1	~2 mm, not globular
		mosquito x 1	~5mm
		fly x 1	~5mm (diff. species?)
		fly x 1	~4 mm, long ovipositors
		non-biting midge x ~~8~~ gz 6	2-3 mm

[1] Identify to lowest taxon possible.

INVERTEBRATE COLLECTION FORMS

Surveyor(s): J. Love
Date: 6-1-19 (last summer sample)

Invertebrate identification

Sample ID	Replicate	Taxonomy[1] gd 6-1-19	Notes
SBFT2	FT2	non-biting midge x ~~3~~ 4	2-3 mm each, tan/gray, "beaded" antennae
(Shellabarger)		non-biting midge x2	6-7 mm, tan/brown stripes
		" " " x4	2-4 mm
		" " " x6	1-7 mm
		black fly x5	"eyelash" flies, ~5-6 mm
STET – springtail ~~termite~~		~~springtail~~ gd x ~~10~~ 2	~1 mm, not globular, elongated, wingless
		non-biting midge x ~~3~~ gd 5	2-3 mm
		fly (diff. species, no long proboscis)	x1, ~7 mm
		black flies x 7, "eyelash" flies,	red eyes, 4-8 mm, largest looks metallic
		non-biting midge x2	~10 mm, striped
		non-biting midge x ~~8~~ gd ~~8~~ 10	3-4 mm
		" " x ~~6~~ 2	~5 mm
		hymenopteran x1	long. segmented antennae, no stinger, waist-like constriction ~5mm, stigma on wings
		globular springtail x1	~1 mm, gray w/ black spots
		fly x2	looks crane-fly like, ~20mm
		non-biting midge x2	~7 mm
		" " x3	3-4 mm
		gastropod x2 (~5 + 15 mm)	v. young snails, shells just forming
		dipteran x1	~12 mm, diff. species, long abdomen, end curves up.
		non-biting midge x ~~9~~ gd 11	2-3 mm
	termite	~~globular springtail~~ ~~2~~ 2	~4 mm
		hemipteran x1	~3 mm, wing buds, piercing mouth
STET springtail ~~termite~~		gd ~~springtail~~ x1	~1-2 mm, not globular, wingless
		non-biting midge x2	~10 mm
		non-biting midge x3	~4-5 mm; one molting

[1] Identify to lowest taxon possible.

PHOTO POINT MONITORING FORM

DATE: 7/11/18, 7/10/18 **PHOTOGRAPHED BY:** T. Do, N. Maas, J. Love

Photo Station	Photo Station Location Description	Station Coordinate		Station Marker Type	Photo Orientation	Photo ID	Photo Numbers	Photo Time	Notes
		Northing^a	Easting^a						
A	Northern marsh interior, in intertidal mudflat area			PA Capped Rebar	N to 0°-360°	A1	5 photos	1050	
B	Western edge of marsh			PB Capped Rebar	90° E	B1		1040	PB on GPS, marker @
				↓	140° SE	B2		↓	utility pole
					210° S	B3			
C	Boardwalk lookout at west end of Edmonds Marsh Trail			NONE	220° SW	C1		1128	on center of boardwalk
				↓	178° S	C2		1128	lookout
					94° E	C3		1129	
D	Main Edmonds Marsh Trail boardwalk lookout at northernmost corner of marsh			NONE	220° SW	D1		1136	on center of boardwalk
				↓	178° S	D2		1138	lookout between signs
					144° SE	D3		1139	
E	Edmonds Marsh Trail boardwalk lookout west of Harbor Square Athletic Club			NONE	292° WNW	E1		1146	on center of boardwalk lookout
				↓	240° WSW	E2		1148	between signs (near tennis court)
F	Edmonds Marsh Trail boardwalk lookout south of Harbor Square Athletic Club			NONE	230° SW	F1		1155	on center of boardwalk lookout
				↓	145° SE	F2		1157	between signs (south of pool)
G	Along SR-104 east of Harbor Square Athletic Club			PG Capped Rebar	200° SSW	G1		1405	Hwy 104 to left of photo
H	Along SR-104 on west side of Shellabarger Marsh			PH Capped Rebar	30° NE	H1		1414	Hwy 104 to left, looking toward N buffer of Shellabarger, lined up w/ light pole across Hwy 104 on left.
I	Along SR-104 at Milepost 25			PI Capped Rebar	320° NW	I1		1425	Hwy 104 to right
				↓	270° W	I2		1427	At MP 25 sign, next to SE 3 transect
					180° S	I3		1429	Hwy 104 to left
J	Southern marsh interior, north of Willow Creek Hatchery			PJ Capped Rebar	N to 0°-360°	J1	8 photos	1030	7/10/18
K	Willow Creek, near hatchery			PK Capped Rebar	W - 270° N - 325° NE-70°	K1	3 photos	1015	7/10/18
L	Point Edwards overlook off Pine Drive.			NONE	34° NE	L1		1055	7/10/18 Lookout on Pine st. Stand
				↓	60° ENE	L2		↓	7/10/18 in between posts 6+7 on
					75° E	L3			7/10/18 middle concrete Slab
M	Point Edwards overlooking stormwater detention pond			NONE	284° W	M1		1105	7/10/18 Lower road, looking over stormwater detention pond. Stand at western most of 4 white posts at edge of road, begining of walking trail

Fall 2018

BIRD SURVEY FORM

Survey Location: BPC-1 (along Harbor Squ. boardwalk)
Surveyor(s): J. Love
Date: 10/23/18
Begin Time: 09:03
End Time: 09:08

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear] clearing	partly-cloudy	overcast	[✓ fog]
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong
Notes: sun peaking through fog				

Human Activity (Please note any relevant human activity within survey area)

Notes: ~~little~~ ~~gt~~ activity on trail, airplane flying over
NO

Species	Seen	Heard	Fly-over	Notes
SOSP x2		✓		calling from cattails (1), 2 seen foraging in alder
BCCH x2		✓		calling
AMRO x2		✓		whinny
Gull		✓		
GCSP		✓		

*Sms sparrows back-and-forth between cattails and ~~[illegible]~~ buffer trees.

BIRD SURVEY FORM

Survey Location: BPC-2 (from Harbor Squ) (marsh Int.)
Surveyor(s): J. Love
Date: 10/23/18
Begin Time: 09:21
End Time: 09:26

Weather Conditions (circle relevant conditions)

sun breaking through fog

Visibility	[✓ clear]	partly-cloudy	overcast	[✓ fog]
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes:

Human Activity (Please note any relevant human activity within survey area)

Notes:

Dog barking, train passed just before survey started

* GBH heard just before survey started, RWBB heard just after survey ended.

Species	Seen	Heard	Fly-over	Notes
SOSP		1		
ANHU x2	✓	✓		foraging high in pine tree along creek
NOHA	✓			Harrier perched in snag
				@ W end of survey loc.
AMGO x3		✓		
5 ~~2~~ Gulls			✓	large, either Western or Glaucous-winged
One ANHU flying high and dive-bombing, other vocalizing				

juvenile harrier, orange-brown breast

BIRD SURVEY FORM

Survey Location: BPC-3 (marsh lookout. from Hatchery)

Surveyor(s): J. Love

Date: 10/23/18

Begin Time: 08:07

End Time: 08:12

Weather Conditions (circle relevant conditions)

Visibility	clear	partly-cloudy	overcast	[✓ fog]
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong

Notes: Hear traffic noise from SR-104

Human Activity (Please note any relevant human activity within survey area)

Notes:

Species	Seen	Heard	Fly-over	Notes
MAWR		✓		calling
AMRO		✓	✓	singing + calling + one fly-over
SOSP		✓		calling
ANHU		✓		
2x NOFL	✓			2 in tree across cattail patch to ne
2x ducks			✓	flying high NE→SW
DOWO		✓		downy wood.

BIRD SURVEY FORM

Survey Location: BPC-4 willow cr. Hatchery

Surveyor(s): J. Love

Date: 10/23/18

Begin Time: 07:54

End Time: 07:59

Weather Conditions (circle relevant conditions)

Visibility	clear	partly-cloudy	overcast	[✓ fog]
Precipitation	none	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong
Notes:				

- Drippy trees but not raining

Human Activity (Please note any relevant human activity within survey area)

Notes: Hear vehicle traffic from SR-104, Dog barking from highway

Species	Seen	Heard	Fly-over	Notes
AMRO		1		whinny
BCCH		11		2 heard
NOFL		1		"clear"
SOSP	1	1		Same individual seen & heard, giving alarm call throughout most of survey.

BIRD SURVEY FORM

Survey Location: BPC-5 (Shellabarger marsh perim.)

Surveyor(s): J. LOVE

Date: 10/23/18

Begin Time: 7:33

End Time: 7:38

Weather Conditions (circle relevant conditions)

Visibility	clear	partly-cloudy	overcast	[✓ fog]
Precipitation	[✓ none]	light rain	rain	snow
Wind	none	[✓ light]	moderate	strong

Notes: BPC marker missing - area recently mowed. Using 3-Hr parking sign as ℄ marker.

Human Activity (Please note any relevant human activity within survey area)

Notes: Hear vehicle traffic from SR-104. No vehicle or pedestrian traffic on side st. (2nd) during survey. One car pulled in immediately afterward.

Species	Seen	Heard	Fly-over	Notes
SOSP x2		✓		2 individs calling back-and-forth across 2nd (high, than call notes).
AMCR			✓	~~8~~ 7 birds flying E⇒W
Gull		✓		
Gull (western or Glaucous-wing.)			✓	3 birds flying W⇒E
2			✓	3 birds - small, flying high, poss. starlings
HOFI		✓		

WATER LEVEL/WATER QUALITY DATA COLLECTION FORM

Surveyor(s): A. Hawley, N. Maas **Weather:** ~ 50° sunny

Date: 10/18/18

Location ID: 8	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 1053	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 53.9 °F	**Conductivity:** 217.6 µS/cm
pH: YSI= 7.56 WW= 7.85	**Dissolved oxygen:** 92.9%
Additional observations/notes: Turb: YSI= 13 FNU WW= 1.4 NTU ORP: 242 mV Press: 766.3 mmHg TDS: 0.19 g/L Sal: 0.14 ppt	

Location ID: 6	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 1132	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 60.7°F	**Conductivity:** 424.5 µS/cm
pH: YSI= ~~7.2~~ new 6.94 WW=7.28	**Dissolved oxygen:** 6.7%
Additional observations/notes: Turb: YSI=16 WW=21 ORP: 148 mV Press: 766.4 mmHg TDS: 0.33 g/L Sal: 0.25 ppt	

Location ID: 5	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 1150	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 60.1 °F	**Conductivity:** 560 µS/cm
pH: YSI= 6.58 WW= 6.84	**Dissolved oxygen:** 3.4%
Additional observations/notes: Turb: YSI= 11.4 WW=4.9 ORP: 74.3 Press: 766.5 mmHg TDS: 0.44 g/L Sal: 0.33 ppt	

WATER LEVEL/WATER QUALITY DATA COLLECTION FORM

Surveyor(s): A. Hawley, N. Maas **Weather:** ~50°F Sunny

Date: 10/18/18

Location ID: 1	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 0905	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 51.3°F	**Conductivity:** 169.6 µS/cm
pH: YSI= 5.83 WW= 7.89	**Dissolved oxygen:** 98.8%
Additional observations/notes: Turbidity: YSI 12.7 FNU WW= 1.1 NTU Press: 766.1 mmHg ORP: 270.0 Salinity: 0.11 ppt TDS: 0.15 g/L	

Location ID: 2	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 0935	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 52.5°F	**Conductivity:** 171.6 µS/cm
pH: YSI= 6.41 WW =8.35	**Dissolved oxygen:** 99.6%
Additional observations/notes: Turb: YSI= 8.9 FNU WW=1.3 NTU ORP= 270.7 mV Press: 766.6 mmHg TDS: 0.15 g/L Sal: 0.11 ppt	

Location ID: 3	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 1010	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 51.4°F	**Conductivity:** 169.5 µS/cm
pH: YSI= 6.95 WW= 8.14	**Dissolved oxygen:** 94 %
Additional observations/notes: Turb: YSI= 40-120 WW= 3.2 ORP: 254 mV Press: 766.5 mmHg TDS: 0.15 g/L Sal: 0.11 ppt	

WATER LEVEL/WATER QUALITY DATA COLLECTION FORM

Surveyor(s): A. Hawley, N. Maas **Weather:** ~ 50° sunny

Date: 10/18/18

Location ID: 4	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 1200	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 59.4 °F	**Conductivity:** 5200 μS/cm
pH: YSI = 6.18 WW = 6.42	**Dissolved oxygen:** 91.5%
Additional observations/notes: Turb: YSI = 6.4 WW = 12 ORP: 241.2 mV TDS: 4.1 g/L	Press: 766.6 mmHg Sal: 3.38 ppt

Location ID: 7	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time: 1230	**Tidal elevation:**
Precipitation in last 48 hours: none	**Water level:**
Water Quality Observations	
Temperature: 54.3°F	**Conductivity:** 36,242 μS/cm
pH: YSI = 7.48 WW = 7.54	**Dissolved oxygen:**
Additional observations/notes: Turb: 21.1 WW = 12 ORP: 217.1 mV TDS: 31.04 g/L	Press: 766.6 Sal: 31.05 ppt

Location ID:	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample time:	**Tidal elevation:**
Precipitation in last 48 hours:	**Water level:**
Water Quality Observations	
Temperature:	**Conductivity:**
pH:	**Dissolved oxygen:**
Additional observations/notes:	

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. RHEUBEN, N. MAAS **Weather:** RAINY, 60s

Date: 10/5/18

Location ID: S16	
Latitude/Northing (Y): —	**Longitude/Easting (X):** —
Sample ID: S16_PROFILE	**Sample time:** 1055
Sampling method: SPADE	**Sample depth:** 20".

Profile Description

Depth (in.)	Matrix		Redox Features				Texture	Notes
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0-3	2.5Y 2.5/1	85					CLAY LOAM	WOODY DEBRIS, ROOTS, INVERTS
3-9	2.5Y 4/1	98 ~~100~~	5Y 2.5/1	2	D	PORE LINING	LOAM	ROOTS
9-20	5Y 5/1	65	5Y 3/1	35	RM	MATRIX	SANDY LOAM	TRACE SMALL GRAVEL
	~~5Y3/1~~	~~35~~	JR 10/5/18				~~SANDY LOAM~~	JR 10/5

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

[2] Location: PL – pore lining, M – matrix

Field Observations

Surface water present? (Y/[✓ N])	**Depth (inches):** —
Water table present? ([✓ Y]/N)	**Depth (inches):** 10"
Saturation present? ([✓ Y]/N)	**Depth (inches):** 9"
Wetland hydrology present? (Y/N):	

Additional observations/notes:

BULK DENSITY 1658g wet for 12" CORE TUBE

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. RHEUBEN, N. MAAS **Weather:** 60s RAIN

Date: 10/5/18

Location ID: SE36

Latitude/Northing (Y): —	**Longitude/Easting (X):** —
Sample ID: SE36_PROFILE	**Sample time:** 1022
Sampling method: SPADE	**Sample depth:** 20 in

Profile Description

Depth (in.)	Matrix		Redox Features				Texture	Notes
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0-5	7.5 YR 2.5/1	95					SANDY LOAM	INVERTS, WOODY DEBRIS
5-11	7.5 YR 3/1	100					SANDY LOAM	NO GRAVEL, WOODY DEBRIS PRESENT
11-20	7.5 YR 3/3	65					LOAMY SAND	
	10 YR 3/4	35					LOAMY SAND	

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

[2] Location: PL – pore lining, M – matrix

Field Observations

Surface water present? (Y/[✓ N])	**Depth (inches):** NA
Water table present? (Y/[✓ N])	**Depth (inches):** NA
Saturation present? (Y/[✓ N])	**Depth (inches):** NA
Wetland hydrology present? (Y/[✓ N]):	

Additional observations/notes:

BULK DENSITY
w/w – 1528g for 12" CORE TUBE

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. RHEUBEN, N. MAAS **Weather:** 60s, MISTING
Date: 10/5/18

Location ID: SHELLABARGER MARSH	
Latitude/Northing (Y): —	**Longitude/Easting (X):** —
Sample ID: SHELLABARGER_PROFILE	**Sample time:** 0950
Sampling method: SPADE	**Sample depth:** 20"

Profile Description

Depth (in.)	Matrix		Redox Features				Texture	Notes
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0-3	5Y2.5/2	100	—	—	—	—	SILTY CLAY LOAM	WOODY DEBRIS, SAPIC-SOMEWHAT SLIPPERY MUCKY MINERAL SOIL
3-5	10YR2/1	100	—	—	—	—	CLAY LOAM	GRAVEL PRESENT, SMALL GRAVEL TO COBBLESIZE
5-20	2.5Y4/1	70	—	—	—	—	LOAMY SAND	30% UNCONSOLIDATED GRAVEL

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains
[2] Location: PL – pore lining, M – matrix

Field Observations

Surface water present? (Y/[✓ N])	**Depth (inches):** NA
Water table present? ([✓ Y]/N)	**Depth (inches):** 4in @ 30 mins
Saturation present? ([✓ Y]/N)	**Depth (inches):** 4in
Wetland hydrology present? (Y/[✓ N]):	

Additional observations/notes:

BULK DENSITY 1398gm for 12" CORE TUBE

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. RHEUDEN , N MAAS **Weather:** CLOUDY, RAIN 60s

Date: 10/5/18

Location ID: N1b

Latitude/Northing (Y): ~~NA~~ JR 10/5/18	**Longitude/Easting (X):** —
Sample ID: N1b_PROFILE	**Sample time:** 0920
Sampling method: SPADE	**Sample depth:** 20"

Profile Description

Depth (in.)	Matrix		Redox Features				Texture	Notes
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0-10	10YR 2/2	90					SILT LOAM	DENSE ROOT MAT 10% ROOTMATT
10-20	2.5 Y4/1	50					SANDY LOAM	–
	2.5Y3/1	50					SANDY LOAM	–

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

[2] Location: PL – pore lining, M – matrix

Field Observations

Surface water present? (Y/[✓ N])	**Depth (inches):**
Water table present? ([✓ Y]/N)	**Depth (inches):** 7" @ 30 min
Saturation present? ([✓ Y]/N)	**Depth (inches):** 6"
Wetland hydrology present? ([✓ Y]/N):	

Additional observations/notes: SULFUR SMELL @ DEPTH ~ >10 in in profile

BULK DENSITY – 1340g for 12in CORE

A2 -

A4

MARSH SEDIMENT OLLECTION FORM

Surveyor(s): J RHEUBEN

Weather: 50 s CLOUDY

Date: OCT 5

Location ID: SED 1

Latitude/Northing (Y):

Longitude/Easting (X):

Sample ID: SED 1 PROFILE

Sample time: 0833

Sampling method:

Sample depth (in.): 9 IN

Profile Description

Depth (in.)	Color	Other characteristics
0-2	5 Y 2.5/1 - 100%	FINE TOP LAYER UNCONSOLIDATED SILT - 100%
2-9 IN	2.5 Y 4/3 - 75% 25% ROOTMAT	ORGANIC MATTER CLAYEY

Additional observations/notes:

MARSH SEDIMENT COLLECTION FORM

Surveyor(s): J RHEUBEN

Weather: 50s + CLOUDY

Date: OCT 5, 2018

Location ID: SED ~~8~~ 2 JR 10/5/18	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample ID: SED 3_PROFILE	**Sample time:** 0822
Sampling method:	**Sample depth (in.):** 6 IN

Profile Description

Depth (in.)	Color	Other characteristics
0-0.5	10 YR 2/1 - MATRIX 100	FLUFFY ORGANIC LAYER UNCONSOLIDATED ORGANIC/SLIPPERY TRACE SILT
0.5-2	10 YR 3/2 -MATRIX 75% ROOTMASS-25%	SILT, MORE ROOTMAT, NO PORELININGS
2-6	MATRIX 5 Y 4/1 95% ROOTMASS 5%	SILT, ROOT, PORELINE PRESENT

Additional observations/notes:

MARSH SEDIMENT COLLECTION FORM

Surveyor(s): JRHEUBEN, N MAAS **Weather:** 50s, CLOUDY

Date: OCT 5, 18

Location ID: SED 3

Latitude/Northing (Y): **Longitude/Easting (X):**

Sample ID: SED 3 _ PROFILE **Sample time:** 08 : 10

Sampling method: SPADE **Sample depth (in.):** 7 IN

Profile Description

Depth (in.)	Color	Other characteristics
0 - 3.5	10 YR 3/3 - MATRIX 75% 25% ORGANIC DETRITUS	DENSE ROOT MAT, SLIPPERY HISTIC, NO PORELINEING TEXTURE, FEATURES
3.5 - 7	2.5 Y 3/1 - MATRIX - 90% 5Y 2.5/1 - PORELINEINGS 10%	LESS ROOT MAT SILT

Additional observations/notes:

MARSH SEDIMENT COLLECTION FORM

Surveyor(s): J. RHEUBEN, N MAAS **Weather:** 50s, OVERCAST

Date: OCT 5 2018

Location ID: SED 4

Latitude/Northing (Y):

Longitude/Easting (X):

Sample ID: SED 4 — PROFILE

Sample time: 0755

Sampling method:

Sample depth (in.): 8 IN

Profile Description

Depth (in.)	Color	Other characteristics
0 - 1	2.5YR 3/2	ORGANIC, dense root mat, SLIPPERY, MACROPORES
1 - 4 ↕	5Y 4/1	SILTY-CLAY ORGANIC MATTER
4 - 8	↓	↓

Additional observations/notes:

PHOTO POINT MONITORING FORM

DATE: 10/5/18 **PHOTOGRAPHED BY:** T. Do

		Station Coordinate							
Photo Station	**Photo Station Location Description**	**Northing^a**	**Easting^a**	**Station Marker Type**	**Photo Orientation**	**Photo ID**	**Photo Numbers**	**Photo Time**	**Notes**
A	Northern marsh interior, in intertidal mudflat area			PA Capped Rebar	N 0°-360°	A1	5 photos	0838	
B	Western edge of marsh			PB capped Rebar	90°E	B1		0800	
				↓	140° SE	B2		0800	
					210° S	B3		0800	
C	Boardwalk lookout at west end of Edmonds Marsh Trail			NONE	220° SW	C1		0903	
				↓	178°S	C2		↓	
					94°E	C3			
D	Main Edmonds Marsh Trail boardwalk lookout at northernmost corner of marsh			NONE	220° SW	D1		0908	
				↓	178° S	D2		↓	
					144°SE	D3			
E	Edmonds Marsh Trail boardwalk lookout west of Harbor Square Athletic Club			NONE	292° WNW	E1		0913	
				↓	240° WSW	E2		↓	
F	Edmonds Marsh Trail boardwalk lookout south of Harbor Square Athletic Club			NONE	230° SW	F1		0918	
				↓	145° SE	F2		↓	
G	Along SR-104 east of Harbor Square Athletic Club			PG Capped Rebar	200° SSW	G1		0930	
H	Along SR-104 on west side of Shellabarger Marsh			PH Capped Rebar	30° NE	H1		0934	
I	Along SR-104 at Milepost 25			PI Capped Rebar	320° NW	I1		0940	
				↓	270°W	I2		↓	
					180°S	I3			
J	Southern marsh interior, north of Willow Creek Hatchery			PJ Capped Rebar	N 0°-360°	J1	8 photos	1040	
K	Willow Creek, near hatchery			PK capped Rebar	270° W, 325° N, 70° NE	K1	3 photos	1024	
L	Point Edwards overlook off Pine Drive			NONE	34°NE	L1		1120	
				↓	60° ENE	L2		↓	
					75° E	L3			
M	Point Edwards overlooking stormwater detention pond			None	284°W	M1		1125	

Winter 2019

BIRD SURVEY FORM

Survey Location: BPC-1 (along Harbor Squ. boardwalk) **Date:** 01/28/19

Surveyor(s): J. Love **Begin Time:** 08:05

End Time: 08:10

Weather Conditions (circle relevant conditions)

Visibility	clear	partly-cloudy	overcast	[✓ fog] slight fog, lifting
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: 37° F, starting to see clear sky

Saw 2 SPTO + one GCKI just before starting formal point count. GCKI was foraging in alder adj. to viewing platform. SPTOs were perched in shrubs adj. to cattail patch.

Human Activity (Please note any relevant human activity within survey area)

Notes:

ferry horn blasted a few times throughot survey.

Species	Seen	Heard	Fly-over	Notes
ANHU		✓		
SOSP		✓		
~~AROBY~~ AMRO (2)	✓	✓		singing + calling
MAWR		✓		
RWBB		✓		
GCSP		✓		
YRWA	✓	✓		female

BIRD SURVEY FORM

Survey Location: BPC-2 (Willow Cr-Marsh Int.)
Date: 01/28/19
Surveyor(s): J. Love
Begin Time: 08:30
End Time: 08:35

Weather Conditions (circle relevant conditions)

visibility 250 m

Visibility	clear	partly-cloudy	overcast	[✓ fog]
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: 37°F
Heard RWBB singing from Unocal side of creek just before formal point count began. Also observed an add. GBH; the pair flew in from SW to perch in pine tree growing along Willow Cr. approx. 80' W of point count marker

Note: Observed 3rd GBH while walking away from station.

Human Activity (Please note any relevant human activity within survey area)

Notes: Dogs barking in distance, noisy work on RR tracks, excavator, etc. can hear traffic of SR-104

Species	Seen	Heard	Fly-over	Notes
SOSP		✓		singing
GBH	✓			in tree adj. to creek
BEWR (2)		✓		from Unocal side of creek
GCSP		✓		(one singing, one calling)
AMCR	✓		✓	

Windward environmental LLC

DRAFT

BIRD SURVEY FORM

Survey Location: BPC-3 (marsh int. from Hatchery)
Surveyor(s): J. Love
Date: 01/28/19
Begin Time: 09:25
End Time: 09:30

Weather Conditions (circle relevant conditions) thin high clouds, now mostly sunny

Visibility	[✓ clear]	partly-cloudy	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: 37°F
SR-104 traffic noise, ~~ferry~~ boat horn blasts in distance.

Human Activity (Please note any relevant human activity within survey area)

Notes: Creek flow E→W right through marked location.
Old bushtit nest hanging off bittersweet nightshade on scrubby alder.
Observed small flock ~8-10 birds of pine siskins in riparian veg. along willow creek just after formal count ended. Also hear Virginia rail grunt calls.

Species	Seen	Heard	Fly-over	Notes
GCSP (8)	✓			eating bitter. nightshade berries, small flock foraging on berries
MAWR (2)		✓		
SOSP (2)		✓		
RWBB		✓		
BCCH (3-4)		✓		
RCKI	✓			male, flashing red crown

BIRD SURVEY FORM

Survey Location: BPC-4 (Hatchery, woods)
Date: 01/28/19
Surveyor(s): J. Love
Begin Time: 09:08
End Time: 09:12

Weather Conditions (circle relevant conditions)

high clouds, some sun breaks

Visibility	clear	[✓ partly-cloudy]	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: Shrubs beginning to bud out - spring?! 37°F
Observed varied thrush in riparian zone along creek just after leaving BPC-4.

Human Activity (Please note any relevant human activity within survey area)

Notes: Traffic noise from SR-104, holding pond outflow loud

Species	Seen	Heard	Fly-over	Notes
BCCH		✓		
SOSP (2)		✓		singing, one close by, one further out
AMCR (3)	✓	✓	✓	
AMRO		✓		
GCKI		✓		

BIRD SURVEY FORM

Survey Location: BPC-5 (Shellabarger Marsh)
Surveyor(s): J. Love
Date: 01/28/19
Begin Time: 07:47
End Time: 07:51

Weather Conditions (circle relevant conditions)

Visibility	clear	partly-cloudy	overcast	[✓ fog]
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong
Notes:				

slight fog, visibility 750m

Human Activity (Please note any relevant human activity within survey area)

Notes: Point count marker gone. Use 3-hr parking sign @ E end of tree line.

Species	Seen	Heard	Fly-over	Notes
ANHU (2)	✓	✓		front yard of neighboring home
AMCR		✓		
DEJU		✓		
RWBB (2)		✓		w/in Marsh int., singing
AMRO (2-3)		✓		calling
SOSP		✓		
SPTO				
WCSP	✓			flock of 6 on berry-bearing shrub in neighbor's yard
SPTO		✓ - calling/mewing		

1 of 3

WATER LEVEL/WATER QUALITY DATA COLLECTION FORM

Surveyor(s): A. Hawley, J. Love
Weather: mid-upper 40s°F, light rain
Date: 1/17/2019

Location ID: 1	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 14:08	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 48.5°F	**Conductivity:** 155.1 µS/cm
pH: 7.02	**Dissolved oxygen:** 96.8%, 11.14 mg/L
Additional observations/notes: pressure = 749.3 mmHg sp. cond. = 222.5 µs/cm TDS = 0.14 g/L sal. = 0.11 ppt ORP = 229.1 mV turb = 0.2 FNU turb (Hatch) = 2.2 NTU water depth = 14 cm	

Location ID: 2	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 14:21	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 48.4°F	**Conductivity:** 155.1 µs/cm
pH: 7.13	**Dissolved oxygen:** 95.9%, 11.04 mg/L
Additional observations/notes: pressure = 749.8 mmHg sp. cond. = 222.7 µs/cm TDS = 0.14 g/L sal. = 0.11 ppt ORP = 217.7 mV (stable) turb = 0.9 FNU turb (Hatch) = 2.3 NTU water depth = 23 cm	

Location ID: 3	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 14:36	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 48.2°F	**Conductivity:** 153.5 µS/cm
pH: 7.12	**Dissolved oxygen:** 85.7%, 9.90 mg/L
Additional observations/notes: pressure = 750 mmHg sp. cond. = 221.0 µS/cm TDS = 0.14 g/L sal. = 0.11 ppt ORP = 205.5 mV turb. = -1.3 FNU and decreasing turb. (Hatch) = 17.6 NTU water depth = 4.5 cm See field book for notes on vegetation and flow	

2 of 3

WATER LEVEL/WATER QUALITY DATA COLLECTION FORM

Surveyor(s): J. Love, A. Hawley
Date: 1/17/2019
Weather: mid-upper 40s°F, light rain

Location ID: 3B	
Latitude/Northing (Y): 47.80489°N	**Longitude/Easting (X):** 122.38498°W
Sample time: 14:49	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 48.8°F	**Conductivity:** 155.8 µS/cm
pH: 7.02	**Dissolved oxygen:** 90.0%, 10.31 mg/L
Additional observations/notes: sal = 0.11 ppt pressure = 750.2 mmHg sp. cond. = 222.2 µS/cm TDS = 0.14 g/L ORP = 204.9 mV turb = -4.6 FNU turb (Hatch) = 13.5 NTU	water depth = 8.5cm see field book for additional notes on ~~flow~~ AH, location, and vegetation.

Location ID: 8	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 15:28	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 48.8°F	**Conductivity:** 185.6 µS/cm
pH: 7.32	**Dissolved oxygen:** 85.4%, 9.78 mg/L
Additional observations/notes: sal. = 0.13 ppt pressure = 750.3 mmHg sp. cond. = 264.7 µS/cm TDS = 0.17 g/L ORP = 176.9 mV turb = 0.6 FNU turb (Hatch) = 2.2 NTU	water depth = 31 cm see field book for flow and vegetation observations.

Location ID: 5	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 15:54	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 46.9°F	**Conductivity:** 464.8 µS/cm
pH: 6.55	**Dissolved oxygen:** 42.4%, 4.97 mg/L
Additional observations/notes: sal. = 0.33 ppt pressure = 750.8 mmHg sp. cond. = 682 µS/cm TDS = 0.44 g/L ORP = 154.2 mV turb = 5.3 FNU turb (Hatch) = 13.8 NTU	water depth = 62 cm

WATER LEVEL/WATER QUALITY DATA COLLECTION FORM

Surveyor(s): J. Love, A. Hawley **Weather:** mid-upper 40s° F, light rain
Date: 1/17/2019

Location ID: 4	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 16:06	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 46.1 °F	**Conductivity:** 276.7 µS/cm
pH: 6.80	**Dissolved oxygen:** 82.2%, 9.76 mg/L
Additional observations/notes: sal. = 0.20 ppt pressure = 751.0 mmHg sp. cond. = 411.3 µS/cm TDS = 0.27 g/L ORP = 174.9 mV turb = 2.1 FNU turb (Hatch) = 5.7 NTU	water depth = 36 cm see field book for observations on flow

Location ID: 6	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 16:17	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 45.8 °F	**Conductivity:** 319.5 µS/cm
pH: 6.76	**Dissolved oxygen:** 46.8%, 5.57 mg/L
Additional observations/notes: sal. = 0.23 ppt pressure = 751.0 mmHg sp. cond. = 477.5 µS/cm TDS = 0.31 g/L ORP = 172.0 mV turb = 1.3 FNU turb (Hatch) = 6.6 NTU	water depth = 41 cm

Location ID: 7	
Latitude/Northing (Y): nm	**Longitude/Easting (X):** nm
Sample time: 16:34	**Tidal elevation:**
Precipitation in last 48 hours: <0.1 in	**Water level:**
Water Quality Observations	
Temperature: 46.7 °F	**Conductivity:** 239.8 µS/cm
pH: 7.06	**Dissolved oxygen:** 87.4%, 10.28 mg/L
Additional observations/notes: sal. = 0.17 ppt pressure = 751.4 mmHg sp. cond. = 353.9 µS/cm TDS = 0.23 g/L ORP = 174.8 mV turb = 0.3 FNU and fluctuating turb (Hatch) = 9.3 NTU	water depth = 44 cm

Date: 1/16/19 Photographed by: Thai Do

Photo Station	Photo Station Location Description	Station Coordinate		Station Marker Type	Photo Orientation	Photo ID	Photo Numbers	Photo Time	Notes
		Northing[a]	Easting[a]						
A	Northern marsh interior, in intertidal mudflat area			PA- Capped Rebar		A1	5 photos	0821	
B	Western edge of marsh			PB- Capped Rebar		B1		0846	
				↓		B2		0846	
						B3		0846	
C	Boardwalk lookout at west end of Edmonds Marsh Trail			None		C1		0850	
				↓		C2		↓	
						C3			
D	Main Edmonds Marsh Trail boardwalk lookout at northernmost corner of marsh			None		D1		0900	
				↓		D2		↓	
						D3			
E	Edmonds Marsh Trail boardwalk lookout west of Harbor Square Athletic Club			None		E1		0902	
				↓		E2		↓	
F	Edmonds Marsh Trail boardwalk lookout south of Harbor Square Athletic Club			None		F1		0905	
				↓		F2		↓	
G	Along SR-104 east of Harbor Square Athletic Club			PG- Capped rebar		G1		0910	
H	Along SR-104 on west side of Shellabarger Marsh			PH- Capped Rebar		H1		0912	
I	Along SR-104 at Milepost 25			PI- Capped rebar		I1		0915	
				↓		I2		↓	
						I3			
J	Southern marsh interior, north of Willow Creek Hatchery			PJ - Capped rebar		J1	8 photos	0935	
K	Willow Creek, near hatchery			PK - Capped rebar		K1	3 photos	0930	
L	Point Edwards overlook off Pine Drive.			None		L1		0950	
				↓		L2/L3		↓	
M	Point Edwards overlook stormwater detention pond			None		M1		0958	

Spring 2019

BIRD SURVEY FORM

(BPC-5)

Survey Location: Shellabarger Marsh
Surveyor(s): J. Love

Date: 5/7/19
Begin Time: 05:50
End Time: 05:55

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear]	partly-cloudy	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: 50°F. Sunrise @ 05:41. Spotted towee observed in buffer veg. just before starting survey.

Human Activity (Please note any relevant human activity within survey area)

Notes: none other than traffic noise; train noise just before starting survey.

Species	Seen	Heard	Fly-over	Notes
MAWR		✓		approx. 3-4 birds from marsh int
WCSP		✓		1 - from Marsh
RWBB		✓		approx. 2 individs. from Marsh
~~COYT~~ JL		~~✓~~		~~1 - from buffer~~ JL
AMRO	✓			3 flying from NE toward marsh
SPTO		✓		from neighboring yard
HOFI		✓		1. from Pine St. end veg.
ANHU		✓		1
WIWA (wilson?)		✓		from N buffer zone
AMCR (crow)			✓	one flying over buffer into marsh

BIRD SURVEY FORM

(BPC-1)

Survey Location: Harbor Sq - n Buffer Zone **Date:** 05/07/19
Surveyor(s): J. Love **Begin Time:** 06:08
End Time: 06:13

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear]	partly-cloudy	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong
Notes:	50°F Sunrise @ 05:41 Hear CA geese honking in distance.			

Human Activity (Please note any relevant human activity within survey area)

Notes: Tram passes blowing horn during survey

Species	Seen	Heard	Fly-over	Notes
COYT		✓		1
BCCH	✓	✓		entering small snag nesting cavity (willow) w/in buffer
AMRO		✓		
RWBB		✓		
MAWR		✓		2-3 individs.
BEWR	✓			In same willow as chick cav.
SPTO		✓		in buffer zone closer to buildings
ANHU		✓		
GCSP		✓		

BIRD SURVEY FORM

(BPC-2)

Survey Location: Marsh Int. from H.S.
Surveyor(s): J. Love

Date: 05/07/19
Begin Time: 06:25
End Time: 06:30

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear]	partly-cloudy	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: 50°F
Red-tailed hawk seen + heard on way to point count station - being chased by crow near/toward Hatchery. Flushed several pairs of mallards from intertidal slough areas - male mallard also observed in creek.

Human Activity (Please note any relevant human activity within survey area)

Notes: None. Creek high - tide high.

*marsh veg. just starting to re-emerge, part. Bracken fern, distichlis + silverweed. Appears to be some iris emerging from bulrush patch near creek @ BPC-2. One small piece wood debris on N side of creek channel, ~5' long, ~10'' DBH, mod. decayed

Species	Seen	Heard	Fly-over	Notes
AMCR	✓	✓		in pine along creek - scolding me
COYT		✓		1
MAWR		✓		2-3 indivds.
RWBB	✓	✓		in pine tree then fly up to Unreal-
RWBB	✓	✓		3-4 add birds (fmale) also scolding me
TRSW	✓		✓	3 - flying over marsh
SOSP	✓			hopping along wood in creek (one pair in nearby cattails
SPTO	✓	✓		perched in pine snag @ creek
ANHU	✓			perched where towhee was
BAEA			✓	

In marsh mudflat areas, ~7 pairs of mallards, marsh full (tide up)

BIRD SURVEY FORM

Survey Location: Willow Cr. Hatch. (BPC-4)
Date: 05/07/19
Surveyor(s): J. Love
Begin Time: 04:55
End Time: 07:00

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear]	partly-cloudy	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: Red-tailed hawk cry just before survey started.

Human Activity (Please note any relevant human activity within survey area)

Notes: SR-104 traffic noise, pond discharging. No other people present.

Species	Seen	Heard	Fly-over	Notes
SOSP		✓		~~2~~ 3 ~~2~~ indvds – two ~~one~~ singing, one calling
AMEO		✓		1
OOWO		✓		

BIRD SURVEY FORM

(BP C-3)

Survey Location: Marsh Int. from Hatchery
Surveyor(s): J. Love
Date: 05/07/19
Begin Time: 07:10
End Time: 07:15

Weather Conditions (circle relevant conditions)

Visibility	[✓ clear]	partly-cloudy	overcast	fog
Precipitation	[✓ none]	light rain	rain	snow
Wind	[✓ none]	light	moderate	strong

Notes: 50 °F
sunrise @ 05:41
Red-breasted nuthatch from riparian just after survey ended.
Common yellowthroat seen in willows to W of station marker just after survey ended.

Human Activity (Please note any relevant human activity within survey area)

Notes: Traffic along SR-104, train whistle

Veg notes: In add. to nightshade, lots of nettle, bedstraw, & bracken fern coming up in this area extending W along creek & into marsh.

• Sample of Hooker's willow collected from along stream in this area

Species	Seen	Heard	Fly-over	Notes
MAWR		✓		3 ~~2~~ males
SOSP		✓		2 "
AMRO		✓		1
RWBB		✓		1
BCCH		✓		2
AMCR	✓	✓		~~1 02~~ 3

in willow patch in marsh
Hear common yellowthroat in marsh from here.
Also RWBB, BEWR, ANHU

VEGETATION SURVEY FORMS

1 OF 1

Surveyor(s): J. Rheuben + J. Love
Date: 4/16/19
Weather: cloudy, dry, 50s °F

Buffer Zone ID: North
Transect No.: N1
Transect Length: 10.9 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	water parsley		100%	
1	twinberry		1% - trace	
2	giant horsetail		50%	
2	morning glory		1% - trace	
2	black thorn. "sapling"		15%	
2	Him. BB		2%	
2	gallium / bedstraw		1% - trace	
3	gallium / bedstraw		50%	
3	field horsetail		15%	
3	~~twinberry~~ @2			
3	lawn grass		5%	
3	note: lots of leaf litter.			

@ 10.9 m
@ 5.9 m
@ 0.9 m

PLOT 1 JR 2/4/68/0
JC 5/5/65/0

PLOT 2 JR 6/0/6/2
JL 8/0/7/0
PLOT 3
JR 36/0/0/9
JL 56/0/0/25

JR 4/16/19

note: new plantings throughout transect

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VEGETATION SURVEY FORMS

1 OF 1

Surveyor(s): JR JL
Date: 4.16.19
Weather: 60s OVERCAST

Buffer Zone ID: NORTH
Transect No.: N2
Transect Length: UNK-

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	MORNING GLORY		TRACE	
1	Dead TYPHA SP		100 %	
	Note: most of transect only contains Him. BB+ Cattail patches			

Jenny
4/16/19

PLOT #1
JR 85 18 96 69
JL 80 82 96 90

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VEGETATION SURVEY FORMS

1 OF 1

note: willow growing here is Hooker's willow.

Surveyor(s): J. Rheuben + J. Love
Date: 4/16/19
Weather: cloudy, dry, 50s °F

Buffer Zone ID: north
Transect No.: n3
Transect Length: 14.6 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	epilobium species		5%	
1	field horsetail		1% - trace	
1	almost all ground covered in muck + shallow standing H2O			
2	LADY FERN		5 %	
2	FIELD HORSETAIL		TRACE	
2	EPILOBIUM SP		5 %	
3	English ivy		5%	
3	giant horsetail		1% - trace	
3	note: most of plot occupied by leaning willow / LWD + leaf litter			

@ 14.6

@ 9.6

@ 4.6

Jenny Love 4/16/19

Densiometer

Plot 1
JR - 0/0/0/0
JL 0/0/0/0

PLOT 2
JL: 2/4/2/0
JR: 2/6/1/3

PLOT 3
JL - 18/0/12/3
JR - 5/6/1/0

1 OF 1

Surveyor(s): J. Rheuben + J. Love
Date: 4/16/19
Weather: cloudy, dry, 50s °F

Buffer Zone ID: n
Transect No.: 4
Transect Length: 7.9 m

*Fallout traps @ end of this transect

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	water parsley		5%	
1	Pacific willow		trace	
1	Note: most of ground (~100%) covered w/ standing H_2O, muck)			
2	sword fern		90%	
2	gallium (bedstraw)		5%	
2	black hornberry (likely) - newly installed + w/o much living leaf tissue present		1% - trace	
2	morning glory		1% - trace	
2	Him. BB		1% - trace	

JR 4/16/19

①7 9m

②2.9m

Dens.

PLOT 1
JR 2/1/0/1
JL 0/1/0/0
PLOT 2
JR 6/0/2/1
JL 5/0/0/0

VEGETATION SURVEY FORMS

1 OF 1

Surveyor(s): J RHEUBEN

Date: 4-15-19

Weather: 60s Sunny

Buffer Zone ID: SE

Transect No.: SE 1

Transect Length: 36.60 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	SALMON BERRY		10	
1	common hawthorn		5%	
2	Salmon Berry		5%	
3	Salmon berry		25	
3	OSOBERRY		TRACE	
3	RCG		TRACE	
4	Salmonberry		~~TRACE~~ JR 4/15 15	
4	RCG		TRACE	
4	OSOBERRY		15	
5	BLACKBERRY		55	
5	STINGNETTLE		10	
5	FIELD HORSETAIL		TRACE	

JR 4/15/19

PLOT #1 N/E/S/W
@36.5 JL-26/24/4/2
JR-2/8/0/0

@31.5 PLOT #2
@26.5 JL-6/2/5/2
JR-2/4/4/4

PLOT #3
@21.5 JL-6/6/3/0
JR-8/2/2/8

PLOT #4
@16.5 JL-6/10/5/3
@11.5 JR-1/4/4/2

PLOT #5
JL-6/32/0/4
JR-2/25/0/3

~~PLOT #6~~ NR
~~JL-~~ JR
~~JR-~~ 4.16.19

note- herb plots flagged to take future densiometer readings w/Jenny

DRAFT

notes about general vicinity of transect: salmonberry + osoberry dom. understory in lower portion (downhill + to fence). Him BB dom. in understory along hillslope to SR-104. Canopy dom. by alder. RCG + some nettle groundcover

VEGETATION SURVEY FORMS

1 OF 1

Surveyor(s): J. Rheuben & J. Love
Date: 4/15/19
Weather: Sunny, 50's F

Buffer Zone ID: SE
Transect No.: 2
Transect Length: 18.6 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	Him BB		30%	
1	trailing BB		5%	
1	note: lots of leaf litter / bare ground			
2	Him BB		15%	@ 13.6 m
2	trailing BB		5%	
2	English hawthorn (suckers)		5%	
2	note: lots of leaf litter / bare ground			
3	trailing BB		~~8%~~ 7%	@ 8.6 m
3	Him. BB		5%	
3	also lots of leaf litter / bare ground here			
4	trailing BB		5%	@ 3.6 m
4	Himalayan BB		25%	
4	stinging nettle		1% - trace	

JL 4.15.19

@ 18.6 m
* fallout traps here

PLOT 1 JR 8/12/28/8
JL 5/10/68/9 (28)

PLOT 2 | JR 0/12/40/2
JL 2/18/88/12

PLOT 3 JR 5/7/4/4
JL 6/61/89/2

Plot 4
JR 20/80/52/2
JL 14/80/48/8

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VEGETATION SURVEY FORMS

1 OF 1

Surveyor(s): J. Rheuben & J. Love
Date: 4.15.19
Weather: partly cloudy / high overcast, 50s °F

Buffer Zone ID: SE
Transect No.: 3
Transect Length: 19.6 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	Him BB		15%	
1	giant horsetail		1% - trace	
2	Him BB		10%	
2	field horsetail		1%	
2	osoberry		15%	
2	reed canarygrass		1% - trace	
3	Him. BB		60%	@ 9.6 m
3	stinging nettle		15%	
4	not accessible due to dense BB - only			@ 4.6 m
	other species present in herb. layer			
	is stinging nettle @ ~ 1% (trace)			

JR 4-15-19

@ 19.6 m

@ 14.6 m

Densiometer

Plot 1:
JR - 48/21/16/11
JL - 70/0/6/26

PLOT 2 - JR 52/52/0/16
JL 58/27/5/17

Plot 3
JR - 42/24/2/12
JL - 84/85/10/0

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VEGETATION SURVEY FORMS

1 OF 2

Surveyor(s): J. Rheuben & J. Love
Date: 4/15/19
Weather: overcast, 50s °F

Buffer Zone ID: S1 (South)
Transect No.: 1
Transect Length: 25.7 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	cherry laurel (laying on ground)		80	
1	English ivy		5	
1	English holly		5	
1	salmonberry seedlings		10	
1	giant horsetail		1 - trace	
1	youth-over-age / piggyback plant		1 - trace	
2	English holly		10	
2	~~salmonberry~~ Him. blackberry		15	
2	lots of dead holly branches covering plot			
3	Him BB		5	
3	stink currant		5	
3	giant horsetail		1 - trace	
4	youth-over-age / piggyback plant		50	
4	acer circinatum		10	
4	reed canarygrass		1 - trace	
4	creeping buttercup		1 - trace	
4	salmonberry		20	
4	black hawthorn - planted		1 - trace	
5	lady fern		35	

– 25.7 –

– Starting @ S1b

@ 20.7 m

@ 15.7 m

@ 10.7 m

@ 5.7m

N. Creek Bothell + Swamp Creek

VEGETATION SURVEY FORMS

~1,000 coho released into Willow Creek + cutthroat trout in upper part of creek. w/in Hatchery

(outplanting sites for

2 OF 2

Surveyor(s): J. RHEUB / J. LOVE
Date: 4/15/19
Weather:

Buffer Zone ID: S1
Transect No.: 1
Transect Length: 25.7m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
5	reed canarygrass		10	
5	deer fern		1 - trace	
5	popweed		5	
5	salmonberry		1 - trace	
	*LWD @ 11.6 m along transect			
	11.5 m long + 30.6 cm DBH			
	decay class: 1-2 (most bark			
	still on, some spots of decay, alder)			
	Data gaps: rose near path is			
	Nootka rose.			
	*Invasive spp. note: Mountain			
	ash (single) growing just W			
	of transect line: ~12 m tall			
	*Marker S1a was missing - possibly			

removed during recent restoration efforts.

n/E/S/W

Other Notes for this transect:

Overall very wet w/skunk cabbage growing intermittently along transect, especially @ both ends.

0.7 m → S1a (begin transect)

Densiometer Readings:

N E S W

Plot 5: JR - 30/25/5/11
JL - 4/2/2/10

Plot 4: JR - 2/12/21/1
JL - 8/10/25/1

Plot 3: JR: 2/2/8/2
JL: 12/6/16/4

Plot 2: JR - 18/0/10/1
JL - 38/6/6/2

Plot 1:
JR - 38/0/0/51
JL - 88/16/2/20

VEGETATION SURVEY FORMS

1 OF 2

Surveyor(s): J RHEUBEN / J LOVE
Date: 4/15/19
Weather: SUNNY, 50s

Buffer Zone ID: SOUTH
Transect No.: S2
Transect Length: 35.5m

48
2 | 96
8
16

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	SWAMP LANTERN		25%	
1	CREEPING BUTTERCUP		75%	
2	RCG		15	
2	HIM BLACK BERRY		5%	
2	CAREX OBNUPTA		30%	
3	skunk cabbage		25%	
3	giant horsetail		1% - trace	
3	Him. BB		1% - trace	
3	Stink currant		1% - trace	
3	Pacific willow		5%	
	note: very wet plot, water ponding just @ surface			
4	skunk cabbage		15%	
4	Him. BB		5%	
4	lady fern		5%	
4	Pacific willow		5%	
4	field horsetail		1% - trace	
4	youth-over-age / piggyback plant		15%	
4	popweed		5%	
4	reed canarygrass		1% - trace	
	UNK # 571		TRACE	

35.5

30.5 @ FALLOUT

@ 25.5
PLOT #1
JL - 90 / 63 / 48 / 20
JR - 54 / 80 / 20 / 86
25.5
N / E / S / W

PLOT #2
JL 20 / 24 / 4 / 2
JR 24 / 8 / 2 / 24

PLOT #3
JR 12 / 14 / 18 / 35
JL 4 / 8 / 86 / 20

Plot #4
JR
JL

@ 20.5m

VEGETATION SURVEY FORMS

2 OF 2

Surveyor(s): J. Rheuben & J. Love
Date: 4/15/19
Weather: Sunny, 50's F

Buffer Zone ID: South
Transect No.: S2
Transect Length: 35.5

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
5	skunk cabbage		15%	
5	youth-ovr-age		45%	
5	slough sedge		~~10%~~ 15%	
5	reed canarygrass		1% - trace	
5	field horsetail		1% - trace	
5	lady fern		1% - trace	
5	salmonberry		5%	
6	lady fern		15%	
6	Him. BB		10%	
6	reed canarygrass		5%	
6	giant horsetail		1% - trace	
6	popweed -		1% - trace	
6	salmonberry		5%	
7	salmonberry		5%	
7	Him BB		5%	
7	creeping buttercup		<1% - trace	
8	youth-over-age		90%	
8	herb Robert		10%	
8	unidentified grass		3%	
8	trailing BB		5%	
8	gallium - bedstraw - trace			

plot #4
JR - 20/48/20/24
JL ~~30~~/30/18/15
@15.5m

plot #5 | JR - 24/24/48/16
JR 35/26/15/30
@10.5m

plot #6 JR 48/24/4/40
JL 34/18/2/44

@5.5m | JR 68/28/4/52
plot #7 | JL 51/29/4/42

@0.5m | JR 60 | 4/8/28
plot #8 | JL 55/10/5/12

VEGETATION SURVEY FORMS

1 OF ___

Surveyor(s): J. Rheubren + J. Love
Date: 4/16/19
Weather: cloudy, dry, 50's °F

Buffer Zone ID: Shellabarger
Transect No.: 1
Transect Length: 17.8 m

Herbaceous stratum – Canopy Coverage method

Plot No.	Species	Indicator Status	Absolute cover (%)	Cover category
1	bittersweet nightshade		15	
1	cattail		1% - trace	
1	Note: most of ground surface covered by dead cattail leaves/canes			
2	~~bitter. Dlight~~ · morning glory		5%	
2	Him BB		1% - trace	
2	note: most of ground surface covered by dead Him BB + nightshade, also leaf litter/sticks.			
3	Him BB		1% - trace	③ 7.8 m
3	Note: no groundcover species, mostly just dead BB canes, leaves, + sticks			

JR 4/16/19

①17.8 m

②12.8 m

Densiometer

Plot 1: JR 10/16/76/32
JL - 13/45/91/17

Plot 2 JR - 16/2/52/0
JL - 8/0/32/0

Plot 3 JR 2/2/8/0
JL 4/4/6/0

note about general vicinity of transect: Canopy dom. by alder, understory dom. by Him BB, also some osoberry + English holly, cherry laurel or otto luyken laurel, sparse morning glory only groundcover species observed.

single scouler's willow

* lots of downed alder trees/branches

INVERTEBRATE COLLECTION FORMS

Surveyor(s): T. Do & A. Hawley
Date: April 15-16, 2019
Weather: 50's, ptly cloudy

Fall-out trap collection

Buffer Zone ID	Transect No.	Sample ID	Replicate	Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Notes
South (Willow Creek)	S2	S2FT-1	1	04.15.19	1015	04.16.19	1015	
South (Willow Creek)	S2	S2FT-2	2	04.15.19	↓	04.16.19	1020	
South (Willow Creek)	S2	S2FT-3	3	04.15.19		04.16.19	1025	
Shellabarger Marsh	SB1	SB1FT-1	1	04.15.19	1310	04.16.19	1310	
Shellabarger Marsh	SB1	SB1FT-2	2	04.15.19	↓	04.16.19	1315	
Shellabarger Marsh	SB1	SB1FT-3	3	04.15.19		04.16.19	1320	
Southeast	SE2	SE2FT-1	1	04.15.19	1200	04.16.19	1240	
Southeast	SE2	SE2FT-2	2	04.15.19	↓	04.16.19	1245	
Southeast	SE2	SE2FT-3	3	04.15.19		04.16.19	1250	
North	N1	N~~1~~4FT-1	1	04.15.19	1245	04.16.19	1440	
North	N1	N~~1~~4FT-2	2	04.15.19	↓	04.16.19	1445	
North	N1	N~~1~~4FT-3	3	04.15.19		04.16.19	1450	

PHOTO POINT MONITORING FORM

DATE: April 17, 2019

PHOTOGRAPHED BY: T. Do & A. Hawley

Photo Station	Photo Station Location Description	Station Coordinate		Station Marker Type	Photo Orientation	Photo ID	Photo Numbers	Photo Time	Notes
		Northing[a]	Easting[a]						
A	Northern marsh interior, in intertidal mudflat area			PA-capped rebar		A1	2711-2718	1425	360° view 8 photos
B	Western edge of marsh			PB-capped rebar		B1	29	1523	
						B2	30		
						B3	31	↓	
C	Boardwalk lookout at west end of Edmonds Marsh Trail			None		C1	26	1518	
						C2	27		
						C3	28	↓	
D	Main Edmonds Marsh Trail boardwalk lookout at northernmost corner of marsh			None		D1	23	1516	
						D2	24		
						D3	25	↓	
E	Edmonds Marsh Trail boardwalk lookout west of Harbor Square Athletic Club			None		E1	21	1512	
						E2	22	↓	
F	Edmonds Marsh Trail boardwalk lookout south of Harbor Square Athletic Club			None		F1	19	1510	
						F2	20	↓	
G	Along SR-104 east of Harbor Square Athletic Club			PA-capped rebar		G1	081	0845	
H	Along SR-104 on west side of Shellabarger Marsh			PH-capped rebar		H1	077	0817	
I	Along SR-104 at Milepost 25			PI-capped rebar		I1	078	0825	
						I2	079	↓	

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. Rheuben + J. Love **Weather:** cloudy, dry, 50s °F

Date: 4/16/19

Location ID: n1 @ 8.3 m (near plot 2, unable to dig pit @ plot 2 due to roots)	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample ID: n1 soil pit	**Sample time:** 13:20
Sampling method: hand dug soil obs. pit	**Sample depth:** 32 cm

Profile Description

Depth ~~(in.)~~ cm bgs	Matrix		Redox Features				Texture	Notes
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
32-30	Gley 2 4/10B	75	7.5YR 4/4	25			sandy loam	
30-23	5YR 3/1	90	7.5YR 4/6	10			sandy loam	pore linings present - same color as redox features
23-15	10YR 3/1	75 ~~100%~~	no redox features				clay loam	root mat ~25% present, no pore linings
15-8	5YR 2.5/1	65	no redox features				silty clay loam	root mat ~ 35%
8-0	10YR 3/1	65					silty clay	root mat ~35%, slippery, om present

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

[2] Location: PL – pore lining, M – matrix

Field Observations

Surface water present? (Y/[✓ N])	**Depth (inches):**
Water table present? ([✓ Y]/N) @ 27 cm bgs	**Depth (inches):**
Saturation present? ([✓ Y]/N) 23 cm bgs	**Depth (inches):**
Wetland hydrology present? (Y/N):	

Additional observations/notes:

UPLAND SOIL COLLECTION FORM

Surveyor(s): J Rheuben / J Love **Weather:** Overcast 50s F Dry

Date:

Location ID: South 1B

Latitude/Northing (Y): —

Longitude/Easting (X): —

Sample ID: S1B _ Profile

Sample time: 1030

Sampling method: Spade

Sample depth: 36 cm

Profile Description

Depth (in.)	Matrix		Redox Features				Texture	Notes
	Color (moist)	%	Color (moist)	%	Type[1]	Location[2]		
0 - 8	5Y 4/1	60					Clay Loam	40% Root mass
8-36	5Y 3/1	85					Sandy Loam	85% Rootmass

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

[2] Location: PL – pore lining, M – matrix

Field Observations

Surface water present? ([✓ Y]/N)

Depth (inches):

Water table present? ([✓ Y]/N)

Depth (inches): 12 cm bgs

Saturation present? ([✓ Y]/N)

Depth (inches): ~~15~~ 9 cm bgs

Wetland hydrology present? ([✓ Y]/N):

Additional observations/notes:

Earthworms present 0-12 cm

no Redox features observed

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. Rheuben & J. Love **Weather:** overcast, 50's°F, dry

Date: 4-16-19

Location ID: SE-3								
Latitude/Northing (Y):				**Longitude/Easting (X):**				
Sample ID: SE-3				**Sample time:** 09:40				
Sampling method: hand dug obs. pit				**Sample depth:** 35 cm				
Profile Description								
Depth cm ~~(in.)~~ bgs	**Matrix**		**Redox Features**				**Texture**	**Notes**
	Color (moist)	**%**	**Color (moist)**	**%**	**Type¹**	**Location²**		
35-22	10YR 4/4	60	no	redox	features		loamy sand	pebbles ~1/2-1" (2-2.5cm) large,
22-13	2.5Y 3/2	100	no	redox	features		loamy sand	fewer pebbles than in lowest level, approx. 1cm
12-0	2.5Y 3/1	100	no	redox	features		sandy clay loam	roots & rootlets present
35-22	10YR 4/6	40	"			"		

¹ Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

² Location: PL – pore lining, M – matrix

Field Observations

Surface water present? (Y/[✓ N])	**Depth (inches):**
Water table present? (Y/[✓ N])	**Depth (inches):**
Saturation present? ([✓ Y]/N) barely present @ 34cm	**Depth (inches):**
Wetland hydrology present? (Y/[✓ N])	

Additional observations/notes:

horse chestnut tree growing to W of fence adj. to soil obs. pit / Transect SE-3

UPLAND SOIL COLLECTION FORM

Surveyor(s): J. Rheuben + J. Love **Weather:** cloudy, dry, 50s °F

Date: 4/16/19

Location ID: Shellabarger	
Latitude/Northing (Y):	**Longitude/Easting (X):**
Sample ID: Plot 2	**Sample time:** 10:45
Sampling method: hand dug soil obs. pit	**Sample depth:** 30 cm

Profile Description

Depth ~~**(in)**~~ cm bgs	**Matrix**		**Redox Features**				**Texture**	**Notes**
	Color (moist)	**%**	**Color (moist)**	**%**	**Type[1]**	**Location[2]**		
30-16	5Y 4/1	100	none				sandy loam	variety of gravel + sand, 30% gravel + sm. pebbles, jagged + angular
16-0	5Y 2.5/2	100	none				clay loam	roots present, no rocks, worms present, no porelinings or concretions

[1] Type: C – concentration, D – depletion, RM – reduced matrix, CS – covered or coated sand grains

[2] Location: PL – pore lining, M – matrix

Field Observations

not @ test pit but present nearby — **Surface water present?** ~~([✓ Y]/N) 16 cm bgs~~ gw	**Depth (inches):**
Water table present? ([✓ Y]/N) 16 cm bgs	**Depth (inches):**
Saturation present? ([✓ Y]/N) 14 cm bgs	**Depth (inches):**
Wetland hydrology present? (Y/N):	

Additional observations/notes:

DRAFT

APPENDIX B. FIELD LOGBOOKS

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Edmonds Marsh Field Notebook
4/23/18 - 10/18/18

Field
Notebook #1

INCH
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3
4
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6

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Project Edmonds Marsh Study
2018-2019

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CONTENTS

PAGE	REFERENCE	DATE

4/23/18

Edmonds Marsh Initial Buffer Evaluation. Weather: clear, sunny, 60s°F

10:30 Arrive at Willow Creek Hatchery

Staff: J. Love and T. Do

Native Plant Demonstration Garden - native shrubs and groundcovers

Forested wetland / riparian corridor within hatchery property:

-Mostly native canopy and subcanopy. Dominant species include Douglas fir, red alder, big leaf maple (at higher elevation & drier), salmonberry, osoberry, skunk cabbage, lady fern, many western red cedar seedlings in understory, fringecup, bleeding heart, lilly-of-the-valley, vine maple. Also present in smaller quantities; red-osier dogwood, stink currant, baldhip rose, hemlock

Invasive species present: few scattered holly, Himalayan blackberry throughout area, some reed canarygrass and Herb Robert along trails. Ivy near hemlock. Evening nightshade & RCG on emerg. areas beyond buffer.

Habitat structure: a few large standing snags, lots of downed logs in some areas, note sapsucker holes on downed logs.

Wildlife use: high activity for bird use - lots of calling and singing. Observed (audio): Anna's hummingbird, towee, pine siskin, marsh wren, kinglets, Canada Geese (distant honking), variety of sparrows, robins. Sapsucker and woodpecker holes observed in standing and fallen wood debris. Honey bees on salmonberry flowers - Downy woodpecker, flicker, Bewick's wren, chickadees, pileated woodpecker (visual)

Rite in the Rain

Observations within marsh beyond hatchery property:

Veg. dominated by cattail, and bitter nightshade. Dense layer of bitter nightshade on ground and climbing scrubby alder trees. Heavy use by marsh wren, few red-winged blackbird.

- Noted song sparrow carrying nesting material at very edge of riparian zone along creek channel.

13:15 Survey of Stella's Marsh: NE buffer area (access off 2nd and Alder):

Reed canarygrass and Him. BB dominate the understory up to cattail edge. Scouler's willow and red alder scrub-canopy (lots of dead wood on alders) Also some corkscrew willow @ street end.

Wildlife observations: Song sparrow, marsh wren, crows, BC chickadee, red-winged blackbirds heard from Edmonds Pk. Apts.

Walk along SR-104 (southward) to S end of 125-ft buffer zone. Along highway, a mix of cattail, RCG and other grasses, and Him. BB. At S end of buffer zone, Pac. willow dominant with lots of bitter nightshade in understory (growing on a fence?) near culverts. Also RCG and Him. BB here. Extending to S, Him. BB. dom. in understory beneath Pac. willow.

Along N end of City-owned undeveloped parcel, following access path along S side of STP property: large laurel shrub along Highway 104, & some smaller laurel shrubs along path, also Scouler's willow, alder, Him BB, Pac. willow, osoberry, evergreen huck. plantings, sword fern plantings, scattered holly, ivy on ground & climbing, large Pac. willow

Rite in the Rain

Parked at Edmonds Park Apts. to evaluate S&E side of Stella's buffers:

Canopy dom. by Pac. willows, understory dom. by Him. BB, RCG, also nettle, curly dock, equisetum, ivy growing up willow trees.

Hear red-winged BB and pair of crows hanging out. Small clump of WR cedar trees @ corner of parking lot.

14:11 Harbor Square

- Begin survey at end of wooden boardwalk. Invasive species present here: Japanese knotweed, purple loosestrife, Him. BB. & Scotch pine in more upland/dry areas along RR tracks, phragmites patch adj. to RR-ROW, cattail patch (may be narrowleaf)

Along paved path, native plantings include snowberry, red-flowering currant, rose, red-osier dogwood and ornamental dogwood, thimbleberry, mock orange, OR grape, twinberry. Overstory at edge of planting zone: Pac. willow, red alder. with WRC seedlings, snowberry, cascara, nettle, RCG, curly dock, sword fern, osoberry, vine maple, lady fern, water parsley, salmonberry, paper birch

SD outfalls @ edge of Harbor Square parking lot:

- outfall to unlined ditch, ditch traverses approx. 30' to cattail patch (incl. meander bends). Outfall furthest W.

- outfall to E: traverses approx. 20' to edge of cattail/water parsley patch

Wildlife observations within marsh: song sparrows in buffer areas, red-winged blackbird calling from perch within marsh, Great blue heron in marsh interior, Killdeer foraging on mudflats, small flock of tree swallows flying above Willow Cr. w/in marsh interior, bald eagle fly-over, rabbit observed near boardwalk, poss. coyote tracks in mudflat of marsh interior.

15:50 Walk ~~NE~~ ~~SO~~ S 4.23.18 along ~~E~~ W 4/23/18 side of Highway 104. Canopy dom. by red alder, single Douglas fir. Him BB, Pac. willow, Scotch broom in understory. Narrow strip of buffer veg. to cattail. At culvert under 104, dense cattail, bitter nightshade, also Him. BB & RCG. sm. quantity salmonberry & BLM (in understory), birch and hemlock. Sm. stand of Douglas fir mixed w/ alder across highway from City Park.

Scattered English hawthorn in this zone, horsetail

16:15 End site visit.

J. Fore 4.23.18

5/9/18

Weather conditions: mostly sunny, breezy,

WW staff: J. Love and R. Gouguet

12:30 Stop at N buffer zone (along Harbor Square) and access marsh interior to test sediment corer apparatus. Traverse marsh interior to reach Willow Creek channel adjacent to Unocal detention basin.
Wildlife observations: swallows perching at (nesting?) in one of the nest boxes provided at perimeter of mudflat area. Canine tracks (possibly coyote) in mudflat area).

13:30 Stop at Willow Creek Hatchery. Observe creek and adjacent riparian forest. Noted broken Am. robin's egg shell and deer tracks on trail near creek channel.
End site visit @ 14:10.

7/9/18

Beginning of baseline monitoring study.

Weather: mostly cloudy but with sun breaks, 65°F, no precip.

WW staff: J. Love, T. Do, J. Rheuben, N. Maas

09:30 Meet at Willow Creek Fish Hatchery. Health and Safety meeting, discuss logistics for day.

10:00 Enter Hatchery property. Meet Hatchery volunteers, explain our purpose for being here today. Turn on GPS and allow calibration / fixing.

10:15 Begin establishment of baseline veg. transect. Select random # 211 from random number table. Will locate transect @ 211 ft along baseline

Rite in the Rain

14:10 Completed 1st transect. Will est. 2nd trans. b/c 1st only 22.75 m long (restricted b/c located immediately north of fish rearing pond.

2nd random #: 296

14:15 Lay out 1st marker for 2nd transect line. Need to return tomorrow with GPS unit to finish establishing.

14:45 Head to Harbor Square and n Buffer Zone to meet up with ~~Jenny~~ Nina and Thai. note: trail camera also set up within hatchery property and will be checked tomorrow for height, orientation, and function.

15:15 Observe marked transect locations w/in N buffer zone - will collect data on 7/10.

15:30 Depart site - end of field day.

1545 Return to Windward

1400 Establish transects at N zone

BL 0-800 ft.

Random #s:

N1 @ 407 ft.

N2 @ 665 ft

N3 @ 816 ft

N4 @ 084 ft.

JR 5-9-18

Rite in the Rain

7-10-18 T D

Weather: Low 60's, cloudy

0800 ARRIVE @ WILLOW CREEK
(J. RHEUBEN, N. MAAS, T. DO)

0805 H/S BRIEFING

0810 Begin transect S2.

0900 After trying to break through blackberry, unable to pass, re-randomized location selected between end of BL and S1 Radom number generated was 34. Moved 34 meters from end of BL to re-establish S2.

0905 Begin veg. transect S2, Total distance 34.5 m to edge of buffer zone.

0935 J. Love arrives

10:40 Observe 1 female mallard with 4 ducklings in Willow Cr. Also observed deer tracks near where wildlife camera deployed

1130 Completed transects, fallout traps bird location and photo points in

07 10 18 TDO

South zone (Hatching area)

1200 Begin transects in North zone

1230 lunch break

1300 Continue transects in North zone
Set transect points in SE zone

1400 End transects in North zone
Complete transect points in SE zone. Had to relocate 1 transect point b/c random number was beyond buffer area.

1500 Establish sed transect baseline and total length of interest is 120 m. (4 × 30 m segments)
24, 26, 18, 1
Sed BL 0-87m. Random # is 30m for transect.

BL transect for SE zone
0-800 ft.
Random #s: 544, 653, 742
742 out of buffer zone, new # generated: 267
SE 1 @ 653 ft.
SE 2 @ 544 ft
SE 3 @ 267 ft.

Rite in the Rain

07.10.18 TDO

Numerous canine/coyote tracks throughout interior mudflat area.

1615 End of field day.

TDO 07.10.18 TD

07.11.18 TDO

0745 Arrive at Stellabanga Marsh. J. Kheubsen, N. Maas, TDO 60's sunny.

0800 H/S briefing.

0810 Begin establishing baseline for transect ~~0-74 m~~ 0-74m
Random #: 61
SB1 @ 61m

0830 Begin setting fallout traps

0850 Locate Bird point count location #5

0920 Head to SE zone to set up Fallout trap.
Random selector: 2, traps set at SE2

0930 Begin setting fallout traps

1010 Begin locating invert sed. points (for transect established yesterday)

1040 Establish photopoint locations B and A

1115 Establish photo point locations C, D, E, F along boardwalk

1130 Set up wildlife cameras 2&3 in marsh interior

Rite in the Rain.

07.11.18 TDO

1215 lunch break
1245 Supply run.
1300 Pick up fallout trap in South Zone (SZFT)
345 Set up Fallout traps in North Zone.
Random # 1-4: selected 4.
Traps set at N4FT
1400 Establish photopoints G,H,I and transect SE3
1415 Complete photopoints and transect @ SE3
1430 Depart area - End of field day.

Notes on wildlife:
Garter snake(s) seen at N buffer zone in Shellabarger Marsh.

Deer/coyote/goose tracks in interior Edmonds Marsh. Also saw Killdeer.

TDO
07.11.18

07.12.18 TDO

0815 Arrive at Marsh.
J. Rheuben, N. Maas, TDO
60°s, sunny
0820 H/S briefing.
photopoint
0830 Locate BPC1 (and PF) location in GPS.
0840 Head to Shellabarger Marsh to check/retrieve fallout traps.
0935 J. Love arrives
0945 Head to retrieve fallout traps at SE2

10:00 J. Love and J. Rheuben begin interior marsh veg. mapping.
TDO & N. Maas work and SED 1-4
Cattail Line 1: moving S from main (1st) boardwalk lookout.
Japanese Knotweed present on S + E sides of this viewing platform. Also Himalayan BB and hops, purple loosestrife (3-5 plants) and a small clump of Scot's broom intermixed along fence line. Hear marsh wren and Killdeer vocalizing from interior.

07.12.18 J. Love

Delineate hard stem bulrush patches #1-5 by walking perimeter w/ GPS.

Purple loosestrife, RCG, and morning glory growing along boardwalk but generally in a pretty narrow band.

Patch of arrow. and three sq. w/in cattail patch just S of planted shrub buffer. ~~Some~~ Clump of pacific willow just upland.

Map long cattail bound. Then encountered hardstem bulrush patch 6 there is some loosestrife as well as a grass species - specimen collected.

1230 lunch break

07.12.18 J. love

Hardstem bulrush patch 7 near drainage slough E of boardwalk.

Patch near camera 2: saltgrass, threesquare plus 1 grasses. Specimens of the grasses collected for ID.

Most of what is growing amongst hardstem bulrush in W marsh area is predominantly three square. w/in mudflat areas are brass buttons and extending patches of threesquare and hardstem bulrush ENT

Small patch of unidentified grass just W of C. lyngbeyi patch. Entered into GPS as unknown grass 1 - specimen collected for ID. Distichlis, triglochlin, and a small quantity of 3 square also present in this patch.

07.12.18 J. Love

Lots of potentilla intermixed with cattail in cattail patch on N side of phrag. patch.

Hardstem bulrush patch 10 just to SE of phrag. patch

Barn swallows flying / foraging over mudflat area, landing in mudflat. Killdeer foraging and vocalizing - obviously disturbed by our presence in the marsh. Violet green swallows also flying over vegetated areas. Have observed butterflies and dragonflies alighting on interior mudflat areas. Large electric blue dragonfly with black wings. Crows foraging in mudflats.

14:30 Placed bird point count #3 station in marsh interior nw of hatchery property. Near alder (scrubby)

07.12.18 J. Love/TDo

covered in bittersweet nightshade. Hear common yellowthroat in marsh and bushtits in riparian forests.

1445 Work on veg transect SE1.
1450 Completed SED1-4 and retrieve fallout traps in N4.
1500 Completed fallout traps. Reset wildlife camera for Jenny
1515 Meet up w/ Jenny & Jenna at SE1. Nina and Jenna continue transect monitoring.
1600 Complete transect.
1615 End of field day.

TDo
07.12.18

Rite in the Rain

7/17/2018 J. Love

meter calibration by AH in office

turbidity check @ 1046 = 10.0 NTU
(10 NTU standard)

pH calibration @ 1050

	4	7	10
initial	3.96	6.98	9.86
final	3.90	6.97	9.90

slope = -56.3 mV temp = 24.4°C

12:20 J. Love and A. Hawley arrive @ Willow Creek Fish Hatchery to collect WQ data. Begin at Willow Creek, just upstream from bridge where 2 logs cross creek.

Coords on handheld GPS:
47.80382 °N
122.38377 °W

Coords on cell phone GPS:
N 47 48.22896
W 122 23.02746

Turbidity meter: 2.5 NTU

pH meter: 7.67

7/17/18 J. Love

YSI Pro DSS meter:
59.6 °F = temp.
762.2 mm Hg = press.
99.2 % DO
9.93 mg/L DO
238.9 sp. cond. ~~(µS/cm)~~ AH
(µS/cm)
194.7 µS/cm conductivity
0.16 g/L = TDS
0.11 ppt = salinity
pH = 7.63
167.0 mV = ORP
-2.5 FNU = turbidity
water depth = 6.75 in.

weather: sunny, 77°F

1250 edge of riparian forest canopy, just downstream of where the 2 branches of Willow Creek come together.

coords on handheld GPS:
47.80447 °N
122.38434 °W

7·17·18 J. Love

coords on cell phone GPS
N 47. 48.24506
W 122 23.06210
water depth = 6 in.
turbidity meter = 3.4 NTU
YSI : temp = 59.9 °F
pressure = 762.2 mmHg
DO = 98.8 %
DO = 9.85 mg/L
sp. cond. 239.0 µS/cm
cond. 195.7 µS/cm
TDS = 0.16 g/L
salinity = 0.11 ppt
pH = 7.85
ORP = 153.6 mV
turbidity = −2.5 FNU
pH meter: 8.01

1320 in cattail/night shade vegetation north of wooded portion of Hatchery property
water depth = 5 1/2 in.
GPS (hand held)
47.80463 °N
122.38504 °W

7·17·18 J. Love

GPS (cell phone):
N 47 48.26566
W 122 23.11048
~~YSI: At~~
can see flow from south (from Willow Creek) below the cattail vegetation
YSI:
temp = 60.4 °F
press = 762.2 mm Hg
DO (%) = 89.6
DO (mg/L) = 8.88
sp. cond. = 238.9 µS/cm
cond. = 196.8 µS/cm
TDS = 0.16 g/L
salinity = 0.11 ppt
pH = 7.66
ORP = 136.3 mV
turbidity = −1.7 FNU
turbidity meter = 3.8 NTU
pH meter = 7.78

1430 tidal/drainage channel @ northwest corner of marsh under large Pacific willow and patch hard-stem bull rush

Rite in the Rain

7·17·18 J. Love

coords (hand-held GPS) (accuracy fluctuating b/w 66-148 ft)
47.80821 °N
122.38623°W

YSI: temp: ~~70.7°F~~ AH
pressure = ~~762.1 mmHg~~ AH
DO= ~~85~~ AH
DO=
sp. cond. =
cond. =
TDS=
salinity= ~~7.9 ppt~~ AH
pH=
ORP=
turbidity=

no flow. Stagnant water. Measurements fluctuating too much. Probe in shallow water. Did not take readings with YSI probe.
water depth = 2.25 in
used beaker to collect water for pH and turbidity meters.
loose sediment. Lots of vegetation.
turbidity meter = 14.4 NTU
pH meter: pH = 6.50

7·17·18 J. Love

temp. (pH meter) = 22.8°C
cell phone GPS:
N 47 48.51261
W 122 23.14264

1452 water depth = 19 in.
~~a~~ AH southeastern Harbor Square outfall. no flow.
turbidity meter: turb = 8.2 NTU
pH meter: pH = 6.68
YSI probe:
temp = 68.0°F
pressure = 762.0 mmHg
DO = 5.2 %
DO = 0.47 mg/L
Sp. cond. = 600 µS/cm
cond = 542 µS/cm
TDS = 0.39 g/L
salinity = 0.29 ppt
pH = 6.62
ORP = 29.5 mV and increasing
turbidity = -3.7 FNU

→

Rite in the Rain

7.17.18 J. Love

1512 northwest Harbor Square outfall.
under first landing of westernmost
boardwalk.
water depth = 9½ in
organic sheen on surface.
GPS (hand held)
47.80848°N
122.38647°W
GPS (cell phone)
N 47 48.50846
W 122 23.18457
turbidity meter:
turbidity = 20.3 NTU
pH meter:
pH = 7.04
YS I probe:
temp: 72.1°F
pressure = 762.0 mm Hg
DO = 9.3 %
DO = 0.81 mg/L
sp. cond. = 280.9 µS/cm
cond. = 266.1 µS/cm
TDS = 0.18 g/L
salinity = 0.13 ppt

7.17.18 J. Love

pH = 6.73
ORP = 65 + decreasing
turbidity = -8.3 FNU

1552 outlet basin.
water depth = 4½ in.
GPS (handheld)
47.80726°N
122.38600°W
GPS (cell phone)
N 47 48.49223
W 122 23.23767
turbidity meter
turbidity = 3.8 NTU
pH meter:
pH = 8.20
YSI probe:
temp = 74.9°F
pressure = 761.7 mm Hg
DO = 131.7 %
DO = 11.11 mg/L
sp. cond. = 899 µS/cm
cond. = 878 µS/cm
TDS = 0.59 g/L

Rite in the Rain

7.17.18 J. Love

salinity= 0.44 ppt
pH= 7.87
ORP= 160.9 mV
turbidity= -6.4 FNU
Just after/close to low tide.
Flow rate estimates:
Right culvert ~0.5 gal/sec
left culvert ~~~0.5 gal~~ ~1-2 gal/sec
total of about 3 gal/sec

1625 Shellabarger/SR104 culvert location.
Water depth= 13 in.
YSI probe:
temp= 63.7°F
press= 761.6 mmHg
DO= 87.7%
DO= 8.38 mg/L
sp. cond.= 283.9 µS/cm
cond.= 243.4 µS/cm
TDS= 0.18 g/L
salinity= 0.14 ppt
pH= 7.68
ORP= 147.5 & increasing (mV)
turbidity= -7.5 FNU

7.17.18 J. Love

handheld GPS
16-23 ft : accuracy
47.80675 °N
122.38351 °W
collected sample in beaker for pH + turbidity meters at car.
turbidity meter: ~~2.2~~ 2.2 NTU

Note: checked marsh locations adjacent to SR-104 @ CB outflow points but water was very shallow and muddy @ the N location, and there was no standing water @ the S location.

pH meter: 8.28
20.3°C

16:45 Completed water quality monitoring

wildlife observations today: observed Great Blue Heron flying in from N toward Willow Creek (observed from

Rite in the Rain

7·17·18 J. Love

Marsh just N of Hatchery property, heron was flying to portion of creek on Unocal | Chevron property. Observed 2 brown creepers on standing snag [illegible] adjacent to willow Creek where Willow Creek passes through forested portion of Hatchery prop. — one of the birds captured and ate a moth that had been resting on the snag - both continued to forage on the snag. Observed a mixed flock of chickadees in this same area and heard a flock of bushtits. Also @ Hatchery: heard a towee, a Pacific slope flycatcher, and observed a dead, juvenile squirrel or chipmunk w/in demonstration garden area adj. to sidewalk. Along Harbor Square boardwalk: Heard a common yellowthroat and a Killdeer.

JL 7.17.18

7·19·18 J. Love

Arrive @ Edmonds marsh to conduct summer bird surveys.
WW. Staff: J. Love
Weather: high overcast clouds, 58°, no precip., slight breeze
Sunrise: 05:30

05:38 Arrive at BPC station #1 along Harbor Squ. boardwalk lookout.

05:40 Begin 1st count.
Note: just a few seconds after official count ended, observed one duck (likely mallard) fly directly overhead toward marsh interior, and observed 2nd flying W→E over marsh

05:51 Arrive @ BPC 2. Begin survey.

05:59 Retrieve trail cam SD cards. Observed 1 adult and 1 juvenile spotted Sandpiper (adult "teetering") in mudflat area near N trail cam. Juvenile down

7·19·18 J. Love

06:33 Arrive @ BPC 5 (off 2nd Ave).

06:35 Begin survey.

06:45 Arrive @ Willow Creek Hatchery. Hear Swainson's thrush, downy woodpecker, and Pacific slope flycatcher on way in. Downy vocalizing from hill behind (S of) Hatchery.

06:50 Begin survey @ BPC 4 (in Hatchery riparian zone).

07:03 Begin survey @ BPC3 (in marsh just NW of Hatchery prop.

07:25 Retrieve SD card from Hatchery cam. Complete field work for day.

JL 7·19·18

8·23·18 J. Love

R. Gouguet and J. Love @ Edmonds Marsh @ 11:15. Checking wildlife cams and water loggers. Weather: 60°F, cloudy, no precip.

Tide:

11:20 Pulled 1st data logger #7481. Located w/in drainage channel closest to main observation deck/boardwalk.

Entered marsh from 1st observation lookout deck along Harbor Sq. In this area, morning glory, bittersweet nightshade, and purple loosestrife growing w/in cattail patch just marsh-ward of riparian (forested/scrub-shrub) buffer.

Wildlife: ~~Eagle~~ 2 Herons flying just to S of marsh near RR tracks (while train passing). Killdeer flock foraging in central portion of mudflat! 11 mallards flying overhead.

11:31 - Redeployed logger 7481.

Rite in the Rain

8.23.18 J. Love

11:40 Pulled logger #7471. Located @ downstream end of Willow Cr. (@ bend, adj. to RR tracks). Download data. Redeploy @ 11:50.

12:00 Pulled logger #7478. Download data.
This logger located just upstream Willow Creek of logger 7471.
Redeploy @ 12:05

Juvenile bald eagle perched on pine snag along Willow Cr. (on Unocal prop.)

12:20 Pulled logger furthest E along Willow Cr. # 7490.
Redeployed @ 12:23.

12:30 Pulled logger #7476. Located in marsh interior. Redeployed @ 12:40.

12:50 Change SD cards in wildlife cams. Depart marsh.

10-05-18 T. Do

0715 Arrive on-site.
N. Maas
J. Rheuben
T. Do

0730 H/S briefing.
Low tide @ 0800 0.10 ft.
Work
Begin work to get sediment samples and photopoints.

0753 Collect EDM18-SED4
root fibers & org material
tr. silt, clay, brown, no odor.

0800 Photos at PB. (3 photos)

0810 Collect EDM18-SED3
root fibers, & org material
tr. silt, brown no odor

0823 Collect EDM18-SED2
root fibers, org. material
silt, clay, dk. gray, ~~no~~ H_2S odor.

0832 Collect EDM18-SED1
root fibers, org. material
silt, dk gray, no odor

0838 Photos at PA, 5 photos (360°)

0904 Photos at PC, 3 photos

Rite in the Rain

10.05.18 TDO

0908 Photos at PD, 3 photos
0913 Photos at PE, 2 photos
0918 Photos at PF, 2 photos
0920 Collect EDM18-SOIL1
(N. buffer zone test pit)
Root debris, org. material
dk. brown, f. sand, tr. silt.
no odor. w.w. of bulk density = 1340 g
0930 Photo at PG, 1 photo
0934 Photo at PH, 1 photo
0940 Photos at PI, 3 photos
0950 Collect EDM18-SOIL2
(Shellabarger buffer zone test pit)
Root debris, org. material.
dk. brown, fine-med sand w/
tr silt, no odor; ww bulk dens = 1394g.
1024 Photos at PK, 3 photos
1022 Collect EDM18-SOIL3
SE buffer zone test pit.
brown ~~gray~~. f-m-c sand, small
gravel, no odor root debris, org.
material; ww bulk density = 1528g.
1040 Photos at PJ, 8 photos, 360°

10.05.18 TDO

1055 Collect EDM18-SOIL4
WC Hatchery buffer zone test pit
dk brown, silt w/ f/m sand,
root/org. debris, worms,
no odor; ww bulk density = 1658g.
~~Collect~~ TDO
1120 Photos at PL, 3 photos
1125 Photo at PM, 1 photo.
1145 End of fall survey.

TDO
10.05.18

Rite in the Rain

10/10/18
WW Staff: J. Love
Weather: 53°F, mostly cloudy, no precip.

10:00 Arrive @ Harbor Square. Post photo point placards along Harbor Square boardwalk.

Invasive species notes:

-Bittersweet night. growing along upper cattail fringe between Photo Station F through cattail patch along main wooden boardwalk.

Phragmites + knotweed patches spreading to
n 47°48.508'
W 122° 23.236'

* Garmin GPSMAP 64st GPS unit.

10:30 Begin collection of add. info. on interior marsh veg.

Pulled 2 marsh interior trail cams for photo download + maintenance.

Wildlife observed in the marsh today: song sparrows, white crowned sparrow, Anna's hummingbird, flicker, robins in buffer areas, Am. goldfinches, bushtits, killdeer in mudflat areas (startled by my presence while walking within the marsh interior, belted kingfisher heard.

Lots of fat spiders and slugs in the marsh today!

Likely coyote tracks observed in multiple mudflat areas.

11:57 Depart site.

Rite in the Rain

10/11/18 N.Maas

0930 Arrive at Edmonds Marsh. N.Maas, R. Gou
1000 Basin Station: V7468
swap meter and download data
1025 Download data from barometer on
north buffer
1043 Swap and download data for
CTD meter near sediment l.
(meter #3)
meter somewhat dirty w/ soft
mud/sediment
1101 Swap and download data for
CTD meter #4
meter somewhat dirty w/ soft, fine
sediment, unlikely to effect meter
reading
1114 Swap and download data for
CTD #2
meter somewhat dirty w/ soft
mud/ sediment
1127 Swap and download data for
CTD #1
meter relatively clean
1147 Swap and download data for
CTD #5
meter relatively clean w/ some sand

10/11/18 N. Maas

1205 Mark pickleweed on GPS
location 'PW1'
1218 Download barometer at hatchery
location
1230 ~~End fi~~ place photopoint
placard at Point Edwards
upper location
1245 End field day, return to
office

Pickleweed edge coordinates:
47.80761 °N
122.38668 °W

10.11.18

Rite in the Rain

10/18/18 A. Hawley

Water quality monitoring

Turbidity check: ~~10.05 AH~~ 10.1 on 10.0 NTU standard

pH calibration		4	7	10
initial	→	3.99	7.02	10.00
final	→	3.92	6.96	9.96

temp.: 23.1 slope: – 57.2

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LEVEL
№ 311FX

Edmonds Marsh
Field Notebook #2
[redacted]
10/18/18 – 04/16/19

~~[illegible]~~ 10/18/18 A. Hawley ~~[illegible]~~

Water Quality monitoring

0855 WW arrives at Hatchery property

WW staff: A. Hawley, N. Maas

weather: ~50°F, sunny

Head to location #1.

0905 Arrive at location #1

water depth = 6.0 in.

YSI measurements:

temp = 51.3 °F

DO = 98.8%

10.96 mg/L

Cond = 169.6 µS/cm

pH = 5.83

ORP = 270.0

turb = 12.7 FNU

press = 766.1 mmHg

salinity = 0.12 ppt

TDS = 0.15 g/L

Handheld GPS

47.80752 °N

122.38590° W

Phone GPS

~~47.8040 N~~ AH 47.8038 °N

-122.3838 W

10/18/18 A. Hawley

WW pH meter = 7.89

WW turbidity meter = 1.1 NTU

0935 Arrive at location 2 and collect water

water depth = 5.7 in.

YSI:

temp. = 52.5°F

press = 766.6 mmHg

DO = 99.6%

DO = 10.87 mg/L

Cond = 171.6 µS/cm

TDS = 0.15 g/L

Sal. = 0.11 ppt

pH = 6.41

ORP = 270.7

turb. = 8.9 FNU

WW pH meter = 8.35

WW turbidity meter = 1.3

Handheld GPS = 47.80435N

122.38436W

Phone GPS = 47.8044N -122.3844 W

Rite in the Rain

10/18/18 A. Hawley

1010 Arrive @ Location #3

water depth ~ 4 in

Handheld GPS

47.80464 °N

122.38499 °W

Phone GPS

47.8045 °N

122.3850 °W

YSI meter measurements

Temp = 51.4 °F

Pressure = 766.5 mmHg

DO = 94.0%

10.42 mg/L

Cond = 169.5 µS/cm

TDS: 0.15 g/L

Sal. = 0.11 ppt

pH = 6.95 pH

turbidity = 40-120 FNU - will not stabilize

ORP = 254 mV

WW turbidity meter = 3.2

WW pH meter = 8.14

1037 Head towards location ~~8~~ Alt 8

10/18/18 A. Hawley

1045 @ CB-N

shallow water, stagnant, no flow, turbid/dark and murky

~10 ft north of Edmonds Marsh sign

culvert just north of this CB - no flow, stagnant & dark water

this is location 8

1053 Arrive back at location 8

water depth ~ 12 in

phone ~~Handheld~~ Alt GPS = 47.8068 °N

122.3835 'W

hand held ~~Phone~~ Alt GPS = 47.80467 °N

only 1 satellite 122.38500° W

YSI measurements:

temp = 53.9 °F

Pressure = 766.3 mmHg

DO = 92.9%

9.97 mg/L

Cond = 217.6 µS/cm

TDS = 0.19 g/L

Salinity = 0.14 ppt

pH = 7.56

10/18/18 A. Hawley

ORP= 242 mV
turb= 13 FNU
WW pH meter= 7.85
WW turbidity meter= 1.4

1115 Check out location at City Park. Marshy area is saturated but water doesn't appear to be flowing. Slight sheen. Can hear flow (trickle) but cannot find it.

1128 Arrive at Harbor Square

1132 Arrive at location 6. Stagnant water, sheen, lots of organic debris, sheen appears to be biological.

Handheld GPS: 47.80677°N
1 Satellite 122.38346°W
Phone GPS: 47.8085°N
122.3865°W
water depth > 1 ft

10/18/18 A. Hawley

YSI measurements:
temp: 60.7°F
pressure: 766.4 mmHg
DO: 6.7 %
0.62 mg/L
Conductivity = 424.5 µS/cm
TDS = 0.33 g/L
Salinity = 0.25 ppt
pH = 6.94
ORP = 148 mV
turbidity = 16 FNU
WW pH meter = 7.28
WW turbidity meter = 21

1150 Arrive @ location 5
Stagnant water, appears to be a film on water surface
water depth > 1 ft
Handheld GPS: 47.80677°N
1 satellite 122.38346°W
phone GPS: 47.8082°N
122.3860°W
YSI Measurements:
temp: 60.1°F

Rite in the Rain

10/18/18 A. Hawley

YSI measurements cont'd:

pressure = 766.5 mmHg

conductivity = 560 µS/cm

TDS = 0.44 g/L

sal. = 0.33 ppt

pH = 6.58

turb = 11.4 FNU

ORP = 74.3 mV

DO = ~~4.1%~~ AH 3.4%

~~0.4~~ AH 0.34 mg/L

WW pH meter = 6.84

WW turbidity meter = 4.9

1200 Arrive @ location #4

water depth ~3.5-4 in

Handheld GPS = 47.80825°N
122.38637°W

phone GPS = 47.8083°N
122.3863°W

YSI measurements:

temp = 59.4°F

pressure = 766.6 mm Hg

conductivity = 5200 µS/cm

TDS = 4.1 g/L

10/18/18 A. Hawley

salinity = 3.38 ppt

pH = 6.18

turbidity = 6.4 FNU

ORP = 241.2 mV

DO = ~~79.%~~ AH 91.5%
8.94 mg/L

WW pH meter = 6.42

WW turbidity meter = 12

1230 Arrive location 7

Handheld GPS: 47.80619°N
122.39129°W

Phone GPS: 47.8062°N
122.3912°W

Waterdepth >2 ft

Water flowing in to Marsh, brown, relatively fast flow

YSI Measurements:

temp = 54.3°F

pressure = 766.6mmHg

DO = 79.0%
6.94 mg/L

Cond = 36,242 µS/cm

TDS = 31.04 g/L

Rite in the Rain

10/18/18 A-Hawley

sal.= 31.05 ppt
pH= 7.48
ORP = 217.1 mV
turb = 21.1 FNU
WW pH meter = 7.54
WW turbidity meter = 12

1300 Done w/ field work.

10/18/18 A.Hawley A.Hawley

10/22/18 N. Maas

0930 Arrive at Edmonds Marsh main viewing area (N.Maas)

0945 Arrive at location G, begin swap of CTD meters

1003 Swap meter # 5, download data and adjust parameters

1015 Begin swap of meter #4, data download and parameter adjustment

1023 Begin swap of meter #2

1030 Begin swap of meter #1

1035 Begin swap of meter #3

1050 Ron to check barometer at hatchery, Nina departs Edmonds for WW office. End of field day.

10/22/18 NINA MAAS

10/23/16 J. Love

07:25 Arrive @ Shellabarger Marsh to begin fall bird surveys.

WW staff: J. Love
Weather: 46°F, foggy, no precip., Sunrise: 07:41 v. slight breeze

07:33 Conduct survey @ BPC-(Shellabarger Marsh perimeter station). Marker missing – used 3-Hr parking sign as marker.

07:47 Arrive @ Willow Cr. Fish Hatchery to conduct surveys @ 2 locations.

wildlife notes: Observed young raccoon sleeping in leaning snag, just within marsh interior at edge of riparian forest. Also heard coyotes yipping within marsh.

10/23/18 J. Love

Serviced Hatchery trail cam.

09:02 Arrive @ Harbor Square to conduct survey along boardwalk.

09:21 Conduct survey @ BPC-2

09:30 Complete bird surveys and re-deploy marsh interior trail cameras.

Other wildlife / bird notes: observed 2 belted kingfishers flying together over marsh just before departure. Also observed several killdeer (approx. 15) and heard 3-4 marsh wrens calling from interior. Flushed a single Dunlin from slough traversing marsh to BPC-2.

10:15 Departed marsh. End of field work for today.

Rite in the Rain

12/4/18 N. Maas

0905 Arrive at boardwalk meet Ron G.

0920 Arrive at location 6 begin swap and download of data loggers

0935 Arrive back at boardwalk, walk to interior marsh. Begin data download and swap of data loggers at location 4

0948 Retrieve data logger 1 NM, download data and swap logger

Begin retrieval of logger

1000 Swap batteries and SD card in wildlife camera near location 1 NM

1020 Return to location 1 NM to switch mislabeled and retrieve/swap location 3

1020 Retrieve logger 2; swap logger and download data

1040 Retrieve data logger 5, swap logger and download data

1050 Swap SD cards at wildlife camera near location 4

1105 Finish camera, leave boardwalk

1115 Arrive at Hatchery to change

12/4/18 N. Maas

camera SD card.

1125 Run out of batteries, head to hardware store

1140 Return to hatchery and replace batteries in wildlife camera

1150 Finish at marsh. Head to Windward.

Notes: Station ID 23 mislabeled, should be station 2. At correct location in place.

N. Maas

1/8/19 J. Love

Weather: 46°F, rain

12:30 Arrive @ Marsh outlet basin to pull logger

13:20 Stopped device. Station #7 (new ID for this logger). Dropped conductivity setting to 30 mS/cm since we will be deploying this logger into freshwater portion of marsh. Set-up to begin collecting data @ 15:30 today.

13:25 Repaired logger will be Station #8. Set-up w/ same conductivity setting (30 mS/cm) and same start time setting (@ 15:30 today).

14:05 @ Willow Cr. Hatchery. Pull pressure gage and download data.

14:20 Install gage @ Station #7 within Marsh interior adjacent to Hatchery property. Gage is approx. 15-16" SW from Photo station "PJ" marker. Gage to catch Willow Creek flows.

14:40 Install logger @ Station #8 on downstream (W) side of SR 104 culvert to capture Shellabarger Creek flow data. Flag hanging over top of casing.

Coords:

47.80676° N
122.38381° W

15:00 Return to car @ Hatchery and depart site.

J. Love Jennifer Love 1.8.19

Rite in the Rain

1/16/19 N Maas

0805 Arrive at main lookout near photo station D

Photo point D sign in tact

Photopoint C sign in tact

coyote track in marsh (that photo)

Red throated humming bird near photo station D

Photopoint E sign in tact

0925 Depart marsh boardwalk area head to hatchery

0930 Arrive at hatchery, take photos J & K

0945 Depart hatchery

0948 Arrive at photopoint L, sign in tact

head to photopoint M.

1000 Finish all photopoints, head to office

1/16/19 N Maas

1/17/19 A. Hawley

Meter calibration for water quality measurements

Turbidity meter check @ 0840

10.0 NTU standard = 10.0

0848 pH meter calibration

	4	7	10
initial	3.99	7.11	10.08
final	3.91	7.00	9.94

slope = −56.6 mV

temp = 21.3°C

1030 leave for Edmonds (Abby + Jenny)

1110 arrive Joe's house for probe calibration

Sp. cond pre = 62

distilled water = 4.7

(temp—aim for 25°C)

set meter to 1000 per bottle

1132 sp. cond. calibrated

1134 tap water post = 63.2 (sp. cond)

DO pre-calibration (very small

<1 in – amount of water in bottom w/

covers lightly screwed on to

1137 allow for venting) = ~~99.2~~ % DO

99.1

1/17/19 A. Hawley

1139 DO post-calibration = 97.5 % DO

1141 tap water DO = 144.9 % DO

DO = 14.~~60~~ 59 AH mg/L

pH next

pH 7 fluid

1145 pre-cal = 7.10

start calibration

accept calibration, rinse tap H_2O then fluid

pH 10 fluid

1150 pre-calibration = 10.14

pH 4 fluid

rinse with tap water then fluid

1159 accept calibration 4.00

1210 ORP ≈ 307.2 (pre-calibration)

for ORP solution, do not re-use

wash but can re-use solution

used for calibration

1218 ORP = 262.5 pre-calibration

accept calibration

re-start ORP calibration b/c

of slope

accept calibration

re-calibrate

accept calibration

1/17/19 A. Hawley

re-calibrate

accept calibration

1227 post-calibration ORP = 241.8

tap water rinse

1230 2.9 FNU = turbidity in tap water pre-calibration

use distilled water for calibration

distilled water rinse

1232 turb = 4.8 FNU (distilled water pre-calibration)

calibrate

accept calibration

select finish calibration @ 0

calibrate second time

accept calibration

finish calibration @ 0

1235 turb = 0.0 post-calibration in distilled water

replace in tap water for post-calibration reading

AH 1243 turb = -1.5 FNU in tap water

low, so go back to distilled water.

Rinse, then read

1/17/19 AH A. Hawley

1245 turb = 5.86 distilled water
pre-calibration
calibrate - reading high
accept calibration
recalibrate
accept calibration
recalibrate
accept calibration
finish - meter rejected so
recalibrate
accept calibration (accept anyway)

1251 turb = -0.0 FNU post-calibration distilled water
read tap water

1252 turb = -1.6 FNU
still low so calibrate again
Rinse w/ distilled water first

1257 turb= -0.6 FNU
distilled water pre-calibration
accept calibration and finish
(accept anyway)

1259 turb = 0.0 FNU post-cal w/
distilled water
read tap water

1/17/19 J. Love + A. Hawley

1301 turb = -0.9 FNU tap water

1310 Head to marsh

1400 Arrive @ Station 1
Measurements:

Weather: v. light precip, Overcast, 50 °F

YSI Pro DSS readings:

Time: 14:08
Temp: 48.5°F
Pressure: 749.3 mm Hg
DO (%): 96.8
DO (mg/L): 11.14
SPC µS/cm: 222.5
C µS/cm: 155.1
TDS (g/L): 0.14
Sal. (ppt): 0.11
pH: 7.02
ORP (mV): 229.1
Turb. (FNU): 0.2

Water depth: 14 cm

Hach turbidity meter: 2.2 ntu

Rite in the Rain

1/17/19 A.Hawley

1418 Arrive @ Station 2

1421 turb ≅ 2.2 FNU & fluctuating

temp = 48.4°F

pressure = 749.8 mm Hg

DO = 95.9 %

DO = 11.04 mg/L

spCond = 222.7 µS/cm

Cond = 155.1 µS/cm

TDS = 0.14 g/L

salinity = 0.11 ppt

pH = 7.13

ORP = 217.7 mV (stable)

turbidity = 0.9 FNU

water depth = 23 cm

Hach turb. meter: 2.3 NTU

1432 Arrive @ Station 3

Shallow water so collect sample in probe cover

1436 temp = 48.2°F

pressure = 750 mmHg

DO = 85.7 %

DO = 9.90 mg/L

1/17/19 A.Hawley

Sp cond = 221.0 µS/cm

Cond = 153.5 µS/cm

TDS = 0.14 g/L

salinity = 0.11 ppt ~~[illegible]~~ AH

pH = 7.12

ORP = 205.5 mV

turb = -1.3 FNU and decreasing

Hatch turb = 17.6 NTU

Bittersweet night shade and cattail; willow creek flow through cattail patch; non-channelized, spread out flow

Shallow water with visual sediment in flow

water depth = 4.5 cm

1444 Arrive @ Station AH 3B near ~~stream~~ AH Alder covered in bittersweet night shade

1/17/19 A. Hawley

GPS: 47.80489°N
122.38498°W

1449 temp = 48.8°F
pressure = 750.2 mmHg
DO = 90.0 %
DO = 10.31 mg/L
sp Cond = 222.2 µS/cm
Cond = 155.8 µS/cm
TDS = 0.14 g/L
salinity = 0.11 ppt
pH = 7.02
ORP = 204.9 mV
turbidity = -4.6 FNU
water depth = 8.5 cm
Hatch turbidity meter = ↓

Hach turb. meter: 13.5 NTU

1524 Arrive @ ~~6~~ # Station 8
1528 temp = 48.8°F
pressure = 750.3 mmHg
DO = 85.4%
DO = 9.78 mg/L
sp Cond = 264.7 µS/cm

1/17/19 A. Hawley

Cond = 185.6 µS/cm
TDS = 0.17 g/L
salinity = 0.13 ppt
pH = 7.32
ORP = 176.9 mV
turbidity = 0.6 FNU
water depth = 31 cm
Hatch turb. meter = 2.2 NTU

very slight flow; pieces of debris moving on surface; reed canary grass, bittersweet nightshade; Himalayan blackberry; cattail, unidentified speedwell species

1547 Arrive @ Station 5
1554 temp = 46.9°F
press = 750.8 mmHg
DO = 42.4%
DO = 4.97 mg/L
sp. cond = 682 µS/cm
Cond = 464.8 µS/cm
TDS = 0.44 g/L
sal = 0.33 ppt

Rite in the Rain

1/17/19 A.Hawley

pH=6.55
ORP= 154.2 mV
turb= 5.3 FNU
water depth = 62 cm
turb (Hatch meter) = 13.8 NTU

1603 Arrive @ Station 4
slow moving water with seight sheen on surface; lots of floating organic debris

1606 temp = 46.1 °F
press = 751.0 mm Hg
DO= 82.2%
DO= 9.76 mg/L
SpCond= 411.3 µs/cm
Cond= 276.7 µs/cm
TDS = 0.27 g/L
sal = 0.20 ppt
pH = 6.80
ORP= 174.9 mV
turb= 2.1 FNU
turb (Hatch) = 5.7 NTU
water depth= 36 cm

1/17/19 A.Hawley

1613 Arrive @ Station 6
Stagnant water

1617 temp= 45.8 °F
press= 751.0 mm Hg
DO= 46.8%
DO= 5.57 mg/L
SpCond= 477.5 µS/cm
cond= 319.5 µs/cm
TDS= 0.31 g/L
sal = 0.23 ppt
pH = 6.76
ORP= 172.0 mV
turb= 1.3 FNU
turb = 6.6 NTU
water depth= 41 cm

1632 Arrive at Station 7
1634 temp= 46.7°F
press= 751.4 mm Hg
DO= 87.4%
DO = 10.28 mg/L
Sp Cond= 353.9 µS/cm
Cond= 239.8 µS/cm
TDS= 0.23 g/L

Rite in the Rain

1/17/19 A. Hawley

Sal = 0.17 ppt
pH = 7.06
ORP = 174.8 mV
turb = 0.3 + fluctuating FNU
turb(Hatch) = 9.3 NTU
water depth = 44 cm

1642 Done w/ water quality monitoring. Return probe to Joe and head back to office.

A. Hawley AHawley 1/17/19

1/28/19 Winter Bird Surveys
MW Staff: J. Love
Weather: 39°F, high cloud cover, fog (but visibility 750 m)
Sunrise @ 07:42.

07:35 Arrive @ Shellabarger Marsh - survey BPC-5.

07:55 Arrive @ Harbor Square to survey BPC-1 + BPC-2.

08:50 Complete surveys @ BPC-1 + BPC-2. Add. wildlife observations (outside of formal point counts): Observed coyote laying in grassy vegetation (Distichlis + potentilla) @ E end of mudflats between swallow nest boxes. Coyote sauntered off after seeing me approach.
Lots of birds observed w/in n buffer zone in between survey times: dark-eyed juncos, mixed flock of sparrows (golden-crowned + white-crowned) large flock of ~30 Canada geese flying over marsh, spotted towees.

Rite in the Rain

1/28/19 J. Love

Also observed a small number of Killdeer (a few groups of 2-6 birds) resting on mudflats in marsh interior.

08:58 Arrive @ Willow Cr. Hatchery to conduct surveys @ BPC-3 + BPC-4.

09:55 Complete surveys @ Hatchery stations. Add. wildlife observations made outside of point-count survey windows: several song sparrows both in riparian and open marsh areas, a few Anna's hummingbirds (one gathering nesting material from cattail head), a spotted towee in marsh, a few marsh wrens, several black-capped chickadees (in marsh + riparian forest buffer), a flock of pine siskin (8-10 birds) in riparian veg. along Willow Cr. near BPC-3, a varied thrush in Hatchery

1/28/19 J. Love

riparian zone right along Willow Cr., several Am. robins observed/heard throughout whole area.

10:00 Complete observations + depart site.

J. Love J. Love 1:28:19

Rite in the Rain

THURSDAY 3/7/19 J. RHEUBEN

WW STAFF: J. RHEUBEN + R. GOUGET

WEATHER: 40° F, CLOUDY, ON/OFF PRECIP.

11:00 DEPART WINDWARD

11:30 ARRIVE @ EDMONDS MARSH
(HARBOR SQUARE)

12:00 RETRIEVE + COLLECT DATA
FOR LOGGERS
#1, # ~~#~~ 3, #2, #9 JR

12:09 ERASE + REDEPLOY #1, #2, #3
: #9 WILL BE MOVED TO
ROVING LOCATION #5

13:05 COLLECT ROVING LOGGER
#4 + DEPLOY TO ROVING LOCATION
#5.

13:45 ATTEMPT TO RETRIEVE
ROVING LOCATION #6,
NOT FOUND. WILL LEAVE
UNTIL SPRING EVENT.
COLLECT BAROMETRIC
PRESSURE DATA.

NOTE: ALL LOGGERS SET TO BEGIN
COLLECTION @ 1300 TODAY
EXCEPT #4 + #5 – set to begin @
1330.

1415 RETURN TO CAR + DEPART
HARBOR SQUARE.

JR 3-7-19

4/12/19 A. Hawley

YSI meter calibration for Spring 2019 water quality monitoring

AH
1000 Begin with sp. conductivity calibration

conductivity pre-calibration = 3.5 µS/cm

pre-cal sp. cond = 3.7 µS/cm

DI cond = 14.2 µS/cm

sp. cond = 14.5 µS/cm

set cal. value to 1000 per bottle

1029 sp. cond. calibrated

Results out of range

Restart calibration

sp. cond. calibration successful.

1100 tapwater post-cal. sp. cond = 69.7 µS/cm

1102 DO: pre-calibration (very small amount of water with cover lightly screwed on to allow for venting)

+AH DO = 99.6 % DO

1105 calibrate % DO

DO post-calibration = 99.9 % DO

1109 post-DO-calibration, tap water

DO = 100.0%, 8.24 mg/L

4/12/19 A. Hawley

1110 pH

pH 7 fluid

pre-calibration = 8.00

1115 start pH calibration

accept calibration

Rinse w/ tap water

Rinse w/ pH 10 solution

pre-cal = 10.67

1122 accept calibration

Rinse w/ tap water

Rinse w/ pH 4 fluid

pH 4 calibration

pre-cal = 5.19

accept calibration

meter says: Results questionable

DO not accept

1129 Re start pH calibration

pre-cal pH 7 = 7.78

1134 accept calibration

pH 10. pre-cal = 10.52

accept calibration

pH 4. pre-cal = 4.98

accept calibration

1143 accept full calibration

Rite in the Rain

4/12/19 A. Hawley

1144 Move to ORP
pre-calibration = 349.6 mV
accept calibration
Recalibrate
pre-cal = 232.9 mV
accept calibration
re-calibrate
1152 accept calibration
recalibrate
pre-cal = 233.0 mV
accept calibration
1154 post-calibration = 233.1 mV
tap water rinse
pre-turbidity calibration
turbidity in tap water = 4.6 FNU
distilled water rinse
1158 Distilled water pre-calibration
turbidity = -0.8 FNU
calibrate turbidity
accept calibration
Finish calibration
1201 calibrate second time
accept calibration
finish calibration

4/12/19 A. Hawley

1204 post-calibration turbidity
in DI = 0.0 FNU
1206 post calibration turbidity
in tap water = 3.3 FNU
Done with calibration

4/12/19 A. Hawley A. Hawley

Rite in the Rain

4/15/19 Spring monitoring A. Hawley

0725 Turbidity meter check - 10 NTU standard
10.1 NTU

0730 Hach pH meter calibration

	4	7	10
initial	3.93	7.00	9.94
final	3.91	7.00	9.95

temp = 21.2°C
slope = -56.5 mV

0745 load truck with field equipment
and supplies.

~~0915~~ JAH
0900 arrive Hatchery (A. H., J. R.)
meet T. Do
meet J. Love

0930 Health & Safety meeting

0940 Head into hatchery area for
monitoring.

1015 deployed invertebrate traps S2

1035 Replaced battery & SD card
at Camera.

1050 At WQM location 1

1053 depth 4"
Temp. 49.2° F
Pressure 757.1 mm Hg
DO. 98.7%
DO 11.26 mg/L

04.15.19 T. Do

SpC 111.8 µS/cm
Cond. 78.7 µS/cm
TDS 0.07 g/L
Sal. 0.05 ppt
pH 7.82
ORP 17.6 mV
Turb. 1.5 FNU

WW. pH 6.90
Turb. 2.0 NTU/FNU

1105 At WQM location 2

1107 depth 5.5"
Temp. 49.6° F
Pressure 757.2 mm/Hg
D.O. 99.2%
D.O. 11.26 mg/L
SpC 231.1 µS/cm
Cond. 163.9 µS/cm
TDS 0.15 g/L
Sal. 0.11 ppt
pH 6.72
ORP 58.1 mV
Turb. 3.4 FNU

WW Turb. 5.6 NTU/FNU
pH. 7.39

Rite in the Rain

04.15.19 TDO

1117 At WQM location 3
1120 Depth 1"
Temp. 49.7°F
Pressure 757.2 mmHg
DO 90.8%
DO 10.31 mg/L
SpC 230.8 µS/cm
Cond. 163.8 µS/cm
TDS 0.15 g/L
Sal. 0.11 ppt
pH 6.54
ORP 63.7 mV
Turb. 2.4 FNU
WW. pH 7.88
Turb. 2.3 NTU/FNU
1128 At location 3b
1130 Depth 1.5"
Temp. 50.4°F
Pressure 757.1 mmHg
DO 73.3%
DO 8.20 mg/L
SpC 226.2 µS/cm
Cond. 162.4 µS/cm
TDS 0.15 g/L

04.15.19 TDO

Sal. 0.11 ppt
pH 5.97
ORP 66.5 mV
Turb. ~3.0 FNU (unstable)
WW pH ~~7.60~~ 7.44
Turb. 4.0 NTU/FNU
1200 Set fallout trap @ SE2
1208 At WQM location 8
1210 Depth 14"
Temp. 51.5°F
Pressure 757.1 mmHg
DO 91.3%
DO 10.09 mg/L
SpC 277.0 µS/cm
Cond. 202.0 µS/cm
TDS 0.18 g/L
Sal. 0.13 ppt
pH 6.68
ORP 54.4 mV
Turb. 0.7 FNU
WW pH 7.83
Turb. 1.3 NTU/FNU
1245 Set invert Fall out at NIFT
1310 Set invert Fall out at SB1

Rite in the Rain

04.15.19 TDO

1315 Lunch break

1415 Photopoint Survey

1440 Wildlife camera battery check
change SD card.

1500 Wildlife camera battery check
change SD card.

1545 Complete monitoring survey tasks
for today.

TDO
04.15.19

4/16/19 Spring Monitoring - Day 2 A. Hawley

0725 turbidity meter check (10 NTU standard)
10.0 NTU

0730 pH meter calibration

	4	7	10
initial	3.92	7.00	9.93
final	3.92	7.01	9.94

slope = -56.4 mV
temp = 22.1°C

0830 leave WW office (A.H, J.R)

0900 meet T. Do at Hatchery
J. Love arrives

0930 Health + Safety meeting

0942 Water quality station 7
near marina

0947

Depth	12"	
Temp	49.0	°F
Pressure	761.6	mmHg
DO	81.0	%
DO	8.26	mg/L
SpC	28960	uS/cm
Cond	20350	uS/cm
TDS	18.93	g/L
Sal	17.85	ppt
pH	6.20	

Rite in the Rain.

04.16.19 TDO.

ORP 50.8 mV
Turb. 1.6 FNU
WW pH 6.19
Turb. 2.3 NTU/FNU
1015 Retrieve F/O traps at Willow Creek (S2)
1050 At WQM location 5 - stagnant
1052 Depth 20"
Temp 52.1 °F
Pressure 762.0 mmHg
DO 5.4 %
DO 0.59 mg/L
SpC 627.0 µS/cm
Cond. 459.8 µS/cm
TDS 0.46 g/L
Sal. 0.34 ppt
pH ~~TDS~~ 6.85
ORP -114.2 mV
Turb. 8.5 FNU
WW pH 7.25
Turb. 12.9 NTU/FNU
1100 At WQM location 4 - stagnant, bact. sheen
1103 Depth 6.5"
Temp. 51.4 °F

04.16.19 TDO

Pressure 762.1 mmHg
DO 104.9 %
DO 10.18 mg/L
SpC 37,004 µS/cm } fluctuating
Cond. 27,103 µS/cm
TDS 24.11 g/L
Sal. 23.46 ppt
pH 6.13
ORP 82.7 mV
Turb. 41.1 FNU fluctuating
WW pH 6.71
Turb. 139 NTU/FNU
1112 At WQM location 6, stagnant.
1114 Depth 13"
Temp. 52.6 °F
Pressure 762.1 mmHg
DO 26.5 %
DO 2.89 mg/L
SpC 371.4 µS/cm
Cond. 275.1 µS/cm
TDS 0.30 g/L
Sal. 0.23 ppt
pH 7.34
ORP -50.6 mV
Turb. 4.0 FNU

Rite in the Rain

04.16.19 TDo

WW pH 7.26

Turb. 8.4 NTU/FNU

1145 Lunch break

1240 Retrieve traps at SE2

1310 Retrieve traps at SB1

1330 LWD near Photo point C, decay class IV

diameter = 13in

length = 50 in.

no bark, moss all over north side

47.80332 °N

122.38392 °W

1334 LWD, decay class IV

18 in diameter

10 ft 5 in. in length

slightly more decayed than LWD@1330

47.80842°N

122.38728°W

1345 LWD along Willow Creek, decay class IV

diameter = 6 in

length ≈ 10 ft

47.80663°N, 122.38728°W

no bark, not much decay

1440 Retrieve Fallout traps

@ NE4

1530 leave Edmonds marsh A. Hawley

4/16/19

MADE IN TACOMA
— SINCE 1916 —
Rite in the Rain®
DEFYING MOTHER NATURE

WHAT to write with? for BEST results

USE WET OR DRY
most pens stop writing when wet
- ALL PENCILS
- *RITE IN THE RAIN PENS*
- WAX MARKERS
- CRAYONS
- OIL PASTELS / PAINT

WHEN DRY ONLY
what you write won't wash off
- PERMANENT MARKERS
- STANDARD BALLPOINTS

WON'T WORK
water-based inks bead off sheet
- GEL PENS
- MOST HIGHLIGHTERS
- FOUNTAIN PENS
- WATER COLORS
- ACRYLIC PAINT

Yes, Rite in the Rain is a wood-based & recyclable paper, but unlike plain paper... **it won't turn to mush when exposed to:**

rain storms · heavy sweat · oil & grease · mud & grime · laundry mishap

ALL-WEATHER TOUGH!

BRAND HISTORY
J.L. DARLING est. 1916

The *Rite in the Rain* story began a century ago in the forests of the Great Pacific Northwest. Entrepreneur Jerry Darling recognized the logging industry's need for a durable material that could be written on and survive in poor weather conditions. Jerry developed a special coating that created a unique moisture shield on the hand-dipped sheets of paper that he and his wife, Mary, processed at their home. From these humble beginnings our first all-weather paper was born. Over the many years we've perfected and patented our environmentally responsible coating process. Still located in Tacoma, our continued mission is to provide innovative products for professionals and enthusiasts who brave the outdoors.

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6 32281 03119 2

Rite in the Rain®

ALL-WEATHER

LEVEL

Nº 311FX

Edmonds Marsh
Field Notebook #3

04/15/19 – 7/1/19

04/15/19 Spring Monitoring J. Love

CTD data logger maint.

14:35 Pulled logger #7 (from cattail patch down Willow Cr. from Hatchery). Data downloaded, logger cleaned + placed back in casing. Set to re-start @ 15:30.

15:01 Pulled logger #8 (from W side of SR-104 culvert). Data downloaded, logger cleaned + placed back in casing. Set to re-start @ 15:30.

15:09 Pulled logger #9 (from E side of SR-104 culvert). Data downloaded, logger cleaned + placed back in casing. Set to re-start @ 15:30.

Wildlife obs. from 04/15 (entire day):

- @ Hatchery heard pileated woodpecker, flickers, ruby-crowned kinglets, chickadees, robins. Saw crow bathing in Willow Cr. and a male mallard in the creek. Saw a marsh wren @ nest (nest built into dead, standing stalks/leaves of last year's cattails) w/in Marsh interior from Hatchery near Photo Station J. Observed sack of large frog eggs w/in Shellabarger Cr. just upstream from (E of) SR-104 culvert - very near culvert. Bewick's wrens heard within and around hatchery. Song sparrows seen and heard in Hatchery and in Marsh interior from Hatchery. Saw deer ~~foraging~~ browsing along Willow Cr. w/in Hatchery.

J. Love

04/15/19

Rite in the Rain

04/16/19

wildlife observations from today's field work:

while collecting vegetation data in SE buffer zone, heard a rufous hummingbird and heard + saw two red-tailed hawks. One of the hawks had a snake in its talons, and the other appeared to be trying to take it. while collecting data in N buffer zone saw 3 American wigeons foraging in the Marsh mudflat areas during low tide. Also heard killdeer vocalizing from mudflat areas. Saw Anna's hummingbird in the native shrub-planted portion of the N buffer zone. Heard white-crowned sparrows + common yellowthroat singing from within marsh, as well as marsh wren

from the western (salt) portion of the marsh.

J. 04/16/19

Rite in the Rain

05/07/19 J. Love

Spring bird surveys.
Weather: Clear, 50°F, calm (no wind)
Sunrise @ 05:41.

05:40 Arrive @ Shellabarger Marsh
for first survey.

06:00 Arrive @ Harbor Square to
survey n. Buffer Zone &
marsh interior stations.

Note about veg. along S. side of
Willow Cr. near BPC-2: Pine
trees (dead + alive - good snags). Scotch
broom. black twin., ivy. salmonberry,
willow.

06:48 Arrive @ Willow Cr. Hatchery
to survey last 2 stations.

07:30 Completed bird surveys and
adjusted position of Hatchery
trail camera. Depart site.
End of field work for day.

05/23/19 J. RHEUBEN

0939 ARRIVE TO E. M. FOR SURVEYOR/
DOWNLOAD DATA LOGGERS.
J. LOVE] WW ENV
J. RHEUBEN
DOUG ______] DHA SURVEYORS
SUNNY 60-70s IN TEMP.

0955 LOCATE STATION 3 AND
DOWNLOAD DATA USING DIVER-FIELD
↳ ISSUES w/ DIVER OFFICE
SERIAL - V7470
note - Fouled w/ SEAWEED.

1010 TECHNICAL ISSUES w/ SOFTWARE
TROUBLESHOOTING

1035 SUCCESSFUL DATA RETRIEVAL
OF STATION 3 (V7470)
RESET + REDEPLOY
1200 PM START TIME

1049 LOCATE STATION 4, DOWNLOAD
DATA, ~~RE~~

1052 RESET + REDEPLOY — 1200 START
TIME

Rite in the Rain

05/23/2019 J.RHEOBEN

1100 MEET SURVEYOR AND ~~THE~~ ASSIST w/ SURVEY ON STATION 3 + REDEPLOY

1113 ASSIST w/ SURVEY OF STATION 4 REDEPLOY

1028 ARRIVE @ STATION 5 (V7476) AND DOWNLOAD DATA. SURVEYING SIMULTANEOUSLY IN PROCESS. RESET (BEGIN @ 1200) + Redeploy

1142 ARRIVE @ STATION 2 - NO DATA LOGGER. SURVEYING ASSIST.

1201 ARRIVE @ STATION 1 (V7481) + DOWNLOAD DATA, SURVEYING SIMULTANEOUSLY IN PROCESS
note - DIVER popped up error - PRESSURE HIT MAXIMUM VALUE
RESET (BEGIN @ 1300) + Redeploy
Reading pressure @ 2150 cm H_2O

1225 ARRIVE @ WILLOW CREEK FISH HATCHERY

---

425 275 4508
425 771 0235 ext

05/23/19 J.RHEOBEN

1239 ARRIVE @ STATION 7 (V 7468) DOWNLOAD DATA. SURVEYING SIMULTANEOUSLY IN PROCESS. RESET + REDEPLOY (BEGIN @ 1300)

1241 TAKE BAROMETRIC DATA RESET + REDEPLOY (BEGIN @ 1300)

1307 ARRIVE @ STATION 8 (V 7480) DOWNLOAD DATA, SURVEYING SIMULTANEOUSLY. RESET + REDEPLOY (BEGIN @ 1350)

1318 ARRIVE @ STATION 9 (V 7478) DOWNLOAD DATA, SURVEYING SIMULTANEOUSLY.
Reset + Redeploy (BEGIN @ 1330)
note time difference - DST

1346 ARRIVE @ OUTFALL STATION (STATION 6). NO ~~CTD~~ JR CTD LOGGER PRESENT. ASSIST w/ SURVEY.

1400 WORK COMPLETE, DEMOBILIZE BACK TO WINDWARD

Rite in the Rain

05/23/19 J. Love

<u>Wildlife observations</u>: Swainson's thrush heard @ willow cr. Fish Hatchery, 2 purple martins flying over marsh (seen + heard), Killdeer seen + heard on mudflats.

05.23.19 J.Love - wildlife obs.

7-1-2019 J. RHEUBEN

1123 ARRIVE AT HATCHERY SITE. MEET W. R. GOUGET.

1134 ARRIVE @ WQ STATION ~~4~~ 7 JR 7-1-19. PULL LOGGER, INSTALL CAP + LEAD LINE. [V 7468] PULL WILDLIFE CAM. #1 JR 7-1-19

1201 ARRIVE @ WQ STATION 8. VEGETATION HEAVY, REQ. REMOVAL. INSTALL CAP + LEAD LINE ADJ. TO CULVERT. [V 7480]

1206 ARRIVE @ WQ STATION 9. PVC HOLDER WAS REMOVED AND REPLACED. NOTE! THIS INVALIDATES ELEVS. TAKEN BY SURVEYOR. INSTALL CAP + LEADLINE.

1221 MOBILIZE + ARRIVE TO HARBOR SQUARE.

7-1-2019 J. RHEUBEN

1227 ARRIVE TO WQ STATION 3.
REMOVE PHOTO POINT STATION MATERIALS
~~CAP~~ PULL LOGGER, CAP + INSTALL
LEAD LINE.

1236 ARRIVE TO WQ STATION 4.
PULL LOGGER, CAP + INSTALL LEAD LINE.
NOTE. LOGGER IS INNUNDATED w/
SEDIMENT. [√7471]

1243 ARRIVE TO WQ STATION 5. PULL LOGGER,
CAP + INSTALL LEAD LINE.

1250 ARRIVE AT WQ STATION 2.
CAP + INSTALL LEAD LINE.

1256 ARRIVE AT WQ STATION 1.
CAP + INSTALL LEAD LINE.
PULL. WILDLIFE CAMERA 3.

1315 PULL WILDLIFE CAMERA ~~4~~ 2, JR 7-2-19
PULL BENTHIC INVERT SAMPLE
TRANSECTS.

1345 DEMOBILIZE TO WINDWARD

7-1-2019

Study Field Work Completed.

APPENDIX C. SOIL AND SEDIMENT LABORATORY REPORT

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Analytical Resources, Incorporated
Analytical Chemists and Consultants

01 November 2018

Amara Vandervort
Windward Environmental, LLC
200 West Mercer Street, Suite 401
Seattle, WA 98119-3958

RE: Edmonds Marsh Baseline

Please find enclosed sample receipt documentation and analytical results for samples from the project referenced above.

Sample analyses were performed according to ARI's Quality Assurance Plan and any provided project specific Quality Assurance Plan. Each analytical section of this report has been approved and reviewed by an analytical peer, the appropriate Laboratory Supervisor or qualified substitute, and a technical reviewer.

Should you have any questions or problems, please feel free to contact us at your convenience.

Associated Work Order(s)	Associated SDG ID(s)
18J0136	N/A

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the enclose Narrative. ARI, an accredited laboratory, certifies that the report results for which ARI is accredited meets all the requirements of the accrediting body. A list of certified analyses, accreditations, and expiration dates is included in this report.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his/her designee, as verified by the following signature.

Analytical Resources, Inc.

Susan Dunnihoo

Susan Dunnihoo, Director, Client Services

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

ACCREDITED IN ACCORDANCE WITH nelac
Cert# 100006-011

PJLA Testing
Accreditation # 66169

1 of 1 18J0136

CHAIN-OF-CUSTODY/TEST REQUEST FORM

№ 3173

Project/Client Name: Edmonds Marsh - Fall 2018
Project Number: Task 1 - Baseline Study
Contact Name: Amara Vandervort
Sampled By: J. Rheuben, N. Maas, T. DO

Ship to: ARI
Attn: Sue Dunnihoo
Shipper: hand del'd
Form filled out by: T. DO

Shipping Date: 10.05.18
Airbill Number:
Turnaround requested: Std.

Sample Collection Date (m/d/y)	Time	Sample Identification	Volume of Sample / # of Containers	Matrix	Test(s) Requested (check test(s) required)							Comments / Instructions [Jar tag number(s)]
					Grain size	TOC/pH	bulk density					
10.05.18	0753	EDM18-SED4	2	SED	X	X						
	0810	EDM18-SED3	2	SED	X	X						
	0823	EDM18-SED2	2	SED	X	X						
	0832	EDM18-SED1	2	SED	X	X						
	0920	EDM18-SOIL1	3	SOIL	X	X	X					BD WW 1340g
	0950	EDM18-SOIL2	3	SOIL	X	X	X					BD WW 1398g
	1022	EDM18-SOIL3	3	SOIL	X	X	X					BD WW 1528g
	1035	EDM18-SOIL4	3	SOIL	X	X	X					BD WW 1658g
		Total Number of Containers	20	Purchase Order / Statement of Work #								

1) Released by: WINDWARD	1) Rec'd by: Stephanie Fisher	2) Released by:	2) Rec'd by:
Print name: JENNA RHEUBEN		Print name:	
Signature:		Signature:	
Company:	Company: ARI	Company:	Company:
Date/Time: 10/5/18 1417	Date/Time: 10-5-18 1418	Date/Time:	Date/Time:

* Distribution: White copies accompany shipment; yellow retained by consignor.

Windward environmental LLC

200 West Mercer Street
Suite 401
Seattle, WA 98119
Tel: (206) 378-1364
Fax: (206) 217-9343

To be completed by Laboratory upon sample receipt:

Date of receipt::	Laboratory W.O. #:
Condition upon receipt:	Time of receipt:
Cooler temperature:	Received by:

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Windward
Project Name: Edmonds Marsh
COC No(s): [✓ NA]
Delivered by: Fed-Ex UPS Courier [✓ Hand Delivered] Other:
Assigned ARI Job No: 18J0136
Tracking No: NA

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler?	YES	[✓ NO]
Were custody papers included with the cooler?	[✓ YES]	NO
Were custody papers properly filled out (ink, signed, etc.)	[✓ YES]	NO

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry) 12.8
Time: 1410
If cooler temperature is out of compliance fill out form 00070F
Temp Gun ID#: D002565
Cooler Accepted by: Sef Date: 10-5-18 Time: 1418

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	[✓ NO]
What kind of packing material was used? ... Bubble Wrap Wet Ice Gel Packs [✓ Baggies] Foam Block Paper Other:			
Was sufficient ice used (if appropriate)?	NA	YES	[✓ NO]
Were all bottles sealed in individual plastic bags?		YES	[✓ NO]
Did all bottles arrive in good condition (unbroken)?		[✓ YES]	NO
Were all bottle labels complete and legible?		[✓ YES]	NO
Did the number of containers listed on COC match with the number of containers received?		[✓ YES]	NO
Did all bottle labels and tags agree with custody papers?		[✓ YES]	NO
Were all bottles used correct for the requested analyses?		[✓ YES]	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...	[✓ NA]	YES	NO
Were all VOC vials free of air bubbles?	[✓ NA]	YES	NO
Was sufficient amount of sample sent in each bottle?		[✓ YES]	NO
Date VOC Trip Blank was made at ARI	[✓ NA]		

Was Sample Split by ARI : [✓ NA] YES Date/Time: Equipment: Split by:

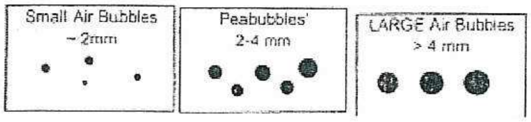
Samples Logged by: JBW Date: 10/05/18 Time: 1659

*** Notify Project Manager of discrepancies or concerns ***

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

By: Date:



Small → "sm" (< 2 mm)
Peabubbles → "pb" (2 to < 4 mm)
Large → "lg" (4 to < 6 mm)
Headspace → "hs" (> 6 mm)

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Temperature Compliance Form

ARI Work Order: 18J0136

Cooler#: 1 **Temperature(°C):** 12.8

Sample ID	Bottle Count	Bottle Type
Samples received above 10°		

Cooler#: **Temperature(°C):**

Sample ID	Bottle Count	Bottle Type

Cooler#: **Temperature(°C):**

Sample ID	Bottle Count	Bottle Type

Cooler#: **Temperature(°C):**

Sample ID	Bottle Count	Bottle Type

Completed by: Date: 10-5-18 Time: 1418

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: 18J0136
Project #: 18S010-72
Client : Analytical Resources, Inc.
Source: Multiple
MTC Sample#: Multiple

Date Received: October 9, 2018
Sampled By: Others
Date Reported: October 31, 2018
Tested By: B. Goble, K. DeChurch

CASE NARRATIVE

1. Eight samples were submitted for grain size analysis according to Puget Sound Estuary Protocol (PSEP) methodology. The samples were run in a single batch and one sample from this job was chosen for triplicate analysis. The triplicate data is reported on the QA summary. The samples contained organic matter which may have broken down, affecting the grain size analysis.
2. Four samples were submitted for bulk density (wet/dry density) determination.
3. The data is provided in summary tables and plots.
4. There were no other noted anomalies during this testing.

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Reviewed by: Elizabeth Goble

Project: 18J0136

Project #: 18S010-72

Date Received: October 9, 2018

Date Tested: October 25, 2018

Client: Analytical Resources, Inc.

Sampled by: Others

Tested by: B. Goble, K. DeChurch

Apparent Grain Size Distribution Summary

Percent Finer Than Indicated Size

Sample No.	Gravel			Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt				Clay	
Phi Size	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
Sieve Size (microns)	3/8"	#4 (4750)	#10 (2000)	#18 (1000)	#35 (500)	#60 (250)	#120 (125)	#230 (63)	31.0	15.6	7.8	3.9	2.0	1.0
18J01336-06	100.0	86.4	74.2	65.2	45.6	17.1	11.7	10.1	5.4	4.4	3.2	1.3	0.9	0.5
	100.0	88.6	74.6	65.1	44.0	15.2	10.1	8.7	4.6	3.8	2.7	1.2	0.7	0.5
	100.0	86.6	74.8	65.0	43.8	15.3	10.3	8.7	5.3	4.5	3.4	1.5	0.9	0.6
18J0136-01	100.0	94.2	91.8	84.0	77.4	69.5	65.4	62.5	56.5	39.6	27.4	19.0	14.5	9.9
18J0136-02	100.0	73.8	58.4	49.6	43.7	39.6	36.5	34.5	31.5	24.9	21.4	17.2	15.6	13.0
18J0136-03	100.0	97.2	93.5	88.6	84.2	79.6	75.9	69.7	50.9	32.0	22.3	16.5	13.1	9.1
18J0136-04	100.0	95.7	63.7	44.7	34.5	27.8	24.1	19.8	18.1	10.0	8.3	7.1	6.7	6.2
18J0136-05	100.0	90.8	63.2	41.9	29.2	21.4	15.8	14.9	4.2	3.9	3.3	1.9	1.3	0.8
18J0136-07	100.0	91.0	80.4	67.1	52.9	27.5	16.7	13.2	9.4	6.8	4.8	2.7	1.8	0.9
18J0136-08	100.0	95.1	87.8	83.5	77.1	52.8	28.3	18.9	13.4	9.3	6.5	3.4	2.0	1.0

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Reviewed by: ______________________

Project: 18J0136
Project #: 18S010-72
Date Received: October 9, 2018
Date Tested: October 25, 2018

Client: Analytical Resources, Inc.
Sampled by: Others
Tested by: B. Goble, K. DeChurch

Apparent Grain Size Distribution Summary

Percent Retained in Each Size Fraction

Sample No.	Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Coarse Silt	Medium Silt	Fine Silt	Very Fine Silt	Clay			Total Fines
Phi Size	< -1	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	> 10	> 4
Sieve Size (microns)	> #10 (2000)	10-18 (2000-1000)	18-35 (1000-500)	35-60 (500-250)	60-120 (250-125)	120-230 (125-62)	62.5-31.0	31.0-15.6	15.6-7.8	7.8-3.9	3.9-2.0	2.0-1.0	<1.0	<230 (<62)
18J01336-06	25.8	9.0	19.6	28.5	5.4	1.6	4.7	1.0	1.1	1.9	0.4	0.3	0.5	10.1
	25.4	9.5	21.1	28.8	5.1	1.4	4.1	0.8	1.2	1.5	0.5	0.2	0.5	8.7
	25.2	9.8	21.1	28.6	5.0	1.6	3.4	0.8	1.2	1.9	0.6	0.3	0.6	8.7
18J0136-01	8.2	7.8	6.6	7.9	4.1	2.9	6.1	16.8	12.2	8.4	4.6	4.6	9.9	62.5
18J0136-02	41.6	8.9	5.9	4.1	3.0	2.0	3.0	6.6	3.5	4.2	1.6	2.5	13.0	34.5
18J0136-03	6.5	4.9	4.4	4.6	3.7	6.2	18.8	18.9	9.7	5.8	3.4	4.0	9.1	69.7
18J0136-04	36.3	19.0	10.2	6.7	3.8	4.2	1.8	8.0	1.8	1.1	0.5	0.5	6.2	19.8
18J0136-05	36.8	21.3	12.7	7.8	5.5	0.9	10.7	0.3	0.7	1.3	0.6	0.5	0.8	14.9
18J0136-07	19.6	13.3	14.3	25.3	10.9	3.5	3.7	2.6	2.0	2.1	0.9	0.9	0.9	13.2
18J0136-08	12.2	4.3	6.3	24.4	24.5	9.4	5.5	4.1	2.8	3.1	1.4	1.1	1.0	18.9

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Reviewed by: EGabe Goble

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: 18J0136
Project #: 18S010-72
Date Received: October 9, 2018
Date Tested: October 25, 2018

Client: Analytical Resources, Inc.
Sampled by: Others
Tested by: B. Goble, K. DeChurch

Relative Standard Deviation, By Phi Size

Sample ID	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
18J01336-06	100.0	86.4	74.2	65.2	45.6	17.1	11.7	10.1	5.4	4.4	3.2	1.3	0.9	0.5
	100.0	88.6	74.6	65.1	44.0	15.2	10.1	8.7	4.6	3.8	2.7	1.2	0.7	0.5
	100.0	86.6	74.8	65.0	43.8	15.3	10.3	8.7	5.3	4.5	3.4	1.5	0.9	0.6
AVE	100.0	87.2	74.5	65.1	44.5	15.9	10.7	9.2	5.1	4.2	3.1	1.3	0.8	0.6
STDEV	0.0	1.0	0.2	0.1	0.8	0.9	0.7	0.7	0.3	0.3	0.3	0.1	0.1	0.0
%RSD	0.0	1.1	0.3	0.1	1.8	5.4	6.7	7.1	6.5	6.9	9.3	10.1	9.9	7.0

The Triplicate Applies To The Following Samples

Client ID	Date Sampled	Date Extracted	Date Complete	QA Ratio (95-105)	Data Qualifiers	Pipette Portion (5.0-25.0g)
18J01336-06	10/5/2018	10/11/2018	10/25/2018	104.8		8.8
	10/5/2018	10/11/2018	10/25/2018	104.1		7.2
	10/5/2018	10/11/2018	10/25/2018	103.3		6.9
18J0136-01	10/5/2018	10/11/2018	10/25/2018	96.2		10.4
18J0136-02	10/5/2018	10/11/2018	10/25/2018	99.2		6.9
18J0136-03	10/5/2018	10/11/2018	10/25/2018	101.1		10.0
18J0136-04	10/5/2018	10/11/2018	10/25/2018	99.1		6.6
18J0136-05	10/5/2018	10/11/2018	10/25/2018	101.5		8.0
18J0136-07	10/5/2018	10/11/2018	10/25/2018	102.1		15.1
18J0136-08	10/5/2018	10/11/2018	10/25/2018	99.9		6.7

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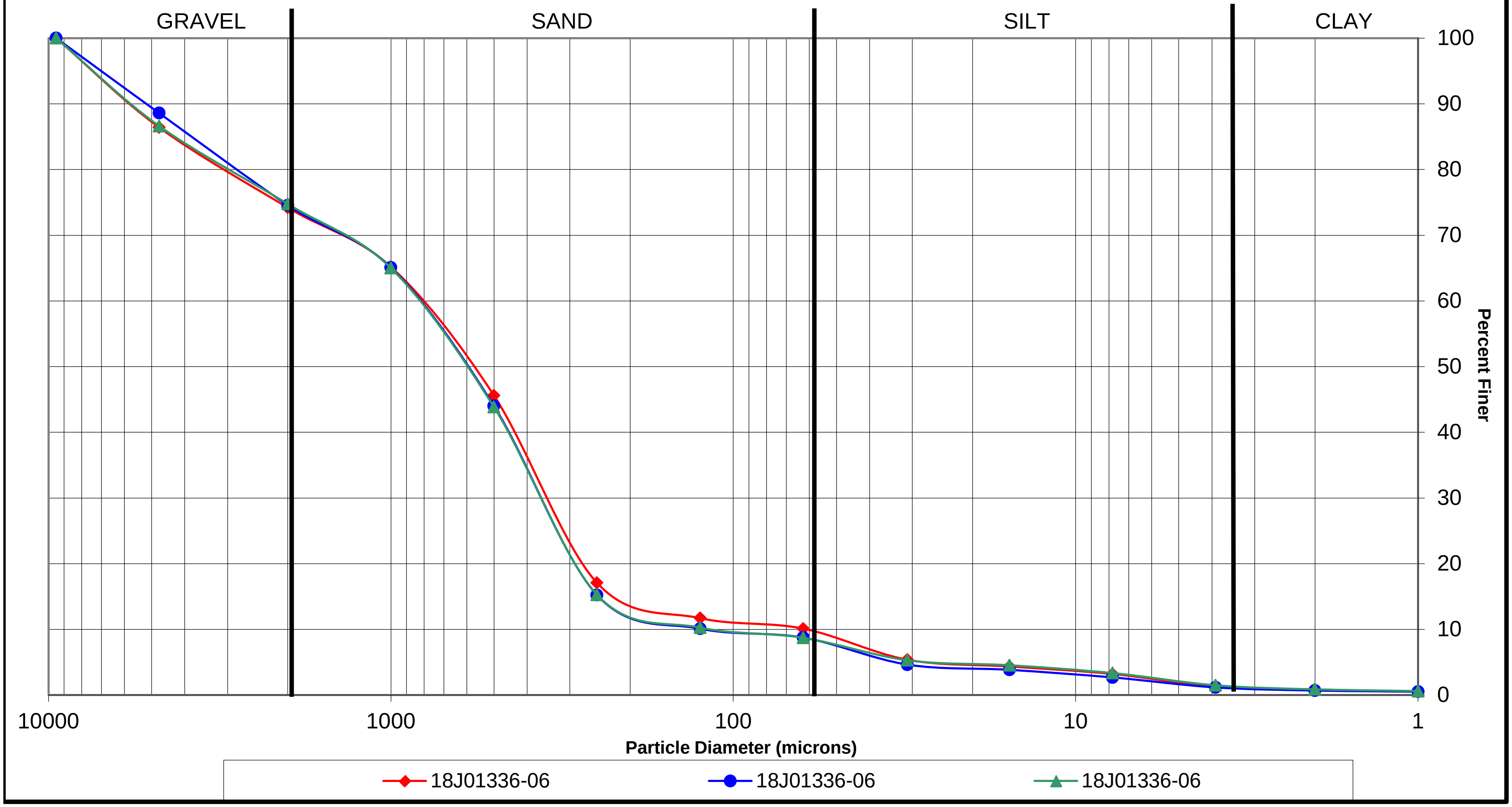
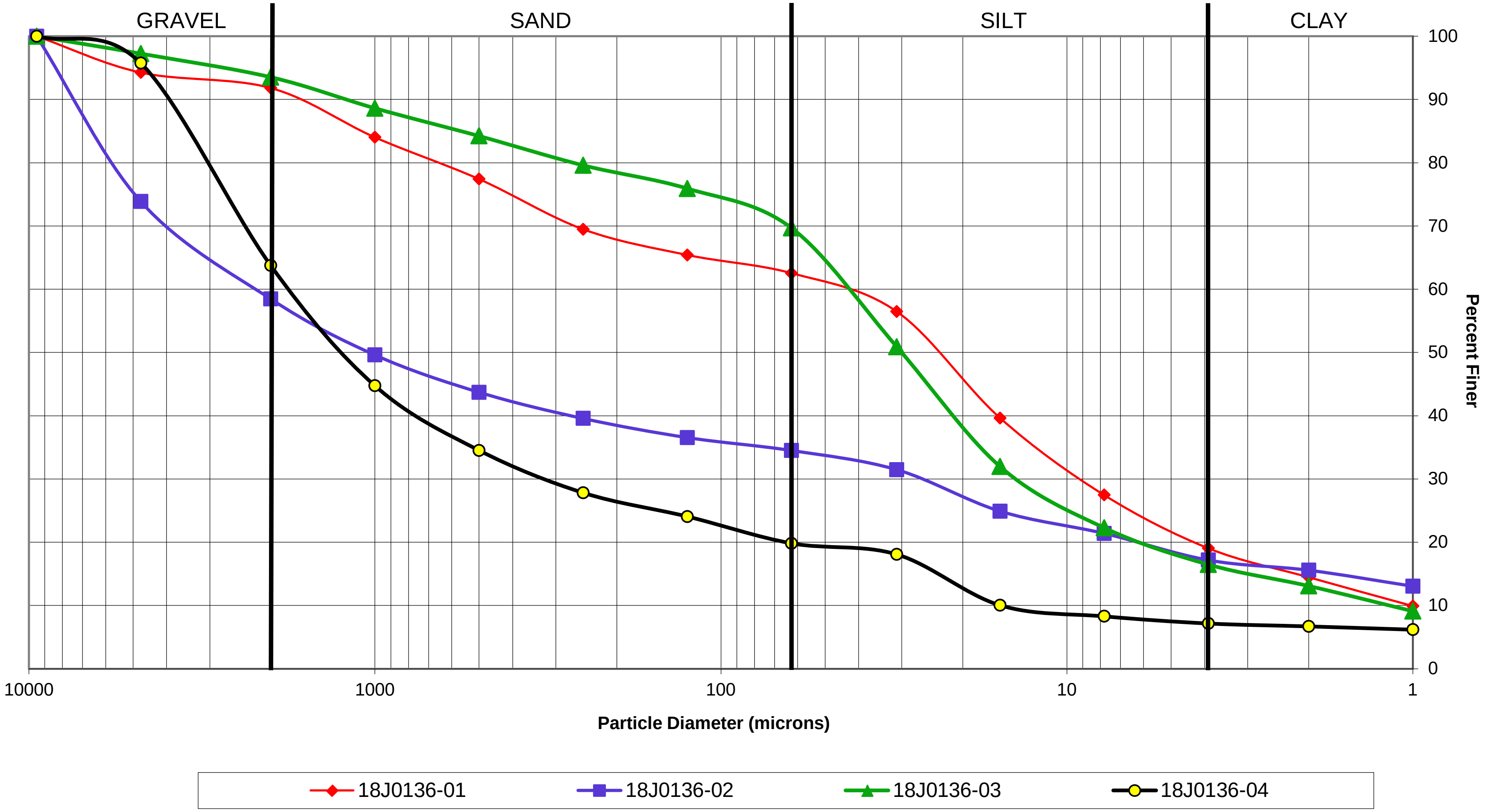
Reviewed by: EGabe Goble

PSEP Grain Size Distribution

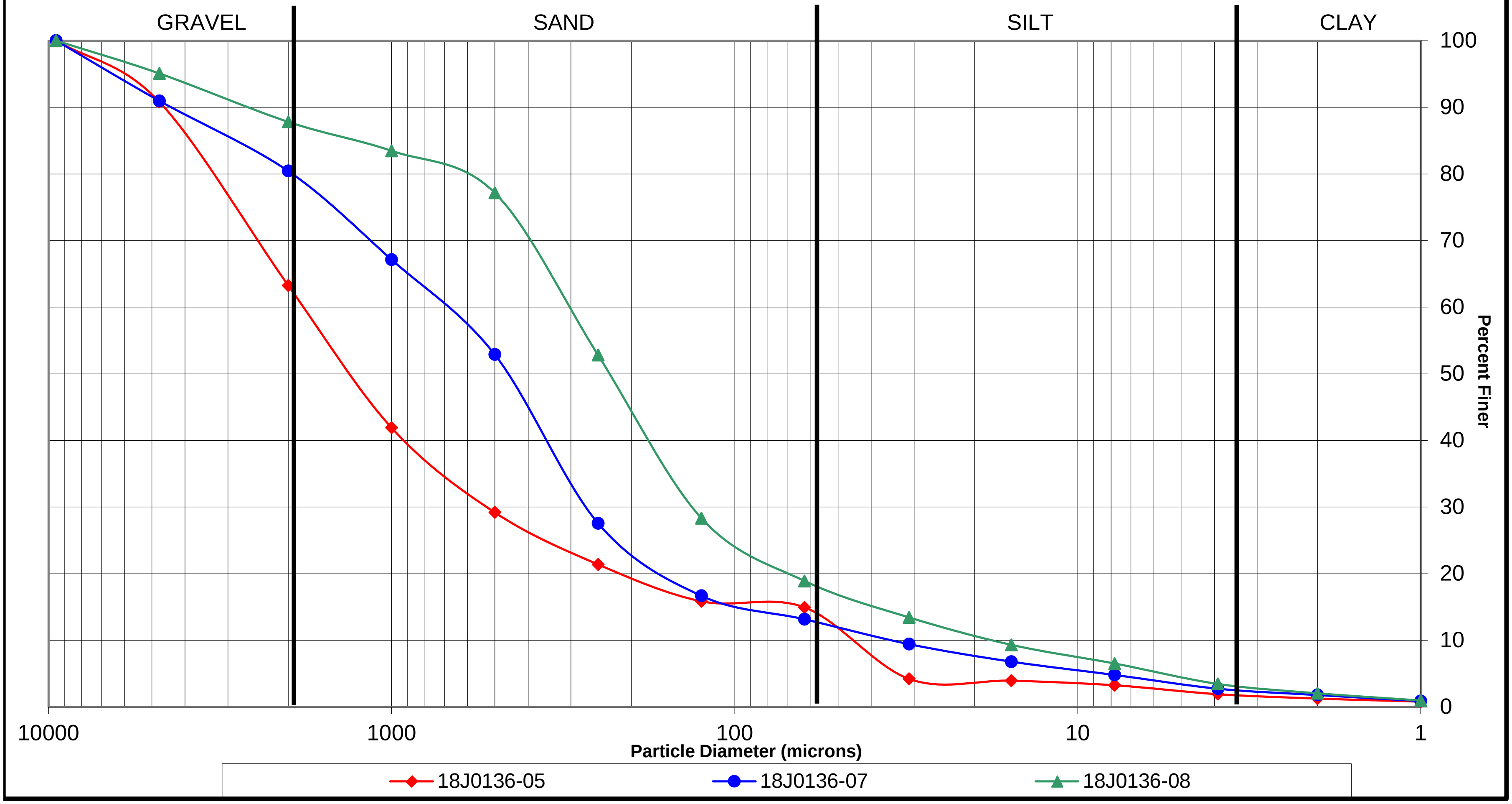
Triplicate Sample Plot



PSEP Grain Size Distribution



PSEP Grain Size Distribution



Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: 18J0136
Project #: 18S010-72
Date Received: October 9, 2018
Date Tested: October 16, 2018

Client: Analytical Resources, Inc.

Sampled by: Others
Tested by: B. Goble

Bulk Density

Sample #	Wet Density, pcf	Moisture Content, %	Dry Density, pcf
18J0136-05	85.7	107.1%	41.4
18J0136-06	97.9	72.2%	56.8
18J0136-07	101.3	53.9%	65.8
18J0136-08	112.8	31.5%	85.8

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Reviewed by:

Case Narrative

Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline
Work Order: 18J0136

Sample receipt

Samples as listed on the preceding page were received 05-Oct-2018 14:18 under ARI work order 18J0136. For details regarding sample receipt, please refer to the Cooler Receipt Form.

Analyses for grainsize and bulk density were subcontracted to Materials Testing and Consulting in Olympia , WA.

Wet Chemistry (pH, Total Solids and TOC)

The samples were prepared and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The method blanks were clean at the reporting limits.

The LCS percent recoveries were within control limits.

The TOC laboratory QC was run in triplicate. As the computer system only handles duplicate analyses, the replicate samples have been reported as DUP1 and DUP2. The recovery for DUP2 is outside limits for a duplicate analysis, but evaluated as triplicates, the RSD is 13.9%.

ANALYTICAL REPORT FOR SAMPLES

Laboratory ID	Sample ID	Matrix	Date Sampled	Date Received
18J0136-01	EDM18-SED4	Solid	10/05/18 07:53	10/05/18 14:18
18J0136-02	EDM18-SED3	Solid	10/05/18 08:10	10/05/18 14:18
18J0136-03	EDM18-SED2	Solid	10/05/18 08:23	10/05/18 14:18
18J0136-04	EDM18-SED1	Solid	10/05/18 08:32	10/05/18 14:18
18J0136-05	EDM18-SOIL1	Solid	10/05/18 09:20	10/05/18 14:18
18J0136-06	EDM18-SOIL2	Solid	10/05/18 09:50	10/05/18 14:18
18J0136-07	EDM18-SOIL3	Solid	10/05/18 10:22	10/05/18 14:18
18J0136-08	EDM18-SOIL4	Solid	10/05/18 10:55	10/05/18 14:18

INTERNAL CHAIN OF CUSTODY

Work Order: 18J0136

Client:	Windward Environmental, LLC	Received:	05-Oct-2018 14:18
Project:	Edmonds Marsh Baseline	Received By:	Stephanie Fishel
Number:	Task 1 - Baseline Study	Temp (°C):	12.80

18J0136-01 (EDM18-SED4) Sampled 10/05/2018 07:53

Current Status	*Out*	*Location*	*In*
18J0136-01 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:02 by JBW	***START***	10/05/2018 17:02 by JBW
	10/05/2018 17:02 by JBW	***START***	10/05/2018 17:02 by JBW
	10/05/2018 17:02 by JBW	***START***	10/05/2018 17:02 by JBW
	10/05/2018 17:02 by JBW	***START***	10/05/2018 17:02 by JBW

18J0136-02 (EDM18-SED3) Sampled 10/05/2018 08:10

Current Status	*Out*	*Location*	*In*
18J0136-02 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW

18J0136-03 (EDM18-SED2) Sampled 10/05/2018 08:23

Current Status	*Out*	*Location*	*In*
18J0136-03 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW

18J0136-04 (EDM18-SED1) Sampled 10/05/2018 08:32

Current Status	*Out*	*Location*	*In*
18J0136-04 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW

18J0136-05 (EDM18-SOIL1) Sampled 10/05/2018 09:20

Current Status	*Out*	*Location*	*In*
18J0136-05 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW
	10/05/2018 17:03 by JBW	***START***	10/05/2018 17:03 by JBW

18J0136-06 (EDM18-SOIL2) Sampled 10/05/2018 09:50

Current Status	*Out*	*Location*	*In*
18J0136-06 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW

INTERNAL CHAIN OF CUSTODY

Work Order: 18J0136

Client:	Windward Environmental, LLC	Received:	05-Oct-2018 14:18
Project:	Edmonds Marsh Baseline	Received By:	Stephanie Fishel
Number:	Task 1 - Baseline Study	Temp (°C):	12.80

18J0136-07 (EDM18-SOIL3) Sampled 10/05/2018 10:22

Current Status	*Out*	*Location*	*In*
18J0136-07 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW

18J0136-08 (EDM18-SOIL4) Sampled 10/05/2018 10:55

Current Status	*Out*	*Location*	*In*
18J0136-08 B [Glass WM, Clear, 8 oz]			*Hazard Info:*
Sample Receiving	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW
	10/05/2018 17:04 by JBW	***START***	10/05/2018 17:04 by JBW

QUALIFIERS AND NOTES

Qualifier	Definition
U	This analyte is not detected above the applicable reporting or detection limit.
D	The reported value is from a dilution
*	Flagged value is not within established control limits.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SED4

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Sediment	Laboratory ID:	18J0136-01	SDG:	18J0136
Sampled:	10/05/18 07:53	Prepared:	10/11/18 08:25	File ID:	
% Solids:	36.75	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	5.18	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SED3

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-02	SDG:	18J0136
Sampled:	10/05/18 08:10	Prepared:	10/11/18 08:25	File ID:	
% Solids:	12.53	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	4.32	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SED2

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-03	SDG:	18J0136
Sampled:	10/05/18 08:23	Prepared:	10/11/18 08:25	File ID:	
% Solids:	25.39	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	6.43	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SED1

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Sediment	Laboratory ID:	18J0136-04	SDG:	18J0136
Sampled:	10/05/18 08:32	Prepared:	10/11/18 08:25	File ID:	
% Solids:	15.91	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	6.32	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SOIL1

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Soil Laboratory ID: 18J0136-05 SDG: 18J0136

Sampled: 10/05/18 09:20 Prepared: 10/11/18 08:25 File ID:

% Solids: 14.89 Preparation: EPA 9045D Analyzed: 10/11/18 10:58

Batch: BGJ0389 Sequence: SGJ0194 Initial/Final: 20 g Wet / 20 mL

Instrument: Accumet AR60 Calibration: UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	6.57	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SOIL2

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Soil	Laboratory ID:	18J0136-06	SDG:	18J0136
Sampled:	10/05/18 09:50	Prepared:	10/11/18 08:25	File ID:	
% Solids:	32.55	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	6.21	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SOIL3

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Soil	Laboratory ID:	18J0136-07	SDG:	18J0136
Sampled:	10/05/18 10:22	Prepared:	10/11/18 08:25	File ID:	
% Solids:	73.82	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	4.57	1	0.01	0.01	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9045D

EDM18-SOIL4

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-08	SDG:	18J0136
Sampled:	10/05/18 10:55	Prepared:	10/11/18 08:25	File ID:	
% Solids:	64.37	Preparation:	EPA 9045D	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Sequence:	SGJ0194	Initial/Final:	20 g Wet / 20 mL
Instrument:	Accumet AR60			Calibration:	UNASSIGNED

CAS NO.	Analyte	Concentration (pH Units)	Dilution Factor	MDL	MRL	Q
	pH	5.86	1	0.01	0.01	

PREPARATION BATCH SUMMARY

EPA 9045D

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline
Batch: BGJ0389
Batch Matrix: Solid
Preparation: EPA 9045D

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
EDM18-SED4	18J0136-01		10/11/18 08:25	
EDM18-SED3	18J0136-02		10/11/18 08:25	
EDM18-SED2	18J0136-03		10/11/18 08:25	
EDM18-SED1	18J0136-04		10/11/18 08:25	
EDM18-SOIL1	18J0136-05		10/11/18 08:25	
EDM18-SOIL2	18J0136-06		10/11/18 08:25	
EDM18-SOIL3	18J0136-07		10/11/18 08:25	
EDM18-SOIL4	18J0136-08		10/11/18 08:25	
LCS	BGJ0389-BS1		10/11/18 08:25	
EDM18-SED4	BGJ0389-DUP1		10/11/18 08:25	

EDM18-SED4

DUPLICATES

EPA 9045D

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Matrix: Solid

Batch: BGJ0389

Preparation: EPA 9045D

Source Sample Name: EDM18-SED4

SDG: 18J0136

Project: Edmonds Marsh Baseline

Laboratory ID: BGJ0389-DUP1

Lab Source ID: 18J0136-01

Initial/Final: 20 g / 20 mL

% Solids: 36.75

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION	DUPLICATE CONCENTRATION	RPD %	Q
pH	20	5.18	5.19	0.193	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

LCS / LCS DUPLICATE RECOVERY

EPA 9045D

Laboratory:	Analytical Resources, Inc.	SDG:	18J0136
Client:	Windward Environmental, LLC	Project:	Edmonds Marsh Baseline
Matrix:	Solid	Analyzed:	10/11/18 10:58
Batch:	BGJ0389	Laboratory ID:	BGJ0389-BS1
Preparation:	EPA 9045D	Sequence Name:	LCS
Initial/Final:	20 g / 20 mL		

COMPOUND	SPIKE ADDED (pH Units)	LCS CONCENTRATION (pH Units)	Q	LCS % REC. #	QC LIMITS REC.
pH	7.00	7.03		100	0 - 200

* Indicates values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9045D

Laboratory:	Analytical Resources, Inc.	SDG:	18J0136
Client:	Windward Environmental, LLC	Project:	Edmonds Marsh Baseline
Sequence:	SGJ0194	Instrument:	Accumet AR60
		Calibration:	UNASSIGNED

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Initial Cal Check	SGJ0194-ICV1		NA	10/11/18 10:58
LCS	BGJ0389-BS1		Solid	10/11/18 10:58
EDM18-SED4	18J0136-01		Solid	10/11/18 10:58
EDM18-SED4	BGJ0389-DUP1		Solid	10/11/18 10:58
EDM18-SED3	18J0136-02		Solid	10/11/18 10:58
EDM18-SED2	18J0136-03		Solid	10/11/18 10:58
EDM18-SED1	18J0136-04		Solid	10/11/18 10:58
EDM18-SOIL1	18J0136-05		Solid	10/11/18 10:58
EDM18-SOIL2	18J0136-06		Solid	10/11/18 10:58
EDM18-SOIL3	18J0136-07		Solid	10/11/18 10:58
EDM18-SOIL4	18J0136-08		Solid	10/11/18 10:58
Calibration Check	SGJ0194-CCV1		NA	10/11/18 10:58
Calibration Check	SGJ0194-CCV2		NA	10/11/18 10:58

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9045D

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Instrument ID: Accumet AR60

Calibration: UNASSIGNED

Control Limt: +/- %

Sequence: SGJ0194

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SGJ0194-CCV1	pH	7.0000	7.03	100	pH Units	EPA 9045D
SGJ0194-CCV2	pH	7.0000	7.04	101	pH Units	EPA 9045D
SGJ0194-ICV1	pH	7.0000	7.02	100	pH Units	EPA 9045D

* Values outside of QC limits

HOLDING TIME SUMMARY

Analysis: EPA 9045D

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
EDM18-SED4 18J0136-01	10/05/18 07:53	10/05/18 14:18	10/11/18 08:25	6	14	10/11/18 10:58			
EDM18-SED3 18J0136-02	10/05/18 08:10	10/05/18 14:18	10/11/18 08:25	6	14	10/11/18 10:58			
EDM18-SED2 18J0136-03	10/05/18 08:23	10/05/18 14:18	10/11/18 08:25	6	14	10/11/18 10:58			
EDM18-SED1 18J0136-04	10/05/18 08:32	10/05/18 14:18	10/11/18 08:25	5	14	10/11/18 10:58			
EDM18-SOIL1 18J0136-05	10/05/18 09:20	10/05/18 14:18	10/11/18 08:25	5	14	10/11/18 10:58			
EDM18-SOIL2 18J0136-06	10/05/18 09:50	10/05/18 14:18	10/11/18 08:25	5	14	10/11/18 10:58			
EDM18-SOIL3 18J0136-07	10/05/18 10:22	10/05/18 14:18	10/11/18 08:25	5	14	10/11/18 10:58			
EDM18-SOIL4 18J0136-08	10/05/18 10:55	10/05/18 14:18	10/11/18 08:25	5	14	10/11/18 10:58			
Duplicate BGJ0389-DUP1	10/05/18 07:53	10/05/18 14:18	10/11/18 08:25	6	14	10/11/18 10:58			

* Indicates hold time exceedance.

METHOD DETECTION
AND REPORTING LIMITS

EPA 9045D

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Instrument: Accumet AR60

Analyte	MDL	RL	Units
pH	0.01	0.01	pH Units

ThermoFisher
SCIENTIFIC

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

Certificate of Analysis

Thermo Fisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0090918

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. Thermo Fisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing. Fisher does not maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	**SB107**	**Quality Test / Release Date**	**2/7/2018**
Lot Number	**180084**	**Expiration Date**	**Feb/2020**
Description	**BUFFER SOLUTION, CERTIFIED, PH 7.00**		
Country of Origin	**United States**		
Chemical Origin	**Organic - non animal**		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		

Result name	Units	Specifications	Test Value
APPEARANCE		REPORT	Clear,yellow liquid
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST
NIST STD : pH 9.180	BORAX	= LOT 187E	LOT 187E
NIST STD USED: pH 7a	POT DIHYDRO PHOS	= LOT 186IG	LOT 186IG
NIST STD USED: pH 7b	DISOD HYDRO PHOS	= LOT 186IIG	LOT 186IIG
OPTICAL ABSORBANCE	PASS/FAIL	= PASS TEST	PASS TEST
PH AT 25 DEGREES C		Inclusive Between 6.99 - 7.01	7.00
TRACEABLE TO NIST	PASS/FAIL	= PASS TEST	PASS TEST

Teresa Bailey-Wyche

Quality Assurance Specialist - Certificate of Analysis Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as an extension of this catalog number listed above. If there are any questions with this certificate, please call (800) 227-6701.
*Based on suggested storage condition.

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SED4

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Sediment	Laboratory ID:	18J0136-01RE1	SDG:	18J0136
Sampled:	10/05/18 07:53	Prepared:	10/10/18 11:41	File ID:	10180658.prn
% Solids:	36.75	Preparation:	PSEP 1986 (modified)	Analyzed:	10/18/18 07:05
Batch:	BGJ0366	Sequence:	SGJ0282	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	8.16	1	0.02	0.02	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SED3

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Sediment	Laboratory ID:	18J0136-02	SDG:	18J0136
Sampled:	10/05/18 08:10	Prepared:	10/10/18 11:41	File ID:	10170955.prn
% Solids:	12.53	Preparation:	PSEP 1986 (modified)	Analyzed:	10/17/18 10:02
Batch:	BGJ0366	Sequence:	SGJ0234	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	9.56	1	0.02	0.02	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SED2

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Sediment	Laboratory ID:	18J0136-03	SDG:	18J0136
Sampled:	10/05/18 08:23	Prepared:	10/10/18 11:41	File ID:	10171231.prn
% Solids:	25.39	Preparation:	PSEP 1986 (modified)	Analyzed:	10/17/18 12:38
Batch:	BGJ0366	Sequence:	SGJ0234	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	7.07	1	0.02	0.02	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SED1

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-04RE1	SDG:	18J0136
Sampled:	10/05/18 08:32	Prepared:	10/10/18 11:41	File ID:	10171256.prn
% Solids:	15.91	Preparation:	PSEP 1986 (modified)	Analyzed:	10/17/18 13:02
Batch:	BGJ0366	Sequence:	SGJ0234	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	13.1	1	0.02	0.02	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SOIL1

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-05RE1	SDG:	18J0136
Sampled:	10/05/18 09:20	Prepared:	10/10/18 11:41	File ID:	10180856.prn
% Solids:	14.89	Preparation:	PSEP 1986 (modified)	Analyzed:	10/18/18 09:04
Batch:	BGJ0366	Sequence:	SGJ0282	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	35.6	10	0.20	0.20	D

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SOIL2

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-06	SDG:	18J0136
Sampled:	10/05/18 09:50	Prepared:	10/10/18 11:41	File ID:	10180909.prn
% Solids:	32.55	Preparation:	PSEP 1986 (modified)	Analyzed:	10/18/18 09:16
Batch:	BGJ0366	Sequence:	SGJ0282	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	18.0	10	0.20	0.20	D

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SOIL3

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-07	SDG:	18J0136
Sampled:	10/05/18 10:22	Prepared:	10/10/18 11:41	File ID:	10180919.prn
% Solids:	73.82	Preparation:	PSEP 1986 (modified)	Analyzed:	10/18/18 09:24
Batch:	BGJ0366	Sequence:	SGJ0282	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	2.40	1	0.02	0.02	

Form I
INORGANIC ANALYSIS DATA SHEET
EPA 9060A m

EDM18-SOIL4

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-08	SDG:	18J0136
Sampled:	10/05/18 10:55	Prepared:	10/10/18 11:41	File ID:	10180943.prn
% Solids:	64.37	Preparation:	PSEP 1986 (modified)	Analyzed:	10/18/18 09:50
Batch:	BGJ0366	Sequence:	SGJ0282	Initial/Final:	1 g Wet / 1 mL
Instrument:	APOLLO1			Calibration:	BE00079

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	3.41	1	0.02	0.02	

PREPARATION BATCH SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Batch: BGJ0366 Batch Matrix: Solid

Preparation: PSEP 1986 (modified)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
EDM18-SED4	18J0136-01RE1	10180658.prn	10/10/18 11:41	Added 10/18/2018 by KLE
EDM18-SED3	18J0136-02	10170955.prn	10/10/18 11:41	
EDM18-SED2	18J0136-03	10171231.prn	10/10/18 11:41	
EDM18-SED1	18J0136-04RE1	10171256.prn	10/10/18 11:41	Added 10/18/2018 by KLE
EDM18-SOIL1	18J0136-05RE1	10180856.prn	10/10/18 11:41	Added 10/18/2018 by KLE
EDM18-SOIL2	18J0136-06	10180909.prn	10/10/18 11:41	
EDM18-SOIL3	18J0136-07	10180919.prn	10/10/18 11:41	
EDM18-SOIL4	18J0136-08	10180943.prn	10/10/18 11:41	
Blank	BGJ0366-BLK1	10170812.prn	10/10/18 11:41	
EDM18-SED4	BGJ0366-DUP1	10180709.prn	10/10/18 11:41	
EDM18-SED4	BGJ0366-DUP2	10180719.prn	10/10/18 11:41	
MRL Check	BGJ0366-MRL1	10170801.prn	10/10/18 11:41	
EDM18-SED4	BGJ0366-MS1	10180827.prn	10/15/18 00:00	
Reference	BGJ0366-SRM1	10170856.prn	10/10/18 11:41	

Form I

METHOD BLANK DATA SHEET

EPA 9060A m

TotalAnalytes

Blank

Batch: BGJ0366
Laboratory ID: BGJ0366-BLK1
Prepared: 10/10/18 11:41
Matrix: Solid
Preparation: PSEP 1986 (modified)
Analyzed: 10/17/18 08:16
Sequence: SGJ0234
Calibration: BE00079
Instrument: APOLLO1

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Organic Carbon	ND	1	0.02	0.02	U

EDM18-SED4

DUPLICATES

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Laboratory ID: BGJ0366-DUP1

Batch: BGJ0366

Lab Source ID: 18J0136-01RE1

Preparation: PSEP 1986 (modified)

Initial/Final: 1 g / 1 mL

Source Sample Name: EDM18-SED4

% Solids: 36.75

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION	DUPLICATE CONCENTRATION	RPD %	Q
Total Organic Carbon	20	8.16	8.97	9.47	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

EDM18-SED4

DUPLICATES

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Laboratory ID: BGJ0366-DUP2

Batch: BGJ0366

Lab Source ID: 18J0136-01RE1

Preparation: PSEP 1986 (modified)

Initial/Final: 1 g / 1 mL

Source Sample Name: EDM18-SED4

% Solids: 36.75

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION	DUPLICATE CONCENTRATION	RPD %	Q
Total Organic Carbon	20	8.16	6.36	24.7	*

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

EDM18-SED4

MS / MS DUPLICATE RECOVERY
EPA 9060A m

Laboratory: Analytical Resources, Inc.
Client: Windward Environmental, LLC
Matrix: Solid
Batch: BGJ0366
Preparation: PSEP 1986 (modified)
Initial/Final: 2.404351 g / 2.404351 mL

SDG: 18J0136
Project: Edmonds Marsh Baseline
Analyzed: 10/18/18 08:34
Laboratory ID: BGJ0366-MS1
Sequence Name: Matrix Spike
Source Sample: EDM18-SED4

COMPOUND	SPIKE ADDED (%)	SAMPLE CONCENTRATION (%)	Q	MS CONCENTRATION (%)	Q	MS % REC. #	QC LIMITS REC.
Total Organic Carbon	5.32	8.16		13.6		103	75 - 125

* Values outside of QC limits

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Sequence: SGE0419

Instrument: APOLLO1

Calibration: BE00079

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Cal Standard	SGE0419-CAL1	5240836	NA	05/24/18 08:45
Cal Standard	SGE0419-CAL2	5240853	NA	05/24/18 09:13
Cal Standard	SGE0419-CAL3	5240935	NA	05/24/18 09:47
Cal Standard	SGE0419-CAL4	5241021	NA	05/24/18 10:32
Cal Standard	SGE0419-CAL5	5241044	NA	05/24/18 10:58
Initial Cal Check	SGE0419-ICV1	5241100	NA	05/24/18 11:04
Initial Cal Blank	SGE0419-ICB1	5241106	NA	05/24/18 11:09

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	18J0136
Client:	Windward Environmental, LLC	Project:	Edmonds Marsh Baseline
Sequence:	SGJ0234	Instrument:	APOLLO1
		Calibration:	BE00079

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Initial Cal Check	SGJ0234-ICV1	10170726.prn	NA	10/17/18 07:31
Initial Cal Blank	SGJ0234-ICB1	10170733.prn	NA	10/17/18 07:35
MRL Check	BGJ0366-MRL1	10170801.prn	Solid	10/17/18 08:04
Blank	BGJ0366-BLK1	10170812.prn	Solid	10/17/18 08:16
Reference	BGJ0366-SRM1	10170856.prn	Solid	10/17/18 09:00
EDM18-SED3	18J0136-02	10170955.prn	Solid	10/17/18 10:02
Calibration Check	SGJ0234-CCV1	10171032.prn	NA	10/17/18 10:38
Calibration Blank	SGJ0234-CCB1	10171040.prn	NA	10/17/18 10:48
EDM18-SED2	18J0136-03	10171231.prn	Solid	10/17/18 12:38
EDM18-SED1	18J0136-04RE1	10171256.prn	Solid	10/17/18 13:02
Calibration Check	SGJ0234-CCV2	10171306.prn	NA	10/17/18 13:12
Calibration Blank	SGJ0234-CCB2	10171313.prn	NA	10/17/18 13:20

ANALYSIS BATCH (SEQUENCE) SUMMARY

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	18J0136
Client:	Windward Environmental, LLC	Project:	Edmonds Marsh Baseline
Sequence:	SGJ0282	Instrument:	APOLLO1
		Calibration:	BE00079

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Initial Cal Check	SGJ0282-ICV1	10180621.prn	NA	10/18/18 06:26
Initial Cal Blank	SGJ0282-ICB2	10180637.prn	NA	10/18/18 06:39
EDM18-SED4	18J0136-01RE1	10180658.prn	Solid	10/18/18 07:05
EDM18-SED4	BGJ0366-DUP1	10180709.prn	Solid	10/18/18 07:16
EDM18-SED4	BGJ0366-DUP2	10180719.prn	Solid	10/18/18 07:26
EDM18-SED4	BGJ0366-MS1	10180827.prn	Solid	10/18/18 08:34
EDM18-SOIL1	18J0136-05RE1	10180856.prn	Solid	10/18/18 09:04
EDM18-SOIL2	18J0136-06	10180909.prn	Solid	10/18/18 09:16
EDM18-SOIL3	18J0136-07	10180919.prn	Solid	10/18/18 09:24
Calibration Check	SGJ0282-CCV1	10180927.prn	NA	10/18/18 09:32
Calibration Blank	SGJ0282-CCB1	10180934.prn	NA	10/18/18 09:36
EDM18-SOIL4	18J0136-08	10180943.prn	Solid	10/18/18 09:50
Calibration Check	SGJ0282-CCV2	10181057.prn	NA	10/18/18 11:02
Calibration Blank	SGJ0282-CCB2	10181112.prn	NA	10/18/18 11:15

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Calibration: BE00079

Instrument: APOLLO1

Calibration Date: 05/24/2018 8:00

Compound	Level 01		Level 02		Level 03		Level 04		Level 05		Level 06	
		RF		RF		RF		RF		RF		RF
Total Organic Carbon	0	0	200.02	8387.597	500.05	8008.403	1000.1	8222.479	2500.2	8419.511		

INITIAL CALIBRATION DATA

EPA 9060A m

Laboratory:	Analytical Resources, Inc.	SDG:	18J0136
Client:	Windward Environmental, LLC	Project:	Edmonds Marsh Baseline
Calibration:	BE00079	Instrument:	APOLLO1
Calibration Date:	05/24/2018 8:00		

COMPOUND	Mean RF	RF RSD	Linear COD	Quad COD	COD Limit	Q
Total Organic Carbon	6607.598	56.0	0.9998			

INSTRUMENT BLANKS

EPA 9060A m

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Instrument ID: APOLLO1

Sequence: SGE0419

SDG: 18J0136

Project: Edmonds Marsh Baseline

Calibration: BE00079

Date Analyzed: 05/24/18 11:09

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SGE0419-ICB1	Total Organic Carbon	38.0	200	200	ppm	

INSTRUMENT BLANKS
EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline
Instrument ID: APOLLO1
Calibration: BE00079
Sequence: SGJ0234
Date Analyzed: 10/17/18 07:35

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SGJ0234-ICB1	Total Organic Carbon	18.7	200	200	ppm	
SGJ0234-CCB1	Total Organic Carbon	23.7	200	200	ppm	
SGJ0234-CCB2	Total Organic Carbon	22.2	200	200	ppm	

INSTRUMENT BLANKS

EPA 9060A m

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Instrument ID: APOLLO1

Sequence: SGJ0282

SDG: 18J0136

Project: Edmonds Marsh Baseline

Calibration: BE00079

Date Analyzed: 10/18/18 06:39

Lab Sample ID	Analyte	Found	MDL	MRL	Units	C
SGJ0282-ICB2	Total Organic Carbon	18.7	200	200	ppm	
SGJ0282-CCB1	Total Organic Carbon	18.9	200	200	ppm	
SGJ0282-CCB2	Total Organic Carbon	18.3	200	200	ppm	

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Instrument ID: APOLLO1

Calibration: BE00079

Control Limt: +/- 10.00%

Sequence: SGE0419

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SGE0419-ICV1	Total Organic Carbon	1000.0	1080	108	ppm	EPA 9060A m

* Values outside of QC limits

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline
Instrument ID: APOLLO1
Calibration: BE00079
Control Limt: +/- 10.00%
Sequence: SGJ0234

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SGJ0234-ICV1	Total Organic Carbon	1000.0	1000	100	ppm	EPA 9060A m
SGJ0234-CCV1	Total Organic Carbon	1000.0	978	97.8	ppm	EPA 9060A m
SGJ0234-CCV2	Total Organic Carbon	1000.0	1020	102	ppm	EPA 9060A m

* Values outside of QC limits

INITIAL AND CONTINUING CALIBRATION CHECK

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Instrument ID: APOLLO1

Calibration: BE00079

Control Limt: +/- 10.00%

Sequence: SGJ0282

Lab Sample ID	Analyte	True	Found	%R	Units	Method
SGJ0282-ICV1	Total Organic Carbon	1000.0	978	97.8	ppm	EPA 9060A m
SGJ0282-CCV1	Total Organic Carbon	1000.0	962	96.2	ppm	EPA 9060A m
SGJ0282-CCV2	Total Organic Carbon	1000.0	1020	102	ppm	EPA 9060A m

* Values outside of QC limits

STANDARD REFERENCE MATERIAL RECOVERY

EPA 9060A m

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline
Matrix: Solid
Laboratory ID: BGJ0366-SRM1
Batch: BGJ0366
Initial/Final: 1 g / 1 mL
Preparation: PSEP 1986 (modified)
Analyzed: 10/17/2018 9:00
Standard ID: G009192
Description: NIST 1941 B prepped for TOC
Expires: 01/18/2019

ANALYTE	TRUE (%)	FOUND (%)	MDL	MRL	Q	SRM % REC.	QC LIMITS REC.
Total Organic Carbon	2.6768	2.54	0.02	0.02		94.9	75 - 125

* Values outside of QC limits

HOLDING TIME SUMMARY

Analysis: EPA 9060A m

Laboratory: Analytical Resources, Inc. SDG: 18J0136
Client: Windward Environmental, LLC Project: Edmonds Marsh Baseline

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
EDM18-SED4 18J0136-01RE1	10/05/18 07:53	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 07:05			
EDM18-SED3 18J0136-02	10/05/18 08:10	10/05/18 14:18	10/10/18 11:41	5	14	10/17/18 10:02			
EDM18-SED2 18J0136-03	10/05/18 08:23	10/05/18 14:18	10/10/18 11:41	5	14	10/17/18 12:38			
EDM18-SED1 18J0136-04RE1	10/05/18 08:32	10/05/18 14:18	10/10/18 11:41	5	14	10/17/18 13:02			
EDM18-SOIL1 18J0136-05RE1	10/05/18 09:20	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 09:04			
EDM18-SOIL2 18J0136-06	10/05/18 09:50	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 09:16			
EDM18-SOIL3 18J0136-07	10/05/18 10:22	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 09:24			
EDM18-SOIL4 18J0136-08	10/05/18 10:55	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 09:50			
Duplicate BGJ0366-DUP1	10/05/18 07:53	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 07:16			
Duplicate BGJ0366-DUP2	10/05/18 07:53	10/05/18 14:18	10/10/18 11:41	5	14	10/18/18 07:26			
Matrix Spike BGJ0366-MS1	10/05/18 07:53	10/05/18 14:18	10/15/18 00:00	9	14	10/18/18 08:34			

* Indicates hold time exceedance.

METHOD DETECTION AND REPORTING LIMITS

EPA 9060A m

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Instrument: APOLLO1

Analyte	MDL	RL	Units
Total Organic Carbon	0.02	0.02	%

National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1941b

Organics in Marine Sediment

This Standard Reference Material (SRM) is marine sediment collected at the mouth of the Baltimore (MD) Harbor. SRM 1941b is intended for use in evaluating analytical methods for the determination of selected polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, and chlorinated pesticides in marine sediment and similar matrices. Information values are also provided for total organic carbon (TOC), total carbon, hydrogen, and nitrogen. All of the constituents for which certified, reference, and information values are provided in SRM 1941b were naturally present in the sediment before processing. A unit of SRM 1941b consists of a bottle containing 50 g of radiation-sterilized, freeze-dried sediment.

Certified Mass Fraction Values: Certified mass fraction values for 24 PAHs, 29 PCB congeners, and 7 chlorinated pesticides are provided in Tables 1 through 3. The certified values for the PAHs, PCB congeners, and chlorinated pesticides are based on the agreement of results obtained at NIST from two or more chemically independent analytical techniques along with results from an interlaboratory comparison study [1]. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [1].

Reference Mass Fraction Values: Reference mass fraction values for 44 additional PAHs (some in combination), 13 additional PCB congeners, and 2 additional chlorinated pesticides are provided in Tables 4 to 7. Reference values for 27 alkylated PAH groups are provided in Table 8 and for selected hopanes and steranes in Table 9. A reference value for total organic carbon is provided in Table 10. Reference values are noncertified values that are the best estimate of the true value; however, the values do not meet the NIST criteria for certification and are provided with associated uncertainties that may reflect only measurement precision, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods [1].

Information Mass Fraction Values: Information mass fraction values are provided in Table 11 for carbon, hydrogen, and nitrogen. An information value is considered to be a value that will be of use to the SRM user, but insufficient information is available to assess the uncertainty associated with the value [1].

Expiration of Certification: The certification of **SRM 1941b** is valid, within the measurement uncertainty specified, until **01 October 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Handling, Storage, and Use"). This certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

The coordination of the technical measurements leading to the certification of this material was under the leadership of M.M. Schantz and S.A. Wise of the NIST Analytical Chemistry Division.

Analytical measurements for the certification of SRM 1941b were performed at NIST by J.R. Kucklick, B.J. Porter, D.L. Poster, M.M. Schantz, P. Schubert, S. Tutschku, and L.L. Yu of the NIST Analytical Chemistry Division.

Stephen A. Wise, Chief
Analytical Chemistry Division

Robert L. Watters, Jr., Chief
Measurement Services Division

Gaithersburg, MD 20899
Certificate Issue Date: 10 April 2012
Certificate Revision History on Page 13

Measurements for TOC were provided by a commercial laboratory and T.L. Wade of the Geochemical and Environmental Research Group, Texas A&M University (College Station, TX). The carbon, hydrogen, and nitrogen data were provided by a commercial laboratory. Results for the PAHs, PCBs, and chlorinated pesticides from 38 laboratories (see Appendix A) that participated in an interlaboratory comparison exercise coordinated by NIST were used. Results for the alkylated PAH groups, hopanes, and steranes from 33 laboratories (see Appendix B) that participated in another interlaboratory comparison exercise coordinated by NIST were also used.

Collection and preparation of SRM 1941b were performed by M.P. Cronise and C.N. Fales of the NIST Measurement Services Division and B.J. Porter and M.M. Schantz of the NIST Analytical Chemistry Division. The sediment material was collected with the assistance of G.G. Lauenstein, J. Collier, and J. Lewis (National Oceanic and Atmospheric Administration, Silver Spring, MD).

Consultation on the statistical design of the experimental work and evaluation of the data were provided by S.D. Leigh and J.H. Yen of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

INSTRUCTIONS FOR HANDLING, STORAGE, AND USE

Handling: This material is naturally occurring marine sediment from an urban area and may contain constituents of unknown toxicities; therefore, caution and care should be exercised during its handling and use.

Storage: SRM 1941b must be stored in its original bottle at temperatures less than 30 °C and away from direct sunlight.

Use: Prior to removal of subsamples for analysis, the contents of the bottle should be mixed. The mass fractions of constituents in SRM 1941b are reported on a dry-mass basis. The SRM, as received, contains a mass fraction of approximately 2.4 % moisture (see "Conversion to Dry-Mass Basis"). The sediment sample should be dried to a constant mass before weighing for analysis; or a separate subsample of the sediment should be removed from the bottle at the time of analysis and dried to determine the mass fraction on a dry-mass basis. If the constituents of interest are volatile, then the moisture must be determined with a separate subsample.

PREPARATION AND ANALYSIS(1)

Sample Collection and Preparation: The sediment used to prepare this SRM was collected from the Chesapeake Bay at the mouth of the Baltimore (MD) Harbor near the Francis Scott Key Bridge (39°12.3'N and 76°31.4'W). This location is very near the site where SRM 1941 and SRM 1941a were collected. The sediment was collected using a Kynar-coated modified Van Veen-type grab sampler. A total of approximately 3300 kg of wet sediment was collected from the site. The sediment was freeze-dried, sieved at 150 µm (100 % passing), homogenized in a cone blender, radiation sterilized (^{60}Co), and then packaged in screw-capped amber glass bottles each containing approximately 50 g.

Conversion to Dry-Mass Basis: The results for the constituents in SRM 1941b are reported on a dry-mass basis; however, the material "as received" contains residual moisture. The amount of moisture in SRM 1941b was determined by measuring the mass loss after freeze-drying subsamples of 1.1 g to 1.3 g for four days at 1 Pa with a –10 °C shelf temperature and a –50 °C condenser temperature. The moisture content in SRM 1941b at the time of the certification analyses was 2.39 % ± 0.08 % (95 % confidence level). Analytical results for the organic constituents were determined on an as-received basis and then converted to a dry-mass basis by dividing by the conversion factor of 0.9761 (gram dry mass per gram as-received mass).

Polycyclic Aromatic Hydrocarbons: The general approach used for the value assignment of the PAHs in SRM 1941b was similar to that reported in detail elsewhere [2]. The approach consisted of combining results from analyses using various combinations of different extraction techniques and solvents, clean-up/isolation procedures, and chromatographic separation and detection techniques: Soxhlet extraction and pressurized-fluid extraction (PFE) using dichloromethane (DCM) or a hexane/acetone mixture, cleanup of the extracts using solid-phase extraction (SPE) or normal-phase liquid chromatography (LC), followed by analysis using the following techniques: (1) reversed-phase liquid chromatography with fluorescence detection (LC-FL) analysis of the total PAH fraction, (2) reversed-phase LC-FL analysis of isomeric PAH fractions isolated by normal-phase LC (i.e., multidimensional LC), (3) gas chromatography/mass spectrometry (GC/MS) analysis of the PAH fraction on three stationary phases of different

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(1) Certain commercial equipment, instruments or materials are identified in this certificate to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

selectivity, i.e., a 5 % (all column compositions are given as mole fractions in %) phenyl-substituted methylpolysiloxane phase, a 50 % phenyl-substituted methylpolysiloxane phase, and a relatively non-polar proprietary phase.

Three sets of GC/MS results, designated as GC/MS (I), GC/MS (II), and GC/MS (III), were obtained using three columns with different selectivities for the separation of PAHs. For GC/MS (I) analyses, duplicate subsamples of approximately 1 g from ten bottles of SRM 1941b were extracted using PFE with DCM. Copper powder was added to the extract to remove elemental sulfur. The concentrated extract was passed through an aminopropyl SPE cartridge and eluted with 2 % DCM in hexane (all solvent concentrations are given as volume fractions in %). The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 μm film thickness; DB-5 MS, J&W Scientific, Folsom, CA). The GC/MS (II) analyses were performed using 5 g subsamples from six bottles of SRM 1941b. These samples were extracted using PFE with DCM. The high molecular mass compounds were removed from the extracts using size exclusion chromatography (SEC) with a preparative-scale divinylbenzene-polystyrene column (10 μm particle size with 10 nm diameter pores), and the sulfur was removed from the extracts by adding copper powder. The concentrated extract was passed through an aminopropyl SPE cartridge and eluted with 10 % DCM in hexane. The analysis was by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 50 % phenyl-substituted methylpolysiloxane phase (0.25 μm film thickness; DB-17 MS, J&W Scientific, Folsom, CA). For the GC/MS (III), 9 g subsamples from six bottles of SRM 1941b were Soxhlet-extracted for 18 h with 250 mL of a mixture of 50 % hexane/50 % acetone. Copper powder was added to the extract to remove elemental sulfur, and the concentrated extract was passed through a silica SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a relatively non-polar proprietary phase (0.25 μm film thickness; DB-XLB, J&W Scientific, Folsom, CA).

Two sets of LC-FL results, designated as LC-FL (total) and LC-FL (isomer), were used in the certification process. For the LC-FL (total), subsamples of approximately 1 g from six bottles of SRM 1941b were extracted using PFE with a mixture of 50 % hexane/50 % acetone. The extracts were concentrated and then processed through an aminopropylsilane SPE cartridge using 2 % DCM in hexane to obtain the total PAH fraction. For the LC-FL (isomer), a 5 g subsample from the six bottles was extracted using PFE with DCM and processed through an aminopropylsilane SPE cartridge using 10 % DCM in hexane; the PAH fraction was then fractionated further on a semi-preparative aminopropylsilane column (μBondapak NH_2, 9 mm i.d. × 30 cm, Waters Associates, Milford, MA) to isolate isomeric PAH fractions as described previously [3–6]. The total PAH fraction and the isomeric PAH fractions were analyzed using a 5 μm particle-size polymeric octadecylsilane (C_{18}) column (4.6 mm i.d. × 25 cm, Hypersil-PAH, Keystone Scientific, Inc., Bellefonte, PA) with wavelength-programmed fluorescence detection [4,5].

For the GC/MS and LC-FL measurements described above, selected perdeuterated PAHs were added to the sediment prior to solvent extraction for use as internal standards for quantification purposes.

In addition to the analyses performed at NIST, SRM 1941b was used in an interlaboratory comparison exercise in 1999 as part of the NIST Intercomparison Exercise Program for Organic Contaminants in the Marine Environment [7]. Results from 38 laboratories that participated in this exercise were used as the sixth data set in the determination of the certified values for PAHs in SRM 1941b. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest.

Homogeneity Assessment for PAHs: The homogeneity of SRM 1941b was assessed by analyzing duplicate samples of approximately 1 g from ten bottles selected by stratified random sampling. Samples were extracted, processed, and analyzed as described above for GC/MS (I). No statistically significant differences among bottles were observed for the PAHs at this sample size.

PAH Isomers of Molecular Mass 300 and 302: For the determination of the molecular mass 300 and 302 isomers, three subsamples of approximately 5 g each were extracted using PFE with DCM. The extracts were then concentrated with a solvent change to hexane and passed through an aminopropyl SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 50 % phenyl-substituted methylpolysiloxane phase (0.25 μm film thickness; DB-17MS, J&W Scientific, Folsom, CA). Perdeuterated dibenzo[*a,i*]pyrene was added to the sediment prior to extraction for use as an internal standard [8].

PCBs and Chlorinated Pesticides: The general approach used for the determination of PCBs and chlorinated pesticides in SRM 1941b consisted of combining results from analyses using various combinations of different extraction techniques and solvents, cleanup/isolation procedures, and chromatographic separation and detection techniques. Techniques and solvents included Soxhlet extraction and PFE using DCM or a hexane/acetone mixture, clean-up/isolation using SPE or LC, followed by analysis using GC/MS and gas chromatography with electron capture detection (GC-ECD) on two columns with different selectivity for the separation of PCBs and chlorinated pesticides. The analytical methods are described in detail elsewhere [2].

Six sets of results were obtained and designated as GC-ECD (I) A and B, GC/MS (I) A and B, GC/MS (II), and Interlaboratory Comparison Exercise. For the GC-ECD (I) analyses, approximately 10 g subsamples from six bottles of SRM 1941b were extracted using PFE with DCM. Copper powder was added to the extract to remove elemental sulfur, and SEC, as described above, was used to remove the high molecular mass compounds. The concentrated extract was then fractionated on a semi-preparative aminopropylsilane column to isolate two fractions containing: (1) the PCBs and lower-polarity pesticides and (2) the more polar pesticides. GC-ECD analyses of the two fractions were performed on two columns of different selectivities for PCB separations: 0.25 mm × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-5, J&W Scientific, Folsom, CA), and a 0.25 mm × 60 m fused silica capillary column with a non-polar proprietary phase (0.25 µm film thickness; DB-XLB, J&W Scientific, Folsom, CA). The results from the 5 % phenyl phase are designated as GC-ECD (IA) and the results from the proprietary phase are designated as GC-ECD (IB). For the GC-ECD analyses, two PCB congeners that are not significantly present in the sediment extract (PCB 103 and PCB 198 [9.10]) and endosulfan I-d_4, 4,4`-DDE-d_8, 4,4'-DD-d_8, and 4,4'-DDT-d_8 were added to the sediment prior to extraction for use as internal standards for quantification purposes.

Two sets of results were obtained by GC/MS. For GC/MS (I), approximately 9 g subsamples from six bottles were Soxhlet- extracted with a mixture of 50 % hexane/50 % acetone for approximately 18 h. Copper powder was added to the extract to remove elemental sulfur, and the concentrated extract was passed through a silica SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS with two ionization modes, electron impact (EI) and negative ion chemical ionization (NICI). The GC/MS EI method, GC/MS (IA), used a 0.25 mm i.d. × 60 m fused silica capillary column with a relatively non-polar proprietary phase (0.25 µm film thickness; DB-XLB, J&W Scientific, Folsom, CA). The GC/MS NICI method, GC/MS (IB), used a 0.25 mm i.d. × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness: DB-5MS, J&W Scientific, Folsom, CA). The GC/MS (II) results were obtained in the same manner as the GC/MS (IA) analyses except that three subsamples were Soxhlet-extracted with DCM for approximately 18 h. For the GC/MS analyses, selected carbon-13 labeled PCB congeners and chlorinated pesticides were added to the sediment prior to extraction for use as internal standards for quantification purposes.

In addition to the analyses performed at NIST, SRM 1941b was used in an interlaboratory comparison exercise in 1999 as part of the NIST Intercomparison Exercise Program for Organic Contaminants in the Marine Environment [7]. Results from 38 laboratories that participated in this exercise were used as the sixth data set in the determination of the certified values for PCB congeners and chlorinated pesticides in SRM 1941b. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest.

The reference value for PCB 77 was determined from a separate fraction. The samples were extracted and processed as for GC-ECD (I) above. The first (PCB and lower-polarity pesticide) fraction from the semi-preparative aminopropylsilane column was further fractionated using a Cosmosil PYE (pyrenylethyl group bonded) column (5 µm particle size, 4.6 mm i.d. × 25 cm ; Phenomenex. Torrance, CA) [11]. Three fractions were collected: the first fraction contained the pesticides and multi-*ortho* PCBs, the second fraction contained the polychlorinated naphthalenes, non-*ortho* PCB congeners, and some mono-*ortho* PCB congeners, and the third fraction removed the residual planar compounds from the column. The second fraction was analyzed by GC/MS NICI using the same column as GC/MS (IB) above. Carbon-13 labeled PCB 77 was used as an internal standard for quantification purposes.

Alkylated PAH Groups, Hopanes, and Steranes: SRM 1941b was used in an interlaboratory comparison exercise in 2011 [12}. Results from 33 laboratories that participated in this exercise were used in the determination of the reference values for alkylated PAH groups, hopanes, and steranes in SRM 1941b. Note that not all laboratories returned data for each analyte. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest. For the alkylated PAHs, the majority of the laboratories (>90 %) used the parent PAH for determination of the response factor for the corresponding alkylated group.

Total Organic Carbon: Two laboratories provided results for TOC using similar procedures. Briefly, subsamples of approximately 200 mg were reacted with 6 mol/L hydrochloric acid and rinsed with deionized water prior to combustion in a gas fusion furnace. The carbon monoxide and carbon dioxide produced were measured and compared to a blank for calculation of the percent TOC. Each laboratory analyzed subsamples from three bottles of SRM 1941b. One of the laboratories also analyzed three subsamples from three bottles of SRM 1941b for carbon, hydrogen, and nitrogen.

Table 1. Certified Mass Fraction Values for Selected PAHs in SRM 1941b

PAHs	Mass Fractions(a) µg/kg		
1 Naphthalene(b,c,d,e,f,g)	848	±	95(h)
2 Fluorene(b,c,d,e,f,g)	85	±	15(h)
3 Phenanthrene(b,c,d,e,f,g)	406	±	44(h)
4 Anthracene(b,c,d,e,f,g)	184	±	18(h)
5 3-Methylphenanthrene(b,c,d)	105	±	13(h)
6 2-Methylphenathrene(b,c,d)	128	±	14(h)
7 1-Methylphenanthrene(b,c,d,g)	73.2	±	5.9(h)
8 Fluoranthene(b,c,d,e,f,g)	651	±	50(h)
9 Pyrene(b,c,d,e,f,g)	581	±	39(h)
10 Benz[*a*]anthracene(b,c,d,e,f,g)	335	±	25(h)
11 Chrysene(d,f)	291	±	31(h)
12 Triphenylene(d,f)	108	±	5(i)
13 Benzo[*b*]fluoranthene(c,e)	453	±	21(h)
14 Benzo[*k*]fluoranthene(b,c,d,e)	225	±	18(h)
15 Benzo[*e*]pyrene(b,c,d,g)	325	±	25(h)
16 Benzo[*a*]pyrene(b,c,d,f,g)	358	±	17(h)
17 Perylene(b,c,d,f,g)	397	±	45(h)
18 Benzo[*ghi*]perylene(b,c,d,f,g)	307	±	45(h)
19 Indeno[1,2,3-*cd*]pyrene(b,c,d,f,g)	341	±	57(h)
20 Dibenz[*a,j*]anthracene(b,c,d,f)	48.9	±	4.6(h)
21 Dibenz[*a,c*]anthracene(c,f)	36.7	±	5.2(h)
22 Dibenz[*a,h*]anthracene(c,f)	53	±	10(h)
23 Benzo[*b*]chrysene(b,c,d,f)	53	±	12(h)
24 Picene(b,c,d)	46.6	±	4.7(h)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (I) on 5 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(c) GC/MS (II) on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(d) GC/MS (III) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(e) LC-FL (total) of total PAH fraction after PFE with DCM.

(f) LC-FL (~~isomer~~) ~~of isomeric~~ PAH fractions after PFE with DCM.

(g) 1999 Interlaboratory Comparison Study [7] with 21 to 29 laboratories submitting data for each PAH.

(h) Certified values are weighted means of the results from two to six analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO Guide [14,15].

(i) The certified value is an unweighted mean of the results from two analytical methods. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO Guide [14,15].

Table 2. Certified Mass Fraction Values for Selected PCB Congeners[a] in SRM 1941b

PCB Congeners		Mass Fractions[b] µg/kg		
PCB 8	(2,4'-Dichlorobiphenyl)[c,d,e,f,g]	1.65	±	0.19[h]
PCB 18	(2,2',5-Trichlorobiphenyl)[c,d,e,f,g]	2.39	±	0.29[h]
PCB 28	(2,4.4'-Trichlorobiphenyl)[c,d,e,f,g]	4.52	±	0.57[h]
PCB 31	(2,4',5-Trichlorobiphenyl)[c,e,f]	3.18	±	0.41[h]
PCB 44	(2,2'3,5'-Tetrachlorobiphenyl)[c,d,e,f,g]	3.85	±	0.20[i]
PCB 49	(2,2'4,5'-Tetrachlorobiphenyl)[c,d,e,f]	4.34	±	0.28[i]
PCB 52	(2,2',5,5'-Tetrachlorobiphenyl)[c,d,e,f,g]	5.24	±	0.28[i]
PCB 66	(2,3',4,4'-Tetrachlorobiphenyl)[c,e,f,g,j]	4.96	±	0.53[i]
PCB 87	(2,2',3,4,5'-Pentachlorobiphenyl)[c,d,f,j]	1.14	±	0.16[h]
PCB 95	(2,2',3,5',6-Pentachlorobiphenyl)[c,e,f,g]	3.93	±	0.62[i]
PCB 99	(2,2',4,4',5-Pentachlorobiphenyl)[c,d,e,f,g]	2.90	±	0.36[i]
PCB 101	(2,2',4,5,5'-Pentachlorobiphenyl)[c,e,f,g,j]	5.11	±	0.34[i]
PCB 105	(2,3,3',4,4'-Pentachlorobiphenyl)[c,d,e,f,g,j]	1.43	±	0.10[i]
PCB 110	(2,3,3',4',6-Pentachlorobiphenyl)[c,e,f,j]	4.62	±	0.36[i]
PCB 118	(2,3',4,4',5-Pentachlorobiphenyl)[c,d,e,f,g,j]	4.23	±	0.19[i]
PCB 128	(2,2',3,3',4.4'-Hexachlorobiphenyl)[c,d,e,f,g,j]	0.696	±	0.044[i]
PCB 138	(2,2',3.4,4',5'-Hexachlorobiphenyl)[c,e,f,j]	3.60	±	0.28[i]
PCB 149	(2,2',3.4',5',6-Hexachlorobiphenyl)[c,d,e,j]	4.35	±	0.26[h]
PCB 153	(2,2',4.4',5.5'-Hexachlorobiphenyl)[c,d,e,f,g,j]	5.47	±	0.32[i]
PCB 156	(2,3.3',4,4'.5-Hexachlorobiphenyl)[c,d,e,f,j]	0.507	±	0.090[h]
PCB 170	(2,2',3.3',4.4',5-Heptachlorobiphenyl)[c,d,e,f,g,j]	1.35	±	0.09[i]
PCB 180	(2,2',3.4,4'.5,5'-Heptachlorobiphenyl)[c,d,e,f,g,j]	3.24	±	0.51[i]
PCB 183	(2,2',3.4,4',5'.6-Heptachlorobiphenyl)[c,d,e,j]	0.979	±	0.087[h]
PCB 187	(2,2',3.4',5.5',6-Heptachlorobiphenyl)[c,d,e,f,g,j]	2.17	±	0.22[i]
PCB 194	(2,2',3,3',4,4'.5.5'-Octachlorobiphenyl)[c,d,e,j]	1.04	±	0.06[h]
PCB 195	(2,2',3,3',4.4',5.6-Octachlorbiphenyl)[c,e,g,j]	0.645	±	0.060[i]
PCB 201	(2,2',3.3',4,5',6,6'-Octachlorobiphenyl)[c,e,j]	0.777	±	0.034[h]
PCB 206	(2,2',3,3',4.4',5.5',6-Nonachlorobiphenyl)[c,e,f,g,j]	2.42	±	0.19[i]
PCB 209	Decachlorobiphenyl[c,d,e,f,g,j]	4.86	±	0.45[i]

[a] PCB congeners are numbered according to the scheme proposed by Ballschmiter and Zell [9] and later revised by Schulte and Malisch [10] to conform with IUPAC rules; for the specific congeners mentioned in this SRM, only PCB 201 and PCB 107 (see Table 5) are different in the numbering systems. Under the Ballschmiter and Zell numbering system, the IUPAC PCB 201 is listed as PCB 200 and the IUPAC PCB 107 is listed as PCB 108.

[b] Mass fractions reported on dry-mass basis: material as received contains approximately 2.4 % moisture.

[c] GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

[d] GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

[e] GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

[f] GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

[g] 1999 Interlaboratory Comparison Study [7] with 13 to 31 laboratories submitting data for each PCB congener.

[h] Certified values are unweighted means of the results from three to five analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within method variance following the ISO Guide [14,15].

[i] Certified values are weighted means of the results from three to six analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO Guide [14,15].

[j] GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

Table 3. Certified Mass Fraction Values for Selected Chlorinated Pesticides in SRM 1941b

Chlorinated Pesticides	Mass Fractions(a) μg/kg		
Hexachlorobenzene(b,c,d,e)	5.83	±	0.38(f)
cis-Chlordane(b,c,d,e g)	0.85	±	0.11(h)
trans-Chlordane(b,c,e)	0.566	±	0.093(f)
cis-Nonachlor(b,e,g)	0.378	±	0.053(h)
trans-Nonachlor(b,c,d,e,g)	0.438	±	0.073(f)
4,4'-DDE(b,d,e,g)	3.22	±	0.28(h)
4,4'-DDD(b,d,e,g)	4.66	±	0.46(h)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(c) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(d) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(e) 1999 Interlaboratory Comparison Study [7] with 13 to 31 laboratories submitting data for each pesticide.

(f) Certified values are unweighted means of the results from three to five analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO Guide [14,15].

(g) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(h) Certified values are weighted means of the results from three to five analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO Guide [14,15].

Table 4. Reference Mass Fraction Values for Selected PAHs in SRM 1941b

PAHs	Mass Fractions(a) µg/kg		
1-Methylnaphthalene(b,c,d,e)	127	±	14(f)
2-Methylnaphthalene(b,c,d,e)	276	±	53(f)
2,6-Dimethylnaphthalene(b,c,d,e)	75.9	±	4.5(f)
2,3,5-Trimethylnaphthalene(b,c,d,e)	25.5	±	5.1(f)
Biphenyl(b,c,d,e)	74.0	±	8.0(f)
Acenaphthylene(b,c,d,e)	53.3	±	6.4(f)
Acenaphthene(b,c d,e)	38.4	±	5.2(f)
9-Methylphenanthrene(c)	63.5	±	2.5(g)
4-Methylphenanthrene and 9-Methylphenanthrene(b,d)	80.1	±	4.8(f)
2-Methylanthracene(c,d)	36	±	15(f)
8-Methylfluoranthene(b)	49.5	±	2.7(g)
7-Methylfluoranthene(b)	45.4	±	1.5(g)
1-Methylfluoranthene(b)	42.4	±	2.1(g)
3-Methylfluoranthene(b)	28.8	±	1.3(g)
2-Methylpyrene(b)	78.7	±	4.0(g)
4-Methylpyrene(b)	66.4	±	2.6(g)
1-Methylpyrene(b)	52.5	±	2.3(g)
Acephenanthrene(d)	30.5	±	1.9(g)
Benzo[*c*]phenanthrene(b,c,d)	58	±	15(f)
Benzo[*a*]fluoranthene(b,c,d)	73	±	18(f)
Benzo[*j*]fluoranthene(c)	217	±	5(g)
Indeno[1,2,3-*cd*]fluoranthene(d)	9.63	±	0.34(g)
Pentaphene(d)	25.3	±	1.0(g)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (I) on 5 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(c) GC/MS (II) on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(d) GC/MS (III) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(e) 1999 Interlaboratory Comparison Study [7] with 14 to 26 laboratories submitting data for each PAH.

(f) Reference values are weighted means of the results from two to four analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO Guide [14,15].

(g) Reference values are the means of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution for the associated degrees of freedom (19 for footnote b and 5 for footnotes c and d) and 95 % confidence level for each analyte.

Table 5. Reference Mass Fraction Values for Selected PAHs of Molecular Mass 300 and 302 in SRM 1941b

PAHs	Mass Fractions[a,b,c] µg/kg
Coronene	72.6 ± 4.7
Dibenzo[*b,e*]fluoranthene	10.3 ± 0.3
Naphtho[1,2-*b*]fluoranthene	91.0 ± 3.1
Naphtho[1,2-*k*]fluoranthene and Naphtho[2,3-*j*]fluoranthene	79.8 ± 2.5
Naphtho[2,3-*b*]fluoranthene	23.5 ± 0.3
Dibenzo[*b,k*]fluoranthene	95.6 ± 3.1
Dibenzo[*a,k*]fluoranthene	26.6 ± 0.4
Dibenzo[*j,l*]fluoranthene	63.8 ± 1.8
Dibenzo[*a,l*]pyrene	11.1 ± 1.0
Naphtho[2,3-*k*]fluoranthene	10.7 ± 0.6
Naphtho[1,2-*a*]pyrene	16.7 ± 1.4
Naphtho[2,3-*e*]pyrene	33.2 ± 2.3
Dibenzo[*a,e*]pyrene	76.1 ± 3.6
Naphtho[2,1-*a*]pyrene	59.2 ± 1.8
Dibenzo[*e,i*]pyrene	35.0 ± 2.4
Naphtho[2,3-*a*]pyrene	16.5 ± 0.6
Benzo[*b*]perylene	38.2 ± 1.2
Dibenzo[*a,i*]pyrene	25.5 ± 1.0
Dibenzo[*a,h*]pyrene	6.94 ± 0.29

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) Reference values are the means of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution for two degrees of freedom and 95 % confidence level for each analyte.

(c) GC/MS on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM [8].

Table 6. Reference Mass Fraction Values for Selected PCB Congeners(a) in SRM 1941b

PCB Congeners		Mass Fractions(b,c) µg/kg
PCB 45	(2,2',3,6-Tetrachlorobiphenyl)(d,e)	0.73 ± 0.12
PCB 56	(2,3,3',4-Tetrachlorobiphenyl)(d,f,g)	1.21 ± 0.11
PCB 63	(2,3,4',5-Tetrachlorobiphenyl)(e,f,g)	0.213 ± 0.040
PCB 70	(2,3',4',5-Tetrachlorobiphenyl)(c,f,g)	4.99 ± 0.29
PCB 74	(2,4,4',5-Tetrachlorobiphenyl)(e,f,g)	2.04 ± 0.15
PCB 77	(3,3',4,4'-Tetrachlorobiphenyl)(h)	0.31 ± 0.03
PCB 107	(2,3,3',4,5'-Pentachlorobiphenyl)(d,e,f,g)	0.628 ± 0.028
PCB 132	(2,2',3,3',4,6'-Hexachlorobiphenyl)(d,f,g)	1.28 ± 0.27
PCB 146	(2,2',3,4',5,5'-Hexachlorobiphenyl)(e,f,g)	1.22 ± 0.12
PCB 158	(2,3,3',4,4',6-Hexachlorobiphenyl)(d,e,f,g)	0.65 ± 0.15
PCB 163	(2,3,3',4',5,6-Hexachlorobiphenyl)(e,f,g)	1.28 ± 0.06
PCB 174	(2,2',3,3',4,5,6'-Heptachlorobiphenyl)(d,e,f,g)	1.51 ± 0.39
PCB 193	(2,3,3',4',5,5',6-Heptachlorobiphenyl)(d,e,f,g)	0.292 ± 0.075

(a) PCB congeners are numbered according to the scheme proposed by Ballschmiter and Zell [9] and later revised by Schulte and Malisch [10] to conform with IUPAC rules; for the specific congeners mentioned in this SRM, only PCB 201 (see Table 2) and PCB 107 are different in the numbering systems. Under the Ballschmiter and Zell numbering system, the IUPAC PCB 201 is listed as PCB 200 and the IUPAC PCB 107 is listed as PCB 108.

(b) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(c) For these PCB congeners except PCB 77, the reference values are unweighted means of the results from two to four analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled within-method variance following the ISO Guide [14,15]. For PCB 77, the reference value is the mean of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution corresponding to two degrees of freedom and 95 % confidence level for PCB 77.

(d) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(e) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(f) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(g) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(h) GC/MS NICI on a 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC-ECD (I) fractionated using a PYE column.

Table 7. Reference Mass Fraction Values for Selected Chlorinated Pesticides in SRM 1941b

Chlorinated Pesticides	Mass Fractions(a,b) µg/kg
2,4'-DDE(c,d)	0.38 ± 0.12
4,4'-DDT(e,f)	1.12 ± 0.42

(a) Mass Fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) The reference values are unweighted means of the results from two analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO Guide [14,15].

(c) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(d) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(e) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(f) 1999 Interlaboratory Comparison Study [7] with 10 laboratories submitting data for 4,4'-DDT.

Table 8. Reference Mass Fraction Values for Selected Alkylated PAH Groups in SRM 1941b

Alkylated PAH Group	Mass Fraction(a,b) mg/kg
C2-decalins	18 ± 5
C4-decalins	41 ± 4
C2-naphthalenes	187 ± 53
C3-naphthalenes	158 ± 42
C1-benzothiophenes	25 ± 14
C2-benzothiophenes	20 ± 11
C3-benzothiophenes	22 ± 13
C4-benzothiophenes	18 ± 5
C1-fluorenes	57 ± 18
C2-fluorenes	122 ± 43
C3-fluorenes	128 ± 31
C1-phenanthrenes/anthracenes	313 ± 99
C2-phenanthrenes/anthracenes	247 ± 62
C3-phenanthrenes/anthracenes	165 ± 46
C4-phenanthrenes/anthracenes	87 ± 36
C1-dibenzothiophenes	54 ± 13
C2-dibenzothiophenes	91 ± 18
C3-dibenzothiophenes	84 ± 15
C4-dibenzothiophenes	57 ± 13
C1-fluoranthenes/pyrenes	252 ± 48
C2-fluoranthenes/pyrenes	205 ± 38
C3-fluoranthenes/pyrenes	102 ± 22
C4-fluoranthenes/pyrenes	121 ± 59
C1-benzanthraces/chrysenes/triphenylenes	208 ± 43
C2-benzanthraces/chrysenes/triphenylenes	120 ± 24
C3-benzanthraces/chrysenes/triphenylenes	73 ± 31
C4-benzanthraces/chrysenes/triphenylenes	41 ± 11

(a) The reference mass fraction value reported on a dry-mass basis is the median of results using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the median, and the coverage factor, $k = 2$.

(b) Data from the interlaboratory study [12].

Table 9. Reference Mass Fraction Values for Selected Hopanes and Steranes in SRM 1941b

Hopane or Sterane	Mass Fraction(a b) mg/kg
17α(H)-22,29,30-Trisnorhopane	54 ± 18
17α(H)-21β(H)-30-Norhopane	137 ± 21
17α(H)-21β(H)-30-Hopane	215 ± 44
17α(H)-21β(H)-22R-Homohopane	44 ± 10
17α(H)-21β(H)-22S-Homohopane	48 ± 13
5α(H)-14α(H),17α(H)-Cholestane 20R	41 ± 11
5α(H)-14β(H),17β(H)-Cholestane 20R	27 ± 6
5α(H)-14β(H),17β(H)-24-Methylcholestane 20R	21 ± 8
5α(H)-14α(H),17α(H)-24-Ethylcholestane 20R	19 ± 5
5α(H)-14β(H),17β(H)-24-Ethylcholestane 20R	41 ± 9

(a) The reference mass fraction value reported on a dry-mass basis is the median of results using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the median, and the coverage factor, $k = 2$.

(b) Data from the interlaboratory study [12].

Table 10. Reference Mass Fraction Value for Total Organic Carbon in SRM 1941b

Total Organic Carbon (TOC)	2.99 % ± 0.24 %(a,b)

(a) Mass fraction is reported on a dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) The reference value for total organic carbon is a weighted mean value from routine measurements made by two laboratories [21]. The uncertainty listed is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance. The reporting follows the ISO Guides [2].

Table 11. Information Mass Fraction Values for Carbon, Hydrogen, and Nitrogen in SRM 1941b

Elements	Mass Fractions(a) %
Carbon	3.3
Hydrogen	1.2
Nitrogen	<0.5

(a) Mass fraction is reported on a dry-mass basis; material as received contains approximately 2.4 % moisture.

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Certificate Revision History: 10 April 2012 (This revision adds reference values for alkylated PAH groups, hopanes, and steranes; extension of certification period; editorial changes). 16 August 2004 (This revision removes the reference values for the butyl tins and makes editorial changes). 15 July 2002 (Original certificate date)

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.

APPENDIX A

The laboratories listed below performed measurements that contributed to the certification of PAHs, PCBs, and chlorinated pesticides in SRM 1941b Organics in Marine Sediment.

Arthur D. Little, Inc; Cambridge, MA, USA
Axys Analytical Services; Sidney, BC, Canada
B & B Laboratories; College Station, TX, USA
Battelle Ocean Sciences; Duxbury, MA, USA
Bedford Institute of Oceanography; Dartmouth, NS, Canada
California Department of Fish and Game; Rancho Cordova, CA, USA
Central Contra Costa Sanitary District; Martinez, CA, USA
Chesapeake Biological Laboratory; Solomons, MD, USA
Centro de Investigaciones Energeticas Medioambientales y Tecnologicas; Madrid, Spain
City of Los Angeles Environmental Monitoring Division; Playa del Rey, CA, USA
City of San Jose Environmental Services Department; San Jose, CA, USA
Columbia Analytical Services; Kelso, WA, USA
East Bay Municipal Utility District; Oakland, CA, USA
Florida Department of Environmental Protection; Tallahassee, FL, USA
Manchester Environmental Laboratory; Port Orchard, WA, USA
Murray State University; Murray, KY. USA
Massachusetts Water Resources Authority Central Lab; Winthrop, MA, USA
National Research Council of Canada; Ottawa, Ontario, Canada
National Oceanic and Atmospheric Association (NOAA), National Marine Fisheries Service (NMFS), Auke Bay Laboratory; Juneau, AK, USA
NOAA, National Ocean Service/Center for Coastal Environmental Health and Biomolecular Research; Charleston, SC, USA
NOAA, NMFS, Sandy Hook Marine Laboratory; Highlands, NJ, USA
NOAA, NMFS, Northwest Fisheries Science Center; Seattle, WA, USA
Orange County Sanitation District; Fountain Valley, CA, USA
Philip Analytical Services; Burlington, Ontario, Canada
Serv de Hidrografia Naval; Buenos Aires, Argentina
Skidaway Institute of Technology; Savannah, GA, USA
Southwest Laboratory of Oklahoma; Broken Arrow, OK, USA
Severn Trent Knoxville Laboratory; Knoxville, TN, USA
Texas A&M University, Geochemical and Environmental Research Group; College Station, TX, USA
Texas Parks and Wildlife Department: San Marcos, TX, USA
University of California at Los Angeles, Institute of Geophysics and Planetary Physics; Los Angeles, CA, USA
University of Connecticut, Environmental Research Institute; Storrs, CT, USA
University of Rhode Island, Graduate School of Oceanography; Narragansett, RI, USA
US Department of Agriculture, Environmental Chemistry Laboratory; Beltsville, MD, USA
US Environmental Protection Agency, Atlantic Ecology Division; Narragansett, RI, USA
US Geological Survey, National Water Quality Laboratory: Denver, CO, USA
Woods Hole Group Environmental Lab; Raynham, MA, USA
Wright State University; Dayton, OH, USA

APPENDIX B

The laboratories listed below performed measurements that contributed to the certification of alkylated PAH groups, hopanes, and steranes in SRM 1941b Organics in Marine Sediment.

Alpha Analytical, Inc.; Mansfield, MA, USA
Analytical Resources, Inc.; Tukwila, WA, USA
Axys Analytical Services; Sydney, BC, Canada
Battelle Analytical & Environmental Chemistry Laboratory; Duxbury, MA, USA
Center for Laboratory Sciences; Pasco, WA, USA
Columbia Analytical Services; Jacksonville, FL, USA
Columbia Analytical Services; Rochester, NY, USA
Columbia Analytical Services, Kelso, WA, USA
Florida Department of Environmental Protection; Tallahassee, FL. USA
Florida International University; North Miami, FL, USA
Michigan Department of Natural Resources and Environment; Lansing, MI. USA
Mississippi State Chemical Laboratory; Mississippi State, MS. USA
NIST; Charleston, SC. USA
NIST; Gaithersburg, MD, USA
NOAA/NCCOS/NOS; Charleston, SC, USA
NOAA/NMFS/Alaska Fisheries Science Center; Juneau. AK, USA
NY State Department of Health; Albany, NY, USA
Pace Analytical Services. Inc. Minneapolis; Minneapolis, MN. USA
RJ Lee Group, Inc: Monroeville, PA. USA
TDI/B&B Laboratories. Inc.; College Station, TX
TestAmerica Laboratories; Mobile, AL, USA
TestAmerica Laboratories; West Sacramento, CA, USA
TestAmerica Laboratories; University Park, IL. USA
TestAmerica Laboratories; Schriever. LA, USA
TestAmerica Laboratories; Edison, NJ. USA
TestAmerica Laboratories; Knoxville, TN. USA
TestAmerica Laboratories; Pittsburgh, PA, USA
TestAmerica Laboratories; South Burlington. VT, USA
TestAmerica Laboratories; Tacoma, WA, USA
US Army Engineer Research and Development Center; Vicksburg, MS, USA
USGS Columbia Environmental Research Center; Columbia, MO. USA
University of Iowa, State Hygienic Laboratory; Iowa City, IO, USA
Washington State Public Health Laboratories; Shoreline, WA, USA

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-0001

September 18, 2014

Analytical Resources Inc
Dave Mitchell
4611 S 134th Place
Suite 100
Tukwila, WA 98168-3240

Fax Number: (206) 695-6201

Customer Purchase Order Number: O/R# 0000126382
NIST Sales Order Number: 1310741

Dear NIST Standard Reference Material Customer:

This letter is to notify the users of SRM 1941b Organics in Marine Sediment of the revised Certificate of Analysis (COA) dated 10 June 2014. In this revision, the units were corrected from mg/kg to µg/kg in Tables 8 and 9. The certificate revision also includes other editorial changes. Please replace your existing SRM 1941b COA with the revised certificate.

For your convenience, the revised certificate is attached. It is also available on the NIST SRM web site at http://www.nist.gov/srm and can be viewed and printed directly:

https://www-s.nist.gov/srmors/view_detail.cfm?srm=1941B

If you are not the actual user of this material, I sincerely appreciate your help in providing this information to the appropriate person(s). If I can be of further assistance, please do not hesitate to contact me at robert.watters@nist.gov or 301-975-4122. If there are any technical questions or concerns, you may contact John Kucklick of the NIST Chemical Sciences Division at john.kucklick@nist.gov or 843-725-4816. Thank you for your assistance in this matter.

Sincerely,

Robert L. Watters Jr.

Dr. Robert L. Watters, Jr., Director
Office of Reference Materials

Enclosure

cc: John Kucklick

National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1941b

Organics in Marine Sediment

This Standard Reference Material (SRM) is marine sediment collected at the mouth of the Baltimore (MD) Harbor. SRM 1941b is intended for use in evaluating analytical methods for the determination of selected polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, and chlorinated pesticides in marine sediment and similar matrices. Information values are also provided for total organic carbon (TOC), total carbon, hydrogen, and nitrogen. All of the constituents for which certified, reference, and information values are provided in SRM 1941b were naturally present in the sediment before processing. A unit of SRM 1941b consists of a bottle containing 50 g of radiation-sterilized, freeze-dried sediment.

Certified Mass Fraction Values: Certified mass fraction values for PAHs, PCB congeners, and chlorinated pesticides are provided in Table 1 through Table 3. The certified values for the PAHs, PCB congeners, and chlorinated pesticides are based on the agreement of results obtained at NIST from two or more chemically independent analytical techniques along with results from an interlaboratory comparison study [1]. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [1].

Reference Mass Fraction Values: Reference mass fraction values for additional PAHs (some in combination), additional PCB congeners, and additional chlorinated pesticides are provided in Table 4 through Table 7. Reference values for alkylated PAH groups are provided in Table 8 and for selected hopanes and steranes in Table 9. A reference value for total organic carbon is provided in Table 10. Reference values are noncertified values that are the best estimate of the true value; however, the values do not meet the NIST criteria for certification and are provided with associated uncertainties that may reflect only measurement precision, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods [1].

Information Mass Fraction Values: Information mass fraction values are provided in Table 11 for carbon, hydrogen, and nitrogen. An information value is considered to be a value that will be of use to the SRM user, but insufficient information is available to assess the uncertainty associated with the value [1].

Expiration of Certification: The certification of **SRM 1941b** is valid, within the measurement uncertainty specified, until **01 October 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Handling, Storage, and Use"). This certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Coordination of the technical measurements leading to the certification of this material was under the leadership of M.M. Schantz and S.A. Wise of the NIST Chemical Sciences Division.

Analytical measurements for the certification of SRM 1941b were performed at NIST by J.R. Kucklick, B.J. Porter, D.L. Poster, M.M. Schantz, P. Schubert, S. Tutschku, and L.L. Yu of the NIST Chemical Sciences Division.

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Robert L. Watters, Jr., Director
Office of Reference Materials

Gaithersburg, MD 20899
Certificate Issue Date: 10 June 2014
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Measurements for TOC were provided by a commercial laboratory and T.L. Wade of the Geochemical and Environmental Research Group, Texas A&M University (College Station, TX). The carbon, hydrogen, and nitrogen data were provided by a commercial laboratory. Results for the PAHs, PCBs, and chlorinated pesticides from 38 laboratories (see Appendix A) that participated in an interlaboratory comparison exercise coordinated by NIST were used. Results for the alkylated PAH groups, hopanes, and steranes from 33 laboratories (see Appendix B) that participated in another interlaboratory comparison exercise coordinated by NIST were also used.

Collection and preparation of SRM 1941b were performed by M.P. Cronise and C.N. Fales of the NIST Office of Reference Materials and B.J. Porter and M.M. Schantz of the NIST Chemical Sciences Division. The sediment material was collected with the assistance of G.G. Lauenstein, J. Collier, and J. Lewis (National Oceanic and Atmospheric Administration, Silver Spring, MD).

Consultation on the statistical design of the experimental work and evaluation of the data were provided by S.D. Leigh and J.H. Yen of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

INSTRUCTIONS FOR HANDLING, STORAGE, AND USE

Handling: This material is naturally occurring marine sediment from an urban area and may contain constituents of unknown toxicities; therefore, caution and care should be exercised during its handling and use.

Storage: SRM 1941b must be stored in its original bottle at temperatures less than 30 °C and away from direct sunlight.

Use: Prior to removal of subsamples for analysis, the contents of the bottle should be mixed. The mass fractions of constituents in SRM 1941b are reported on a dry-mass basis. The SRM, as received, contains a mass fraction of approximately 2.4 % moisture (see "Conversion to Dry-Mass Basis"). The sediment sample should be dried to a constant mass before weighing for analysis; or a separate subsample of the sediment should be removed from the bottle at the time of analysis and dried to determine the mass fraction on a dry-mass basis. If the constituents of interest are volatile, then the moisture must be determined with a separate subsample.

PREPARATION AND ANALYSIS(1)

Sample Collection and Preparation: The sediment used to prepare this SRM was collected from the Chesapeake Bay at the mouth of the Baltimore (MD) Harbor near the Francis Scott Key Bridge (39°12.3'N and 76°31.4'W). This location is very near the site where SRM 1941 and SRM 1941a were collected. The sediment was collected using a Kynar-coated modified Van Veen-type grab sampler. A total of approximately 3300 kg of wet sediment was collected from the site. The sediment was freeze-dried, sieved at 150 µm (100 % passing), homogenized in a cone blender, radiation sterilized (^{60}Co), and then packaged in screw-capped amber glass bottles each containing approximately 50 g.

Conversion to Dry-Mass Basis: The results for the constituents in SRM 1941b are reported on a dry-mass basis; however, the material "as received" contains residual moisture. The amount of moisture in SRM 1941b was determined by measuring the mass loss after freeze-drying subsamples of 1.1 g to 1.3 g for four days at 1 Pa with a –10 °C shelf temperature and a –50 °C condenser temperature. The moisture content in SRM 1941b at the time of the certification analyses was 2.39 % ± 0.08 % (95 % confidence level). Analytical results for the organic constituents were determined on an as-received basis and then converted to a dry-mass basis by dividing by the conversion factor of 0.9761 (gram dry mass per gram as-received mass).

Polycyclic Aromatic Hydrocarbons: The general approach used for the value assignment of the PAHs in SRM 1941b was similar to that reported in detail elsewhere [2]. The approach consisted of combining results from analyses using various combinations of different extraction techniques and solvents, clean-up/isolation procedures, and chromatographic separation and detection techniques: Soxhlet extraction and pressurized-fluid extraction (PFE) using dichloromethane (DCM) or a hexane/acetone mixture, cleanup of the extracts using solid-phase extraction (SPE) or normal-phase liquid chromatography (LC), followed by analysis using the following techniques: (1) reversed-phase liquid chromatography with fluorescence detection (LC-FL) analysis of the total PAH fraction, (2) reversed-phase LC-FL analysis of isomeric PAH fractions isolated by normal-phase LC (i.e., multidimensional LC), (3) gas chromatography/mass spectrometry (GC/MS) analysis of the PAH fraction on three stationary phases of different selectivity, i.e., a 5 % (all column compositions are given as mole fractions in %) phenyl-substituted methylpolysiloxane phase, a 50 % phenyl-substituted methylpolysiloxane phase, and a relatively non-polar proprietary phase.

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(1) Certain commercial equipment, instruments or materials are identified in this certificate to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Three sets of GC/MS results, designated as GC/MS (I), GC/MS (II), and GC/MS (III), were obtained using three columns with different selectivities for the separation of PAHs. For GC/MS (I) analyses, duplicate subsamples of approximately 1 g from ten bottles of SRM 1941b were extracted using PFE with DCM. Copper powder was added to the extract to remove elemental sulfur. The concentrated extract was passed through an aminopropyl SPE cartridge and eluted with 2 % DCM in hexane (all solvent concentrations are given as volume fractions in %). The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-5 MS, J&W Scientific, Folsom, CA). The GC/MS (II) analyses were performed using 5 g subsamples from six bottles of SRM 1941b. These samples were extracted using PFE with DCM. The high molecular mass compounds were removed from the extracts using size exclusion chromatography (SEC) with a preparative-scale divinylbenzene-polystyrene column (10 µm particle size with 10 nm diameter pores), and the sulfur was removed from the extracts by adding copper powder. The concentrated extract was passed through an aminopropyl SPE cartridge and eluted with 10 % DCM in hexane. The analysis was by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 50 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-17 MS, J&W Scientific). For the GC/MS (III), 9 g subsamples from six bottles of SRM 1941b were Soxhlet-extracted for 18 h with 250 mL of a mixture of 50 % hexane/50 % acetone. Copper powder was added to the extract to remove elemental sulfur, and the concentrated extract was passed through a silica SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a relatively non-polar proprietary phase (0.25 µm film thickness; DB-XLB, J&W Scientific).

Two sets of LC-FL results, designated as LC-FL (total) and LC-FL (isomer), were used in the certification process. For the LC-FL (total), subsamples of approximately 1 g from six bottles of SRM 1941b were extracted using PFE with a mixture of 50 % hexane/50 % acetone. The extracts were concentrated and then processed through an aminopropylsilane SPE cartridge using 2 % DCM in hexane to obtain the total PAH fraction. For the LC-FL (isomer), a 5 g subsample from the six bottles was extracted using PFE with DCM and processed through an aminopropylsilane SPE cartridge using 10 % DCM in hexane; the PAH fraction was then fractionated further on a semi-preparative aminopropylsilane column (µBondapak NH_2, 9 mm i.d. × 30 cm, Waters Associates, Milford, MA) to isolate isomeric PAH fractions as described previously [3–6]. The total PAH fraction and the isomeric PAH fractions were analyzed using a 5 µm particle-size polymeric octadecylsilane (C_{18}) column (4.6 mm i.d. × 25 cm, Hypersil-PAH, Keystone Scientific, Inc., Bellefonte, PA) with wavelength-programmed fluorescence detection [4,5].

For the GC/MS and LC-FL measurements described above, selected perdeuterated PAHs were added to the sediment prior to solvent extraction for use as internal standards for quantification purposes.

In addition to the analyses performed at NIST, SRM 1941b was used in an interlaboratory comparison exercise in 1999 as part of the NIST Intercomparison Exercise Program for Organic Contaminants in the Marine Environment [7]. Results from 38 laboratories that participated in this exercise were used as the sixth data set in the determination of the certified values for PAHs in SRM 1941b. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest.

Homogeneity Assessment for PAHs: The homogeneity of SRM 1941b was assessed by analyzing duplicate samples of approximately 1 g from ten bottles selected by stratified random sampling. Samples were extracted, processed, and analyzed as described above for GC/MS (I). No statistically significant differences among bottles were observed for the PAHs at this sample size.

PAH Isomers of Molecular Mass 300 and 302: For the determination of the molecular mass 300 and 302 isomers, three subsamples of approximately 5 g each were extracted using PFE with DCM. The extracts were then concentrated with a solvent change to hexane and passed through an aminopropyl SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 50 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-17MS, J&W Scientific). Perdeuterated dibenzo[*a,i*]pyrene was added to the sediment prior to extraction for use as an internal standard [8].

PCBs and Chlorinated Pesticides: The general approach used for the determination of PCBs and chlorinated pesticides in SRM 1941b consisted of combining results from analyses using various combinations of different extraction techniques and solvents, cleanup/isolation procedures, and chromatographic separation and detection techniques. Techniques and solvents included Soxhlet extraction and PFE using DCM or a hexane/acetone mixture, clean-up/isolation using SPE or LC, followed by analysis using GC/MS and gas chromatography with electron capture detection (GC-ECD) on two columns with different selectivity for the separation of PCBs and chlorinated pesticides. The analytical methods are described in detail elsewhere [2].

Six sets of results were obtained and designated as GC-ECD (I) A and B, GC/MS (I) A and B, GC/MS (II), and Interlaboratory Comparison Exercise. For the GC-ECD (I) analyses, approximately 10 g subsamples from six bottles of SRM 1941b were extracted using PFE with DCM. Copper powder was added to the extract to remove elemental sulfur, and SEC, as described above, was used to remove the high molecular mass compounds. The concentrated extract was then fractionated on a semi-preparative aminopropylsilane column to isolate two fractions containing: (1) the PCBs and lower-polarity pesticides and (2) the more polar pesticides. GC-ECD analyses of the two fractions were performed on two columns of different selectivities for PCB separations: 0.25 mm × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-5, J&W Scientific), and a 0.25 mm × 60 m fused silica capillary column with a non-polar proprietary phase (0.25 µm film thickness; DB-XLB, J&W Scientific). The results from the 5 % phenyl phase are designated as GC-ECD (IA) and the results from the proprietary phase are designated as GC-ECD (IB). For the GC-ECD analyses, two PCB congeners that are not significantly present in the sediment extract (PCB 103 and PCB 198 [9,10]) and endosulfan I-d_4, 4,4'-DDE-d_8, 4,4'-DD-d_8, and 4,4'-DDT-d_8 were added to the sediment prior to extraction for use as internal standards for quantification purposes.

Two sets of results were obtained by GC/MS. For GC/MS (I), approximately 9 g subsamples from six bottles were Soxhlet- extracted with a mixture of 50 % hexane/50 % acetone for approximately 18 h. Copper powder was added to the extract to remove elemental sulfur, and the concentrated extract was passed through a silica SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS with two ionization modes, electron impact (EI) and negative ion chemical ionization (NICI). The GC/MS EI method, GC/MS (IA), used a 0.25 mm i.d. × 60 m fused silica capillary column with a relatively non-polar proprietary phase (0.25 µm film thickness; DB-XLB, J&W Scientific). The GC/MS NICI method, GC/MS (IB), used a 0.25 mm i.d. × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-5MS, J&W Scientific). The GC/MS (II) results were obtained in the same manner as the GC/MS (IA) analyses except that three subsamples were Soxhlet-extracted with DCM for approximately 18 h. For the GC/MS analyses, selected carbon-13 labeled PCB congeners and chlorinated pesticides were added to the sediment prior to extraction for use as internal standards for quantification purposes.

In addition to the analyses performed at NIST, SRM 1941b was used in an interlaboratory comparison exercise in 1999 as part of the NIST Intercomparison Exercise Program for Organic Contaminants in the Marine Environment [7]. Results from 38 laboratories that participated in this exercise were used as the sixth data set in the determination of the certified values for PCB congeners and chlorinated pesticides in SRM 1941b. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest.

The reference value for PCB 77 was determined from a separate fraction. The samples were extracted and processed as for GC-ECD (I) above. The first (PCB and lower-polarity pesticide) fraction from the semi-preparative aminopropylsilane column was further fractionated using a Cosmosil PYE (pyrenylethyl group bonded) column (5 µm particle size, 4.6 mm i.d. × 25 cm ; Phenomenex, Torrance, CA) [11]. Three fractions were collected: the first fraction contained the pesticides and multi-*ortho* PCBs, the second fraction contained the polychlorinated naphthalenes, non-*ortho* PCB congeners, and some mono-*ortho* PCB congeners, and the third fraction removed the residual planar compounds from the column. The second fraction was analyzed by GC/MS NICI using the same column as GC/MS (IB) above. Carbon-13 labeled PCB 77 was used as an internal standard for quantification purposes.

Alkylated PAH Groups, Hopanes, and Steranes: SRM 1941b was used in an interlaboratory comparison exercise in 2011 [12]. Results from 33 laboratories that participated in this exercise were used in the determination of the reference values for alkylated PAH groups, hopanes, and steranes in SRM 1941b. Note that not all laboratories returned data for each analyte. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest. For the alkylated PAHs, the majority of the laboratories (>90 %) used the parent PAH for determination of the response factor for the corresponding alkylated group.

Total Organic Carbon: Two laboratories provided results for TOC using similar procedures. Briefly, subsamples of approximately 200 mg were reacted with 6 mol/L hydrochloric acid and rinsed with deionized water prior to combustion in a gas fusion furnace. The carbon monoxide and carbon dioxide produced were measured and compared to a blank for calculation of the percent TOC. Each laboratory analyzed subsamples from three bottles of SRM 1941b. One of the laboratories also analyzed three subsamples from three bottles of SRM 1941b for carbon, hydrogen, and nitrogen.

Table 1. Certified Mass Fraction Values for PAHs in SRM 1941b

PAHs	Mass Fractions(a) (µg/kg)		
Naphthalene(b,c,d,e,f,g)	848	±	95(h)
Fluorene(b,c,d,e,f,g)	85	±	15(h)
Phenanthrene(b,c,d,e,f,g)	406	±	44(h)
Anthracene(b,c,d,e,f,g)	184	±	18(h)
3-Methylphenanthrene(b,c,d)	105	±	13(h)
2-Methylphenathrene(b,c,d)	128	±	14(h)
1-Methylphenanthrene(b,c,d,g)	73.2	±	5.9(h)
Fluoranthene(b,c,d,e,f,g)	651	±	50(h)
Pyrene(b,c,d,e,f,g)	581	±	39(h)
Benz[*a*]anthracene(b,c,d,e,f,g)	335	±	25(h)
Chrysene(d,f)	291	±	31(h)
Triphenylene(d,f)	108	±	5(i)
Benzo[*b*]fluoranthene(c,e)	453	±	21(h)
Benzo[*k*]fluoranthene(b,c,d,e)	225	±	18(h)
Benzo[*e*]pyrene(b,c,d,g)	325	±	25(h)
Benzo[*a*]pyrene(b,c,d,f,g)	358	±	17(h)
Perylene(b,c,d,f,g)	397	±	45(h)
Benzo[*ghi*]perylene(b,c,d,f,g)	307	±	45(h)
Indeno[1,2,3-*cd*]pyrene(b,c,d,f,g)	341	±	57(h)
Dibenz[*a,j*]anthracene(b,c,d,f)	48.9	±	4.6(h)
Dibenz[*a,c*]anthracene(c,f)	36.7	±	5.2(h)
Dibenz[*a,h*]anthracene(c,f)	53	±	10(h)
Benzo[*b*]chrysene(b,c,d,f)	53	±	12(h)
Picene(b,c,d)	46.6	±	4.7(h)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (I) on 5 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(c) GC/MS (II) on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(d) GC/MS (III) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(e) LC-FL (total) of total PAH fraction after PFE with DCM.

(f) LC-FL (isomer) of isomeric PAH fractions after PFE with DCM.

(g) 1999 Interlaboratory Comparison Study [7] with 21 to 29 laboratories submitting data for each PAH.

(h) Certified values are weighted means of the results from two to six analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(i) The certified value is an unweighted mean of the results from two analytical methods. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

Table 2. Certified Mass Fraction Values for PCB Congeners(a) in SRM 1941b

PCB Congeners			Mass Fractions(b) (µg/kg)		
PCB	8	(2,4'-Dichlorobiphenyl)(c,d,e,f,g)	1.65	±	0.19(h)
PCB	18	(2,2',5-Trichlorobiphenyl)(c,d,e,f,g)	2.39	±	0.29(h)
PCB	28	(2,4,4'-Trichlorobiphenyl)(c,d,e,f,g)	4.52	±	0.57(h)
PCB	31	(2,4',5-Trichlorobiphenyl)(c,e,f)	3.18	±	0.41(h)
PCB	44	(2,2'3,5'-Tetrachlorobiphenyl)(c,d,e,f,g)	3.85	±	0.20(i)
PCB	49	(2,2'4,5'-Tetrachlorobiphenyl)(c,d,e,f)	4.34	±	0.28(i)
PCB	52	(2,2',5,5'-Tetrachlorobiphenyl)(c,d,e,f,g)	5.24	±	0.28(i)
PCB	66	(2,3',4,4'-Tetrachlorobiphenyl)(c,e,f,g,j)	4.96	±	0.53(i)
PCB	87	(2,2',3,4,5'-Pentachlorobiphenyl)(c,d,f,j)	1.14	±	0.16(h)
PCB	95	(2,2',3,5',6-Pentachlorobiphenyl)(c,e,f,g)	3.93	±	0.62(i)
PCB	99	(2,2',4,4',5-Pentachlorobiphenyl)(c,d,e,f,g)	2.90	±	0.36(i)
PCB	101	(2,2',4,5,5'-Pentachlorobiphenyl)(c,e,f,g,j)	5.11	±	0.34(i)
PCB	105	(2,3,3',4,4'-Pentachlorobiphenyl)(c,d,e,f,g,j)	1.43	±	0.10(i)
PCB	110	(2,3,3',4',6-Pentachlorobiphenyl)(c,e,f,j)	4.62	±	0.36(i)
PCB	118	(2,3',4,4',5-Pentachlorobiphenyl)(c,d,e,f,g,j)	4.23	±	0.19(i)
PCB	128	(2,2',3,3',4,4'-Hexachlorobiphenyl)(c,d,e,f,g,j)	0.696	±	0.044(i)
PCB	138	(2,2',3,4,4',5'-Hexachlorobiphenyl)(c,e,f,j)	3.60	±	0.28(i)
PCB	149	(2,2',3,4',5',6-Hexachlorobiphenyl)(c,d,e,j)	4.35	±	0.26(h)
PCB	153	(2,2',4,4',5,5'-Hexachlorobiphenyl)(c,d,e,f,g,j)	5.47	±	0.32(i)
PCB	156	(2,3,3',4,4',5-Hexachlorobiphenyl)(c,d,e,f,j)	0.507	±	0.090(h)
PCB	170	(2,2',3,3',4,4',5-Heptachlorobiphenyl)(c,d,e,f,g,j)	1.35	±	0.09(i)
PCB	180	(2,2',3,4,4',5,5'-Heptachlorobiphenyl)(c,d,e,f,g,j)	3.24	±	0.51(i)
PCB	183	(2,2',3,4,4',5',6-Heptachlorobiphenyl)(c,d,e,j)	0.979	±	0.087(h)
PCB	187	(2,2',3,4',5,5',6-Heptachlorobiphenyl)(c,d,e,f,g,j)	2.17	±	0.22(i)
PCB	194	(2,2',3,3',4,4',5,5'-Octachlorobiphenyl)(c,d,e,j)	1.04	±	0.06(h)
PCB	195	(2,2',3,3',4,4',5,6-Octachlorbiphenyl)(c,e,g,j)	0.645	±	0.060(i)
PCB	201	(2,2',3,3',4,5',6,6'-Octachlorobiphenyl)(c,e,j)	0.777	±	0.034(h)
PCB	206	(2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)(c,e,f,g,j)	2.42	±	0.19(i)
PCB	209	Decachlorobiphenyl(c,d,e,f,g,j)	4.86	±	0.45(i)

(a) PCB congeners are numbered according to the scheme proposed by Ballschmiter and Zell [9] and later revised by Schulte and Malisch [10] to conform to IUPAC rules, except PCB 201. Under the Ballschmiter and Zell numbering system, the IUPAC PCB 201 is listed as PCB 200.

(b) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(c) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(d) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(e) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(f) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(g) 1999 Interlaboratory Comparison Study [7] with 13 to 31 laboratories submitting data for each PCB congener.

(h) Certified values are unweighted means of the results from three to five analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(i) Certified values are weighted means of the results from three to six analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(j) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

Table 3. Certified Mass Fraction Values for Chlorinated Pesticides in SRM 1941b

Chlorinated Pesticides	Mass Fractions(a) (µg/kg)
Hexachlorobenzene(b,c,d,e)	5.83 ± 0.38(f)
cis-Chlordane(b,c,d,e,g)	0.85 ± 0.11(h)
trans-Chlordane(b,c,e)	0.566 ± 0.093(f)
cis-Nonachlor(b,e,g)	0.378 ± 0.053(h)
trans-Nonachlor(b,c,d,e,g)	0.438 ± 0.073(f)
4,4'-DDE(b,d,e,g)	3.22 ± 0.28(h)
4,4'-DDD(b,d,e,g)	4.66 ± 0.46(h)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(c) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(d) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(e) 1999 Interlaboratory Comparison Study [7] with 13 to 31 laboratories submitting data for each pesticide.

(f) Certified values are unweighted means of the results from three to five analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(g) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(h) Certified values are weighted means of the results from three to five analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

Table 4. Reference Mass Fraction Values for PAHs in SRM 1941b

PAHs	Mass Fractions(a) (µg/kg)		
1-Methylnaphthalene(b,c,d,e)	127	±	14(f)
2-Methylnaphthalene(b,c,d,e)	276	±	53(f)
2,6-Dimethylnaphthalene(b,c,d,e)	75.9	±	4.5(f)
2,3,5-Trimethylnaphthalene(b,c,d,e)	25.5	±	5.1(f)
Biphenyl(b,c,d,e)	74.0	±	8.0(f)
Acenaphthylene(b,c,d,e)	53.3	±	6.4(f)
Acenaphthene(b,c,d,e)	38.4	±	5.2(f)
9-Methylphenanthrene(c)	63.5	±	2.5(g)
4-Methylphenanthrene and 9-Methylphenanthrene(b,d)	80.1	±	4.8(f)
2-Methylanthracene(c,d)	36	±	15(f)
8-Methylfluoranthene(b)	49.5	±	2.7(g)
7-Methylfluoranthene(b)	45.4	±	1.5(g)
1-Methylfluoranthene(b)	42.4	±	2.1(g)
3-Methylfluoranthene(b)	28.8	±	1.3(g)
2-Methylpyrene(b)	78.7	±	4.0(g)
4-Methylpyrene(b)	66.4	±	2.6(g)
1-Methylpyrene(b)	52.5	±	2.3(g)
Acephenanthrene(d)	30.5	±	1.9(g)
Benzo[*c*]phenanthrene(b,c,d)	58	±	15(f)
Benzo[*a*]fluoranthene(b,c,d)	73	±	18(f)
Benzo[*j*]fluoranthene(c)	217	±	5(g)
Indeno[1,2,3-*cd*]fluoranthene(d)	9.63	±	0.34(g)
Pentaphene(d)	25.3	±	1.0(g)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (I) on 5 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(c) GC/MS (II) on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(d) GC/MS (III) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(e) 1999 Interlaboratory Comparison Study [7] with 14 to 26 laboratories submitting data for each PAH.

(f) Reference values are weighted means of the results from two to four analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed as determined by the methods indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(g) Reference values are the means of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution for the associated degrees of freedom (19 for footnote b and 5 for footnotes c and d) and 95 % confidence level for each analyte. The measurand is the total mass fraction of the constituent listed as determined by the method indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

Table 5. Reference Mass Fraction Values for PAHs of Molecular Mass 300 and 302 in SRM 1941b

PAHs of Molecular Mass 300 and 302	Mass Fractions[a,b,c] (µg/kg)		
Coronene	72.6	±	4.7
Dibenzo[*b,e*]fluoranthene	10.3	±	0.3
Naphtho[1,2-*b*]fluoranthene	91.0	±	3.1
Naphtho[1,2-*k*]fluoranthene and Naphtho[2,3-*j*]fluoranthene	79.8	±	2.5
Naphtho[2,3-*b*]fluoranthene	23.5	±	0.3
Dibenzo[*b,k*]fluoranthene	95.6	±	3.1
Dibenzo[*a,k*]fluoranthene	26.6	±	0.4
Dibenzo[*j,l*]fluoranthene	63.8	±	1.8
Dibenzo[*a,l*]pyrene	11.1	±	1.0
Naphtho[2,3-*k*]fluoranthene	10.7	±	0.6
Naphtho[1,2-*a*]pyrene	16.7	±	1.4
Naphtho[2,3-*e*]pyrene	33.2	±	2.3
Dibenzo[*a,e*]pyrene	76.1	±	3.6
Naphtho[2,1-*a*]pyrene	59.2	±	1.8
Dibenzo[*e,i*]pyrene	35.0	±	2.4
Naphtho[2,3-*a*]pyrene	16.5	±	0.6
Benzo[*b*]perylene	38.2	±	1.2
Dibenzo[*a,i*]pyrene	25.5	±	1.0
Dibenzo[*a,h*]pyrene	6.94	±	0.29

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) Reference values are the means of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution for two degrees of freedom and 95 % confidence level for each analyte. The measurand is the total mass fraction of the constituent listed as determined by the method indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(c) GC/MS on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM [8].

Table 6. Reference Mass Fraction Values for PCB Congeners(a) in SRM 1941b

PCB Congeners			Mass Fractions(b,c) (µg/kg)		
PCB	45	(2,2',3,6-Tetrachlorobiphenyl)(d,e)	0.73	±	0.12
PCB	56	(2,3,3',4-Tetrachlorobiphenyl)(d,f,g)	1.21	±	0.11
PCB	63	(2,3,4',5-Tetrachlorobiphenyl)(e,f,g)	0.213	±	0.040
PCB	70	(2,3',4',5-Tetrachlorobiphenyl)(e,f,g)	4.99	±	0.29
PCB	74	(2,4,4',5-Tetrachlorobiphenyl)(e,f,g)	2.04	±	0.15
PCB	77	(3,3',4,4'-Tetrachlorobiphenyl)(h)	0.31	±	0.03
PCB	107	(2,3,3',4,5'-Pentachlorobiphenyl)(d,e,f,g)	0.628	±	0.028
PCB	132	(2,2',3,3',4,6'-Hexachlorobiphenyl)(d,f,g)	1.28	±	0.27
PCB	146	(2,2',3,4',5,5'-Hexachlorobiphenyl)(e,f,g)	1.22	±	0.12
PCB	158	(2,3,3',4,4',6-Hexachlorobiphenyl)(d,e,f,g)	0.65	±	0.15
PCB	163	(2,3,3',4',5,6-Hexachlorobiphenyl)(e,f,g)	1.28	±	0.06
PCB	174	(2,2',3,3',4,5,6'-Heptachlorobiphenyl)(d,e,f,g)	1.51	±	0.39
PCB	193	(2,3,3',4',5,5',6-Heptachlorobiphenyl)(d,e,f,g)	0.292	±	0.075

(a) PCB congeners are numbered according to the scheme proposed by Ballschmiter and Zell [9] and later revised by Schulte and Malisch [10] to conform with IUPAC rules, except PCB 107. Under the Ballschmiter and Zell numbering system, the IUPAC PCB 107 is listed as PCB 108.

(b) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(c) For these PCB congeners except PCB 77, the reference values are unweighted means of the results from two to four analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled within-method variance following the ISO/JCGM Guide [14,15]. For PCB 77, the reference value is the mean of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_{c}$, where u_{c} is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's *t*-distribution corresponding to two degrees of freedom and 95 % confidence level for PCB 77. The measurand is the total mass fraction of the constituent listed as determined by the methods or method indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry mass basis.

(d) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(e) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(f) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(g) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(h) GC/MS NICI on a 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC-ECD (I) fractionated using a PYE column.

Table 7. Reference Mass Fraction Values for Selected Chlorinated Pesticides in SRM 1941b

Chlorinated Pesticides	Mass Fractions[a,b] (µg/kg)
2,4'-DDE[c,d]	0.38 ± 0.12
4,4'-DDT[e,f]	1.12 ± 0.42

(a) Mass Fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) The reference values are unweighted means of the results from two analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed as determined by the methods indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(c) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(d) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(e) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(f) 1999 Interlaboratory Comparison Study [7] with 10 laboratories submitting data for 4,4'-DDT.

Table 8. Reference Mass Fraction Values for Alkylated PAH Groups in SRM 1941b

Alkylated PAH Group	Mass Fraction[a,b] (µg/kg)
C2-decalins	18 ± 5
C4-decalins	41 ± 4
C2-naphthalenes	187 ± 53
C3-naphthalenes	158 ± 42
C1-benzothiophenes	25 ± 14
C2-benzothiophenes	20 ± 11
C3-benzothiophenes	22 ± 13
C4-benzothiophenes	18 ± 5
C1-fluorenes	57 ± 18
C2-fluorenes	122 ± 43
C3-fluorenes	128 ± 31
C1-phenanthrenes/anthracenes	313 ± 99
C2-phenanthrenes/anthracenes	247 ± 62
C3-phenanthrenes/anthracenes	165 ± 46
C4-phenanthrenes/anthracenes	87 ± 36
C1-dibenzothiophenes	54 ± 13
C2-dibenzothiophenes	91 ± 18
C3-dibenzothiophenes	84 ± 15
C4-dibenzothiophenes	57 ± 13
C1-fluoranthenes/pyrenes	252 ± 48
C2-fluoranthenes/pyrenes	205 ± 38
C3-fluoranthenes/pyrenes	102 ± 22
C4-fluoranthenes/pyrenes	121 ± 59
C1-benzanthraces/chrysenes/triphenylenes	208 ± 43
C2-benzanthraces/chrysenes/triphenylenes	120 ± 24
C3-benzanthraces/chrysenes/triphenylenes	73 ± 31
C4-benzanthraces/chrysenes/triphenylenes	41 ± 11

(a) The reference mass fraction value reported on a dry-mass basis is the median of results using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the median, and the coverage factor, $k = 2$. The measurand is the total mass fraction of the constituent listed as determined by the interlaboratory study as indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(b) Data from the interlaboratory study [12].

Table 9. Reference Mass Fraction Values for Hopanes and Steranes in SRM 1941b

Hopane or Sterane	Mass Fraction(a,b) (µg/kg)
17α(H)-22,29,30-Trisnorhopane	54 ± 18
17α(H)-21β(H)-30-Norhopane	137 ± 21
17α(H)-21β(H)-30-Hopane	215 ± 44
17α(H)-21β(H)-22R-Homohopane	44 ± 10
17α(H)-21β(H)-22S-Homohopane	48 ± 13
5α(H)-14α(H),17α(H)-Cholestane 20R	41 ± 11
5α(H)-14β(H),17β(H)-Cholestane 20R	27 ± 6
5α(H)-14β(H),17β(H)-24-Methylcholestane 20R	21 ± 8
5α(H)-14α(H),17α(H)-24-Ethylcholestane 20R	19 ± 5
5α(H)-14β(H),17β(H)-24-Ethylcholestane 20R	41 ± 9

(a) The reference mass fraction value reported on a dry-mass basis is the median of results using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the median, and the coverage factor, $k = 2$. The measurand is the total mass fraction of the constituent listed as determined by the interlaboratory study as indicted and the values listed are metrologically traceable to the SI unit of mass fraction in microgram analyte per kilogram sample on a dry-mass basis.

(b) Data from the interlaboratory study [12].

Table 10. Reference Mass Fraction Value for Total Organic Carbon in SRM 1941b

Total Organic Carbon (TOC) 2.99 % ± 0.24 %(a,b)

(a) Mass fraction is reported on a dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) The reference value for total organic carbon is a weighted mean value from routine measurements made by two laboratories [21]. The uncertainty listed is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance. The reporting follows the ISO/JCGM Guides [2]. The measurand is the total mass fraction of the constituent listed as determined by the methods indicted and the values listed are metrologically traceable to the SI unit of mass fraction in percent per sample on a dry-mass basis.

Table 11. Information Mass Fraction Values for Carbon, Hydrogen, and Nitrogen in SRM 1941b

Elements	Mass Fractions(a) (%)
Carbon	3.3
Hydrogen	1.2
Nitrogen	<0.5

(a) Mass fraction is reported on a dry-mass basis; material as received contains approximately 2.4 % moisture.

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Certificate Revision History: 10 June 2014 (Units corrected from mg/kg to µg/kg in Tables 8 and 9; editorial changes); 10 April 2012 (Reference value added for alkylated PAH groups, hopanes, and steranes; extension of certification period; editorial changes); 16 August 2004 (Reference values for the butyl tins removed; editorial changes); 15 July 2002 (Original certificate date).

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.

APPENDIX A

The laboratories listed below performed measurements that contributed to the certification of PAHs, PCBs, and chlorinated pesticides in SRM 1941b Organics in Marine Sediment.

Arthur D. Little, Inc; Cambridge, MA
Axys Analytical Services; Sidney, BC, Canada
B & B Laboratories; College Station, TX
Battelle Ocean Sciences; Duxbury, MA
Bedford Institute of Oceanography; Dartmouth, NS, Canada
California Department of Fish and Game; Rancho Cordova, CA
Central Contra Costa Sanitary District; Martinez, CA
Chesapeake Biological Laboratory; Solomons, MD
Centro de Investigaciones Energeticas Medioambientales y Tecnologicas; Madrid, Spain
City of Los Angeles Environmental Monitoring Division; Playa del Rey, CA
City of San Jose Environmental Services Department; San Jose, CA
Columbia Analytical Services; Kelso, WA
East Bay Municipal Utility District; Oakland, CA
Florida Department of Environmental Protection; Tallahassee, FL
Manchester Environmental Laboratory; Port Orchard, WA
Murray State University; Murray, KY
Massachusetts Water Resources Authority Central Lab; Winthrop, MA
National Research Council of Canada; Ottawa, Ontario, Canada
National Oceanic and Atmospheric Association (NOAA), National Marine Fisheries Service (NMFS), Auke Bay Laboratory; Juneau, AK
NOAA, National Ocean Service/Center for Coastal Environmental Health and Biomolecular Research; Charleston, SC
NOAA, NMFS, Sandy Hook Marine Laboratory; Highlands, NJ
NOAA, NMFS, Northwest Fisheries Science Center; Seattle, WA
Orange County Sanitation District; Fountain Valley, CA
Philip Analytical Services; Burlington, Ontario, Canada
Serv de Hidrografia Naval; Buenos Aires, Argentina
Skidaway Institute of Technology; Savannah, GA
Southwest Laboratory of Oklahoma; Broken Arrow, OK
Severn Trent Knoxville Laboratory; Knoxville, TN
Texas A&M University, Geochemical and Environmental Research Group; College Station, TX
Texas Parks and Wildlife Department; San Marcos, TX
University of California at Los Angeles, Institute of Geophysics and Planetary Physics; Los Angeles, CA
University of Connecticut, Environmental Research Institute; Storrs, CT
University of Rhode Island, Graduate School of Oceanography; Narragansett, RI
US Department of Agriculture, Environmental Chemistry Laboratory; Beltsville, MD
US Environmental Protection Agency, Atlantic Ecology Division; Narragansett, RI
US Geological Survey, National Water Quality Laboratory; Denver, CO
Woods Hole Group Environmental Lab; Raynham, MA
Wright State University; Dayton, OH

APPENDIX B

The laboratories listed below performed measurements that contributed to the certification of alkylated PAH groups, hopanes, and steranes in SRM 1941b Organics in Marine Sediment.

Alpha Analytical, Inc.; Mansfield, MA
Analytical Resources, Inc.; Tukwila, WA
Axys Analytical Services; Sydney, BC, Canada
Battelle Analytical & Environmental Chemistry Laboratory; Duxbury, MA
Center for Laboratory Sciences; Pasco, WA
Columbia Analytical Services; Jacksonville, FL
Columbia Analytical Services; Rochester, NY
Columbia Analytical Services, Kelso, WA
Florida Department of Environmental Protection; Tallahassee, FL
Florida International University; North Miami, FL
Michigan Department of Natural Resources and Environment; Lansing, MI
Mississippi State Chemical Laboratory; Mississippi State, MS
NIST; Charleston, SC
NIST; Gaithersburg, MD
NOAA/NCCOS/NOS; Charleston, SC
NOAA/NMFS/Alaska Fisheries Science Center; Juneau, AK
NY State Department of Health; Albany, NY
Pace Analytical Services, Inc. Minneapolis; Minneapolis, MN
RJ Lee Group, Inc; Monroeville, PA
TDI/B&B Laboratories, Inc.; College Station, TX
TestAmerica Laboratories; Mobile, AL
TestAmerica Laboratories; West Sacramento, CA
TestAmerica Laboratories; University Park, IL
TestAmerica Laboratories; Schriever, LA
TestAmerica Laboratories; Edison, NJ
TestAmerica Laboratories; Knoxville, TN
TestAmerica Laboratories; Pittsburgh, PA
TestAmerica Laboratories; South Burlington, VT
TestAmerica Laboratories; Tacoma, WA
US Army Engineer Research and Development Center; Vicksburg, MS
USGS Columbia Environmental Research Center; Columbia, MO
University of Iowa, State Hygienic Laboratory; Iowa City, IO
Washington State Public Health Laboratories; Shoreline, WA

National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1941b

Organics in Marine Sediment

This Standard Reference Material (SRM) is marine sediment collected at the mouth of the Baltimore (MD) Harbor. SRM 1941b is intended for use in evaluating analytical methods for the determination of selected polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, and chlorinated pesticides in marine sediment and similar matrices. Information values are also provided for total organic carbon (TOC), total carbon, hydrogen, and nitrogen. All of the constituents for which certified, reference, and information values are provided in SRM 1941b were naturally present in the sediment before processing. A unit of SRM 1941b consists of a bottle containing 50 g of radiation-sterilized, freeze-dried sediment.

Certified Mass Fraction Values: Certified mass fraction values for PAHs, PCB congeners, and chlorinated pesticides are provided in Table 1 through Table 3. The certified values for the PAHs, PCB congeners, and chlorinated pesticides are based on the agreement of results obtained at NIST from two or more chemically independent analytical techniques along with results from an interlaboratory comparison study [1]. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [1].

Reference Mass Fraction Values: Reference mass fraction values for additional PAHs (some in combination), additional PCB congeners, and additional chlorinated pesticides are provided in Table 4 through Table 7. Reference values for alkylated PAH groups are provided in Table 8 and for selected hopanes and steranes in Table 9. A reference value for total organic carbon is provided in Table 10. Reference values are noncertified values that are the best estimate of the true value; however, the values do not meet the NIST criteria for certification and are provided with associated uncertainties that may reflect only measurement precision, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods [1].

Information Mass Fraction Values: Information mass fraction values are provided in Table 11 for carbon, hydrogen, and nitrogen. An information value is considered to be a value that will be of use to the SRM user, but insufficient information is available to assess the uncertainty associated with the value [1]. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 1941b** is valid, within the measurement uncertainty specified, until **01 October 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Handling, Storage, and Use"). This certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Coordination of the technical measurements leading to the certification of this material was under the leadership of M.M. Schantz and S.A. Wise of the NIST Chemical Sciences Division.

Analytical measurements for the certification of SRM 1941b were performed at NIST by J.R. Kucklick, B.J. Porter, D.L. Poster, M.M. Schantz, P. Schubert, S. Tutschku, and L.L. Yu of the NIST Chemical Sciences Division.

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Gaithersburg, MD 20899
Certificate Issue Date: 16 January 2015

Robert L. Watters, Jr., Director
Office of Reference Materials

Measurements for TOC were provided by a commercial laboratory and T.L. Wade of the Geochemical and Environmental Research Group, Texas A&M University (College Station, TX). The carbon, hydrogen, and nitrogen data were provided by a commercial laboratory. Results for the PAHs, PCBs, and chlorinated pesticides from 38 laboratories (see Appendix A) that participated in an interlaboratory comparison exercise coordinated by NIST were used. Results for the alkylated PAH groups, hopanes, and steranes from 33 laboratories (see Appendix B) that participated in another interlaboratory comparison exercise coordinated by NIST were also used.

Collection and preparation of SRM 1941b were performed by M.P. Cronise and C.N. Fales of the NIST Office of Reference Materials and B.J. Porter and M.M. Schantz of the NIST Chemical Sciences Division. The sediment material was collected with the assistance of G.G. Lauenstein, J. Collier, and J. Lewis (National Oceanic and Atmospheric Administration, Silver Spring, MD).

Consultation on the statistical design of the experimental work and evaluation of the data were provided by S.D. Leigh and J.H. Yen of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

INSTRUCTIONS FOR HANDLING, STORAGE, AND USE

Handling: This material is naturally occurring marine sediment from an urban area and may contain constituents of unknown toxicities; therefore, caution and care should be exercised during its handling and use.

Storage: SRM 1941b must be stored in its original bottle at temperatures less than 30 °C and away from direct sunlight.

Use: Prior to removal of subsamples for analysis, the contents of the bottle should be mixed. The mass fractions of constituents in SRM 1941b are reported on a dry-mass basis. The SRM, as received, contains a mass fraction of approximately 2.4 % moisture (see "Conversion to Dry-Mass Basis"). The sediment sample should be dried to a constant mass before weighing for analysis; or a separate subsample of the sediment should be removed from the bottle at the time of analysis and dried to determine the mass fraction on a dry-mass basis. If the constituents of interest are volatile, then the moisture must be determined with a separate subsample.

PREPARATION AND ANALYSIS(1)

Sample Collection and Preparation: The sediment used to prepare this SRM was collected from the Chesapeake Bay at the mouth of the Baltimore (MD) Harbor near the Francis Scott Key Bridge (39°12.3'N and 76°31.4'W). This location is very near the site where SRM 1941 and SRM 1941a were collected. The sediment was collected using a Kynar-coated modified Van Veen-type grab sampler. A total of approximately 3300 kg of wet sediment was collected from the site. The sediment was freeze-dried, sieved at 150 µm (100 % passing), homogenized in a cone blender, radiation sterilized (^{60}Co), and then packaged in screw-capped amber glass bottles each containing approximately 50 g.

Conversion to Dry-Mass Basis: The results for the constituents in SRM 1941b are reported on a dry-mass basis; however, the material "as received" contains residual moisture. The amount of moisture in SRM 1941b was determined by measuring the mass loss after freeze-drying subsamples of 1.1 g to 1.3 g for four days at 1 Pa with a –10 °C shelf temperature and a –50 °C condenser temperature. The moisture content in SRM 1941b at the time of the certification analyses was 2.39 % ± 0.08 % (95 % confidence level). Analytical results for the organic constituents were determined on an as-received basis and then converted to a dry-mass basis by dividing by the conversion factor of 0.9761 (gram dry mass per gram as-received mass).

Polycyclic Aromatic Hydrocarbons: The general approach used for the value assignment of the PAHs in SRM 1941b was similar to that reported in detail elsewhere [2]. The approach consisted of combining results from analyses using various combinations of different extraction techniques and solvents, clean-up/isolation procedures, and chromatographic separation and detection techniques: Soxhlet extraction and pressurized-fluid extraction (PFE) using dichloromethane (DCM) or a hexane/acetone mixture, cleanup of the extracts using solid-phase extraction (SPE) or normal-phase liquid chromatography (LC), followed by analysis using the following techniques: (1) reversed-phase liquid chromatography with fluorescence detection (LC-FL) analysis of the total PAH fraction, (2) reversed-phase

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(1) Certain commercial equipment, instruments or materials are identified in this certificate to adequately specify the

LC-FL analysis of isomeric PAH fractions isolated by normal-phase LC (i.e., multidimensional LC), (3) gas chromatography/mass spectrometry (GC/MS) analysis of the PAH fraction on three stationary phases of different selectivity, i.e., a 5 % (all column compositions are given as mole fractions in %) phenyl-substituted methylpolysiloxane phase, a 50 % phenyl-substituted methylpolysiloxane phase, and a relatively non-polar proprietary phase.

Three sets of GC/MS results, designated as GC/MS (I), GC/MS (II), and GC/MS (III), were obtained using three columns with different selectivities for the separation of PAHs. For GC/MS (I) analyses, duplicate subsamples of approximately 1 g from ten bottles of SRM 1941b were extracted using PFE with DCM. Copper powder was added to the extract to remove elemental sulfur. The concentrated extract was passed through an aminopropyl SPE cartridge and eluted with 2 % DCM in hexane (all solvent concentrations are given as volume fractions in %). The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-5 MS, J&W Scientific, Folsom, CA). The GC/MS (II) analyses were performed using 5 g subsamples from six bottles of SRM 1941b. These samples were extracted using PFE with DCM. The high molecular mass compounds were removed from the extracts using size exclusion chromatography (SEC) with a preparative-scale divinylbenzene-polystyrene column (10 µm particle size with 10 nm diameter pores), and the sulfur was removed from the extracts by adding copper powder. The concentrated extract was passed through an aminopropyl SPE cartridge and eluted with 10 % DCM in hexane. The analysis was by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 50 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-17 MS, J&W Scientific). For the GC/MS (III), 9 g subsamples from six bottles of SRM 1941b were Soxhlet-extracted for 18 h with 250 mL of a mixture of 50 % hexane/50 % acetone. Copper powder was added to the extract to remove elemental sulfur, and the concentrated extract was passed through a silica SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a relatively non-polar proprietary phase (0.25 µm film thickness; DB-XLB, J&W Scientific).

Two sets of LC-FL results, designated as LC-FL (total) and LC-FL (isomer), were used in the certification process. For the LC-FL (total), subsamples of approximately 1 g from six bottles of SRM 1941b were extracted using PFE with a mixture of 50 % hexane/50 % acetone. The extracts were concentrated and then processed through an aminopropylsilane SPE cartridge using 2 % DCM in hexane to obtain the total PAH fraction. For the LC-FL (isomer), a 5 g subsample from the six bottles was extracted using PFE with DCM and processed through an aminopropylsilane SPE cartridge using 10 % DCM in hexane; the PAH fraction was then fractionated further on a semi-preparative aminopropylsilane column (µBondapak NH_2, 9 mm i.d. × 30 cm, Waters Associates, Milford, MA) to isolate isomeric PAH fractions as described previously [3–6]. The total PAH fraction and the isomeric PAH fractions were analyzed using a 5 µm particle-size polymeric octadecylsilane (C_{18}) column (4.6 mm i.d. × 25 cm, Hypersil-PAH, Keystone Scientific, Inc., Bellefonte, PA) with wavelength-programmed fluorescence detection [4,5].

For the GC/MS and LC-FL measurements described above, selected perdeuterated PAHs were added to the sediment prior to solvent extraction for use as internal standards for quantification purposes.

In addition to the analyses performed at NIST, SRM 1941b was used in an interlaboratory comparison exercise in 1999 as part of the NIST Intercomparison Exercise Program for Organic Contaminants in the Marine Environment [7]. Results from 38 laboratories that participated in this exercise were used as the sixth data set in the determination of the certified values for PAHs in SRM 1941b. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest.

Homogeneity Assessment for PAHs: The homogeneity of SRM 1941b was assessed by analyzing duplicate samples of approximately 1 g from ten bottles selected by stratified random sampling. Samples were extracted, processed, and analyzed as described above for GC/MS (I). No statistically significant differences among bottles were observed for the PAHs at this sample size.

PAH Isomers of Molecular Mass 300 and 302: For the determination of the molecular mass 300 and 302 isomers, three subsamples of approximately 5 g each were extracted using PFE with DCM. The extracts were then concentrated with a solvent change to hexane and passed through an aminopropyl SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS using a 0.25 mm i.d. × 60 m fused silica capillary column with a 50 % phenyl-substituted methylpolysiloxane phase (0.25 µm film thickness; DB-17MS, J&W Scientific). Perdeuterated dibenzo[*a,i*]pyrene was added to the sediment prior to extraction for use as an internal standard [8].

PCBs and Chlorinated Pesticides: The general approach used for the determination of PCBs and chlorinated pesticides in SRM 1941b consisted of combining results from analyses using various combinations of different extraction techniques and solvents, cleanup/isolation procedures, and chromatographic separation and detection techniques. Techniques and solvents included Soxhlet extraction and PFE using DCM or a hexane/acetone mixture, clean-up/isolation using SPE or LC, followed by analysis using GC/MS and gas chromatography with electron capture detection (GC-ECD) on two columns with different selectivity for the separation of PCBs and chlorinated pesticides. The analytical methods are described in detail elsewhere [2].

Six sets of results were obtained and designated as GC-ECD (I) A and B, GC/MS (I) A and B, GC/MS (II), and Interlaboratory Comparison Exercise. For the GC-ECD (I) analyses, approximately 10 g subsamples from six bottles of SRM 1941b were extracted using PFE with DCM. Copper powder was added to the extract to remove elemental sulfur, and SEC, as described above, was used to remove the high molecular mass compounds. The concentrated extract was then fractionated on a semi-preparative aminopropylsilane column to isolate two fractions containing: (1) the PCBs and lower-polarity pesticides and (2) the more polar pesticides. GC-ECD analyses of the two fractions were performed on two columns of different selectivities for PCB separations: 0.25 mm × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 μm film thickness; DB-5, J&W Scientific), and a 0.25 mm × 60 m fused silica capillary column with a non-polar proprietary phase (0.25 μm film thickness; DB-XLB, J&W Scientific). The results from the 5 % phenyl phase are designated as GC-ECD (IA) and the results from the proprietary phase are designated as GC-ECD (IB). For the GC-ECD analyses, two PCB congeners that are not significantly present in the sediment extract (PCB 103 and PCB 198 [9,10]) and endosulfan I-d_4, 4,4'-DDE-d_8, 4,4'-DD-d_8, and 4,4'-DDT-d_8 were added to the sediment prior to extraction for use as internal standards for quantification purposes.

Two sets of results were obtained by GC/MS. For GC/MS (I), approximately 9 g subsamples from six bottles were Soxhlet- extracted with a mixture of 50 % hexane/50 % acetone for approximately 18 h. Copper powder was added to the extract to remove elemental sulfur, and the concentrated extract was passed through a silica SPE cartridge and eluted with 10 % DCM in hexane. The processed extract was then analyzed by GC/MS with two ionization modes, electron impact (EI) and negative ion chemical ionization (NICI). The GC/MS EI method, GC/MS (IA), used a 0.25 mm i.d. × 60 m fused silica capillary column with a relatively non-polar proprietary phase (0.25 μm film thickness; DB-XLB, J&W Scientific). The GC/MS NICI method, GC/MS (IB), used a 0.25 mm i.d. × 60 m fused silica capillary column with a 5 % phenyl-substituted methylpolysiloxane phase (0.25 μm film thickness; DB-5MS, J&W Scientific). The GC/MS (II) results were obtained in the same manner as the GC/MS (IA) analyses except that three subsamples were Soxhlet-extracted with DCM for approximately 18 h. For the GC/MS analyses, selected carbon-13 labeled PCB congeners and chlorinated pesticides were added to the sediment prior to extraction for use as internal standards for quantification purposes.

In addition to the analyses performed at NIST, SRM 1941b was used in an interlaboratory comparison exercise in 1999 as part of the NIST Intercomparison Exercise Program for Organic Contaminants in the Marine Environment [7]. Results from 38 laboratories that participated in this exercise were used as the sixth data set in the determination of the certified values for PCB congeners and chlorinated pesticides in SRM 1941b. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest.

The reference value for PCB 77 was determined from a separate fraction. The samples were extracted and processed as for GC-ECD (I) above. The first (PCB and lower-polarity pesticide) fraction from the semi-preparative aminopropylsilane column was further fractionated using a Cosmosil PYE (pyrenylethyl group bonded) column (5 μm particle size, 4.6 mm i.d. × 25 cm ; Phenomenex, Torrance, CA) [11]. Three fractions were collected: the first fraction contained the pesticides and multi-*ortho* PCBs, the second fraction contained the polychlorinated naphthalenes, non-*ortho* PCB congeners, and some mono-*ortho* PCB congeners, and the third fraction removed the residual planar compounds from the column. The second fraction was analyzed by GC/MS NICI using the same column as GC/MS (IB) above. Carbon-13 labeled PCB 77 was used as an internal standard for quantification purposes.

Alkylated PAH Groups, Hopanes, and Steranes: SRM 1941b was used in an interlaboratory comparison exercise in 2011 [12]. Results from 33 laboratories that participated in this exercise were used in the determination of the reference values for alkylated PAH groups, hopanes, and steranes in SRM 1941b. Note that not all laboratories returned data for each analyte. The laboratories participating in this exercise used the analytical procedures routinely used in their laboratories to measure the analytes of interest. For the alkylated PAHs, the majority of the laboratories (>90 %) used the parent PAH for determination of the response factor for the corresponding alkylated group.

Total Organic Carbon (TOC): Two laboratories provided results for TOC using similar procedures. Briefly, subsamples of approximately 200 mg were reacted with 6 mol/L hydrochloric acid and rinsed with deionized water prior to combustion in a gas fusion furnace. The carbon monoxide and carbon dioxide produced were measured and compared to a blank for calculation of the percent TOC. Each laboratory analyzed subsamples from three bottles of SRM 1941b. One of the laboratories also analyzed three subsamples from three bottles of SRM 1941b for carbon, hydrogen, and nitrogen.

Table 1. Certified Mass Fraction Values for PAHs in SRM 1941b

PAHs	Mass Fractions(a) (µg/kg)		
Naphthalene(b,c,d,e,f,g)	848	±	95(h)
Fluorene(b,c,d,e,f,g)	85	±	15(h)
Phenanthrene(b,c,d,e,f,g)	406	±	44(h)
Anthracene(b,c,d,e,f,g)	184	±	18(h)
3-Methylphenanthrene(b,c,d)	105	±	13(h)
2-Methylphenathrene(b,c,d)	128	±	14(h)
1-Methylphenanthrene(b,c,d,g)	73.2	±	5.9(h)
Fluoranthene(b,c,d,e,f,g)	651	±	50(h)
Pyrene(b,c,d,e,f,g)	581	±	39(h)
Benz[*a*]anthracene(b,c,d,e,f,g)	335	±	25(h)
Chrysene(d,f)	291	±	31(h)
Triphenylene(d,f)	108	±	5(i)
Benzo[*b*]fluoranthene(c,e)	453	±	21(h)
Benzo[*k*]fluoranthene(b,c,d,e)	225	±	18(h)
Benzo[*e*]pyrene(b,c,d,g)	325	±	25(h)
Benzo[*a*]pyrene(b,c,d,f,g)	358	±	17(h)
Perylene(b,c,d,f,g)	397	±	45(h)
Benzo[*ghi*]perylene(b,c,d,f,g)	307	±	45(h)
Indeno[1,2,3-*cd*]pyrene(b,c,d,f,g)	341	±	57(h)
Dibenz[*a,j*]anthracene(b,c,d,f)	48.9	±	4.6(h)
Dibenz[*a,c*]anthracene(c,f)	36.7	±	5.2(h)
Dibenz[*a,h*]anthracene(c,f)	53	±	10(h)
Benzo[*b*]chrysene(b,c,d,f)	53	±	12(h)
Picene(b,c,d)	46.6	±	4.7(h)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (I) on 5 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(c) GC/MS (II) on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(d) GC/MS (III) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(e) LC-FL (total) of total PAH fraction after PFE with DCM.

(f) LC-FL (isomer) of isomeric PAH fractions after PFE with DCM.

(g) 1999 Interlaboratory Comparison Study [7] with 21 to 29 laboratories submitting data for each PAH.

(h) Certified values are weighted means of the results from two to six analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(i) The certified value is an unweighted mean of the results from two analytical methods. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the value is metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

Table 2. Certified Mass Fraction Values for PCB Congeners(a) in SRM 1941b

PCB Congeners			Mass Fractions(b) (µg/kg)		
PCB	8	(2,4'-Dichlorobiphenyl)(c,d,e,f,g)	1.65	±	0.19(h)
PCB	18	(2,2',5-Trichlorobiphenyl)(c,d,e,f,g)	2.39	±	0.29(h)
PCB	28	(2,4,4'-Trichlorobiphenyl)(c,d,e,f,g)	4.52	±	0.57(h)
PCB	31	(2,4',5-Trichlorobiphenyl)(c,e,f)	3.18	±	0.41(h)
PCB	44	(2,2'3,5'-Tetrachlorobiphenyl)(c,d,e,f,g)	3.85	±	0.20(i)
PCB	49	(2,2'4,5'-Tetrachlorobiphenyl)(c,d,e,f)	4.34	±	0.28(i)
PCB	52	(2,2',5,5'-Tetrachlorobiphenyl)(c,d,e,f,g)	5.24	±	0.28(i)
PCB	66	(2,3',4,4'-Tetrachlorobiphenyl)(c,e,f,g,j)	4.96	±	0.53(i)
PCB	87	(2,2',3,4,5'-Pentachlorobiphenyl)(c,d,f,j)	1.14	±	0.16(h)
PCB	95	(2,2',3,5',6-Pentachlorobiphenyl)(c,e,f,g)	3.93	±	0.62(i)
PCB	99	(2,2',4,4',5-Pentachlorobiphenyl)(c,d,e,f,g)	2.90	±	0.36(i)
PCB	101	(2,2',4,5,5'-Pentachlorobiphenyl)(c,e,f,g,j)	5.11	±	0.34(i)
PCB	105	(2,3,3',4,4'-Pentachlorobiphenyl)(c,d,e,f,g,j)	1.43	±	0.10(i)
PCB	110	(2,3,3',4',6-Pentachlorobiphenyl)(c,e,f,j)	4.62	±	0.36(i)
PCB	118	(2,3',4,4',5-Pentachlorobiphenyl)(c,d,e,f,g,j)	4.23	±	0.19(i)
PCB	128	(2,2',3,3',4,4'-Hexachlorobiphenyl)(c,d,e,f,g,j)	0.696	±	0.044(i)
PCB	138	(2,2',3,4,4',5'-Hexachlorobiphenyl)(c,e,f,j)	3.60	±	0.28(i)
PCB	149	(2,2',3,4',5',6-Hexachlorobiphenyl)(c,d,e,j)	4.35	±	0.26(h)
PCB	153	(2,2',4,4',5,5'-Hexachlorobiphenyl)(c,d,e,f,g,j)	5.47	±	0.32(i)
PCB	156	(2,3,3',4,4',5-Hexachlorobiphenyl)(c,d,e,f,j)	0.507	±	0.090(h)
PCB	170	(2,2',3,3',4,4',5-Heptachlorobiphenyl)(c,d,e,f,g,j)	1.35	±	0.09(i)
PCB	180	(2,2',3,4,4',5,5'-Heptachlorobiphenyl)(c,d,e,f,g,j)	3.24	±	0.51(i)
PCB	183	(2,2',3,4,4',5',6-Heptachlorobiphenyl)(c,d,e,j)	0.979	±	0.087(h)
PCB	187	(2,2',3,4',5,5',6-Heptachlorobiphenyl)(c,d,e,f,g,j)	2.17	±	0.22(i)
PCB	194	(2,2',3,3',4,4',5,5'-Octachlorobiphenyl)(c,d,e,j)	1.04	±	0.06(h)
PCB	195	(2,2',3,3',4,4',5,6-Octachlorbiphenyl)(c,e,g,j)	0.645	±	0.060(i)
PCB	201	(2,2',3,3',4,5',6,6'-Octachlorobiphenyl)(c,e,j)	0.777	±	0.034(h)
PCB	206	(2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)(c,e,f,g,j)	2.42	±	0.19(i)
PCB	209	Decachlorobiphenyl(c,d,e,f,g,j)	4.86	±	0.45(i)

(a) PCB congeners are numbered according to the scheme proposed by Ballschmiter and Zell [9] and later revised by Schulte and Malisch [10] to conform to IUPAC rules, except PCB 201. Under the Ballschmiter and Zell numbering system, the IUPAC PCB 201 is listed as PCB 200.

(b) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(c) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(d) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(e) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(f) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(g) 1999 Interlaboratory Comparison Study [7] with 13 to 31 laboratories submitting data for each PCB congener.

(h) Certified values are unweighted means of the results from three to five analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(i) Certified values are weighted means of the results from three to six analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(j) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

Table 3. Certified Mass Fraction Values for Chlorinated Pesticides in SRM 1941b

Chlorinated Pesticides	Mass Fractions(a) (μg/kg)		
Hexachlorobenzene(b,c,d,e)	5.83	±	0.38(f)
cis-Chlordane(b,c,d,e,g)	0.85	±	0.11(h)
trans-Chlordane(b,c,e)	0.566	±	0.093(f)
cis-Nonachlor(b,e,g)	0.378	±	0.053(h)
trans-Nonachlor(b,c,d,e,g)	0.438	±	0.073(f)
4,4'-DDE(b,d,e,g)	3.22	±	0.28(h)
4,4'-DDD(b,d,e,g)	4.66	±	0.46(h)

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(c) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(d) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(e) 1999 Interlaboratory Comparison Study [7] with 13 to 31 laboratories submitting data for each pesticide.

(f) Certified values are unweighted means of the results from three to five analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the constituent listed and the values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(g) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(h) Certified values are weighted means of the results from three to five analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the chlorinated pesticides listed and the values listed are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

Table 4. Reference Mass Fraction Values for PAHs in SRM 1941b

PAHs	Mass Fractions[a] (µg/kg)		
1-Methylnaphthalene[b,c,d,e]	127	±	14[f]
2-Methylnaphthalene[b,c,d,e]	276	±	53[f]
2,6-Dimethylnaphthalene[b,c,d,e]	75.9	±	4.5[f]
2,3,5-Trimethylnaphthalene[b,c,d,e]	25.5	±	5.1[f]
Biphenyl[b,c,d,e]	74.0	±	8.0[f]
Acenaphthylene[b,c,d,e]	53.3	±	6.4[f]
Acenaphthene[b,c,d,e]	38.4	±	5.2[f]
9-Methylphenanthrene[c]	63.5	±	2.5[g]
4-Methylphenanthrene and 9-Methylphenanthrene[b,d]	80.1	±	4.8[f]
2-Methylanthracene[c,d]	36	±	15[f]
8-Methylfluoranthene[b]	49.5	±	2.7[g]
7-Methylfluoranthene[b]	45.4	±	1.5[g]
1-Methylfluoranthene[b]	42.4	±	2.1[g]
3-Methylfluoranthene[b]	28.8	±	1.3[g]
2-Methylpyrene[b]	78.7	±	4.0[g]
4-Methylpyrene[b]	66.4	±	2.6[g]
1-Methylpyrene[b]	52.5	±	2.3[g]
Acephenanthrene[d]	30.5	±	1.9[g]
Benzo[*c*]phenanthrene[b,c,d]	58	±	15[f]
Benzo[*a*]fluoranthene[b,c,d]	73	±	18[f]
Benzo[*j*]fluoranthene[c]	217	±	5[g]
Indeno[1,2,3-*cd*]fluoranthene[d]	9.63	±	0.34[g]
Pentaphene[d]	25.3	±	1.0[g]

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) GC/MS (I) on 5 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(c) GC/MS (II) on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM.

(d) GC/MS (III) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(e) 1999 Interlaboratory Comparison Study [7] with 14 to 26 laboratories submitting data for each PAH.

(f) Reference values are weighted means of the results from two to four analytical methods [13]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of PAHs listed as determined by the methods indicted. The values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(g) Reference values are the means of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution for the associated degrees of freedom (19 for footnote b and 5 for footnotes c and d) and 95 % confidence level for each analyte. The measurand is the total mass fraction of the PAHs listed as determined by the method indicted. The values listed are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

Table 5. Reference Mass Fraction Values for PAHs of Molecular Mass 300 and 302 in SRM 1941b

PAHs of Molecular Mass 300 and 302	Mass Fractions[(a,b,c)] (μg/kg)		
Coronene	72.6	±	4.7
Dibenzo[*b,e*]fluoranthene	10.3	±	0.3
Naphtho[1,2-*b*]fluoranthene	91.0	±	3.1
Naphtho[1,2-*k*]fluoranthene and Naphtho[2,3-*j*]fluoranthene	79.8	±	2.5
Naphtho[2,3-*b*]fluoranthene	23.5	±	0.3
Dibenzo[*b,k*]fluoranthene	95.6	±	3.1
Dibenzo[*a,k*]fluoranthene	26.6	±	0.4
Dibenzo[*j,l*]fluoranthene	63.8	±	1.8
Dibenzo[*a,l*]pyrene	11.1	±	1.0
Naphtho[2,3-*k*]fluoranthene	10.7	±	0.6
Naphtho[1,2-*a*]pyrene	16.7	±	1.4
Naphtho[2,3-*e*]pyrene	33.2	±	2.3
Dibenzo[*a,e*]pyrene	76.1	±	3.6
Naphtho[2,1-*a*]pyrene	59.2	±	1.8
Dibenzo[*e,i*]pyrene	35.0	±	2.4
Naphtho[2,3-*a*]pyrene	16.5	±	0.6
Benzo[*b*]perylene	38.2	±	1.2
Dibenzo[*a,i*]pyrene	25.5	±	1.0
Dibenzo[*a,h*]pyrene	6.94	±	0.29

(a) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) Reference values are the means of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution for two degrees of freedom and 95 % confidence level for each analyte. The measurand is the total mass fraction of the constituent listed as determined by the method indicted. The values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(c) GC/MS on 50 % phenyl-substituted methylpolysiloxane phase after PFE with DCM [8].

Table 6. Reference Mass Fraction Values for PCB Congeners(a) in SRM 1941b

PCB Congeners			Mass Fractions(b,c) (µg/kg)		
PCB	45	(2,2',3,6-Tetrachlorobiphenyl)(d,e)	0.73	±	0.12
PCB	56	(2,3,3',4'-Tetrachlorobiphenyl)(d,f,g)	1.21	±	0.11
PCB	63	(2,3,4',5-Tetrachlorobiphenyl)(e,f,g)	0.213	±	0.040
PCB	70	(2,3',4',5-Tetrachlorobiphenyl)(e,f,g)	4.99	±	0.29
PCB	74	(2,4,4',5-Tetrachlorobiphenyl)(e,f,g)	2.04	±	0.15
PCB	77	(3,3',4,4'-Tetrachlorobiphenyl)(h)	0.31	±	0.03
PCB	107	(2,3,3',4',5-Pentachlorobiphenyl)(d,e,f,g)	0.628	±	0.028
PCB	132	(2,2',3,3',4,6'-Hexachlorobiphenyl)(d,f,g)	1.28	±	0.27
PCB	146	(2,2',3,4',5,5'-Hexachlorobiphenyl)(e,f,g)	1.22	±	0.12
PCB	158	(2,3,3',4,4',6-Hexachlorobiphenyl)(d,e,f,g)	0.65	±	0.15
PCB	163	(2,3,3',4',5,6-Hexachlorobiphenyl)(e,f,g)	1.28	±	0.06
PCB	174	(2,2',3,3',4,5,6'-Heptachlorobiphenyl)(d,e,f,g)	1.51	±	0.39
PCB	193	(2,3,3',4',5,5',6-Heptachlorobiphenyl)(d,e,f,g)	0.292	±	0.075

(a) PCB congeners are numbered according to the scheme proposed by Ballschmiter and Zell [9] and later revised by Schulte and Malisch [10] to conform with IUPAC rules, except PCB 107. Under the Ballschmiter and Zell numbering system, the IUPAC PCB 107 is listed as PCB 108.

(b) Mass fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(c) For these PCB congeners except PCB 77, the reference values are unweighted means of the results from two to four analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled within-method variance following the ISO/JCGM Guide [14,15]. For PCB 77, the reference value is the mean of results obtained by NIST using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the analyte mean, and the coverage factor, k, is determined from the Student's t-distribution corresponding to two degrees of freedom and 95 % confidence level for PCB 77. The measurand is the total mass fraction of the PCB Congeners listed as determined by the method or methods indicted. The values listed are metrologically traceable to the SI unit of mass, expressed as microgram per kilogram on a dry-mass basis.

(d) GC-ECD (IA) on 5 % phenyl-substituted methylpolysiloxane phase after PFE extraction with DCM.

(e) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(f) GC/MS (IA) on a relatively non-polar proprietary phase after Soxhlet extraction with 50 % hexane/50 % acetone mixture.

(g) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(h) GC/MS NICI on a 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC-ECD (I) fractionated using a PYE column.

Table 7. Reference Mass Fraction Values for Selected Chlorinated Pesticides in SRM 1941b

Chlorinated Pesticides	Mass Fractions(a,b) (µg/kg)
2,4'-DDE(c,d)	0.38 ± 0.12
4,4'-DDT(e,f)	1.12 ± 0.42

(a) Mass Fractions reported on dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) The reference values are unweighted means of the results from two analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2, calculated by combining a between-method variance [16] with a pooled, within-method variance following the ISO/JCGM Guide [14,15]. The measurand is the total mass fraction of the chlorinated pesticides listed as determined by the methods indicted. The values listed are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(c) GC/MS (IB) on 5 % phenyl-substituted methylpolysiloxane phase; same extracts analyzed as in GC/MS (IA).

(d) GC-ECD (IB) on a relatively non-polar proprietary phase; same extracts analyzed as in GC-ECD (IA).

(e) GC/MS (II) on a relatively non-polar proprietary phase after Soxhlet extraction with DCM.

(f) 1999 Interlaboratory Comparison Study [7] with 10 laboratories submitting data for 4,4'-DDT.

Table 8. Reference Mass Fraction Values for Alkylated PAH Groups in SRM 1941b

Alkylated PAH Group	Mass Fraction(a,b) (µg/kg)
C2-decalins	18 ± 5
C4-decalins	41 ± 4
C2-naphthalenes	187 ± 53
C3-naphthalenes	158 ± 42
C1-benzothiophenes	25 ± 14
C2-benzothiophenes	20 ± 11
C3-benzothiophenes	22 ± 13
C4-benzothiophenes	18 ± 5
C1-fluorenes	57 ± 18
C2-fluorenes	122 ± 43
C3-fluorenes	128 ± 31
C1-phenanthrenes/anthracenes	313 ± 99
C2-phenanthrenes/anthracenes	247 ± 62
C3-phenanthrenes/anthracenes	165 ± 46
C4-phenanthrenes/anthracenes	87 ± 36
C1-dibenzothiophenes	54 ± 13
C2-dibenzothiophenes	91 ± 18
C3-dibenzothiophenes	84 ± 15
C4-dibenzothiophenes	57 ± 13
C1-fluoranthenes/pyrenes	252 ± 48
C2-fluoranthenes/pyrenes	205 ± 38
C3-fluoranthenes/pyrenes	102 ± 22
C4-fluoranthenes/pyrenes	121 ± 59
C1-benzanthraces/chrysenes/triphenylenes	208 ± 43
C2-benzanthraces/chrysenes/triphenylenes	120 ± 24
C3-benzanthraces/chrysenes/triphenylenes	73 ± 31
C4-benzanthraces/chrysenes/triphenylenes	41 ± 11

(a) The reference mass fraction value reported on a dry-mass basis is the median of results using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the median, and the coverage factor, $k = 2$. The measurand is the total mass fraction of the alkylated PAH groups listed as determined by the interlaboratory study methods. The values listed are metrologically traceable to the SI unit of mass fraction, expressed as micrograms per kilogram on a dry-mass basis.

(b) Data from the interlaboratory study [12].

Table 9. Reference Mass Fraction Values for Hopanes and Steranes in SRM 1941b

Hopane or Sterane	Mass Fraction[a,b] (µg/kg)		
17α(H)-22,29,30-Trisnorhopane	54	±	18
17α(H)-21β(H)-30-Norhopane	137	±	21
17α(H)-21β(H)-30-Hopane	215	±	44
17α(H)-21β(H)-22R-Homohopane	44	±	10
17α(H)-21β(H)-22S-Homohopane	48	±	13
5α(H)-14α(H),17α(H)-Cholestane 20R	41	±	11
5α(H)-14β(H),17β(H)-Cholestane 20R	27	±	6
5α(H)-14β(H),17β(H)-24-Methylcholestane 20R	21	±	8
5α(H)-14α(H),17α(H)-24-Ethylcholestane 20R	19	±	5
5α(H)-14β(H),17β(H)-24-Ethylcholestane 20R	41	±	9

(a) The reference mass fraction value reported on a dry-mass basis is the median of results using one analytical technique. The expanded uncertainty, U, is calculated as $U = ku_c$, where u_c is one standard deviation of the median, and the coverage factor, $k = 2$. The measurand is the total mass fraction of the constituent listed as determined by the methods used during the interlaboratory study. The values are metrologically traceable to the SI unit of mass, expressed as micrograms per kilogram on a dry-mass basis.

(b) Data from the interlaboratory study [12].

Table 10. Reference Mass Fraction Value for Total Organic Carbon in SRM 1941b

Total Organic Carbon (TOC)	2.99 % ± 0.24 %(a,b)

(a) Mass fraction is reported on a dry-mass basis; material as received contains approximately 2.4 % moisture.

(b) The reference value for total organic carbon is a weighted mean value from routine measurements made by two laboratories [21]. The uncertainty listed is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence), calculated by combining a between-method variance incorporating inter-method bias with a pooled within-method variance. The reporting follows the ISO/JCGM Guides [2]. The measurand is the total mass fraction of TOC listed as determined by the methods indicted. The values listed are metrologically traceable to the SI unit of mass, expressed as a percent on a dry-mass basis.

Table 11. Information Mass Fraction Values for Carbon, Hydrogen, and Nitrogen in SRM 1941b

Elements	Mass Fractions[a] (%)
Carbon	3.3
Hydrogen	1.2
Nitrogen	<0.5

(a) Mass fraction is reported on a dry-mass basis; material as received contains approximately 2.4 % moisture.

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Certificate Revision History: 16 January 2015 (Corrected IUPAC name for PCB-56 and PCB-107; editorial changes); 10 June 2014 (Units corrected from mg/kg to µg/kg in Tables 8 and 9; editorial changes); 10 April 2012 (Reference value added for alkylated PAH groups, hopanes, and steranes; extension of certification period; editorial changes); 16 August 2004 (Reference values for the butyl tins removed; editorial changes); 15 July 2002 (Original certificate date).

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.

APPENDIX A

The laboratories listed below performed measurements that contributed to the certification of PAHs, PCBs, and chlorinated pesticides in SRM 1941b Organics in Marine Sediment.

Arthur D. Little, Inc; Cambridge, MA
Axys Analytical Services; Sidney, BC, Canada
B & B Laboratories; College Station, TX
Battelle Ocean Sciences; Duxbury, MA
Bedford Institute of Oceanography; Dartmouth, NS, Canada
California Department of Fish and Game; Rancho Cordova, CA
Central Contra Costa Sanitary District; Martinez, CA
Chesapeake Biological Laboratory; Solomons, MD
Centro de Investigaciones Energeticas Medioambientales y Tecnologicas; Madrid, Spain
City of Los Angeles Environmental Monitoring Division; Playa del Rey, CA
City of San Jose Environmental Services Department; San Jose, CA
Columbia Analytical Services; Kelso, WA
East Bay Municipal Utility District; Oakland, CA
Florida Department of Environmental Protection; Tallahassee, FL
Manchester Environmental Laboratory; Port Orchard, WA
Murray State University; Murray, KY
Massachusetts Water Resources Authority Central Lab; Winthrop, MA
National Research Council of Canada; Ottawa, Ontario, Canada
National Oceanic and Atmospheric Association (NOAA), National Marine Fisheries Service (NMFS), Auke Bay Laboratory; Juneau, AK
NOAA, National Ocean Service/Center for Coastal Environmental Health and Biomolecular Research; Charleston, SC
NOAA, NMFS, Sandy Hook Marine Laboratory; Highlands, NJ
NOAA, NMFS, Northwest Fisheries Science Center; Seattle, WA
Orange County Sanitation District; Fountain Valley, CA
Philip Analytical Services; Burlington, Ontario, Canada
Serv de Hidrografia Naval; Buenos Aires, Argentina
Skidaway Institute of Technology; Savannah, GA
Southwest Laboratory of Oklahoma; Broken Arrow, OK
Severn Trent Knoxville Laboratory; Knoxville, TN
Texas A&M University, Geochemical and Environmental Research Group; College Station, TX
Texas Parks and Wildlife Department; San Marcos, TX
University of California at Los Angeles, Institute of Geophysics and Planetary Physics; Los Angeles, CA
University of Connecticut, Environmental Research Institute; Storrs, CT
University of Rhode Island, Graduate School of Oceanography; Narragansett, RI
US Department of Agriculture, Environmental Chemistry Laboratory; Beltsville, MD
US Environmental Protection Agency, Atlantic Ecology Division; Narragansett, RI
US Geological Survey, National Water Quality Laboratory; Denver, CO
Woods Hole Group Environmental Lab; Raynham, MA
Wright State University; Dayton, OH

APPENDIX B

The laboratories listed below performed measurements that contributed to the certification of alkylated PAH groups, hopanes, and steranes in SRM 1941b Organics in Marine Sediment.

Alpha Analytical, Inc.; Mansfield, MA
Analytical Resources, Inc.; Tukwila, WA
Axys Analytical Services; Sydney, BC, Canada
Battelle Analytical & Environmental Chemistry Laboratory; Duxbury, MA
Center for Laboratory Sciences; Pasco, WA
Columbia Analytical Services; Jacksonville, FL
Columbia Analytical Services; Rochester, NY
Columbia Analytical Services, Kelso, WA
Florida Department of Environmental Protection; Tallahassee, FL
Florida International University; North Miami, FL
Michigan Department of Natural Resources and Environment; Lansing, MI
Mississippi State Chemical Laboratory; Mississippi State, MS
NIST; Charleston, SC
NIST; Gaithersburg, MD
NOAA/NCCOS/NOS; Charleston, SC
NOAA/NMFS/Alaska Fisheries Science Center; Juneau, AK
NY State Department of Health; Albany, NY
Pace Analytical Services, Inc. Minneapolis; Minneapolis, MN
RJ Lee Group, Inc; Monroeville, PA
TDI/B&B Laboratories, Inc.; College Station, TX
TestAmerica Laboratories; Mobile, AL
TestAmerica Laboratories; West Sacramento, CA
TestAmerica Laboratories; University Park, IL
TestAmerica Laboratories; Schriever, LA
TestAmerica Laboratories; Edison, NJ
TestAmerica Laboratories; Knoxville, TN
TestAmerica Laboratories; Pittsburgh, PA
TestAmerica Laboratories; South Burlington, VT
TestAmerica Laboratories; Tacoma, WA
US Army Engineer Research and Development Center; Vicksburg, MS
USGS Columbia Environmental Research Center; Columbia, MO
University of Iowa, State Hygienic Laboratory; Iowa City, IO
Washington State Public Health Laboratories; Shoreline, WA

NIST

Date of Issue:
31 March 2014

SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

Product Identifier

SRM Number: 1941b

SRM Name: Organics in Marine Sediment

Other Means of Identification: Not applicable.

Recommended Use of This Material and Restrictions of Use

This Standard Reference Material (SRM) is marine sediment collected at the mouth of the Baltimore (MD) Harbor. SRM 1941b is intended for use in evaluating analytical methods for the determination of selected polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, and chlorinated pesticides in marine sediment and similar matrices. All of the constituents for which certified, reference, and information values are provided in SRM 1941b were naturally present in the sediment before processing. A unit of SRM 1941b consists of a bottle containing 50 g of radiation-sterilized, freeze-dried sediment.

Company Information

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

Telephone: 301-975-2200
FAX: 301-948-3730
E-mail: SRMMSDS@nist.gov
Website: http://www.nist.gov/srm

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

2. HAZARDS IDENTIFICATION

Classification

Physical Hazard: Not classified.
Health Hazard: Not classified.

Label Elements
Symbol
No Symbol/Pictogram

Signal Word
Not applicable.

Hazard Statement(s): Not applicable.

Precautionary Statement(s): Not applicable.

Hazards Not Otherwise Classified: Not applicable.

Ingredients(s) with Unknown Acute Toxicity: Not applicable.

3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Substance: Marine sediment

Other Designations: Sediment.

This material is naturally occurring marine sediment from an urban area. The material contains trace amounts of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, and should be handled with care. Components are listed in compliance with OSHA's 29 CFR 1910.1200; for the actual values see the Certificate of Analysis.

Hazardous Component(s)	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Marine Sediment	Not available	Not available	100

4. FIRST AID MEASURES

Description of First Aid Measures:

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration or oxygen by qualified personnel. Seek immediate medical attention.

Skin Contact: Wash skin with soap and water.

Eye Contact: Flush eyes with water for at least 15 minutes. If necessary, seek medical attention.

Ingestion: If adverse effects occur after ingestion, seek medical treatment.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation.

Indication of any immediate medical attention and special treatment needed, if necessary: If any of the above symptoms are present, seek medical attention if needed.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Negligible fire hazard. Avoid generating dust. See Section 9, "Physical and Chemical Properties" for flammability properties.

Extinguishing Media:
Suitable: Use extinguishing media appropriate for surrounding fire.
Unsuitable: None listed.

Specific Hazards Arising from the Chemical: None listed.

Special Protective Equipment and Precautions for Fire-Fighters: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH approved self-contained breathing apparatus (SCBA).

NFPA Ratings (0 = Minimal; 1 = Slight; 2 = Moderate; 3 = Serious; 4 = Severe)

Health = 1 Fire = 0 Reactivity = 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: Any accumulated material on surfaces should be removed and properly disposed of. Use suitable protective equipment; see Section 8, "Exposure Controls and Personal Protection".

Methods and Materials for Containment and Clean up: Collect spilled material in appropriate container for disposal. Keep out of water supplies and sewers. Keep unnecessary people away, isolate hazard area and deny entry.

7. HANDLING AND STORAGE

Safe Handling Precautions: Minimize dust generation and accumulation on surfaces. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. See Section 8, "Exposure Controls and Personal Protection".

Storage: Store and handling in accordance with all current regulations and standards.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: No occupational exposure limits have been established for marine sediment. This material is a particulate matter and adequate inhalation/respiratory protection should be used to minimize exposure. The exposure limits for Particulates Not Otherwise Regulated (PNOR) are applicable.

OSHA (PEL): 15 mg/m^3 (TWA, total particulates not otherwise regulated)
OSHA (PEL) 5 mg/m^3 (TWA, respirable particulates not otherwise regulated)

NIOSH (REL): 10 mg/m^3 (TWA, total particulates not otherwise regulated, 8 h)
NIOSH (REL): 5 mg/m^3 (TWA, respirable particulates not otherwise regulated)

Engineering Controls: Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

Personal Protection: In accordance with OSHA 29 CFR 1910.132, subpart I, wear appropriate Personal Protective Equipment (PPE) to minimize exposure to this material.

Respiratory Protection: If workplace conditions warrant a respirator, a respiratory protection program that meets OSHA 29CFR 1910.134 must be followed. Refer to NIOSH 42 CFR 84 for applicable certified respirators.

Eye/Face Protection: Wear splash resistant safety goggles with a face shield. An eye wash station should be readily available near areas of use.

Skin and Body Protection: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. Chemical-resistant gloves should be worn at all times when handling chemicals.

9. PHYSICAL AND CHEMICAL PROPERTIES

Descriptive Properties:

Appearance (physical state, color, etc.):	amorphous powder
Molecular Formula:	not applicable
Molar Mass (g/mol):	not applicable
Odor:	not available
Odor threshold:	not available
pH:	not available
Evaporation rate:	not applicable
Melting point/freezing point (°C):	not available
Specific Gravity (water=1)	not available
Vapor Pressure (mmHg):	not applicable
Vapor Density (air = 1):	not applicable
Viscosity (cP):	not applicable
Solubility(ies):	not available
Partition coefficient (n-octanol/water):	not available
Particle Size:	<150 µm

Thermal Stability Properties:

Autoignition Temperature (°C):	not available
Thermal Decomposition (°C):	not available
Initial boiling point and boiling range (°C):	not available
Explosive Limits, LEL (Volume %):	not available
Explosive Limits, UEL (Volume %):	not available
Flash Point (°C):	not available
Flammability (solid, gas):	not available

10. STABILITY AND REACTIVITY

Reactivity: Stable at normal temperatures and pressure.

Stability: X Stable ______ Unstable

Possible Hazardous Reactions: None listed.

Conditions to Avoid: Avoid generating dust.

Incompatible Materials: None listed.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Thermal decomposition will produce oxides of carbon.

Hazardous Polymerization: ______ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Exposure: X Inhalation X Skin ______ Ingestion

Symptoms Related to the Physical, Chemical and Toxicological Characteristics: Generated dust may cause irritation if inhaled.

Potential Health Effects (Acute, Chronic and Delayed):

Inhalation: Generated dust may cause irritation.

Skin Contact: May cause mechanical irritation.

Eye Contact: May cause mechanical irritation.

Ingestion: No data available.

Numerical Measures of Toxicity:

Acute Toxicity: Not classified; no data available.

Skin Corrosion/Irritation: Not classified; no data available.

Serious Eye damage/ Eye irritation: Not classified; no data available.

Respiratory Sensitization: Not classified; no data available.

Skin Sensitization: Not classified; no data available.

Germ Cell Mutagenicity: Not classified; no data available.

Carcinogenicity: Not classified.

Listed as a Carcinogen/Potential Carcinogen ______ Yes X No
Marine sediment is not listed by NTP, IARC or OSHA as a carcinogen.

Reproductive Toxicity: Not classified; no data available.

Specific Target Organ Toxicity, Single Exposure: Not classified; no data available.

Specific Target Organ Toxicity, Repeated Exposure: Not classified; no data available.

Aspiration Hazard: Not classified; no data available.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data: No data available.

Persistence and Degradability: No data available.

Bioaccumulative Potential: No data available.

Mobility in Soil: No data available.

Other Adverse effects: No data available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose of waste in accordance with all applicable federal, state, and local regulations.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Not regulated by DOT or IATA.

15. REGULATORY INFORMATION

U.S. Regulations:

CERCLA Sections 102a/103 (40 CFR 302.4): Not regulated.

SARA Title III Section 302 (40 CFR 355.30): Not regulated.

SARA Title III Section 304 (40 CFR 355.40): Not regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE HEALTH: No.
CHRONIC HEALTH: No.
FIRE: No.
REACTIVE: No.
PRESSURE: No.

State Regulations:
California Proposition 65: Not listed.

U.S. TSCA Inventory: Not listed.

TSCA 12(b), Export Notification: Not listed.

Canadian Regulations:
WHMIS Information: Not provided for this material.

16. OTHER INFORMATION

Issue Date: 31 March 2014

Sources: 29 CFR Occupational Health and Safety Office (OSHA) 1910.1000, *Limits for Air Contaminants*, Table Z-1; available at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992 (accessed Mar 2014).

Center for Disease Control (CDC) NIOSH Pocket Guide to Chemical Hazards, *Particulates not otherwise regulated*; available at http://www.cdc.gov/niosh/npg/npgd0480.html (accessed Mar 2014).

Key of Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists	NRC	Nuclear Regulatory Commission
ALI	Annual Limit on Intake	NTP	National Toxicology Program
CAS	Chemical Abstracts Service	OSHA	Occupational Safety and Health Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PEL	Permissible Exposure Limit
CFR	Code of Federal Regulations	RCRA	Resource Conservation and Recovery Act
DOT	Department of Transportation	REL	Recommended Exposure Limit
EC50	Effective Concentration, 50 %	RM	Reference Material
EINECS	European Inventory of Existing Commercial Chemical Substances	RQ	Reportable Quantity
EPCRA	Emergency Planning and Community Right-to-Know Act	RTECS	Registry of Toxic Effects of Chemical Substances
IARC	International Agency for Research on Cancer	SARA	Superfund Amendments and Reauthorization Act
IATA	International Air Transportation Agency	SCBA	Self-Contained Breathing Apparatus
IDLH	Immediately Dangerous to Life and Health	SRM	Standard Reference Material
LC50	Lethal Concentration, 50 %	STEL	Short Term Exposure Limit
LD50	Lethal Dose, 50 %	TLV	Threshold Limit Value
LEL	Lower Explosive Limit	TPQ	Threshold Planning Quantity
MSDS	Material Safety Data Sheet	TSCA	Toxic Substances Control Act
NFPA	National Fire Protection Association	TWA	Time Weighted Average
NIOSH	National Institute for Occupational Safety and Health	UEL	Upper Explosive Limit
NIST	National Institute of Standards and Technology	WHMIS	Workplace Hazardous Materials Information System

Disclaimer: Physical and chemical data contained in this SDS are provided only for use in assessing the hazardous nature of the material. The SDS was prepared carefully, using current references; however, NIST does not certify the data in the SDS. The certified values for this material are given in the NIST Certificate of Analysis.

Users of this SRM should ensure that the SDS in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srmmsds@nist.gov; or via the Internet at http://www.nist.gov/srm

Bill to: 68455

DAVE MITCHELL
ANALYTICAL RESOURCES INC
4611 S 134TH PLACE
SUITE 100
TUKWILA, WA 98168-3240

1 (206)695-6205

Ship to: 68456

DAVE MITCHELL
ANALYTICAL RESOURCES INC
4611 S 134TH PLACE
SUITE 100
TUKWILA, WA 98168-3240

1 (206)695-6205

Ship via	UPS Ground	**Description**		**Ship from**	
Salesmen	MCMIDM2	**Instructions**		**Blanket**	
Contact	DAVE MITCHELL	**Pro#**		**Truck#**	

Order discrepancies (other than back ordered items) must be reported to our Customer Relations Department at 301-975-6776 within 5 days of receipt of shipment or this order will be considered complete. NIST SRMs/RMs are generally not returnable - with the exception of defective goods or shipments made in error by NIST. To return a SRM/RM, please call for instructions and a Return SRM/RM Authorization Number before shipment. Returns WILL NOT BE ACCEPTED without prior authorization.

Order	UOM	Ship	UOM	B/O	UOM	Item	Description
1	EACH	1	EACH	0	EACH	1941B	Organics in Marine Sediment
						Total qty:	1 / EACH
							NOT FOR HUMAN CONSUMPTION, LABORATORY USE ONLY.

9/21/16
04:04 PM

1700101

Picked by	
Packed by	
# of pieces	
Weight	

G000135

ERA
A Waters Company

Reference Material

▪ Certificate of Analysis ▪

Product: Custom TOC Standard
Catalog Number: 092
Lot No: 11161701A
Certificate Issue Date: January 2, 2018
Expiration Date: January 2, 2019
Revision Number: Original

CERTIFICATION

Parameter	Certified Value [1]	Uncertainty [2]	QC Performance Acceptance Limits [3]			NIST Traceability [4]	
	mg/L	%	mg/L			SRM#	Recovery %
Total Organic Carbon	5,000	0.403	NA	-	NA	185h	101

Matrix: 18 megohm deionized water w/ 0.5% (v/v) H_2SO_4
Density: 1.0076 ± 0.0002 g/mL
Storage: 4 ± 2°C
Manufacturing Notes: The standard was manufactured using Glucose.

1. The Certified Value is equal to 100% of the "made to" values as determined by volumetric and/or gravimetric measurements made during the manufacture of this product.

2. The stated Uncertainty is the total propagated uncertainty at the 95% confidence interval. The uncertainty is based on the preparation and (as noted) internal analytical verification of the product by ERA, multiplied by a coverage factor. The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product.

3. The Performance Acceptance Limits (PALs™) are listed as guidelines for acceptable analytical results given the limitations of the USEPA methodologies commonly used to determine these parameters and closely approximate the 95% confidence interval. The PALs™ are based on analytical verification data generated by ERA, independent referee laboratory results and/or data from USEPA methods, WP, WS and CLP interlaboratory studies. Recovery and advisory range data for these studies are based on ERA's normal manufacturing ranges. If your result falls outside of the PALs™, ERA recommends that you investigate potential sources of error in your preparation and/or analytical procedures. For further technical assistance, call ERA at 1-800-372-0122.

4. Where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed. Traceability Recovery % = [(% recovery certified standard)/(% recovery NIST SRM)]*100. The traceability data shown were compiled by analyzing the ERA standards or their associated stock solutions against the applicable NIST SRMs.

If you have any questions or need technical assistance, please call ERA technical assistance at 1-800-372-0122 or send an email to info@eraqc.com.

Certifying Officer:
Brian Miller

Brian Miller

Quality Officer:
David Kilhefner

David D.

ThermoFisher
SCIENTIFIC

Certificate of Analysis

1 Reagent Lane
Fair Lawn, NJ 07410
201.796.7100 tel
201.796.1329 fax

ThermoFisher Scientific's Quality System has been found to conform to Quality Management System Standard ISO9001:2008 standard by SAI Global Certificate Number CERT - 0090918

This is to certify that units of the lot number below were tested and found to comply with the specifications of the grade listed. Certain data have been supplied by third parties. ThermoFisher Scientific expressly disclaims all warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Certain products (USP/FCC/NF/EP/BP/JP grades) are sold for use in food, drug, or medical device manufacturing.ThermoFisher does not maintain DMF's with the FDA. The following are the actual analytical results obtained:

Catalog Number	P243	Quality Test / Release Date	06/12/2018
Lot Number	181933		
Description	POTASSIUM HYDROGEN PHTHALATE,ACIDIMETRIC STANDARD, A.C.S.		
Country of Origin	Spain	Suggested Retest Date	Jun/2023
Chemical Origin	Organic - non animal		
BSE/TSE Comment	No animal products are used as starting raw material ingredients, or used in processing, including lubricants, processing aids, or any other material that might migrate to the finished product.		
Chemical Comment			

Result Name	Units	Specifications	Test Value
APPEARANCE		REPORT	White crystals
HEAVY METALS (as Pb)	ppm	<= 5	<5
IRON (Fe)	ppm	<= 5	<5
PH OF 0.05M SOLUTION		Inclusive Between 4.00 - 4.02	4.00
CHLORINE COMPOUNDS	%	<= 0.003	<0.003
INSOLUBLE MATTER	%	<= 0.005	<0.005
SULFUR COMPOUNDS	%	<= 0.002	<0.002
ASSAY POTASSIUM HYDROGEN PHTHALATE	%	Inclusive Between 99.95 - 100.05	100.04
TRACEABLE TO NIST KHP STD	POT. ACID PHTHALATE	= LOT 84L	LOT 84L
TRACEABLE TO NIST	SOD CARBONATE	= LOT 351a	LOT 351a
SODIUM (Na)	%	<= 0.005	0.002
IDENTIFICATION	PASS/FAIL	= PASS TEST	PASS TEST

Teresa Bailey-Wyche

Quality Assurance Specialist - Certificate of Analysis Fair Lawn

Note: The data listed is valid for all package sizes of this lot of this product, expressed as an extension of this catalog number listed above.
If there are any questions with this certificate, please call at (800) 227-6701.
*Based on suggested storage condition.

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SED4

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-01	SDG:	18J0136
Sampled:	10/05/18 07:53	Prepared:	10/10/18 11:41	File ID:	
% Solids:	36.75	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	120.294	1	1.000	1.000	
	Total Solids, 70C	38.640	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SED3

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-02	SDG:	18J0136
Sampled:	10/05/18 08:10	Prepared:	10/10/18 11:41	File ID:	
% Solids:	12.53	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	129.739	1	1.000	1.000	
	Total Solids, 70C	18.266	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SED2

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-03	SDG:	18J0136
Sampled:	10/05/18 08:23	Prepared:	10/10/18 11:41	File ID:	
% Solids:	25.39	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	134.019	1	1.000	1.000	
	Total Solids, 70C	25.761	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SED1

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Sediment
Laboratory ID: 18J0136-04
SDG: 18J0136

Sampled: 10/05/18 08:32
Prepared: 10/10/18 11:41
File ID:

% Solids: 15.91
Preparation: PSEP 1986 (modified)
Analyzed: 10/10/18 12:48

Batch: BGJ0366
Sequence:
Initial/Final: 1 g Wet / 1 mL

Instrument: BAL2
Calibration:

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	120.903	1	1.000	1.000	
	Total Solids, 70C	16.686	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SOIL1

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Soil	Laboratory ID:	18J0136-05	SDG:	18J0136
Sampled:	10/05/18 09:20	Prepared:	10/10/18 11:41	File ID:	
% Solids:	14.89	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	118.697	1	1.000	1.000	
	Total Solids, 70C	16.311	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SOIL2

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-06	SDG:	18J0136
Sampled:	10/05/18 09:50	Prepared:	10/10/18 11:41	File ID:	
% Solids:	32.55	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	121.730	1	1.000	1.000	
	Total Solids, 70C	33.975	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SOIL3

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Soil	Laboratory ID:	18J0136-07	SDG:	18J0136
Sampled:	10/05/18 10:22	Prepared:	10/10/18 11:41	File ID:	
% Solids:	73.82	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	113.525	1	1.000	1.000	
	Total Solids, 70C	75.418	1	1.000	1.000	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP 1986

EDM18-SOIL4

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-08	SDG:	18J0136
Sampled:	10/05/18 10:55	Prepared:	10/10/18 11:41	File ID:	
% Solids:	64.37	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Acidification Percentage	112.178	1	1.000	1.000	
	Total Solids, 70C	61.595	1	1.000	1.000	

PREPARATION BATCH SUMMARY

PSEP 1986

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline
Batch: BGJ0366 Batch Matrix: Solid
Preparation: PSEP 1986 (modified)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
EDM18-SED4	18J0136-01		10/10/18 11:41	
EDM18-SED3	18J0136-02		10/10/18 11:41	
EDM18-SED2	18J0136-03		10/10/18 11:41	
EDM18-SED1	18J0136-04		10/10/18 11:41	
EDM18-SOIL1	18J0136-05		10/10/18 11:41	
EDM18-SOIL2	18J0136-06		10/10/18 11:41	
EDM18-SOIL3	18J0136-07		10/10/18 11:41	
EDM18-SOIL4	18J0136-08		10/10/18 11:41	
Blank	BGJ0366-BLK1		10/10/18 11:41	
EDM18-SED4	BGJ0366-DUP1		10/10/18 11:41	
EDM18-SED4	BGJ0366-DUP2		10/10/18 11:41	
MRL Check	BGJ0366-MRL1		10/10/18 11:41	
EDM18-SED4	BGJ0366-MS1		10/15/18 00:00	

No SCV Standard data found

No SCV Standard data found

No LCV Standard data found

No LCV Standard data found

No HCV Standard data found

No HCV Standard data found

HOLDING TIME SUMMARY

Analysis: PSEP 1986

Laboratory:	Analytical Resources, Inc.	SDG:	18J0136
Client:	Windward Environmental, LLC	Project:	Edmonds Marsh Baseline

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
EDM18-SED4 18J0136-01	10/05/18 07:53	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SED3 18J0136-02	10/05/18 08:10	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SED2 18J0136-03	10/05/18 08:23	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SED1 18J0136-04	10/05/18 08:32	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SOIL1 18J0136-05	10/05/18 09:20	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SOIL2 18J0136-06	10/05/18 09:50	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SOIL3 18J0136-07	10/05/18 10:22	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			
EDM18-SOIL4 18J0136-08	10/05/18 10:55	10/05/18 14:18	10/10/18 11:41	5	14	10/10/18 12:48			

* Indicates hold time exceedance.

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INORGANIC ANALYSIS DATA SHEET
SM 2540 G-97

EDM18-SED4

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-01	SDG:	18J0136
Sampled:	10/05/18 07:53	Prepared:	10/10/18 11:41	File ID:	
% Solids:	36.75	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	36.75	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
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EDM18-SED3

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-02	SDG:	18J0136
Sampled:	10/05/18 08:10	Prepared:	10/10/18 11:41	File ID:	
% Solids:	12.53	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	12.53	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
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EDM18-SED2

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Sediment

Laboratory ID: 18J0136-03

SDG: 18J0136

Sampled: 10/05/18 08:23

Prepared: 10/10/18 11:41

File ID:

% Solids: 25.39

Preparation: PSEP 1986 (modified)

Analyzed: 10/10/18 12:48

Batch: BGJ0366

Sequence:

Initial/Final: 1 g Wet / 1 mL

Instrument: BAL2

Calibration:

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	25.39	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
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EDM18-SED1

Laboratory:	Analytical Resources, Inc.				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-04	SDG:	18J0136
Sampled:	10/05/18 08:32	Prepared:	10/10/18 11:41	File ID:	
% Solids:	15.91	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	15.91	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
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EDM18-SOIL1

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-05	SDG:	18J0136
Sampled:	10/05/18 09:20	Prepared:	10/10/18 11:41	File ID:	
% Solids:	14.89	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	14.89	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
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EDM18-SOIL2

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-06	SDG:	18J0136
Sampled:	10/05/18 09:50	Prepared:	10/10/18 11:41	File ID:	
% Solids:	32.55	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	32.55	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
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EDM18-SOIL3

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-07	SDG:	18J0136
Sampled:	10/05/18 10:22	Prepared:	10/10/18 11:41	File ID:	
% Solids:	73.82	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	73.82	1	0.04	0.04	

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INORGANIC ANALYSIS DATA SHEET
SM 2540 G-97

EDM18-SOIL4

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-08	SDG:	18J0136
Sampled:	10/05/18 10:55	Prepared:	10/10/18 11:41	File ID:	
% Solids:	64.37	Preparation:	PSEP 1986 (modified)	Analyzed:	10/10/18 12:48
Batch:	BGJ0366	Sequence:		Initial/Final:	1 g Wet / 1 mL
Instrument:	BAL2			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	64.37	1	0.04	0.04	

PREPARATION BATCH SUMMARY

SM 2540 G-97

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Batch: BGJ0366

Batch Matrix: Solid

Preparation: PSEP 1986 (modified)

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
EDM18-SED4	18J0136-01		10/10/18 11:41	
EDM18-SED3	18J0136-02		10/10/18 11:41	
EDM18-SED2	18J0136-03		10/10/18 11:41	
EDM18-SED1	18J0136-04		10/10/18 11:41	
EDM18-SOIL1	18J0136-05		10/10/18 11:41	
EDM18-SOIL2	18J0136-06		10/10/18 11:41	
EDM18-SOIL3	18J0136-07		10/10/18 11:41	
EDM18-SOIL4	18J0136-08		10/10/18 11:41	
Blank	BGJ0366-BLK1		10/10/18 11:41	
EDM18-SED4	BGJ0366-DUP1		10/10/18 11:41	
EDM18-SED4	BGJ0366-DUP2		10/10/18 11:41	

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METHOD BLANK DATA SHEET
SM 2540 G-97
TotalAnalytes

Blank

Batch: BGJ0366
Laboratory ID: BGJ0366-BLK1
Prepared: 10/10/18 11:41
Matrix: Solid
Preparation: PSEP 1986 (modified)
Analyzed: 10/10/18 12:48
Sequence: SGJ0234
Calibration: BE00079
Instrument: APOLLO1

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
	Total Solids	ND	1	0.04	0.04	U

EDM18-SED4

DUPLICATES

SM 2540 G-97

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Laboratory ID: BGJ0366-DUP1

Batch: BGJ0366

Lab Source ID: 18J0136-01RE1

Preparation: PSEP 1986 (modified)

Initial/Final: 1 g / 1 mL

Source Sample Name: EDM18-SED4

% Solids: 36.75

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION	DUPLICATE CONCENTRATION	RPD %	Q
Total Solids	20	36.75	34.77	5.52	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

EDM18-SED4

DUPLICATES

SM 2540 G-97

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Laboratory ID: BGJ0366-DUP2

Batch: BGJ0366

Lab Source ID: 18J0136-01RE1

Preparation: PSEP 1986 (modified)

Initial/Final: 1 g / 1 mL

Source Sample Name: EDM18-SED4

% Solids: 36.75

ANALYTE	CONTROL LIMIT	SAMPLE CONCENTRATION	DUPLICATE CONCENTRATION	RPD %	Q
Total Solids	20	36.75	37.80	2.83	

*: Values outside of QC limits
L: Analyte concentration is <=5 times the reporting limit and the replicate control limit defaults to Dup = +/- RL instead of 20% RPD

ANALYSIS BATCH (SEQUENCE) SUMMARY

SM 2540 G-97

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Sequence: SGJ0234

SDG: 18J0136

Project: Edmonds Marsh Baseline

Instrument: APOLLO1

Calibration: BE00079

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
Blank	BGJ0366-BLK1		Solid	10/10/18 12:48

ANALYSIS BATCH (SEQUENCE) SUMMARY

SM 2540 G-97

Laboratory: Analytical Resources, Inc.

Client: Windward Environmental, LLC

Sequence: SGJ0282

SDG: 18J0136

Project: Edmonds Marsh Baseline

Instrument: APOLLO1

Calibration: BE00079

Sample Name	Lab Sample ID	Lab File ID	Matrix	Analysis Date/Time
EDM18-SED4	BGJ0366-DUP1		Solid	10/10/18 12:48
EDM18-SED4	BGJ0366-DUP2		Solid	10/10/18 12:48

HOLDING TIME SUMMARY

Analysis: SM 2540 G-97

Laboratory: Analytical Resources, Inc.
SDG: 18J0136
Client: Windward Environmental, LLC
Project: Edmonds Marsh Baseline

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
EDM18-SED4 18J0136-01	10/05/18 07:53	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SED3 18J0136-02	10/05/18 08:10	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SED2 18J0136-03	10/05/18 08:23	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SED1 18J0136-04	10/05/18 08:32	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SOIL1 18J0136-05	10/05/18 09:20	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SOIL2 18J0136-06	10/05/18 09:50	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SOIL3 18J0136-07	10/05/18 10:22	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	
EDM18-SOIL4 18J0136-08	10/05/18 10:55	10/05/18 14:18	10/10/18 11:41	5	28	10/10/18 12:48	5	28	

* Indicates hold time exceedance.

METHOD DETECTION
AND REPORTING LIMITS

SM 2540 G-97

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Instrument:

Analyte	MDL	RL	Units
Total Solids	0.04	0.04	%

METHOD DETECTION
AND REPORTING LIMITS
SM 2540 G-97

Laboratory: Analytical Resources, Inc.

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Instrument: APOLLO1

Analyte	MDL	RL	Units
Total Solids	0.04	0.04	%

PREPARATION BATCH SUMMARY

PSEP-PS

Laboratory: Materials Testing & Consulting, Inc. (Olympia) SDG: 18J0136

Client: Windward Environmental, LLC Project: Edmonds Marsh Baseline

Batch: B102518 Batch Matrix: Solid Preparation: No Prep Geo

SAMPLE NAME	LAB SAMPLE ID	LAB FILE ID	DATE PREPARED	OBSERVATIONS
EDM18-SED4	18J0136-01		10/25/18 00:00	
EDM18-SED4	18J0136-01		10/25/18 00:00	
EDM18-SED3	18J0136-02		10/25/18 00:00	
EDM18-SED3	18J0136-02		10/25/18 00:00	
EDM18-SED2	18J0136-03		10/25/18 00:00	
EDM18-SED2	18J0136-03		10/25/18 00:00	
EDM18-SED1	18J0136-04		10/25/18 00:00	
EDM18-SED1	18J0136-04		10/25/18 00:00	
EDM18-SOIL1	18J0136-05		10/25/18 00:00	
EDM18-SOIL1	18J0136-05		10/25/18 00:00	
EDM18-SOIL2	18J0136-06		10/25/18 00:00	
EDM18-SOIL2	18J0136-06		10/25/18 00:00	
EDM18-SOIL3	18J0136-07		10/25/18 00:00	
EDM18-SOIL3	18J0136-07		10/25/18 00:00	
EDM18-SOIL4	18J0136-08		10/25/18 00:00	
EDM18-SOIL4	18J0136-08		10/25/18 00:00	
EDM18-SOIL2	B102518-DUP1		10/25/18 00:00	
EDM18-SOIL2	B102518-DUP1		10/25/18 00:00	
EDM18-SOIL2	B102518-DUP2		10/25/18 00:00	
EDM18-SOIL2	B102518-DUP2		10/25/18 00:00	

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PSEP-PS

EDM18-SED4

Laboratory:	Materials Testing & Consulting, Inc. (Olympia)				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-01	SDG:	18J0136
Sampled:	10/05/18 07:53	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	8.2	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	7.8	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	6.6	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	7.9	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	4.1	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	2.9	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	6.1	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	16.8	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	12.2	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	8.4	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	4.6	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	4.6	1	0.1	0.1	
GS_FCLAY	Phi Size >10	9.9	1	0.1	0.1	
GS_TOTFINES	Total Fines	62.5	1	0.1	0.1	

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INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SED3

Laboratory: Materials Testing & Consulting, Inc. (Olympia)

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Sediment
Laboratory ID: 18J0136-02
SDG: 18J0136

Sampled: 10/05/18 08:10
Prepared: 10/25/18 00:00
File ID:

% Solids: 0.00
Preparation: No Prep Geo
Analyzed:

Batch: B102518
Sequence:
Initial/Final: /

Instrument: MT&C
Calibration:

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	41.6	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	8.9	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	5.9	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	4.1	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	3.0	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	2.0	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	3.0	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	6.6	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	3.5	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	4.2	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	1.6	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	2.5	1	0.1	0.1	
GS_FCLAY	Phi Size >10	13.0	1	0.1	0.1	
GS_TOTFINES	Total Fines	34.5	1	0.1	0.1	

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INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SED2

Laboratory: Materials Testing & Consulting, Inc. (Olympia)

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Sediment	Laboratory ID:	18J0136-03	SDG:	18J0136
Sampled:	10/05/18 08:23	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	6.5	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	4.9	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	4.4	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	4.6	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	3.7	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	6.2	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	18.8	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	18.9	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	9.7	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	5.8	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	3.4	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	4.0	1	0.1	0.1	
GS_FCLAY	Phi Size >10	9.1	1	0.1	0.1	
GS_TOTFINES	Total Fines	69.7	1	0.1	0.1	

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INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SED1

Laboratory:	Materials Testing & Consulting, Inc. (Olympia)				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Sediment	Laboratory ID:	18J0136-04	SDG:	18J0136
Sampled:	10/05/18 08:32	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	36.3	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	19.0	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	10.2	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	6.7	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	3.8	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	4.2	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	1.8	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	8.0	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	1.8	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	1.1	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	0.5	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	0.5	1	0.1	0.1	
GS_FCLAY	Phi Size >10	6.2	1	0.1	0.1	
GS_TOTFINES	Total Fines	19.8	1	0.1	0.1	

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INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SOIL1

Laboratory:	Materials Testing & Consulting, Inc. (Olympia)				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Soil	Laboratory ID:	18J0136-05	SDG:	18J0136
Sampled:	10/05/18 09:20	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	36.8	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	21.3	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	12.7	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	7.8	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	5.5	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	0.9	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	10.7	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	0.3	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	0.7	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	1.3	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	0.6	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	0.5	1	0.1	0.1	
GS_FCLAY	Phi Size >10	0.8	1	0.1	0.1	
GS_TOTFINES	Total Fines	14.9	1	0.1	0.1	

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INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SOIL2

Laboratory:	Materials Testing & Consulting, Inc. (Olympia)				
Client:	Windward Environmental, LLC				
Project:	Edmonds Marsh Baseline				
Matrix:	Soil	Laboratory ID:	18J0136-06	SDG:	18J0136
Sampled:	10/05/18 09:50	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	25.8	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	9.0	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	19.6	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	28.5	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	5.4	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	1.6	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	4.7	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	1.0	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	1.1	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	1.9	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	0.4	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	0.3	1	0.1	0.1	
GS_FCLAY	Phi Size >10	0.5	1	0.1	0.1	
GS_TOTFINES	Total Fines	10.1	1	0.1	0.1	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SOIL3

Laboratory: Materials Testing & Consulting, Inc. (Olympia)

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-07	SDG:	18J0136
Sampled:	10/05/18 10:22	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	19.6	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	13.3	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	14.3	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	25.3	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	10.9	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	3.5	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	3.7	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	2.6	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	2.0	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	2.1	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	0.9	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	0.9	1	0.1	0.1	
GS_FCLAY	Phi Size >10	0.9	1	0.1	0.1	
GS_TOTFINES	Total Fines	13.2	1	0.1	0.1	

Form I
INORGANIC ANALYSIS DATA SHEET
PSEP-PS

EDM18-SOIL4

Laboratory: Materials Testing & Consulting, Inc. (Olympia)

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix:	Soil	Laboratory ID:	18J0136-08	SDG:	18J0136
Sampled:	10/05/18 10:55	Prepared:	10/25/18 00:00	File ID:	
% Solids:	0.00	Preparation:	No Prep Geo	Analyzed:	
Batch:	B102518	Sequence:		Initial/Final:	/
Instrument:	MT&C			Calibration:	

CAS NO.	Analyte	Concentration (%)	Dilution Factor	MDL	MRL	Q
GS_GRAVEL	Phi Size <-1	12.2	1	0.1	0.1	
GS_VCS	Phi Size -1 to 0	4.3	1	0.1	0.1	
GS_CS	Phi Size 0 to 1	6.3	1	0.1	0.1	
GS_MS	Phi Size 1 to 2	24.4	1	0.1	0.1	
GS_FS	Phi Size 2 to 3	24.5	1	0.1	0.1	
GS_VFS	Phi Size 3 to 4	9.4	1	0.1	0.1	
GS_CSILT	Phi Size 4 to 5	5.5	1	0.1	0.1	
GS_MSILT	Phi Size 5 to 6	4.1	1	0.1	0.1	
GS_FSILT	Phi Size 6 to 7	2.8	1	0.1	0.1	
GS_VFSILT	Phi Size 7 to 8	3.1	1	0.1	0.1	
GS_CCLAY	Phi Size 8 to 9	1.4	1	0.1	0.1	
GS_MCLAY	Phi Size 9 to 10	1.1	1	0.1	0.1	
GS_FCLAY	Phi Size >10	1.0	1	0.1	0.1	
GS_TOTFINES	Total Fines	18.9	1	0.1	0.1	

METHOD DETECTION
AND REPORTING LIMITS

PSEP-PS

Laboratory: Materials Testing & Consulting, Inc. (Olympia)

SDG: 18J0136

Client: Windward Environmental, LLC

Project: Edmonds Marsh Baseline

Matrix: Solid

Instrument:

Analyte	MDL	RL	Units
Phi Size <-1	0.1	0.1	%
Phi Size -1 to 0	0.1	0.1	%
Phi Size 0 to 1	0.1	0.1	%
Phi Size 1 to 2	0.1	0.1	%
Phi Size 2 to 3	0.1	0.1	%
Phi Size 3 to 4	0.1	0.1	%
Phi Size 4 to 5	0.1	0.1	%
Phi Size 5 to 6	0.1	0.1	%
Phi Size 6 to 7	0.1	0.1	%
Phi Size 7 to 8	0.1	0.1	%
Phi Size 8 to 9	0.1	0.1	%
Phi Size 9 to 10	0.1	0.1	%
Phi Size >10	0.1	0.1	%
Total Fines	0.1	0.1	%

APPENDIX D. ADDITIONAL DATA TABLES AND MAPS

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Table D1. Invertebrates identified in fallout traps from the north buffer zone (Transect N4)

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
Summer Samples		
1	Collembola	3 mm, springtail
1	Collembola	3 mm, springtail
1	Collembola	3 mm, springtail
1	Hemiptera	nymph, 3.5 mm[a]
1	unidentified grub	8 mm, likely Lepidoptera, specimen in poor condition
1	Hemiptera	4 mm, possibly black damsel bug
1	Isopoda	8 mm, woodlouse
1	Araneae	5–6 mm
1	Collembola	2.5 mm, springtail
1	Hemiptera	0.5 mm
2	Diptera	4 mm, likely Anthomyiidae
2	Diptera	3 mm, likely Anthomyiidae
2	Diptera	3 mm
2	Orthoptera	4 mm, immature, wingless
2	Collembola	2 mm, springtail
2	Diptera	7 mm, non-biting midge
3	Collembola	2 mm, springtail
3	Isopoda	10 mm, woodlouse
3	Psocoptera	2 mm, barklouse, winged
3	Psocoptera	2 mm, barklouse, winged
3	Diptera	1.5 mm, midge
3	Trichoptera	1.5 mm but broken
3	Collembola	0.5 mm, springtail
Spring Samples		
1	Araneae	2 mm, spider
1	Diptera	3 mm
1	Araneae	2 mm, spider, broken
1	Hymenoptera	1 mm
1	Diptera	2–3 mm
1	Diptera	2–3 mm
1	Diptera	2–3 mm
1	Diptera	2–3 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Diptera	4 mm
1	Diptera	3 mm
1	unidentified	< 1 mm, looks like springtail or bristletail
1	Diptera	broken
1	Diptera	4 mm, black fly
1	Diptera	broken
1	Diptera	2 mm
1	Diptera	3 mm, non-biting midge
1	Diptera	3 mm
1	Diptera	3 mm
2	Diptera	2 mm
2	Diptera	3 mm, black fly
2	Diptera	4 mm, black fly
2	Diptera	4 mm, black fly
2	Diptera	3 mm
2	Diptera	3 mm
2	Diptera	3 mm
2	Diptera	10 mm, cranefly
2	Diptera	5 mm, black fly
2	Diptera	5 mm, black fly
2	Diptera	2 mm
2	Diptera	4 mm
3	Diptera	4 mm, black fly
3	Diptera	2 mm
3	Diptera	3 mm, black fly
3	Hymenoptera	2 mm
3	Odonata	broken but looks like Odonata
3	Diptera	3 mm

[a] Identification made with help from Dr. Merril Peterson.

Table D2. Invertebrates identified in fallout traps from the southeast buffer zone (Transect SE2)

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
Summer Samples		
1	Collembola	1 mm, springtail
1	Collembola	1 mm, springtail

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Gastropoda	slug, 12 mm
1	Diptera	2 mm
1	Araneae	3 mm
1	Collembola	< 1 mm
1	Diptera	2–3 mm
1	Araneae	6 mm
1	Araneae	5 mm
1	Hemiptera	damsel bug
2	Diptera	hunchback fly, 1 mm
2	Araneae	4 mm
2	Coleoptera	5 mm
2	Araneae	1 mm
2	Araneae	3 mm
2	Diptera	hunchback fly, 0.5 mm
2	Hymenoptera	ant, 1 mm
2	unidentified grub	4 mm
2	Araneae	1 mm
2	unidentified instar	1 mm
2	Diptera	1 mm, poor condition
2	unidentified insect	3 mm
3	Araneae	
3	Diptera	5 mm
3	Gastropoda	15 mm
3	Plecoptera	stonefly
3	Collembola	1–2 mm, springtail
3	Diptera	
3	Diptera	
3	Coleoptera	
3	Diptera	crane fly, 3 mm
3	unidentified larva	
3	unidentified larva	
3	Araneae	
Spring Samples		
1	Diptera	4 mm, non-biting midge
1	Isopoda	8 mm, European sowbug
1	Isopoda	8 mm, European sowbug

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Diptera	3 mm, midge
1	Gastropoda	15 mm, slug
1	Diptera	4 mm, non-biting midge
1	Diptera	3 mm
1	Diptera	3 mm
2	Pseudoscorpiones	2 mm, house pseudoscorpion
2	Dermaptera	15 mm, earwig, pseudoscorpion is clinging to its antenna
2	Collembola	2 mm
2	Gastropoda	20 mm, slug
2	Diptera	7 mm, likely Anthomyiidae
2	Diptera	7 mm, non-biting midge
2	Diptera	6 mm, cranefly, missing all legs
2	Araneae	7 mm
2	Diptera	6 mm, likely Anthomyiidae
2	Diptera	10 mm, likely Anthomyiidae
2	Diptera	10 mm, likely Anthomyiidae
2	Psocoptera	1 mm, booklouse or barklouse
2	Opiliones	5 mm, harvestman
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	10 mm
3	Coleoptera	3 mm
3	Diptera	5 mm, likely Anthomyiidae
3	Gastropoda	15 mm, slug
3	Diptera	10 mm, likely Anthomyiidae
3	Diptera	3 mm, non-biting midge
3	Diptera	2 mm, midge, very poor condition
3	Diptera	6 mm, likely Anthomyiidae

Table D3. Invertebrates identified in fallout traps from the south buffer zone (Transect S2)

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
Summer Samples		
1	Opiliones	harvestman
1	Opiliones	harvestman

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Hemiptera	7 mm, most likely *Philaenus spumarius* (meadow spittlebug)[a]
1	Gastropoda	slug
1	Diptera	2–3 mm
1	Coleoptera	2–3 mm, possibly Meloidae (blister beetle)
1	Diptera	
1	Diptera	2 mm
1	Plecoptera	stonefly
1	Collembola	globular springtail
1	Diptera	
1	Diptera	10 mm
1	Diptera	
1	Diptera	6 mm
1	Diptera	
1	Diptera	1–2 mm
2	Diptera	
2	Diptera	
2	Diptera	
2	Diptera	
2	Diptera	
2	Diptera	midge
2	Plecoptera	stonefly
2	Diptera	3 mm
2	Diptera	3 mm
2	Diptera	3 mm
2	Diptera	3 mm
2	Diptera	3 mm
2	Diptera	1–2 mm
2	Diptera	2 mm
2	Hemiptera	aphid
2	Diptera	
2	unidentified larva	
2	Diptera	
2	Diptera	2–6 mm
2	Diptera	2–6 mm
2	Diptera	2–6 mm
2	Diptera	2–6 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Diptera	1–2 mm, gnat
3	Diptera	mosquito
3	Collembola	springtail
3	Diptera	
3	Gastropoda	17 mm, slug
3	Diptera	3 mm, non-biting midge
3	Diptera	5 mm
3	Diptera	4 mm
3	Diptera	mosquito, broken in half
3	Diptera	2.5 mm
3	Diptera	
3	Araneae	0.5 mm
3	Diptera	mosquito
3	Diptera	
3	Diptera	non-biting midge
3	Diptera	
3	Diptera	crane fly
3	Araneae	mite
3	Diptera	
3	Diptera	
3	Diptera	1–1.5 mm
Spring Samples		
1	Diptera	2 mm, non-biting midge
1	Psocoptera	1 mm, booklouse or barklouse
1	Diptera	2 mm, midge
1	Diptera	3 mm, black fly
1	Araneae	1 mm, spider
1	Araneae	4 mm
1	Araneae	2 mm
1	Diptera	1 mm, midge
1	Diptera	3 mm, midge
1	Diptera	black fly
1	Diptera	3 mm, non-biting midge
2	Diptera	7 mm, likely Anthomyiidae
2	Coleoptera	12 mm, beetle
2	Diptera	8 mm, likely Anthomyiidae

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Diptera	8 mm, likely Anthomyiidae
2	Diptera	3 mm, non-biting midge
2	Diptera	3 mm, midge
3	Diptera	midge, poor condition
3	Diptera	2 mm, non-biting midge
3	Diptera	midge, poor condition
3	Diptera	3 mm, non-biting midge
3	Diptera	4 mm, midge
3	Diptera	3 mm
3	Diptera	2 mm
3	Diptera	3 mm, very poor condition
3	Araneae	7 mm
3	Diptera	2 mm

[a] Identification made with help from Dr. Merril Peterson.

Table D4. Invertebrates identified in fallout traps from the Shellabarger Marsh north buffer zone (Transect SB)

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
Summer Samples		
1	Gastropoda	4 mm
1	Diptera	3 mm
1	Diptera	2 mm
1	Collembola	1 mm, springtail
1	Gastropoda	5 mm
1	Collembola	2.5 mm, springtail
1	Coleoptera	4 mm
1	Hemiptera	aphid, 1 mm
1	Diptera	3 mm
1	Araneae	3 mm
1	Collembola	< 1 mm
1	Trichoptera	< 1 mm
1	Araneae	6 mm
1	Araneae	mite, < 1 mm
1	Lepidoptera	5 mm
1	unidentified larva	< 1 mm
1	Hemiptera	aphid, 1 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	unidentified insect	
1	Collembola	< 1 mm, springtail
1	Diptera	1–4 mm, non-biting midge
1	Diptera	1–4 mm, non-biting midge
1	Diptera	1–4 mm, non-biting midge
1	Diptera	1–4 mm, non-biting midge
1	Diptera	1–4 mm, non-biting midge
1	Diptera	1–4 mm, non-biting midge
1	Diptera	5 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	1.5–6 mm, non-biting midge
1	Diptera	3 mm, non-biting midge
1	Diptera	3 mm, non-biting midge
1	Diptera	3 mm, non-biting midge
1	Diptera	2 mm, non-biting midge
1	Diptera	4–5 mm, non-biting midge
1	Diptera	4–5 mm, non-biting midge
1	Diptera	< 1 mm, non-biting midge
1	Diptera	3–6 mm, non-biting midge
1	Diptera	3–6 mm, non-biting midge
1	Diptera	3–6 mm, non-biting midge
1	Diptera	3–6 mm, non-biting midge
1	Diptera	1.5–3 mm, non-biting midge
1	Diptera	1.5–3 mm, non-biting midge
1	Diptera	1.5–3 mm, non-biting midge
1	Diptera	3 mm, non-biting midge
1	Diptera	4–5 mm, non-biting midge
1	Diptera	4–5 mm, non-biting midge
1	Diptera	1 mm, non-biting midge
1	Diptera	4 mm, non-biting midge

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3–4 mm, non-biting midge
1	Diptera	2.5 mm, non-biting midge
1	Diptera	2.5 mm, non-biting midge
1	Diptera	2.5 mm, non-biting midge
1	Diptera	2–5 mm, non-biting midge
1	Diptera	2–5 mm, non-biting midge
1	Diptera	2–5 mm, non-biting midge
1	Diptera	2–5 mm, non-biting midge
1	Diptera	2–5 mm, non-biting midge
1	Diptera	1 mm, non-biting midge
1	Diptera	8 mm, non-biting midge
1	Diptera	1–2 mm, non-biting midge
1	Diptera	1–2 mm, non-biting midge
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	1.5 mm
1	Diptera	4 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	2 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	1 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	3–4 mm
1	Diptera	3–4 mm
1	Diptera	3–4 mm
1	Diptera	3–4 mm
1	Diptera	3–4 mm
1	Diptera	4–7 mm
1	Diptera	4–7 mm
1	Diptera	4–7 mm
1	Diptera	4–7 mm
1	Diptera	4–7 mm
1	Diptera	4–7 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm
1	Diptera	4–5 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Diptera	4–5 mm
1	Diptera	3–7 mm
1	Diptera	3–7 mm
1	Diptera	3–7 mm
1	Diptera	3–7 mm
1	Diptera	3–7 mm
1	Diptera	3–7 mm
1	Diptera	3–7 mm
1	Diptera	2–6 mm
1	Diptera	2–6 mm
1	Diptera	2–6 mm
1	Diptera	2–6 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	3–5 mm
1	Diptera	2.5 mm
1	Diptera	5 mm
1	Diptera	5 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	4 mm
1	Diptera	2 mm
1	Diptera	5 mm
2	Collembola	< 1 mm, globular springtail
2	Hemiptera	aphid, 2 mm
2	Diptera	3–8 mm, likely Anthomyiidae

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	3–8 mm, likely Anthomyiidae
2	Diptera	2 mm, likely Anthomyiidae
2	Diptera	25 mm, crane fly
2	Coleoptera	2 mm
2	Diptera	1 mm, midge
2	Diptera	5–7 mm, non-biting midge
2	Diptera	5–7 mm, non-biting midge
2	Diptera	5–7 mm, non-biting midge
2	Diptera	5–7 mm, non-biting midge
2	Diptera	5–7 mm, non-biting midge
2	Diptera	5–7 mm, non-biting midge
2	Blattodea	3 mm, winged termite
2	Diptera	2.5 mm
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	4–10 mm, non-biting midge
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	5 mm, likely Anthomyiidae
2	Diptera	15 mm, crane fly
2	Diptera	12 mm
2	Hemiptera	7 mm, most likely *Philaenus spumarius* (meadow spittlebug)[a]
2	Araneae	6 mm
2	Collembola	2 mm, elongated springtail
2	Diptera	5 mm, mosquito
2	Diptera	5 mm
2	Diptera	4 mm
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	6–7 mm, non-biting midge
2	Diptera	6–7 mm, non-biting midge
2	Diptera	2–4 mm
2	Diptera	2–4 mm
2	Diptera	2–4 mm
2	Diptera	2–4 mm
2	Diptera	1–7 mm
2	Diptera	1–7 mm
2	Diptera	1–7 mm
2	Diptera	1–7 mm
2	Diptera	1–7 mm
2	Diptera	1–7 mm
2	Diptera	5–6 mm, likely Anthomyiidae
2	Diptera	5–6 mm, likely Anthomyiidae
2	Diptera	5–6 mm, likely Anthomyiidae
2	Diptera	5–6 mm, likely Anthomyiidae
2	Diptera	5–6 mm, likely Anthomyiidae
2	Collembola	1 mm, elongated springtail
2	Collembola	1 mm, elongated springtail
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	7 mm
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	4–8 mm, likely Anthomyiidae
2	Diptera	10 mm, non-biting midge

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Diptera	10 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	5 mm, non-biting midge
2	Diptera	5 mm, non-biting midge
2	Hymenoptera	5 mm
2	Collembola	1 mm, globular springtail
2	Diptera	20 mm, cranefly
2	Diptera	20 mm, cranefly
2	Diptera	7 mm, non-biting midge
2	Diptera	7 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Diptera	3–4 mm, non-biting midge
2	Gastropoda	5 mm, snail
2	Gastropoda	15 mm, snail
2	Diptera	12 mm
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge
2	Diptera	2–3 mm, non-biting midge

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
2	Blattodea	4 mm, termite
2	Hemiptera	3 mm
2	Collembola	1.5 mm, springtail
2	Diptera	10 mm, non-biting midge
2	Diptera	10 mm, non-biting midge
2	Diptera	4–5 mm, non-biting midge
2	Diptera	4–5 mm, non-biting midge
2	Diptera	4–5 mm, non-biting midge
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	5–6 mm
3	Diptera	8 mm
3	Gastropoda	7 mm
3	Diptera	mosquito
3	Diptera	3 mm, cranefly
3	Diptera	mosquito
3	Coleoptera	3 mm
3	Coleoptera	1.5 mm
3	Coleoptera	
3	Coleoptera	4.5 mm
3	Diptera	4 mm, mosquito
3	Diptera	3 mm, mosquito

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
3	Araneae	5 mm
3	Coleoptera	3 mm
3	Diptera	6 mm, mosquito
3	Diptera	2 mm
3	Diptera	2 mm
3	Diptera	2 mm
3	Araneae	2–3 mm
3	Coleoptera	
3	Diptera	9 mm, crane fly
3	Diptera	3 mm, crane fly, specimen degraded
3	Diptera	6.5 mm, crane fly
3	Diptera	3 mm
3	Diptera	4 mm
3	unidentified larva	1.5 mm
3	Hemiptera	4–5 mm, aphid
3	Hemiptera	1–2 mm, aphid
3	Collembola	1 mm, springtail
3	Diptera	
3	Diptera	
3	Hemiptera	1 mm, aphid
3	Diptera	end of abdomen missing
3	Diptera	2 mm
3	Diptera	crane fly, specimen damaged
3	Diptera	2 mm, specimen damaged
3	Diptera	3 mm, specimen damaged
3	Diptera	1.5 mm
3	Diptera	3 mm
3	Diptera	3 mm
3	Diptera	3 mm
3	Diptera	3 mm
3	Diptera	3 mm
3	Diptera	3 mm
3	Coleoptera	2 mm
3	Araneae	2.5 mm
3	Diptera	2.5 mm
3	Diptera	3.5 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
3	Diptera	7 mm
3	Diptera	3 mm
3	Diptera	25 mm, cranefly
3	Hemiptera	2 mm, aphid
3	Diptera	4 mm, cranefly
3	Collembola	1 mm, elongated springtail
3	Diptera	3 mm
3	Diptera	2 mm, midge
3	Diptera	3 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	2–4 mm, midge
3	Diptera	4 mm, cranefly
3	Diptera	2 mm
3	unidentified insect	
Spring Samples		
1	Hymenoptera	12 mm, bee
1	Hymenoptera	7 mm, bee
1	Diptera	4 mm, poor condition
1	Diptera	20 mm, cranefly
1	Diptera	2 mm
1	Araneae	2 mm
1	unidentified insect	3 mm, poor condition, 2 pair of wings
1	Diptera	25 mm, cranefly
1	Diptera	6 mm
1	Diptera	2.5 mm
1	Collembola	2 mm, globular springtail
1	Diptera	4 mm
1	Diptera	3–4 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
1	Diptera	3–4 mm, non-biting midge
1	Diptera	3 mm
1	Diptera	6–7 mm
1	Diptera	6–7 mm, non-biting midge
1	Diptera	6–7 mm
2	Diptera	5 mm
2	Diptera	5.5 mm
2	Diptera	7 mm, biting midge
2	Diptera	1–2 mm, midge
2	Diptera	3–4 mm
2	Diptera	2 mm, broken, midge
2	Collembola	2–3 mm, elongated springtail
2	Diptera	20 mm, crane fly
2	Diptera	7 mm
2	Diptera	5 mm
2	Diptera	4 mm, non-biting midge
2	Diptera	2–3 mm
2	Diptera	1–2 mm
2	Diptera	6–7 mm, non-biting midge
2	Diptera	5–6 mm
2	Diptera	6–7 mm
2	Diptera	6 mm
2	Diptera	4 mm, non-biting midge
2	Diptera	4 mm, non-biting midge
2	Diptera	3–4 mm
2	Diptera	5 mm
2	Diptera	2 mm
2	Diptera	3 mm, broken, non-biting midge
3	Diptera	15 mm, crane fly
3	Diptera	15 mm, crane fly
3	Diptera	15 mm, crane fly
3	Diptera	15 mm, crane fly
3	Diptera	13 mm, crane fly
3	Diptera	5 mm
3	Diptera	4 mm
3	Diptera	3 mm

Replicate	Taxonomy (Order)	Notes (Approx. size, etc.)
3	Araneae	7 mm, spider
3	Araneae	8 mm, spider
3	Diptera	6 mm
3	Diptera	6 mm
3	Diptera	6 mm
3	Diptera	4 mm
3	Diptera	3 mm
3	Diptera	3 mm

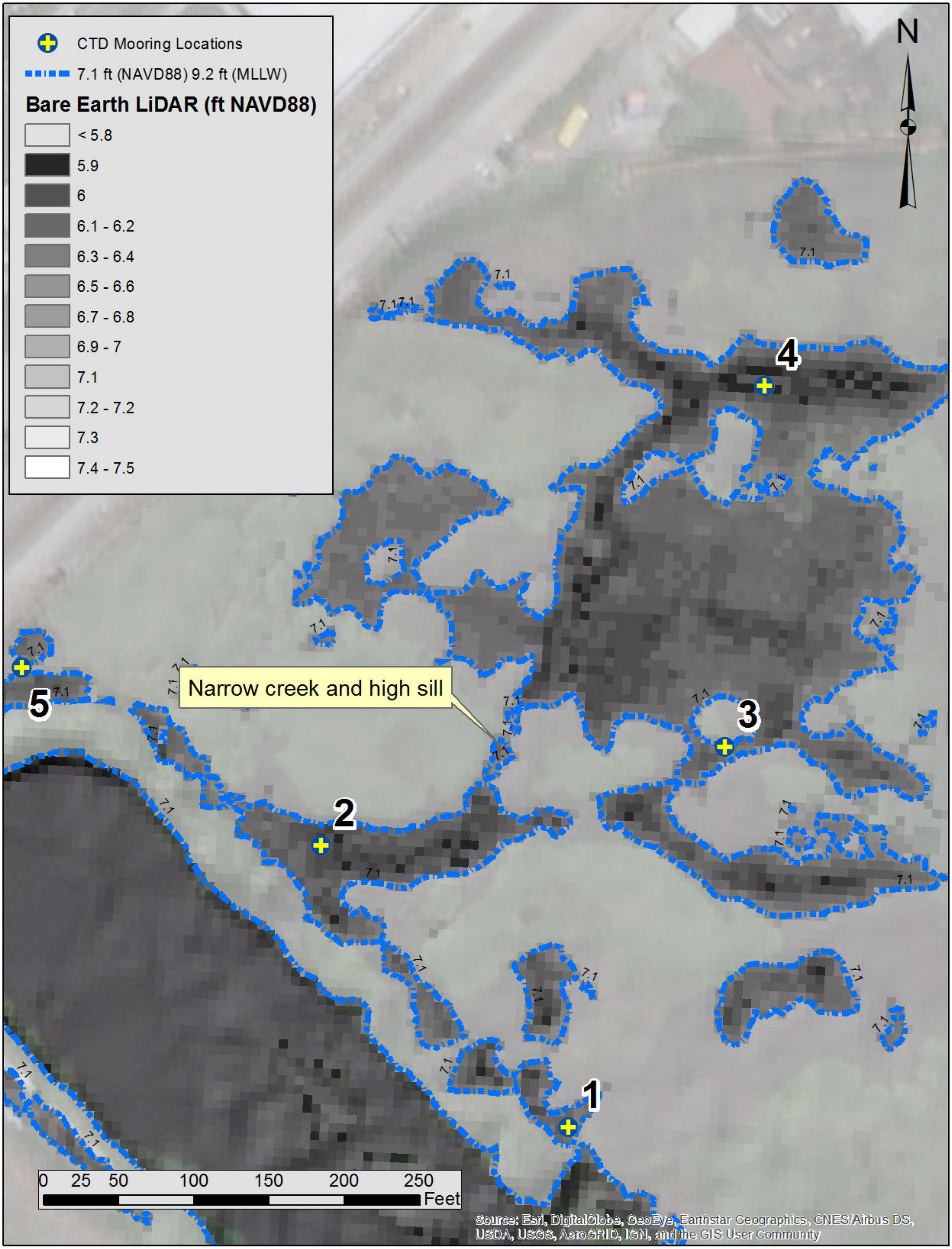
[a] Identification made with help from Dr. Merril Peterson.

Windward environmental LLC

Map NRCS Web Soil Survey of Edmonds and Shellabarger Marshes

3 - Alderwood, gravelly sandy loam; 5 - Alderwood-Everett, gravelly sandy loams; 17 - Everett, very gravelly sandy loam; 27/28 - Kitsap, silt loam; 34 - Mukilteo muck 78 - Urban land

Prepared by JennaR, 7/17/2019; \\mink\company\Projects\Edmonds Marsh\Data\GIS\Maps and Analyses\Data Report\Map 4.3-a_6862_Edmonds and Shellabarger Marsh Soils Map.mxd



Narrow creek and high sill

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

APPENDIX E. WILDLIFE CAMERA PHOTOS

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Trail Camera WC1 – South Buffer Zone

Photo No.:	**1**
Date:	July 11, 2018

Description:

Coyote

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**2**
Date:	July 29, 2018

Description:

Bird in flight

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**3**
Date:	Aug. 14, 2019
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**4**
Date:	Aug. 14, 2019
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**5**
Date:	Aug. 17, 2019

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**6**
Date:	Aug. 23, 2018

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**7**
Date:	Aug. 23, 2018
Description: Adult Columbian black-tailed deer and fawn South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**8**
Date:	Aug. 23, 2018
Description: Adult Columbian black-tailed deer and fawn South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**9**
Date:	Aug. 23, 2018
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**10**
Date:	Aug. 30, 2018
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera	

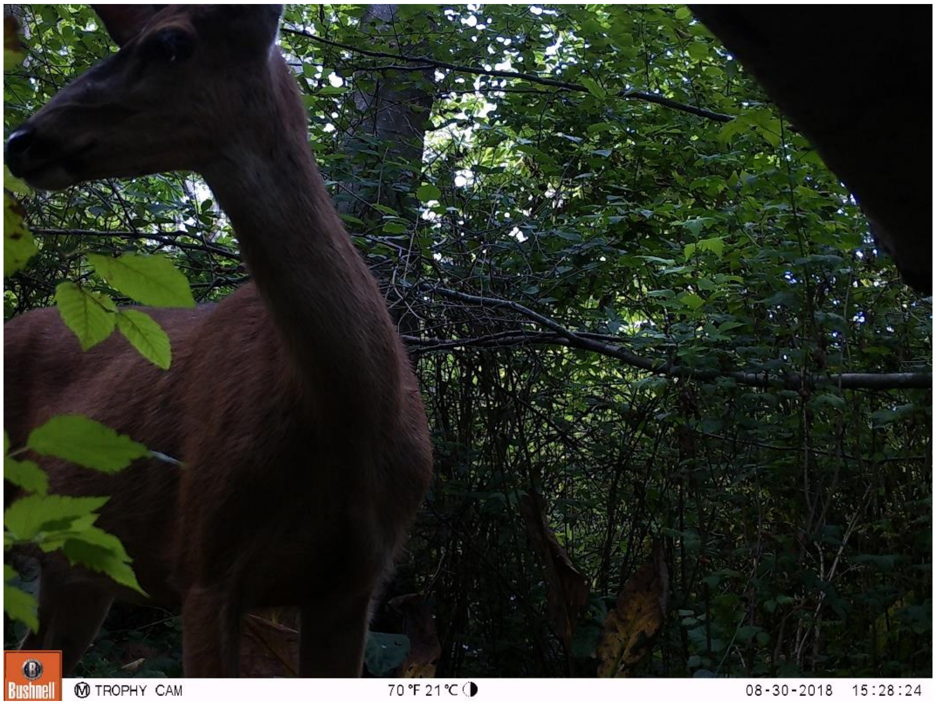


Photo No.:	**11**
Date:	Aug. 30, 2018
Description:	Adult Columbian black-tailed deer and fawn South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**12**
Date:	Aug. 30, 2018
Description:	Fawn South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**13**	
Date:	Aug. 30, 2018	
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**14**	
Date:	Aug. 30, 2018	
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**15**
Date:	Sept. 12, 2018

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**16**
Date:	Sept. 12, 2018

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**17**	
Date:	Sept. 12, 2018	
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera		

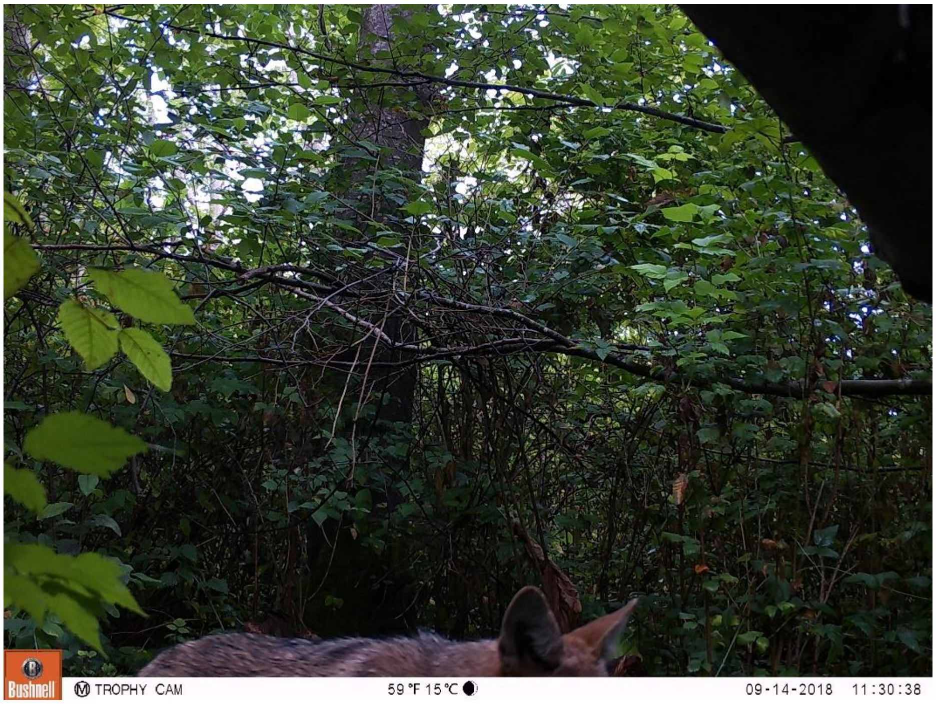
Photo No.:	**18**	
Date:	Sept. 14, 2018	
Description: Coyote South Buffer Zone/Willow Creek fish hatchery camera		

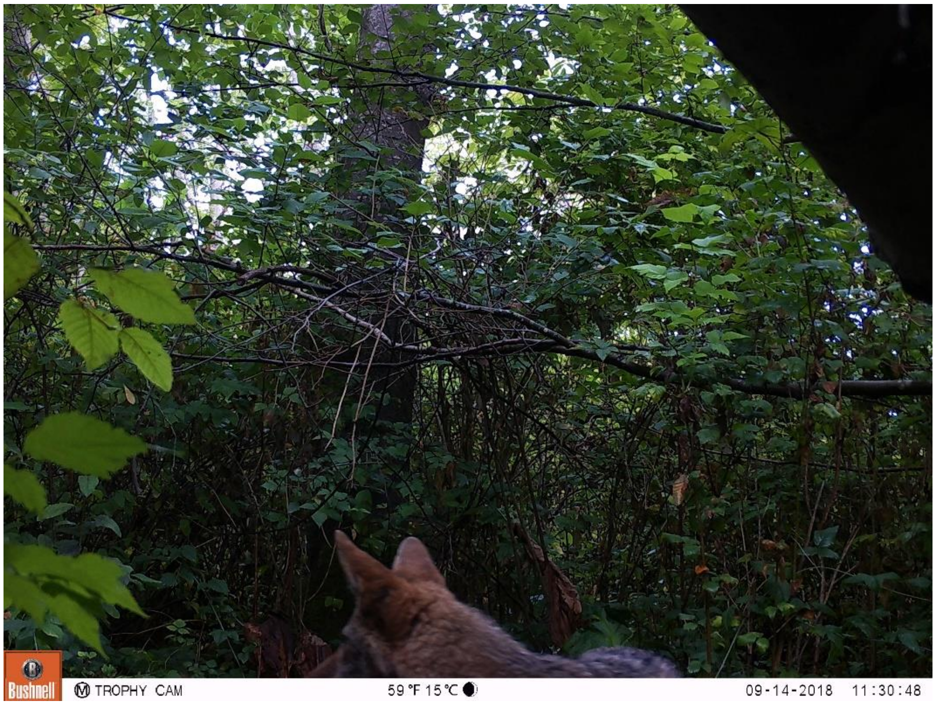
Photo No.:	**19**	
Date:	Sept. 14, 2018	
Description: Coyote South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**20**	
Date:	Oct. 10, 2018	
Description: Coyote South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.: **21**

Date: Oct. 15, 2018

Description:

Columbian black-tailed deer with antlers

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.: **22**

Date: Oct. 15, 2018

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**23**
Date:	Oct. 15, 2018

Description:

Columbian black-tailed deer with antlers

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**24**
Date:	Oct. 20, 2018

Description:

Coyote

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**25**
Date:	Oct. 28, 2019
Description: Coyote South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**26**
Date:	Oct. 28, 2019
Description: Coyote South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**27**	
Date:	Nov. 3, 2018	
Description: Buck with antlers South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**28**	
Date:	Nov. 3, 2018	
Description: Buck with antlers South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**29**	
Date:	Nov. 13, 2018	
Description: Buck with antlers South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**30**	
Date:	Nov. 13, 2018	
Description: Buck with antlers South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**31**
Date:	Dec. 5, 2018

Description:

Kinglet

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**32**
Date:	Dec. 15, 2018

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**33**	
Date:	Jan. 2, 2019	
Description: Black-capped chickadee South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**34**	
Date:	Apr. 15, 2019	
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**35**
Date:	Apr. 27, 2019

Description:

Columbian black-tailed deer

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**36**
Date:	May 24, 2019

Description:

Fawn and adult Columbian black-tailed deer foraging

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**37**	
Date:	May 24, 2019	
Description: Raccoon South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**38**	
Date:	May 30, 2019	
Description: Coyote South Buffer Zone/Willow Creek fish hatchery camera		

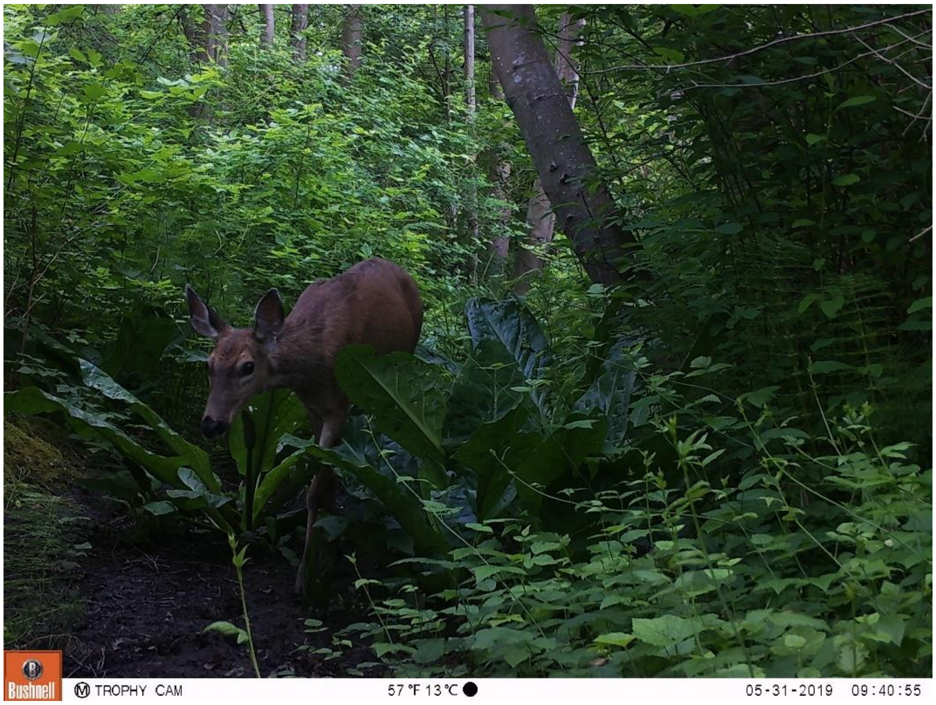
Photo No.:	**39**
Date:	May 31, 2019
Description: Columbian black-tailed deer South Buffer Zone/Willow Creek fish hatchery camera	

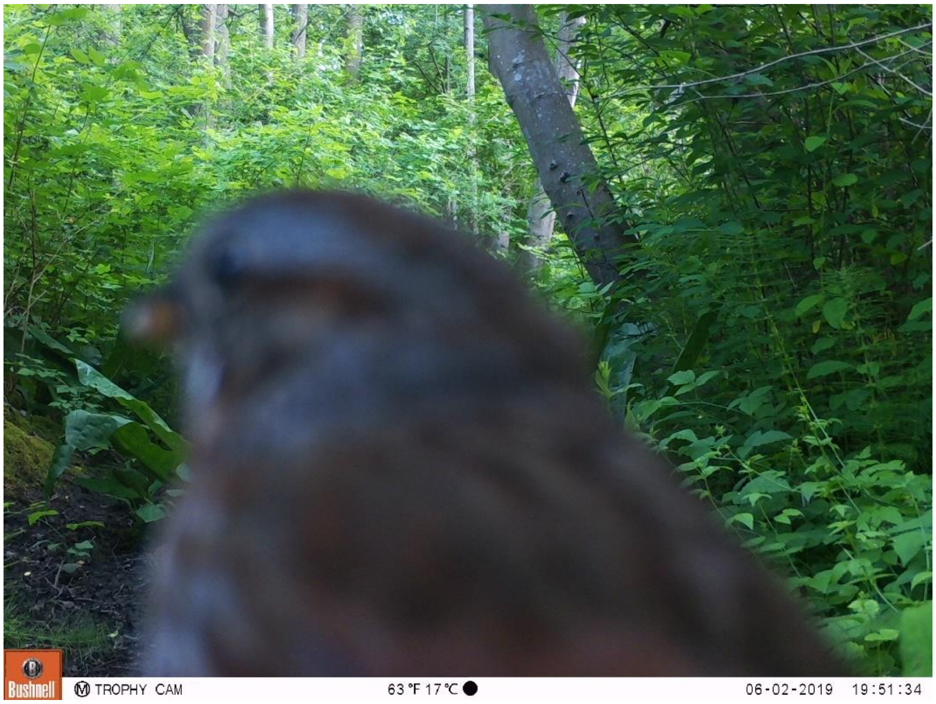
Photo No.:	**40**
Date:	June 2, 2019
Description: Song sparrow South Buffer Zone/Willow Creek fish hatchery camera	

Photo No.:	**41**
Date:	June 06, 2019

Description:

Rabbit

South Buffer Zone/Willow Creek fish hatchery camera

Photo No.:	**42**
Date:	June 08, 2019

Description:

Buck with antlers

South Buffer Zone/Willow Creek fish hatchery camera

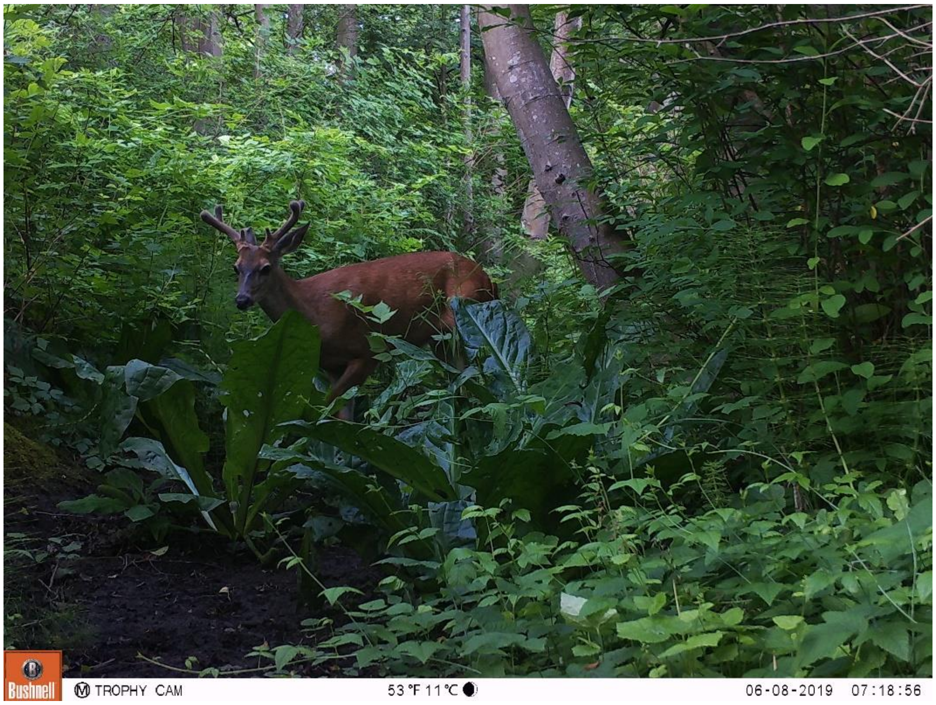


Photo No.:	**41**	
Date:	June 16, 2018	
Description: Raccoon South Buffer Zone/Willow Creek fish hatchery camera		

Photo No.:	**42**	
Date:	June 20, 2019	
Description: Doe and fawns South Buffer Zone/Willow Creek fish hatchery camera		

Trail Camera WC2 – Edmonds Marsh, North Mudflat

Photo No.: **43**

Date: Aug. 7, 2018

Description:

Shorebirds foraging on mudflats

Edmonds Marsh, north mudflat camera

Photo No.: **44**

Date: Aug. 13, 2018

Description:

Killdeer on mudflat

Edmonds Marsh, north mudflat camera

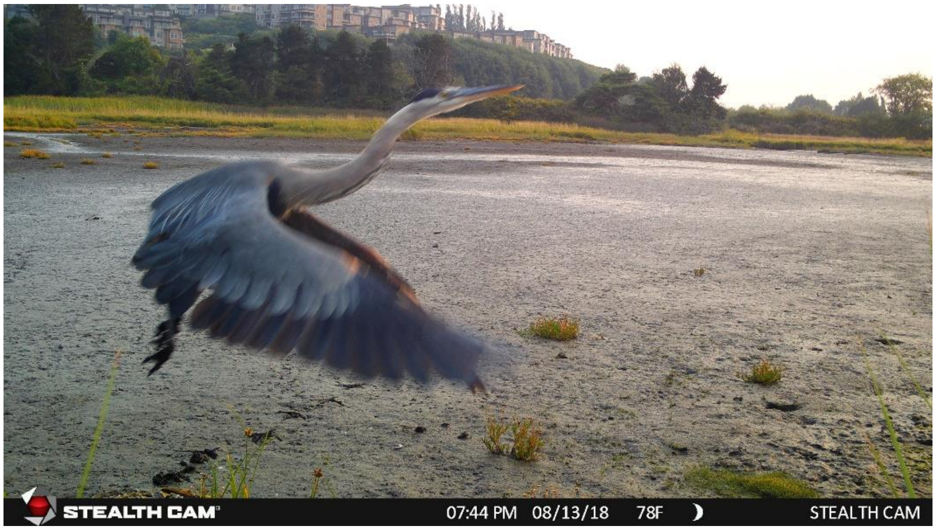
Photo No.:	**45**	
Date:	Aug. 13, 2018	
Description: Great blue heron Edmonds Marsh, north mudflat camera		

Photo No.:	**46**	
Date:	Aug. 15, 2018	
Description: Great blue heron preening Edmonds Marsh, north mudflat camera		

Photo No.:	**47**
Date:	Aug. 15, 2018
Description: Great blue heron taking flight Edmonds Marsh, north mudflat camera	

Photo No.:	**48**
Date:	Aug. 15, 2018
Description: Great blue heron Edmonds Marsh, north mudflat camera	

Photo No.:	**49**
Date:	Aug. 15, 2018

Description:

Great blue heron taking flight

Edmonds Marsh, north mudflat camera

Photo No.:	**50**
Date:	Aug. 15, 2018

Description:

Great blue heron in flight

Edmonds Marsh, north mudflat camera

Photo No.:	**51**
Date:	Aug. 15, 2018
Description: Great blue heron Edmonds Marsh, north mudflat camera	

Photo No.:	**52**
Date:	Aug. 16, 2018
Description: Canada geese Edmonds Marsh, north mudflat camera	

Photo No.:	**53**
Date:	Aug. 18, 2018

Description:

Great blue heron

Edmonds Marsh, north mudflat camera

Photo No.:	**54**
Date:	Aug. 19, 2018

Description:

Great blue heron

Edmonds Marsh, north mudflat camera

Photo No.:	**55**
Date:	Aug. 20, 2018

Description:

Great blue heron in background

Edmonds Marsh, north mudflat camera

Photo No.:	**56**
Date:	Nov. 16, 2018

Description:

Great blue heron

Edmonds Marsh, north mudflat camera

Photo No.:	**57**	
Date:	Dec. 31, 2018	
Description: Great blue heron group Edmonds Marsh, north mudflat camera		

Photo No.:	**58**	
Date:	Dec. 31, 2018	
Description: Great blue heron group Edmonds Marsh, north mudflat camera		

Photo No.:	**59**	
Date:	Feb. 1, 2019	
Description: Great blue heron group Edmonds Marsh, north mudflat camera		

Photo No.:	**60**	
Date:	Mar. 27, 2019	
Description: Waterfowl Edmonds Marsh, north mudflat camera		

Trail Camera WC3 – Edmonds Marsh, South Mudflat

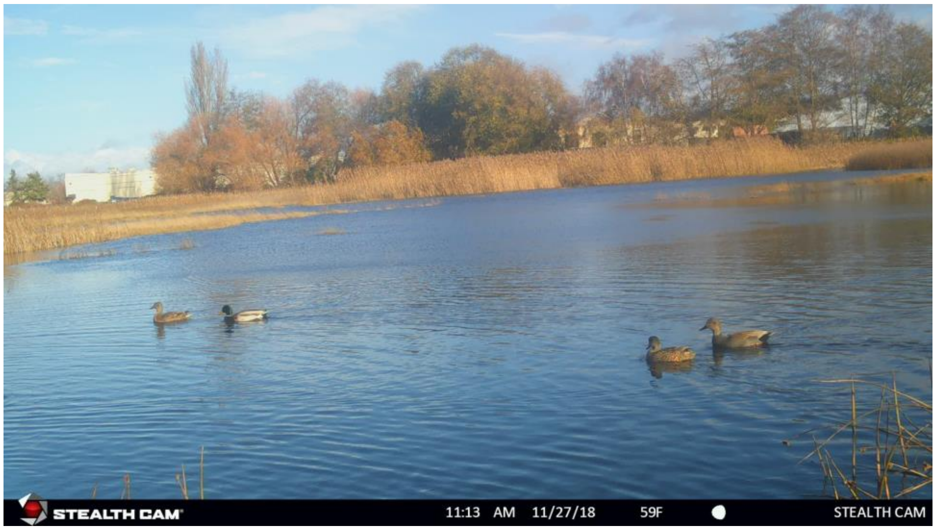
Photo No.:	**61**	
Date:	Nov. 27, 2018	
Description: Gadwall pair and mallard pair Edmonds Marsh, south mudflat camera		

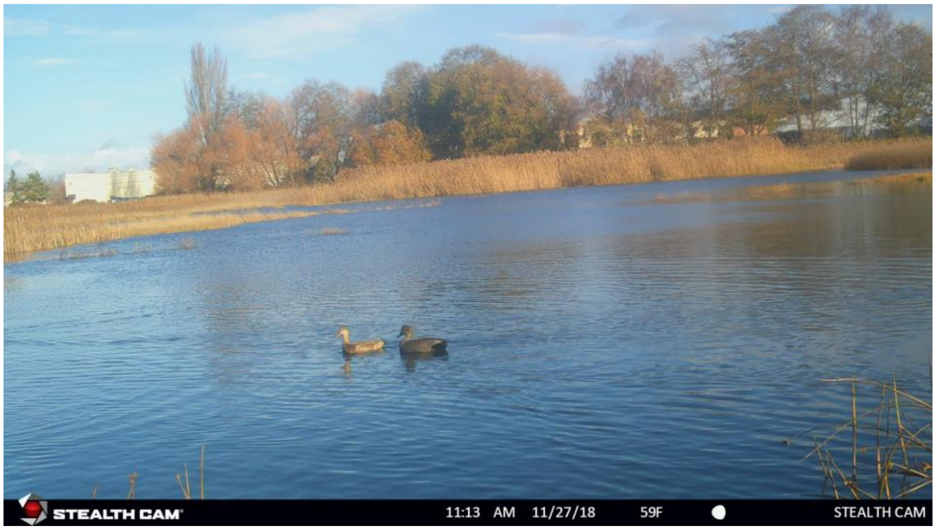
Photo No.:	**62**	
Date:	Nov. 27, 2018	
Description: Gadwall pair Edmonds Marsh, south mudflat camera		

Photo No.:	**63**
Date:	Nov. 27, 2018

Description:

Large group of waterfowl (mostly mallards but other species may be present)

Edmonds Marsh, south mudflat camera

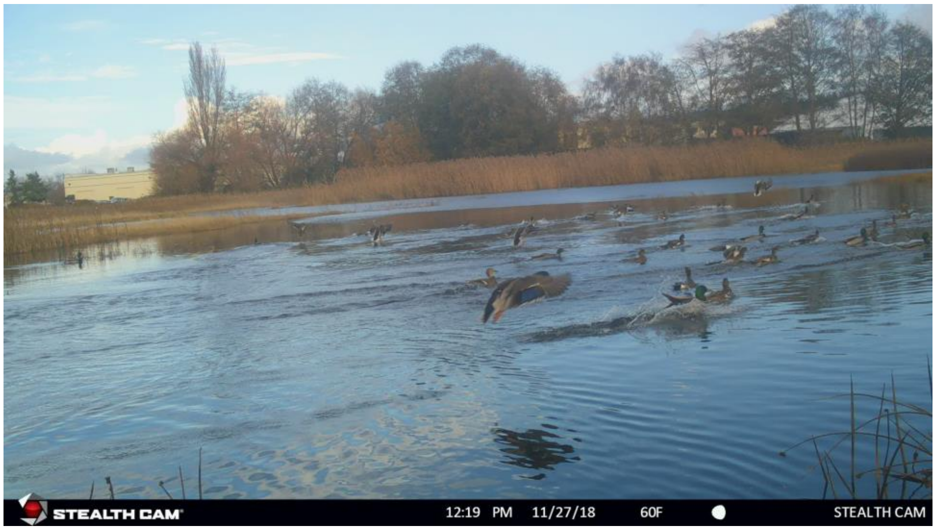
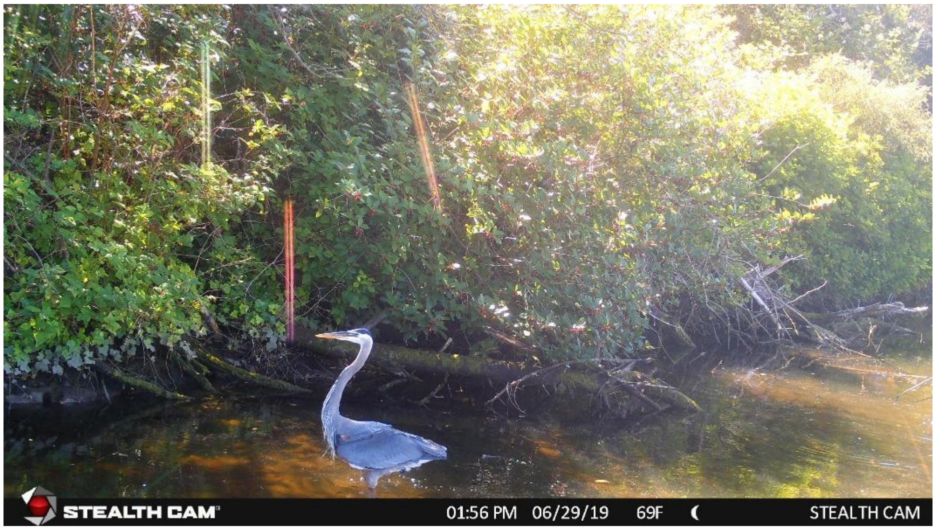


Photo No.:	**64**
Date:	Jun. 29, 2019

Description:

Great blue heron in Willow Creek

Edmonds Marsh, south mudflat camera



APPENDIX F. PHOTOPOINT MONITORING PHOTOS

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Photo No.:	**1**
Date:	Jul. 11, 2018

Description:

View to the north from Photo Station A

Photo No.:	**2**
Date:	Oct. 5, 2018

Description:

View to the north from Photo Station A

Photo No.:	**3**
Date:	Jan. 15, 2019

Description:

View to the north from Photo Station A

Photo No.:	**4**
Date:	Apr. 15, 2019

Description:

View to the north from Photo Station A

Photo No.:	**5**
Date:	Jul. 11, 2018

Description:

View to the northeast from Photo Station A

Photo No.:	**6**
Date:	Oct. 5, 2018

Description:

View to the northeast from Photo Station A

Photo No.:	**7**
Date:	Jan. 16, 2019

Description:

View to the northeast from Photo Station A

Photo No.:	**8**
Date:	Apr. 15, 2019

Description:

View to the northeast from Photo Station A

Photo No.:	**9**
Date:	Jul. 11, 2018

Description:
View to the southeast from Photo Station A

Photo No.:	**10**
Date:	Oct. 5, 2018

Description:
View to the southeast from Photo Station A

Photo No.:	**11**
Date:	Jan. 16, 2019
Description: View to the southeast from Photo Station A	

Photo No.:	**12**
Date:	Apr. 15, 2019
Description: View to the southeast from Photo Station A	

Photo No.:	**13**
Date:	Jul. 11, 2018

Description:
View to the southwest from Photo Station A

Photo No.:	**14**
Date:	Oct. 5, 2018

Description:
View to the southwest from Photo Station A

Photo No.:	**15**
Date:	Jan. 16, 2019
Description: View to the southwest from Photo Station A	

Photo No.:	**16**
Date:	Apr. 15, 2019
Description: View to the southwest from Photo Station A	

Photo No.:	**17**
Date:	Jul. 11, 2018
Description: View to the west from Photo Station A	

Photo No.:	**18**
Date:	Oct. 5, 2018
Description: View to the west from Photo Station A	

Photo No.:	19
Date:	Jan. 16, 2019
Description: View to the west from Photo Station A	

Photo No.:	20
Date:	Apr. 15, 2019
Description: View to the west from Photo Station A	

Photo No.:	**21**
Date:	Jul. 11, 2018
Description: View to the east from Photo Station B	

Photo No.:	**22**
Date:	Oct. 5, 2018
Description: View to the east from Photo Station B	

Photo No.:	**23**
Date:	Jan. 16, 2019
Description: View to the east from Photo Station B	

Photo No.:	**24**
Date:	Apr. 15, 2019
Description: View to the east from Photo Station B	

Photo No.:	**25**
Date:	Jul. 11, 2018
Description: View to the southeast from Photo Station B	

Photo No.:	**26**
Date:	Oct. 5, 2018
Description: View to the southeast from Photo Station B	

Photo No.:	**27**
Date:	Jan. 16, 2019

Description:

View to the southeast from Photo Station B

Photo No.:	**28**
Date:	Apr. 15, 2019

Description:

View to the southeast from Photo Station B

Photo No.:	**29**
Date:	Jul. 11, 2018

Description:

View to the south from Photo Station B

Photo No.:	**30**
Date:	Oct. 5, 2018

Description:

View to the south from Photo Station B

Photo No.:	**31**
Date:	Jan. 16, 2019

Description:
View to the south from Photo Station B


2019/01/16

Photo No.:	**32**
Date:	Apr. 15, 2019

Description:
View to the south from Photo Station B

Photo No.:	**33**
Date:	Jul. 11, 2018

Description:
View to the south from Photo Station C

Photo No.:	**34**
Date:	Oct. 5, 2018

Description:
View to the south from Photo Station C

Photo No.:	**35**
Date:	Jan. 16, 2019

Description:

View to the south from Photo Station C

Photo No.:	**36**
Date:	Apr. 15, 2019

Description:

View to the south from Photo Station C

Photo No.:	**37**
Date:	Jul. 11, 2018

Description:
View to the southeast from Photo Station C

Photo No.:	**38**
Date:	Oct. 5, 2018

Description:
View to the southeast from Photo Station C

Photo No.:	**39**	
Date:	Jan. 16, 2019	
Description: View to the southeast from Photo Station C		

Photo No.:	**40**	
Date:	Apr. 15, 2019	
Description: View to the southeast from Photo Station C		

Photo No.:	**41**
Date:	Jul. 11, 2018

Description:
View to the east from Photo Station C

Photo No.:	**42**
Date:	Oct. 5, 2018

Description:
View to the east from Photo Station C

Photo No.:	**43**
Date:	Jan. 16, 2019

Description:

View to the east from Photo Station C


2019/01/16

Photo No.:	**44**
Date:	Apr. 15, 2019

Description:

View to the east from Photo Station C

Photo No.:	**45**	
Date:	Jul. 11, 2018	
Description: View to the southwest from Photo Station D		

Photo No.:	**46**	
Date:	Oct. 5, 2018	
Description: View to the southwest from Photo Station D		

Photo No.:	**47**
Date:	Jan. 16, 2019

Description:

View to the southwest from Photo Station D

Photo No.:	**48**
Date:	Apr. 15, 2019

Description:

View to the southwest from Photo Station D

Photo No.:	**49**
Date:	Jul. 11, 2018

Description:
View to the south from Photo Station D

Photo No.:	**50**
Date:	Oct. 5, 2018

Description:
View to the south from Photo Station D

Photo No.:	**51**
Date:	Jan. 16, 2019

Description:

View to the south from Photo Station D

Photo No.:	**52**
Date:	Apr. 15, 2019

Description:

View to the south from Photo Station D

Photo No.:	**53**
Date:	Jul. 11, 2018
Description: View to the southeast from Photo Station D	

Photo No.:	**54**
Date:	Oct. 5, 2018
Description: View to the southeast from Photo Station D	

Photo No.:	**55**
Date:	Jan. 16, 2019

Description:
View to the southeast from Photo Station D

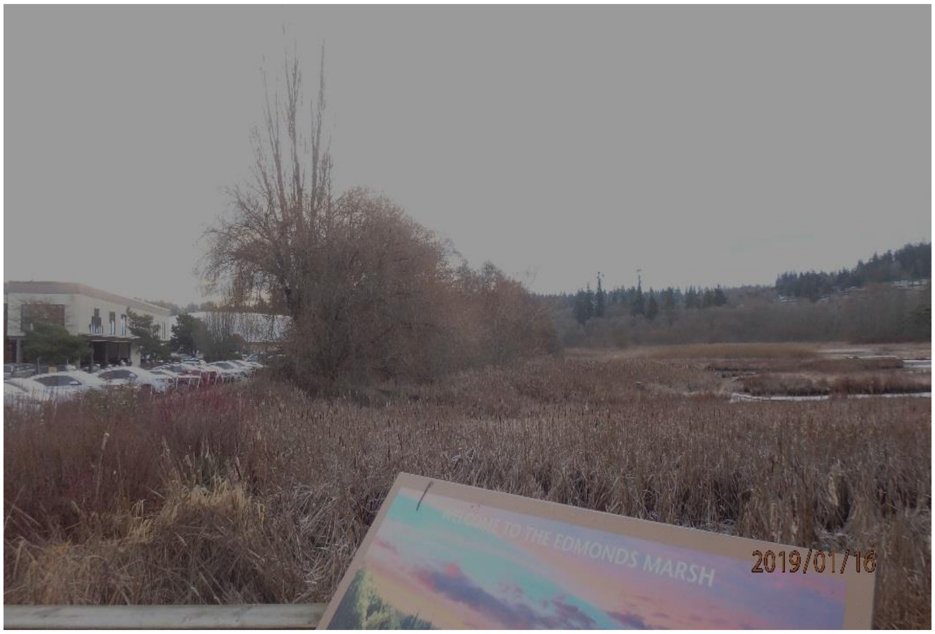

Photo No.:	**56**
Date:	Apr. 15, 2019

Description:
View to the southeast from Photo Station D

Photo No.:	**57**
Date:	Jul. 11, 2018

Description:

View to the southwest from Photo Station E

Photo No.:	**58**
Date:	Oct. 5, 2018

Description:

View to the southwest from Photo Station E

Photo No.:	59
Date:	Jan. 16, 2019

Description:

View to the southwest from Photo Station E

Photo No.:	60
Date:	Apr. 15, 2019

Description:

View to the southwest from Photo Station E

Photo No.:	**61**
Date:	Jul. 11, 2018

Description:

View to the south from Photo Station E

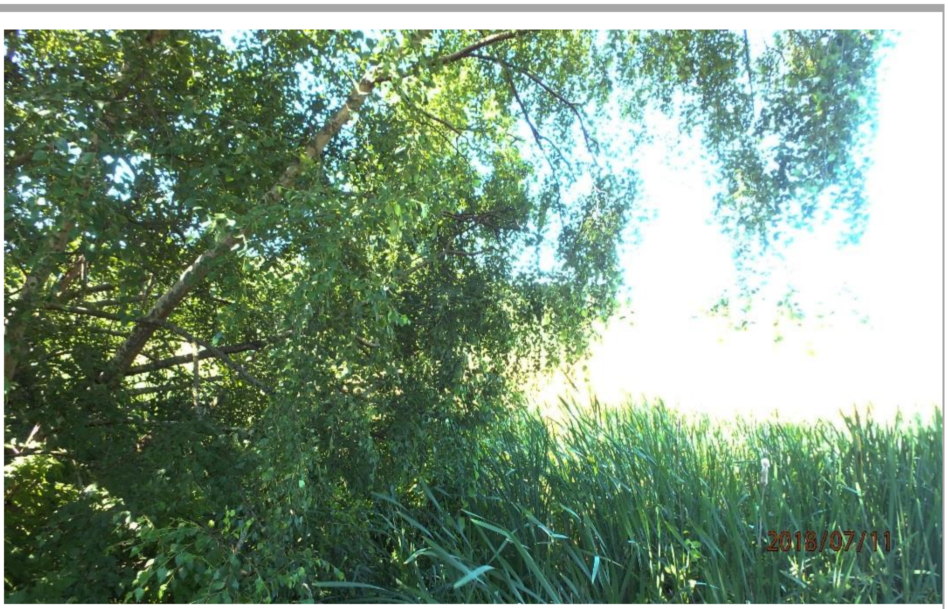

Photo No.:	**62**
Date:	Oct. 5, 2018

Description:

View to the south from Photo Station E

Photo No.:	**63**
Date:	Jan. 16, 2019

Description:

View to the south from Photo Station E

Photo No.:	**64**
Date:	Apr. 15, 2019

Description:

View to the south from Photo Station E

Photo No.:	**65**
Date:	Jul. 11, 2018

Description:

View to the southwest from Photo Station F

Photo No.:	**66**
Date:	Oct. 5, 2018

Description:

View to the southwest from Photo Station F

Photo No.:	**67**
Date:	Jan. 16, 2019

Description:

View to the southwest from Photo Station F

Photo No.:	**68**
Date:	Apr. 15, 2019

Description:

View to the southwest from Photo Station F

Photo No.:	**69**
Date:	Jul. 11, 2018
Description: View to the southeast from Photo Station F	

2018/07/11

Photo No.:	**70**
Date:	Oct. 5, 2018
Description: View to the southeast from Photo Station F	

Photo No.:	**71**
Date:	Jan. 16, 2019

Description:

View to the southeast from Photo Station F

Photo No.:	**72**
Date:	Apr. 15, 2019

Description:

View to the southeast from Photo Station F

Photo No.:	**73**
Date:	Jul. 11, 2018

Description:
View to the south from Photo Station G

Photo No.:	**74**
Date:	Oct. 5, 2018

Description:
View to the south from Photo Station G

Photo No.:	**75**
Date:	Jan. 16, 2019

Description:
View to the south from Photo Station G

Photo No.:	**76**
Date:	Apr. 15, 2019

Description:
View to the south from Photo Station G

Photo No.:	**77**
Date:	Jul. 11, 2018

Description:

View to the northeast from Photo Station H

2018/07/11

Photo No.:	**78**
Date:	Oct. 5, 2018

Description:

View to the northeast from Photo Station H

Photo No.:	**79**
Date:	Jan. 16, 2019

Description:
View to the northeast from Photo Station H

Photo No.:	**80**
Date:	Apr. 15, 2019

Description:
View to the northeast from Photo Station H

Photo No.:	**81**
Date:	Jul. 7, 2018

Description:
View to the northwest from Photo Station I

2018/07/11

Photo No.:	**82**
Date:	Oct. 5, 2018

Description:
View to the northwest from Photo Station I

Photo No.:	**83**
Date:	Jan. 16, 2019

Description:
View to the northwest from Photo Station I

Photo No.:	**84**
Date:	Apr. 15, 2019

Description:
View to the northwest from Photo Station I

Photo No.:	**85**
Date:	Jul. 11, 2018

Description:

View to the west from Photo Station I

Photo No.:	**86**
Date:	Oct. 5, 2018

Description:

View to the west from Photo Station I

Photo No.:	**87**
Date:	Jan. 16, 2019
Description: View to the west from Photo Station I	


2019/01/16

Photo No.:	**88**
Date:	Apr. 15, 2019
Description: View to the west from Photo Station I	


2019/04/15

Photo No.:	**89**
Date:	Jul. 11, 2018

Description:

View to the southwest from Photo Station I

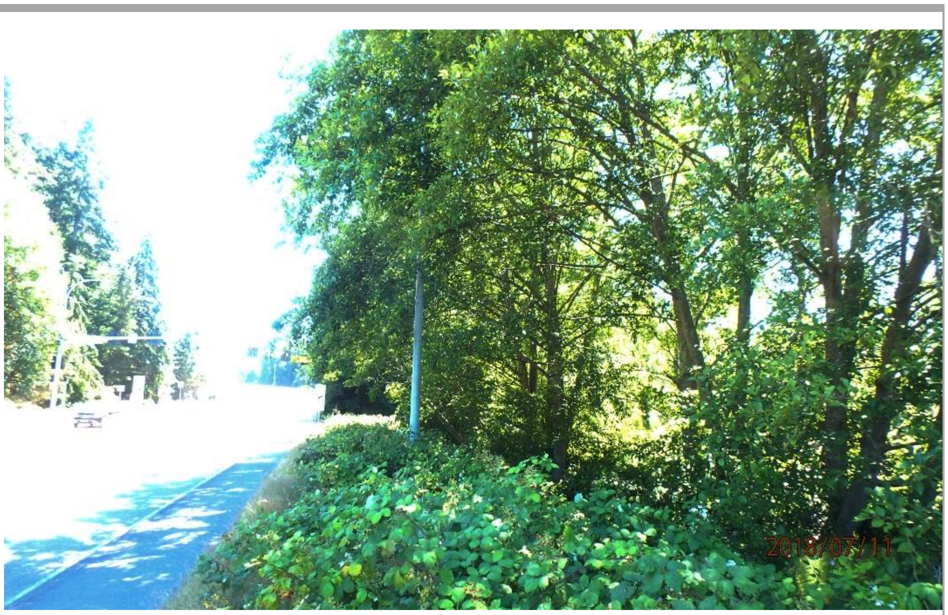

Photo No.:	**90**
Date:	Oct. 5, 20018

Description:

View to the southwest from Photo Station I.

Photo No.:	**91**
Date:	Jan. 16, 2019

Description:

View to the southwest from Photo Station I

Photo No.:	**92**
Date:	Apr. 15, 2019

Description:

View to the southwest from Photo Station I

Photo No.:	**93**
Date:	Jul. 10, 2018
Description: 360° view from Photo Station J	

Photo No.:	**94**
Date:	Oct. 5, 2018
Description: 360° view from Photo Station J	

Photo No.:	**95**
Date:	Jan. 16, 2019

Description:
360° view from Photo Station J

Photo No.:	**96**
Date:	Apr. 15, 2019

Description:
360° view from Photo Station J

Photo No.:	**97**
Date:	Jul. 10, 2018

Description:

360° view from Photo Station J

Photo No.:	**98**
Date:	Oct. 5, 2018

Description:

360° view from Photo Station J

Photo No.:	**99**	
Date:	Jan. 16, 2019	
Description: 360° view from Photo Station J		

Photo No.:	**100**	
Date:	Apr. 15, 2019	
Description: 360° view from Photo Station J		

Photo No.:	**101**
Date:	Jul. 10, 2018
Description: 360° view from Photo Station J	

Photo No.:	**102**
Date:	Oct. 5, 2018
Description: 360° view from Photo Station J	

Photo No.:	**103**
Date:	Jan. 16, 2019

Description:

360° view from Photo Station J

Photo No.:	**104**
Date:	Apr. 15, 2019

Description:

360° view from Photo Station J

Photo No.:	**105**
Date:	Jul. 10, 2018

Description:

360° view from Photo Station J

Photo No.:	**106**
Date:	Oct. 5, 2018

Description:

360° view from Photo Station J

Photo No.:	**107**
Date:	Jan. 16, 2019

Description:

360° view from Photo Station J

Photo No.:	**108**
Date:	Apr. 15, 2019

Description:

360° view from Photo Station J

Photo No.:	**109**
Date:	Jul. 10, 2018

Description:

360° view from Photo Station J

Photo No.:	**110**
Date:	Oct. 5, 2018

Description:

360° view from Photo Station J

Photo No.:	111
Date:	Jan. 16, 2019

Description:

360° view from Photo Station J

Photo No.:	112
Date:	Apr. 15, 2019

Description:

360° view from Photo Station J

Photo No.:	**113**
Date:	Jul. 10, 2018

Description:

360° view from Photo Station J

Photo No.:	**114**
Date:	Oct. 5, 2018

Description:

360° view from Photo Station J

Photo No.:	**115**
Date:	Jan. 16, 2019
Description: 360° view from Photo Station J	

Photo No.:	**116**
Date:	Apr. 15, 2019
Description: 360° view from Photo Station J	

Photo No.:	**117**
Date:	Jul. 10, 2018

Description:

360° view from Photo Station J

Photo No.:	**118**
Date:	Oct. 5, 2018

Description:

360° view from Photo Station J

Photo No.:	**119**
Date:	Jan. 16, 2019

Description:

360° view from Photo Station J

Photo No.:	**120**
Date:	Apr. 15, 2019

Description:

360° view from Photo Station J

Photo No.:	**121**
Date:	Jul. 10, 2018
Description: 360° view from Photo Station J	

Photo No.:	**122**
Date:	Oct. 5, 2018
Description: 360° view from Photo Station J	

Photo No.:	**123**
Date:	Jan. 16, 2019

Description:

360° view from Photo Station J

Photo No.:	**124**
Date:	Apr. 15, 2019

Description:

360° view from Photo Station J

Photo No.:	**125**
Date:	Jul. 10, 2018

Description:

View to the west from Photo Station K

Photo No.:	**126**
Date:	Oct. 5, 2018

Description:

View to the west from Photo Station K

Photo No.:	**127**
Date:	Jan. 16, 2019

Description:
View to the west from Photo Station K

Photo No.:	**128**
Date:	Apr. 15, 2019

Description:
View to the west from Photo Station K

Photo No.:	**129**
Date:	Jul. 10, 2018

Description:

View to the north from Photo Station K

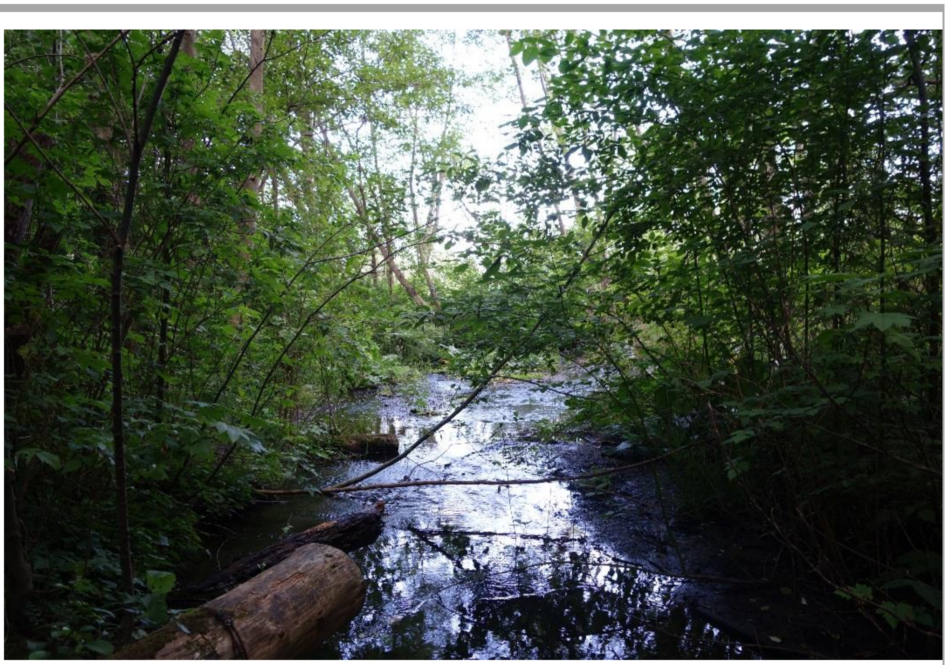

Photo No.:	**130**
Date:	Oct. 5, 2018

Description:

View to the north from Photo Station K

Photo No.:	**131**
Date:	Jan. 16, 2019

Description:
View to the north from Photo Station K

Photo No.:	**132**
Date:	Apr. 15, 2019

Description:
View to the north from Photo Station K

Photo No.:	**133**
Date:	Jul. 10, 2018

Description:

View to the northeast from Photo Station K

Photo No.:	**134**
Date:	Oct. 5, 2018

Description:

View to the northeast from Photo Station K

Photo No.:	135
Date:	Jan. 16, 2019

Description:
View to the northeast from Photo Station K

Photo No.:	136
Date:	Apr. 15, 2019

Description:
View to the northeast from Photo Station K

Photo No.:	**137**
Date:	Jul. 10, 2018

Description:

View to the northeast from Photo Station L

Photo No.:	**138**
Date:	Oct. 5, 2018

Description:

View to the northeast from Photo Station L

Photo No.:	**139**
Date:	Jan. 16, 2019

Description:

View to the northeast from Photo Station L

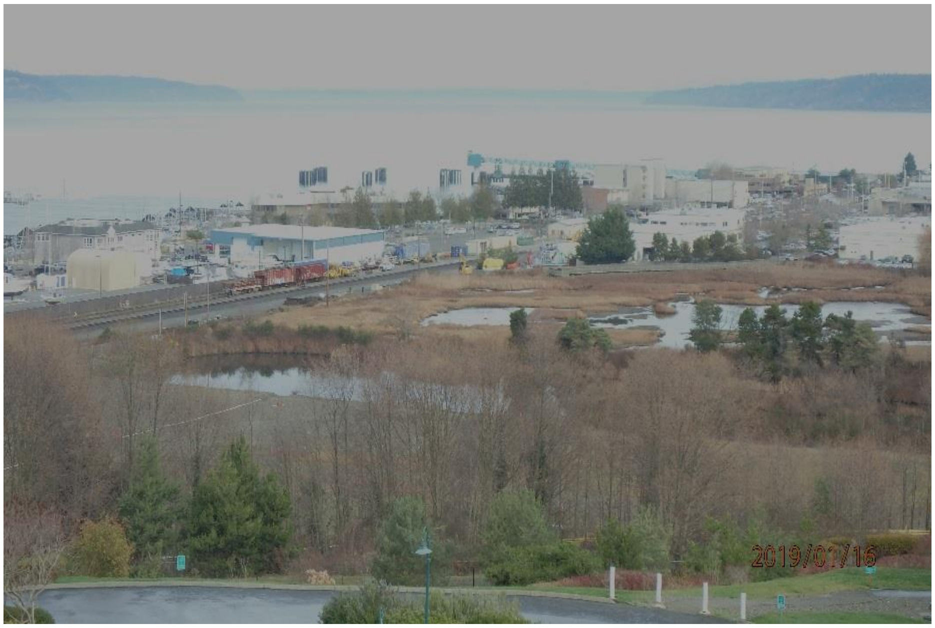

Photo No.:	**140**
Date:	Apr. 15, 2019

Description:

View to the northeast from Photo Station L.

Photo No.:	**141**
Date:	Jul. 10, 2018

Description:
View to the east-northeast from Photo Station L

Photo No.:	**142**
Date:	Oct. 5, 2018

Description:
View to the east-northeast from Photo Station L

Photo No.:	**143**
Date:	Jan. 16, 2019

Description:

View to the east-northeast from Photo Station L

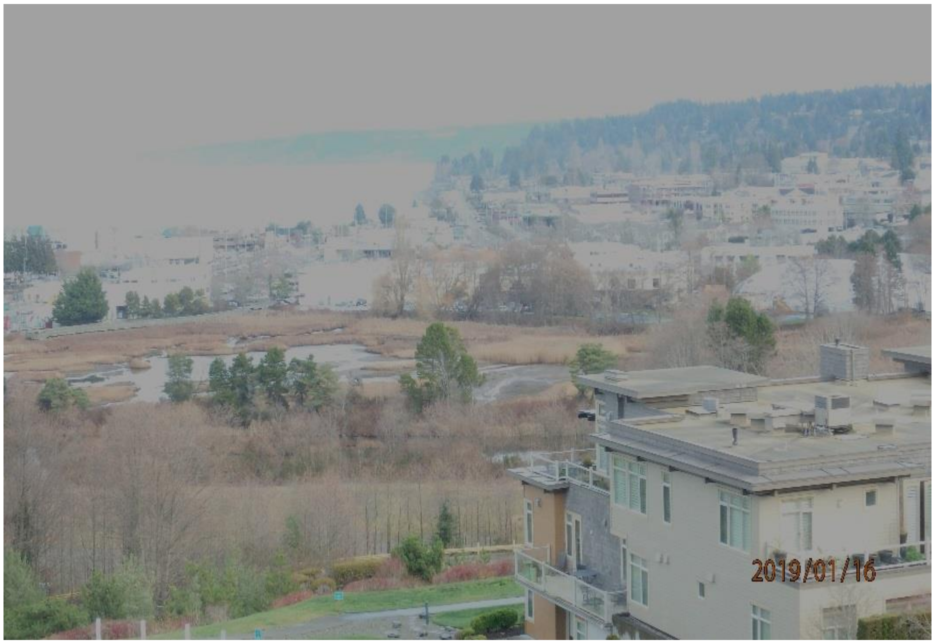

Photo No.:	**144**
Date:	Apr. 15, 2019

Description:

View to the east-northeast from Photo Station L

Photo No.:	**145**
Date:	Jul. 10, 2018

Description:

View to the east from Photo Station L

Photo No.:	**146**
Date:	Oct. 5, 2018

Description:

View to the east from Photo Station L

Photo No.:	**147**
Date:	Jan. 16, 2019

Description:
View to the east from Photo Station L

Photo No.:	**148**
Date:	Apr. 15, 2019

Description:
View to the east from Photo Station L

Photo No.:	**149**
Date:	Jul. 10, 2018

Description:
View to the west from Photo Station M

Photo No.:	**150**
Date:	Oct. 5, 2018

Description:
View to the west from Photo Station M

Photo No.:	**151**
Date:	Jan. 16, 2019

Description:
View to the west from Photo Station M

Photo No.:	**152**
Date:	Apr. 15, 2019

Description:
View to the west from Photo Station M

APPENDIX G. BENTHIC INVERTEBRATES TAXA REPORT

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Analysis of biological samples:
Technical summary of methods and quality assurance procedures
Prepared for Shannon & Wilson, Inc.
Dave Cline, Project Manager
February 6, 2018

by
W. Bollman, Chief Biologist
Rhithron Associates, Inc.
Missoula, Montana

METHODS

Sample processing

Seven macroinvertebrate and 7 periphyton samples collected for the Willow Creek Daylight Project (SW project 21-1-12588) were delivered to Rhithron's laboratory facility in Missoula, Montana on October 9, 2017. All samples arrived in good condition. A chain of custody document containing sample identification information was provided by the Shannon & Wilson (SW) Project Manager. Upon arrival, samples were unpacked and examined, and checked against the SW chain of custody. An inventory spreadsheet was created and uploaded into the Rhithron database prior to sample processing.

Macroinvertebrates

Standard sorting protocols (Plotnikoff and Wiseman 2001) were applied in an attempt to achieve representative subsamples of a minimum of 500 organisms. Caton sub-sampling devices (Caton 1991), divided into 30 grids, each approximately 6 cm by 6 cm were used. Each individual sample was thoroughly mixed in its jar(s), poured out and evenly spread into the Caton tray, and individual grids were randomly selected. The contents of each grid were examined under stereoscopic microscopes using 10x-30x magnification. All aquatic invertebrates from each selected grid were sorted from the substrate, and placed in 80% ethanol for subsequent identification. Grid selection, examination, and sorting continued until at least 500 organisms were sorted or until the entire sample was processed. The final grid was completely sorted of all organisms, and the number of grids sorted was recorded.

After the target number of organisms was obtained in the subsample, an intensive search for New Zealand mudsnails was performed. No specimens of New Zealand mudsnails were found in any sample. All unsorted sample fractions were re-preserved and archived at the Rhithron laboratory.

Organisms were individually examined by certified taxonomists, using 10x – 80x stereoscopic dissecting scopes (Leica S8E) and identified to target taxonomic levels consistent with B-IBI for Puget Sound Lowlands streams protocols (Karr and Chu 1999), using appropriate published taxonomic references and keys.

Chironomids were carefully morphotyped using 10x – 80x stereoscopic dissecting microscopes (Leica S8E) and representative specimens were slide mounted and examined at 200x – 1000x magnification using an Olympus BX 51 or Leica DM 1000 compound microscope. Slide mounted organisms were archived at the Rhithron laboratory.

Identification, counts, life stages, and information about the condition of specimens were recorded on electronic bench sheets. Organisms that could not be identified to the taxonomic targets because of immaturity, poor condition, or lack of complete current regionally-applicable published keys were left at appropriate taxonomic levels that were coarser than those specified. To obtain accuracy in richness measures, these organisms were designated as "not unique" if other specimens from the same group could be taken to target levels. Organisms designated as "unique" were those that could be definitively distinguished from other organisms in the sample.

Identified organisms were preserved in 80% ethanol in labeled vials, and archived at the Rhithron laboratory.

Periphyton

The periphyton samples were preserved with Lugol's solution, and initial sample volumes were measured and recorded. The samples were thoroughly mixed by shaking, and split into 2 aliquots for diatom and soft-bodied algae analyses.

Permanent diatom slides were prepared: subsamples were taken and treated with 70% Nitric acid (HNO_3) and digested using a closed-vessel microwave digestion system (Milestone Ethos EZ), following the method developed by the Academy of Natural Sciences, Philadelphia (ANSP 2002). The samples were neutralized by rinses with distilled water, and subsample volumes were adjusted to obtain adequate densities for slide mounts. Dilution and concentration factors, as appropriate, were recorded for each sample. Subsamples were dried onto 22-mm square coverslips. Coverslips were mounted on slides using Naphrax diatom mount. To ensure a high quality mount for identification and to make replicates available for archives, 2 slide mounts were made from each sample. One of the replicates was selected from each sample batch for identification. A diamond scribe mark was made to define a transect line on the cover slip, and a minimum of 600 diatom valves were identified along the transect mark. A Leica DM 2500 compound microscope, Nomarski contrast, and 1000x magnification were used for identifications. Diatoms were identified to the lowest possible taxonomic level, generally species, following standard taxonomic references.

For soft-bodied algae samples, the raw periphyton sample was manually homogenized and emptied into a porcelain evaporating dish. A small, random sub-sample of algal material was pipetted into a standard Palmer-Maloney counting chamber using a disposable Pasteur pipette. Visible (macroscopic) algae were also sub-sampled, in proportion to their estimated abundance relative to the total volume of algal material in the sample, and added to the liquid fraction on the slide. The Palmer-Maloney cell was then covered with a 22 x 30 mm coverslip.

Soft-bodied algae were identified to genus using a Leica DM 2500 compound microscope under 200X and 400X magnification, following standard taxonomic references. Three hundred cells or natural units of algae were identified, when possible. Living diatom cells were included in these counts. (Including these cells will allow for the calculation of diatom species abundance.)

Quality control procedures

Quality control procedures for initial sample processing and subsampling involved checking sorting efficiency. These checks were conducted on a random selection of 10% of the samples by independent observers who microscopically re-examined 100% of sorted substrate from each sample. Quality control procedures for each sample proceeded as follows:

The quality control technician poured the sorted substrate from a processed sample out into a Caton tray, redistributing the substrate so that it could be accurately lifted out by removing entire grids in a random fashion. Grids were selected, and re-examined until all of the substrate was re-sorted. All organisms that were missed were counted and this number was added to the total number obtained in the original sort. Sorting efficiency was evaluated by applying the following calculation:

$$SE = \frac{n_1}{n_1 + n_2} \times 100$$

where: SE is the sorting efficiency, expressed as a percentage, n_1 is the total number of specimens in the first sort, and n_2 is the total number of specimens in the second sort.

Quality control procedures for taxonomic determinations of invertebrates involved checking accuracy, precision and enumeration. One sample was randomly selected and all organisms re-identified and counted by an independent taxonomist. Taxa lists and enumerations were compared by calculating a Bray-Curtis similarity statistic (Bray and Curtis 1957), Percent Taxonomic Disagreement (PTD) and Percent Difference in Enumeration (PDE). Routinely, discrepancies between the original identifications and the QC identifications are discussed among the taxonomists, and necessary rectifications to the data are made. Discrepancies that cannot be rectified by discussions are routinely sent out to taxonomic specialists for identification.

Data analysis

Taxa and counts for each sample were entered into Rhithron's customized laboratory information management system (LIMS). Standard metric calculations for aquatic invertebrate and periphyton assemblages were made using Rhithron's customized LIMS. Metric calculations and scoring for the B-IBI for Puget Sound Lowlands streams (Karr and Chu 1999) were also performed for the invertebrate samples. A sites-by-taxa and sites-by-metrics data matrix was compiled in Microsoft Excel. Diatom and non-diatom algae identifications were also compiled in Microsoft Excel.

RESULTS

Quality Control Procedures

Results of quality control procedures for subsampling and taxonomy are given in Table 1. Sorting efficiency was 97.40% for the randomly selected sort QC sample. Taxonomic precision for identification and enumeration measured by the Bray-Curtis index was 99.44%, PTD was 1.10% and PDE was 0.56% for the randomly selected taxonomy QC sample, and data entry efficiency averaged 100% for the project. These similarity statistics fall within acceptable industry criteria (Stribling et al. 2003).

Data analysis

Taxa lists and counts, and values and scores for various standard bioassessment metrics and indices calculated by Rhithron are given in the Appendix.

Electronic spreadsheets were provided to the SW Project Manager via e-mail.

REFERENCES

ANSP. 2002. Protocols for the analysis of algal samples collected as part of the U.S. Geological Survey National Water-Quality Assessment Program. The Academy of Natural Sciences Patrick Center for Environmental Research: Report No. 02-06. May 2002.

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Table 1. *Results of quality control procedures for invertebrate subsampling and taxonomy.* Willow Creek Daylight Project 2017.

RAI Sample ID	Station Name	Station ID	Sorting efficiency	Bray-Curtis similarity for taxonomy and enumeration	Percent Taxonomic Disagreement (PTD)	Percent Difference in Enumeration (PDE)
SW17CHM001	Puget Sound	WC-01	97.40%			
SW17CHM002	Lower Willow Creek	WC-02				
SW17CHM003	Willow Creek Marsh	WC-03		99.44%	1.10%	0.56%
SW17CHM004	Willow Creek Marsh	WC-04				
SW17CHM005	Willow Creek Marsh	WC-05				
SW17CHM006	Upper Willow Creek	WC-06				
SW17CHM007	Upper Shellebarger Creek	WC-07				

APPENDIX

Invertebrate taxa lists and metric summaries
Periphyton taxa lists and metric summaries

Willow Creek Daylight Project

2017

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM001

RAI No.: SW17CHM001
Sta. Name: Puget Sound
Client ID: WC-01
Date Coll.: 9/20/2017
No. Jars: 2
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Nemata							
Nemata	17	7.56%	Yes	Unknown		5	UN
Oligochaeta							
Oligochaeta	1	0.44%	Yes	Unknown		10	CG
Polychaeta							
Polychaeta	2	0.89%	Yes	Unknown	Damaged	11	UN
Bivalvia							
Bivalvia	64	28.44%	Yes	Immature		11	CF
Cardiidae							
Cardiidae	2	0.89%	Yes	Unknown		11	UN
Veneridae							
Veneridae	33	14.67%	Yes	Unknown		11	UN
Gastropoda							
Gastropoda	3	1.33%	Yes	Immature		7	SC
Amphipoda							
Amphipoda	12	5.33%	Yes	Unknown	Damaged	4	CG
Anisogammaridae							
Anisogammarus sp.	4	1.78%	Yes	Unknown		11	UN
Corophiidae							
Monocorophium sp.	6	2.67%	Yes	Unknown		11	UN
Caprellidae							
Caprella sp.	6	2.67%	Yes	Unknown		11	UN
Pleustidae							
Pleustidae	14	6.22%	Yes	Unknown	Damaged	11	UN
Phoxocephalidae							
Phoxocephalidae	28	12.44%	Yes	Unknown	Damaged	11	UN
Decapoda							
Decapoda	3	1.33%	Yes	Unknown	Damaged	6	SH
Isopoda							
Isopoda	5	2.22%	Yes	Unknown	Damaged	8	CG
Sphaeromatidae							
Gnorimosphaeroma sp.	4	1.78%	Yes	Unknown		11	UN
Cumacea							
Cumacea	12	5.33%	Yes	Unknown		11	UN
Leptocheliidae							
Leptochelia sp.	2	0.89%	Yes	Unknown		11	UN
Copepoda							
Copepoda	5	2.22%	Yes	Unknown		8	CG
Ostracoda							
Ostracoda	2	0.89%	Yes	Unknown		8	CG
Sample Count	225						

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM002

RAI No.: SW17CHM002 **Sta. Name:** Lower Willow Creek
Client ID: WC-02
Date Coll.: 9/20/2017 **No. Jars:** 2 **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Oligochaeta							
Oligochaeta							
Oligochaeta	18	2.92%	Yes	Unknown		10	CG
Anisogammaridae							
Eogammarus sp.	82	13.31%	Yes	Unknown		11	UN
Decapoda							
Decapoda	3	0.49%	Yes	Unknown	Damaged	6	SH
Sphaeromatidae							
Gnorimosphaeroma sp.	2	0.32%	Yes	Unknown		11	UN
Copepoda							
Copepoda	4	0.65%	Yes	Unknown		8	CG
Ostracoda							
Ostracoda	501	81.33%	Yes	Unknown		8	CG
Diptera							
Ceratopogonidae							
Dasyhelea sp.	3	0.49%	Yes	Larva		11	CG
Chironomidae							
Chironominae							
Chironomus sp.	3	0.49%	Yes	Larva		10	CG
Sample Count	616						

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM003

RAI No.: SW17CHM003 **Sta. Name:** Willow Creek Marsh
Client ID: WC-03
Date Coll.: 9/20/2017 **No. Jars:** 2 **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Oligochaeta							
Oligochaeta							
Oligochaeta	8	4.28%	Yes	Unknown		10	CG
Physidae							
Physidae	19	10.16%	Yes	Unknown		8	SC
Planorbidae							
Planorbidae	1	0.53%	Yes	Unknown	Damaged	6	SC
Diplostraca							
Cladocera	3	1.60%	Yes	Unknown		8	CF
Crangonyctidae							
Crangonyx sp.	47	25.13%	Yes	Unknown		6	CG
Copepoda							
Copepoda	21	11.23%	Yes	Unknown		8	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	3	1.60%	Yes	Larva		6	PR
Culicidae							
Culicidae	71	37.97%	Yes	Larva	Damaged	10	CG
Dixidae							
Dixella sp.	3	1.60%	Yes	Larva		4	CG
Chironomidae							
Chironominae							
Chironomus sp.	9	4.81%	Yes	Larva		10	CG
Polypedilum sp.	1	0.53%	Yes	Larva		6	SH
Tanypodinae							
Procladius sp.	1	0.53%	Yes	Larva		9	PR
Sample Count	187						

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM004

RAI No.:	SW17CHM004			Sta. Name:	Willow Creek Marsh
Client ID:	WC-04				
Date Coll.:	9/20/2017	No. Jars:	2	STORET ID:	

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Asellidae							
Caecidotea sp.	1	50.00%	Yes	Unknown		8	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	1	50.00%	Yes	Larva		6	PR
Sample Count	2						

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM005

RAI No.: SW17CHM005
Sta. Name: Willow Creek Marsh
Client ID: WC-05
Date Coll.: 9/20/2017
No. Jars: 2
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Erpobdellidae							
Erpobdellidae	10	32.26%	Yes	Unknown		8	PR
Oligochaeta							
Oligochaeta	1	3.23%	Yes	Unknown		10	CG
Sphaeriidae							
Sphaeriidae	8	25.81%	Yes	Unknown		8	CF
Plecoptera							
Nemouridae							
Malenka sp.	1	3.23%	Yes	Larva		1	SH
Chironomidae							
Chironominae							
Polypedilum sp.	6	19.35%	Yes	Larva		6	SH
Chironominae							
Rheotanytarsus sp.	1	3.23%	Yes	Larva		6	CF
Orthocladiinae							
Parametriocnemus sp.	1	3.23%	Yes	Larva		5	CG
Prodiamesinae							
Prodiamesa sp.	3	9.68%	Yes	Larva		3	CG
Sample Count	31						

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM006

RAI No.: SW17CHM006
Client ID: WC-06
Date Coll.: 9/20/2017
No. Jars: 2
Sta. Name: Upper Willow Creek
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Trepaxonemata							
Trepaxonemata	7	1.30%	Yes	Unknown		4	PR
Nemata							
Nemata	5	0.93%	Yes	Unknown		5	UN
Oligochaeta							
Oligochaeta	70	13.01%	Yes	Unknown		10	CG
Sphaeriidae							
Sphaeriidae	5	0.93%	Yes	Unknown		8	CF
Crangonyctidae							
Crangonyx sp.	203	37.73%	Yes	Unknown		6	CG
Acari							
Acari	1	0.19%	Yes	Unknown		5	PR
Ephemeroptera							
Baetidae							
Baetis tricaudatus complex	69	12.83%	Yes	Larva		5	CG
Heptageniidae							
Cinygma sp.	6	1.12%	Yes	Larva		0	SC
Plecoptera							
Chloroperlidae							
Sweltsa sp.	4	0.74%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	51	9.48%	Yes	Larva		1	SH
Zapada cinctipes	2	0.37%	Yes	Larva		3	SH
Trichoptera							
Hydropsychidae							
Parapsyche sp.	4	0.74%	Yes	Larva		0	PR
Diptera							
Dixidae							
Dixa sp.	4	0.74%	Yes	Larva		1	CG
Psychodidae							
Psychodidae	2	0.37%	Yes	Larva	Early Instar	4	CG
Simuliidae							
Simulium sp.	86	15.99%	Yes	Larva		6	CF
Simulium sp.	2	0.37%	No	Pupa		6	CF
Tipulidae							
Dicranota sp.	1	0.19%	Yes	Larva		3	PR
Chironomidae							
Chironominae							
Micropsectra sp.	2	0.37%	Yes	Larva		4	CG
Orthocladiinae							
Brillia sp.	10	1.86%	Yes	Larva		4	SH
Parametriocnemus sp.	3	0.56%	Yes	Larva		5	CG
Tvetenia Bavarica Gr.	1	0.19%	Yes	Larva		5	CG
Sample Count	538						

Taxa Listing

Project ID: SW17CHM
RAI No.: SW17CHM007

RAI No.:	SW17CHM007			**Sta. Name:**	Upper Shellebarger Creek
Client ID:	WC-07				
Date Coll.:	9/20/2017	**No. Jars:**	2	**STORET ID:**	

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Trepaxonemata							
Trepaxonemata	21	5.24%	Yes	Unknown		4	PR
Nemata							
Nemata	1	0.25%	Yes	Unknown		5	UN
Erpobdellidae							
Erpobdellidae	1	0.25%	Yes	Unknown		8	PR
Oligochaeta							
Oligochaeta	11	2.74%	Yes	Unknown		10	CG
Sphaeriidae							
Sphaeriidae	3	0.75%	Yes	Unknown		8	CF
Crangonyctidae							
Crangonyx sp.	44	10.97%	Yes	Unknown		6	CG
Acari							
Acari	2	0.50%	Yes	Unknown		5	PR
Ephemeroptera							
Baetidae							
Baetis tricaudatus complex	44	10.97%	Yes	Larva		5	CG
Leptohyphidae							
Tricorythodes sp.	1	0.25%	Yes	Larva		4	CG
Plecoptera							
Nemouridae							
Malenka sp.	29	7.23%	Yes	Larva		1	SH
Trichoptera							
Hydropsychidae							
Parapsyche sp.	1	0.25%	Yes	Larva		0	PR
Diptera							
Psychodidae							
Psychodidae	1	0.25%	Yes	Larva	Damaged	4	CG
Simuliidae							
Simulium sp.	19	4.74%	No	Pupa		6	CF
Simulium sp.	221	55.11%	Yes	Larva		6	CF
Chironomidae							
Orthocladiinae							
Eukiefferiella Claripennis Gr.	1	0.25%	Yes	Larva		8	CG
Tvetenia Bavarica Gr.	1	0.25%	Yes	Larva		5	CG
Sample Count	401						

Metrics Report

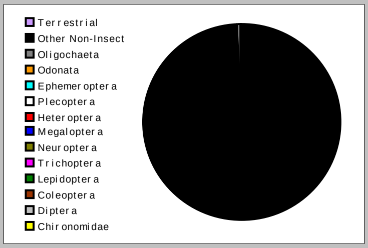
Project ID: SW17CHM
RAI No.: SW17CHM001
Sta. Name: Puget Sound
Client ID: WC-01
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 225
Sample Abundance: 225.00 100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 10cm 0% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	19	224	99.56%
Oligochaeta	1	1	0.44%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera			
Chironomidae			

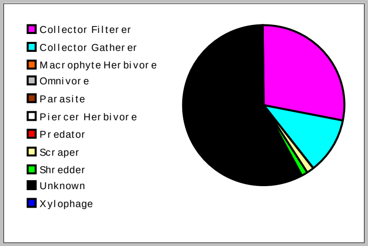


Dominant Taxa

Category	A	PRA
Bivalvia	64	28.44%
Veneridae	33	14.67%
Phoxocephalidae	28	12.44%
Nemata	17	7.56%
Pleustidae	14	6.22%
Cumacea	12	5.33%
Amphipoda	12	5.33%
Monocorophium	6	2.67%
Caprella	6	2.67%
Isopoda	5	2.22%
Copepoda	5	2.22%
Gnorimosphaeroma	4	1.78%
Anisogammarus	4	1.78%
Gastropoda	3	1.33%
Decapoda	3	1.33%

Functional Composition

Category	R	A	PRA
Predator			
Parasite			
Collector Gatherer	5	25	11.11%
Collector Filterer	1	64	28.44%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	1	3	1.33%
Shredder	1	3	1.33%
Omnivore			
Unknown	12	130	57.78%

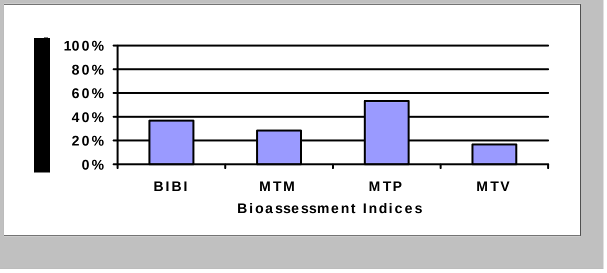


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	20
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	225
All Non-Insect Richness	20
All Non-Insect Percent	100.00%
Oligochaeta+Hirudinea Percent	0.44%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	28.44%
Dominant Taxa (2) Percent	43.11%
Dominant Taxa (3) Percent	55.56%
Dominant Taxa (10) Percent	87.56%
Diversity	
Shannon H (loge)	2.392
Shannon H (log2)	3.451
Margalef D	3.508
Simpson D	0.133
Evenness	0.077
Function	
Predator Richness	0
Predator Percent	0.00%
Filterer Richness	1
Filterer Percent	28.44%
Collector Percent	39.56%
Scraper+Shredder Percent	2.67%
Scraper/Filterer	0.047
Scraper/Scraper+Filterer	0.045
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	4
Semivoltine Richness	1
Multivoltine Percent	3.11%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	0.44%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.700
Pollution Sensitive Richness	0
Pollution Tolerant Percent	2.22%
Hilsenhoff Biotic Index	5.792
Intolerant Percent	0.00%
Supertolerant Percent	5.78%
CTQa	108.000

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	16	53.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	3	16.67%	Severe
MTM	Montana DEQ Mountains (Bukantis 1998)	6	28.57%	Moderate



Metrics Report

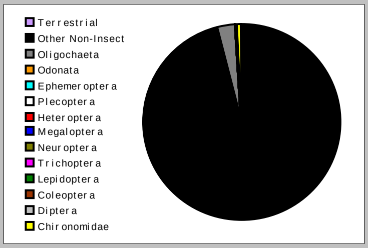
Project ID: SW17CHM
RAI No.: SW17CHM002
Sta. Name: Lower Willow Creek
Client ID: WC-02
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 616
Sample Abundance: 616.00 100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 15cm 0% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	592	96.10%
Oligochaeta	1	18	2.92%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera	1	3	0.49%
Chironomidae	1	3	0.49%

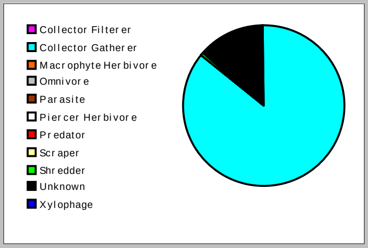


Dominant Taxa

Category	A	PRA
Ostracoda	501	81.33%
Eogammarus	82	13.31%
Oligochaeta	18	2.92%
Copepoda	4	0.65%
Decapoda	3	0.49%
Dasyhelea	3	0.49%
Chironomus	3	0.49%
Gnorimosphaeroma	2	0.32%

Functional Composition

Category	R	A	PRA
Predator			
Parasite			
Collector Gatherer	5	529	85.88%
Collector Filterer			
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	1	3	0.49%
Omnivore			
Unknown	2	84	13.64%

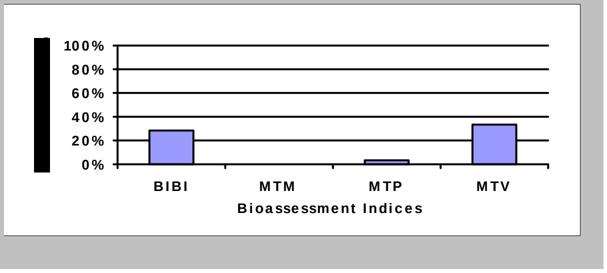


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	8
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	610
All Non-Insect Richness	6
All Non-Insect Percent	99.03%
Oligochaeta+Hirudinea Percent	2.92%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	81.33%
Dominant Taxa (2) Percent	94.64%
Dominant Taxa (3) Percent	97.57%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	0.669
Shannon H (log2)	0.965
Margalef D	1.090
Simpson D	0.680
Evenness	0.085
Function	
Predator Richness	0
Predator Percent	0.00%
Filterer Richness	0
Filterer Percent	0.00%
Collector Percent	85.88%
Scraper+Shredder Percent	0.49%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	1
Burrower Percent	0.49%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	0.49%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	2
Semivoltine Richness	1
Multivoltine Percent	82.47%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	2.92%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.500
Pollution Sensitive Richness	0
Pollution Tolerant Percent	0.49%
Hilsenhoff Biotic Index	8.068
Intolerant Percent	0.00%
Supertolerant Percent	85.39%
CTQa	108.000

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	1	3.33%	Severe
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	6	33.33%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	0	0.00%	Severe



Tuesday, February 06, 2018

Metrics Report

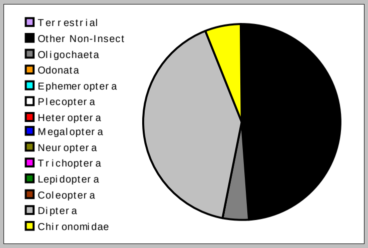
Project ID: SW17CHM
RAI No.: SW17CHM003
Sta. Name: Willow Creek Marsh
Client ID: WC-03
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 187
Sample Abundance: 187.00 100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 8cm 100% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	91	48.66%
Oligochaeta	1	8	4.28%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera	3	77	41.18%
Chironomidae	3	11	5.88%

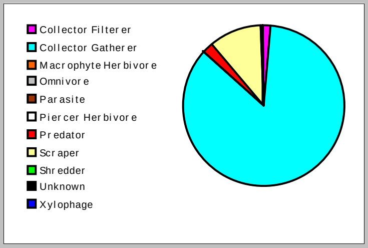


Dominant Taxa

Category	A	PRA
Culicidae	71	37.97%
Crangonyx	47	25.13%
Copepoda	21	11.23%
Physidae	19	10.16%
Chironomus	9	4.81%
Oligochaeta	8	4.28%
Dixella	3	1.60%
Cladocera	3	1.60%
Ceratopogoninae	3	1.60%
Procladius	1	0.53%
Polypedilum	1	0.53%
Planorbidae	1	0.53%

Functional Composition

Category	R	A	PRA
Predator	2	4	2.14%
Parasite			
Collector Gatherer	6	159	85.03%
Collector Filterer	1	3	1.60%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	2	20	10.70%
Shredder	1	1	0.53%
Omnivore			
Unknown			

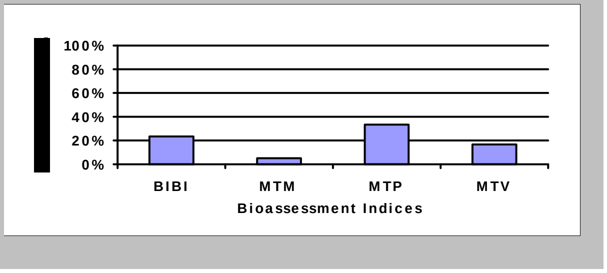


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	12
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	99
All Non-Insect Richness	6
All Non-Insect Percent	52.94%
Oligochaeta+Hirudinea Percent	4.28%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	37.97%
Dominant Taxa (2) Percent	63.10%
Dominant Taxa (3) Percent	74.33%
Dominant Taxa (10) Percent	98.93%
Diversity	
Shannon H (loge)	1.756
Shannon H (log2)	2.534
Margalef D	2.103
Simpson D	0.231
Evenness	0.118
Function	
Predator Richness	2
Predator Percent	2.14%
Filterer Richness	1
Filterer Percent	1.60%
Collector Percent	86.63%
Scraper+Shredder Percent	11.23%
Scraper/Filterer	6.667
Scraper/Scraper+Filterer	0.870
Habit	
Burrower Richness	1
Burrower Percent	4.81%
Swimmer Richness	2
Swimmer Percent	39.57%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	4
Hemoglobin Bearer Percent	6.42%
Air Breather Richness	1
Air Breather Percent	37.97%
Voltinism	
Univoltine Richness	7
Semivoltine Richness	0
Multivoltine Percent	18.72%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	4.81%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.441
Pollution Sensitive Richness	0
Pollution Tolerant Percent	54.01%
Hilsenhoff Biotic Index	8.326
Intolerant Percent	0.00%
Supertolerant Percent	70.59%
CTQa	108.000

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	12	24.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	10	33.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	3	16.67%	Severe
MTM	Montana DEQ Mountains (Bukantis 1998)	1	4.76%	Severe



Tuesday, February 06, 2018

Metrics Report

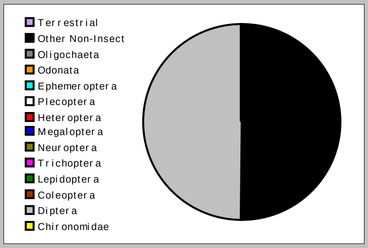
Project ID: SW17CHM
RAI No.: SW17CHM004
Sta. Name: Willow Creek Marsh
Client ID: WC-04
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count:	2		
Sample Abundance:	2.00	100.00%	of sample used
Coll. Procedure:			
Sample Notes:	depth of 30cm 20% riparian cover		

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	1	1	50.00%
Oligochaeta			
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera	1	1	50.00%
Chironomidae			

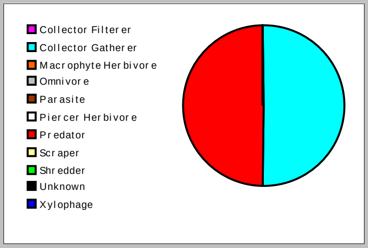


Dominant Taxa

Category	A	PRA
Ceratopogoninae	1	50.00%
Caecidotea	1	50.00%

Functional Composition

Category	R	A	PRA
Predator	1	1	50.00%
Parasite			
Collector Gatherer	1	1	50.00%
Collector Filterer			
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder			
Omnivore			
Unknown			

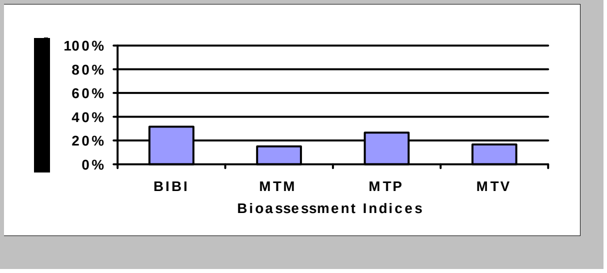


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	2
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	1
All Non-Insect Richness	1
All Non-Insect Percent	50.00%
Oligochaeta+Hirudinea Percent	0.00%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	50.00%
Dominant Taxa (2) Percent	100.00%
Dominant Taxa (3) Percent	100.00%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	0.693
Shannon H (log2)	1.000
Margalef D	1.443
Simpson D	0.000
Evenness	0.500
Function	
Predator Richness	1
Predator Percent	50.00%
Filterer Richness	0
Filterer Percent	0.00%
Collector Percent	50.00%
Scraper+Shredder Percent	0.00%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	1
Semivoltine Richness	0
Multivoltine Percent	0.00%
Tolerance	
Sediment Tolerant Richness	0
Sediment Tolerant Percent	0.00%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.500
Pollution Sensitive Richness	0
Pollution Tolerant Percent	50.00%
Hilsenhoff Biotic Index	7.000
Intolerant Percent	0.00%
Supertolerant Percent	50.00%
CTQa	108.000

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	16	32.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	8	26.67%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	3	16.67%	Severe
MTM	Montana DEQ Mountains (Bukantis 1998)	3	14.29%	Severe



Tuesday, February 06, 2018

Metrics Report

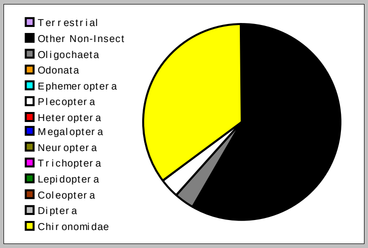
Project ID: SW17CHM
RAI No.: SW17CHM005
Sta. Name: Willow Creek Marsh
Client ID: WC-05
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 31
Sample Abundance: 31.00 100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 14cm 65% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	2	18	58.06%
Oligochaeta	1	1	3.23%
Odonata			
Ephemeroptera			
Plecoptera	1	1	3.23%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera			
Chironomidae	4	11	35.48%

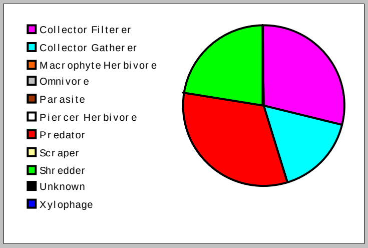


Dominant Taxa

Category	A	PRA
Erpobdellidae	10	32.26%
Sphaeriidae	8	25.81%
Polypedilum	6	19.35%
Prodiamesa	3	9.68%
Rheotanytarsus	1	3.23%
Parametriocnemus	1	3.23%
Oligochaeta	1	3.23%
Malenka	1	3.23%

Functional Composition

Category	R	A	PRA
Predator	1	10	32.26%
Parasite			
Collector Gatherer	3	5	16.13%
Collector Filterer	2	9	29.03%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	2	7	22.58%
Omnivore			
Unknown			

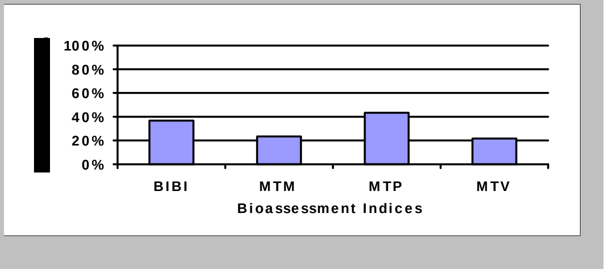


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	8
E Richness	0
P Richness	1
T Richness	0
EPT Richness	1
EPT Percent	3.23%
All Non-Insect Abundance	19
All Non-Insect Richness	3
All Non-Insect Percent	61.29%
Oligochaeta+Hirudinea Percent	35.48%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	32.26%
Dominant Taxa (2) Percent	58.06%
Dominant Taxa (3) Percent	77.42%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	1.701
Shannon H (log2)	2.455
Margalef D	2.038
Simpson D	0.196
Evenness	0.147
Function	
Predator Richness	1
Predator Percent	32.26%
Filterer Richness	2
Filterer Percent	29.03%
Collector Percent	45.16%
Scraper+Shredder Percent	22.58%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	2
Clinger Percent	6.45%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	19.35%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	3
Semivoltine Richness	0
Multivoltine Percent	35.48%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	3.23%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.433
Pollution Sensitive Richness	0
Pollution Tolerant Percent	0.00%
Hilsenhoff Biotic Index	6.806
Intolerant Percent	3.23%
Supertolerant Percent	61.29%
CTQa	97.714

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	13	43.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	4	22.22%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	5	23.81%	Moderate



Metrics Report

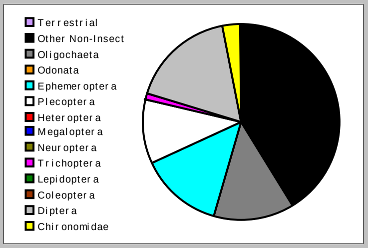
Project ID: SW17CHM
RAI No.: SW17CHM006
Sta. Name: Upper Willow Creek
Client ID: WC-06
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 538
Sample Abundance: 896.67 60.00% of sample used
Coll. Procedure:
Sample Notes: depth of 14cm 90% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	221	41.08%
Oligochaeta	1	70	13.01%
Odonata			
Ephemeroptera	2	75	13.94%
Plecoptera	3	57	10.59%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	1	4	0.74%
Lepidoptera			
Coleoptera			
Diptera	4	95	17.66%
Chironomidae	4	16	2.97%

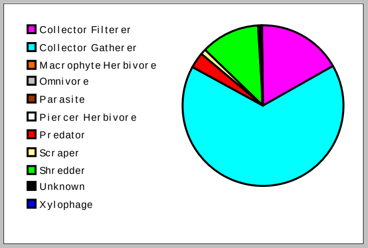


Dominant Taxa

Category	A	PRA
Crangonyx	203	37.73%
Simulium	88	16.36%
Oligochaeta	70	13.01%
Baetis tricaudatus complex	69	12.83%
Malenka	51	9.48%
Brillia	10	1.86%
Trepaxonemata	7	1.30%
Cinygma	6	1.12%
Sphaeriidae	5	0.93%
Nemata	5	0.93%
Sweltsa	4	0.74%
Parapsyche	4	0.74%
Dixa	4	0.74%
Parametriocnemus	3	0.56%
Zapada cinctipes	2	0.37%

Functional Composition

Category	R	A	PRA
Predator	5	17	3.16%
Parasite			
Collector Gatherer	8	354	65.80%
Collector Filterer	2	93	17.29%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	1	6	1.12%
Shredder	3	63	11.71%
Omnivore			
Unknown	1	5	0.93%

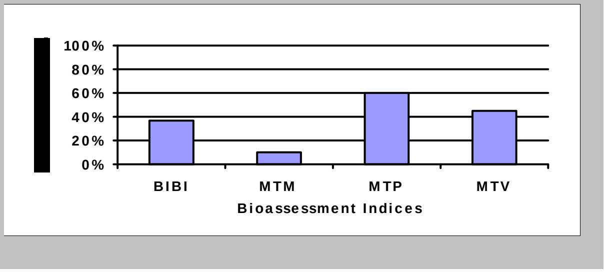


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	20
E Richness	2
P Richness	3
T Richness	1
EPT Richness	6
EPT Percent	25.28%
All Non-Insect Abundance	291
All Non-Insect Richness	6
All Non-Insect Percent	54.09%
Oligochaeta+Hirudinea Percent	13.01%
Baetidae/Ephemeroptera	0.920
Hydropsychidae/Trichoptera	1.000
Dominance	
Dominant Taxon Percent	37.73%
Dominant Taxa (2) Percent	54.09%
Dominant Taxa (3) Percent	67.10%
Dominant Taxa (10) Percent	95.54%
Diversity	
Shannon H (loge)	1.920
Shannon H (log2)	2.770
Margalef D	3.023
Simpson D	0.211
Evenness	0.094
Function	
Predator Richness	5
Predator Percent	3.16%
Filterer Richness	2
Filterer Percent	17.29%
Collector Percent	83.09%
Scraper+Shredder Percent	12.83%
Scraper/Filterer	0.065
Scraper/Scraper+Filterer	0.061
Habit	
Burrower Richness	2
Burrower Percent	2.23%
Swimmer Richness	2
Swimmer Percent	13.57%
Clinger Richness	6
Clinger Percent	28.81%
Characteristics	
Cold Stenotherm Richness	1
Cold Stenotherm Percent	1.12%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	2
Air Breather Percent	0.56%
Voltinism	
Univoltine Richness	11
Semivoltine Richness	1
Multivoltine Percent	17.29%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	13.20%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.931
Pollution Sensitive Richness	1
Pollution Tolerant Percent	0.00%
Hilsenhoff Biotic Index	5.630
Intolerant Percent	12.83%
Supertolerant Percent	13.94%
CTQa	85.000

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	18	60.00%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	8	44.44%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	2	9.52%	Severe



Tuesday, February 06, 2018

Metrics Report

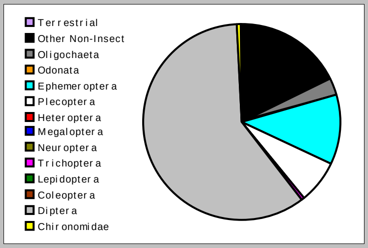
Project ID: SW17CHM
RAI No.: SW17CHM007
Sta. Name: Upper Shellebarger Creek
Client ID: WC-07
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 401
Sample Abundance: 401.00 100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 8cm 100% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	6	72	17.96%
Oligochaeta	1	11	2.74%
Odonata			
Ephemeroptera	2	45	11.22%
Plecoptera	1	29	7.23%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	1	1	0.25%
Lepidoptera			
Coleoptera			
Diptera	2	241	60.10%
Chironomidae	2	2	0.50%

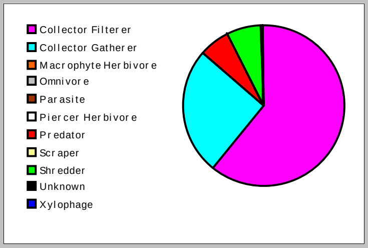


Dominant Taxa

Category	A	PRA
Simulium	240	59.85%
Crangonyx	44	10.97%
Baetis tricaudatus complex	44	10.97%
Malenka	29	7.23%
Trepaxonemata	21	5.24%
Oligochaeta	11	2.74%
Sphaeriidae	3	0.75%
Acari	2	0.50%
Tvetenia Bavarica Gr.	1	0.25%
Tricorythodes	1	0.25%
Psychodidae	1	0.25%
Parapsyche	1	0.25%
Nemata	1	0.25%
Eukiefferiella Claripennis Gr.	1	0.25%
Erpobdellidae	1	0.25%

Functional Composition

Category	R	A	PRA
Predator	4	25	6.23%
Parasite			
Collector Gatherer	7	103	25.69%
Collector Filterer	2	243	60.60%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	1	29	7.23%
Omnivore			
Unknown	1	1	0.25%

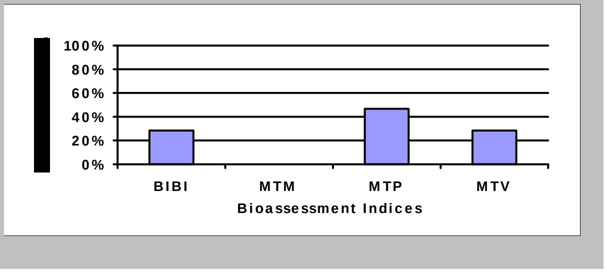


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	15
E Richness	2
P Richness	1
T Richness	1
EPT Richness	4
EPT Percent	18.70%
All Non-Insect Abundance	83
All Non-Insect Richness	7
All Non-Insect Percent	20.70%
Oligochaeta+Hirudinea Percent	2.99%
Baetidae/Ephemeroptera	0.978
Hydropsychidae/Trichoptera	1.000
Dominance	
Dominant Taxon Percent	59.85%
Dominant Taxa (2) Percent	70.82%
Dominant Taxa (3) Percent	81.80%
Dominant Taxa (10) Percent	98.75%
Diversity	
Shannon H (loge)	1.446
Shannon H (log2)	2.087
Margalef D	2.355
Simpson D	0.369
Evenness	0.099
Function	
Predator Richness	4
Predator Percent	6.23%
Filterer Richness	2
Filterer Percent	60.60%
Collector Percent	86.28%
Scraper+Shredder Percent	7.23%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	1
Burrower Percent	0.25%
Swimmer Richness	1
Swimmer Percent	10.97%
Clinger Richness	3
Clinger Percent	67.33%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	1
Air Breather Percent	0.25%
Voltinism	
Univoltine Richness	7
Semivoltine Richness	1
Multivoltine Percent	17.21%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	2.99%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.566
Pollution Sensitive Richness	0
Pollution Tolerant Percent	0.25%
Hilsenhoff Biotic Index	5.524
Intolerant Percent	7.48%
Supertolerant Percent	3.99%
CTQa	97.200

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	14	46.67%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	5	27.78%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	0	0.00%	Severe



Tuesday, February 06, 2018

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP001

RAI No.:	SW17CHP001			**Sta. Name:**	Puget Sound
Client ID:	WC-01				
Date Coll.:	9/20/2017	**No Jars:**	1	**STORET ID:**	WC-01

Sample Notes: Periphyton Area 4.5cm x 5cm, 5cm x 6.5cm (cobbles)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	345	87.56%	345	
Chlorophyta				
Ulva sp.	2	0.51%	2	
Diatoms				
Bacillariophyta				
Achnanthes parvula	1	0.17%		
Achnanthes pseudogroenlandica	1	0.17%		
Achnanthidium rivulare	14	2.33%		
Amphora pediculus	29	4.83%		
Cocconeis costata v. costata	1	0.17%		
Cocconeis scutellum v. parva	53	8.83%		
Diploneis sp.	1	0.17%		Very lightly silicified cell
Gomphonema pumilum v. rigidum	47	7.83%		6 girdle views
Grammatophora oceanica	1	0.17%		
Halamphora coffeaeformis	5	0.83%		
Licmophora communis	7	1.17%		
Melosira lineata	4	0.67%		
Navicula abunda	108	18.00%		
Navicula halinae	6	1.00%		
Navicula perminuta	50	8.33%		
Navicula salinicola	46	7.67%		
Nitzschia sp.	1	0.17%		obscure view
Nitzschia inconspicua	63	10.50%		
Opephora mutabilis	3	0.50%		
Parlibellus berkeleyi	6	1.00%		
Planothidium delicatulum	25	4.17%		
Planothidium dubium	1	0.17%		
Rhoicosphenia abbreviata	2	0.33%		
Tabularia fasciculata	124	20.67%		
Trachyneis aspera	1	0.17%		

Sample Count 947

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP002

RAI No.: SW17CHP002 **Sta. Name:** Lower Willow Creek
Client ID: WC-02
Date Coll.: 9/20/2017 **No Jars:** 1 **STORET ID:** WC-02
Sample Notes: Periphyton Area 9.5cm x 6cm (cobble)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	300	69.93%	300	
Diatoms				
Bacillariophyta				
Achnanthes placentuloides	1	0.17%		A. placentuloides
Berkeleya rutilans	3	0.50%		
Gomphonema sp.	1	0.17%		Girdle view
Halamphora coffeaeformis	20	3.33%		A. coeffeaeformis
Navicula abunda	118	19.67%		N. abundans
Navicula gregaria	14	2.33%		
Navicula paul-schulzii	6	1.00%		paul schulzii
Navicula perminuta	34	5.67%		
Navicula perminuta	2	0.33%		cf big perminuta, because bigger in size.
Nitzschia amplectens	10	1.67%		without striae
Nitzschia dissipata	1	0.17%		
Nitzschia frustulum	21	3.50%		
Nitzschia inconspicua	330	55.00%		
Nitzschia levidensis	2	0.33%		
Nitzschia palea	2	0.33%		
Opephora mutabilis	17	2.83%		2 girdle views
Planothidium delicatulum	11	1.83%		
Planothidium engelbrechtii	3	0.50%		
Staurosira punctiformis	3	0.50%		
Tabularia fasciculata	1	0.17%		

Sample Count 900

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP003

RAI No.: SW17CHP003
Sta. Name: Willow Creek Marsh
Client ID: WC-03
Date Coll.: 9/20/2017
No Jars: 1
STORET ID: WC-03
Sample Notes: Periphyton Area 1cm x 45cm (water parsley stem)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	52	89.66%	52	
Diatoms				
Bacillariophyta				
Achnanthidium minutissimum	21	6.69%		
Amphora pediculus	12	3.82%		
Brachysira microcephala	1	0.32%		
Cocconeis placentula sensu lato	53	16.88%		
Diploneis krammeri	1	0.32%		
Epithemia sp.	1	0.32%		broken valve
Eunotia trinacria	1	0.32%		
Frustulia vulgaris	4	1.27%		2 broken valve
Gomphonema sp.	2	0.64%		broken valve
Gomphonema angustatum	1	0.32%		
Gomphonema kobayasii	2	0.64%		
Gomphonema parvulum	2	0.64%		
Melosira lineata	1	0.32%		
Meridion circulare	3	0.96%		broken valve
Navicula cincta	3	0.96%		
Navicula cryptocephala	20	6.37%		
Navicula cryptotenella	10	3.18%		
Navicula tripunctata	10	3.18%		
Nitzschia sp.	5	1.59%		half broken valve
Nitzschia dissipata	6	1.91%		
Nitzschia frustulum	5	1.59%		
Nitzschia inconspicua	14	4.46%		
Nitzschia linearis	1	0.32%		
Nitzschia palea	2	0.64%		
Pinnularia brebissonii	1	0.32%		
Pinnularia rupestris	7	2.23%		
Pinnularia saprophila	19	6.05%		
Pinnularia subundulata	2	0.64%		
Placoneis clementis	8	2.55%		
Placoneis porifera	1	0.32%		
Planothidium frequentissimum	16	5.10%		
Planothidium haynaldii	2	0.64%		
Planothidium lanceolatum	38	12.10%		
Psammothidium bioretii	2	0.64%		
Pseudostaurosira parasitica	1	0.32%		
Reimeria sinuata	1	0.32%		
Rhoicosphenia abbreviata	5	1.59%		
Rossithidium pusillum	1	0.32%		

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP003

RAI No.:	SW17CHP003	Sta. Name:	Willow Creek Marsh
Client ID:	WC-03		
Date Coll.:	9/20/2017 No Jars: 1	STORET ID:	WC-03

Sample Notes: Periphyton Area 1cm x 45cm (water parsley stem)

Taxonomic Name	Count	PRA	Cell Count	Comment
Sellaphora atomoides	15	4.78%		
Sellaphora nigri	2	0.64%		
Sellaphora pupula	1	0.32%		
Sellaphora saugerresii	3	0.96%		
Sellaphora seminulum	2	0.64%		
Stauroneis gracilis	2	0.64%		
Stauroneis kriegeri	2	0.64%		
Staurosirella pinnata	2	0.64%		
Sample Count	366			

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP004

RAI No.: SW17CHP004 **Sta. Name:** Willow Creek Marsh
Client ID: WC-04
Date Coll.: 9/20/2017 **No Jars:** 1 **STORET ID:** WC-04
Sample Notes: Periphyton Area 2cm x 30cm (wooden stake)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	296	84.57%	296	
Cyanophyta				
Leptolyngbya sp.	4	1.14%	56	
Diatoms				
Bacillariophyta				
Achnanthidium sp.	1	0.17%		big Raphless valve only
Achnanthidium deflexum	2	0.33%		
Achnanthidium minutissimum	55	9.17%		
Achnanthidium rivulare	2	0.33%		
Amphora copulata	2	0.33%		
Amphora pediculus	204	34.00%		
Cocconeis placentula sensu lato	25	4.17%		
Diploneis smithii v. pumila	1	0.17%		
Epithemia sorex	1	0.17%		
Eunotia rushforthii	1	0.17%		
Fragilaria vaucheriae	5	0.83%		
Gomphonema sp.	1	0.17%		girdle view
Gomphonema angustatum	2	0.33%		
Gomphonema parvulum	3	0.50%		
Hippodonta sp.	1	0.17%		girdle view only
Hippodonta capitata	1	0.17%		
Lemnicola hungarica	2	0.33%		
Luticola mutica	1	0.17%		
Mayamaea atomus	2	0.33%		
Melosira lineata	3	0.50%		
Navicula abunda	1	0.17%		
Navicula cincta	1	0.17%		
Navicula cryptocephala	12	2.00%		
Navicula cryptotenella	5	0.83%		
Navicula gregaria	3	0.50%		
Navicula lanceolata	3	0.50%		
Navicula reichardtiana	1	0.17%		
Nitzschia sp.	4	0.67%		Girdle view and broken valve
Nitzschia dissipata	9	1.50%		
Nitzschia frustulum	12	2.00%		
Nitzschia hantzschiana	3	0.50%		
Nitzschia inconspicua	8	1.33%		
Nitzschia linearis	6	1.00%		
Nitzschia palea	4	0.67%		
Planothidium frequentissimum	28	4.67%		
Planothidium haynaldii	2	0.33%		
Planothidium lanceolatum	105	17.50%		2 girdle views

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP004

RAI No.: SW17CHP004 **Sta. Name:** Willow Creek Marsh
Client ID: WC-04
Date Coll.: 9/20/2017 **No Jars:** 1 **STORET ID:** WC-04
Sample Notes: Periphyton Area 2cm x 30cm (wooden stake)

Taxonomic Name	Count	PRA	Cell Count	Comment
Platessa hustedtii	1	0.17%		
Rhoicosphenia abbreviata	20	3.33%		
Sellaphora sp.	5	0.83%		Girdle views
Sellaphora atomoides	19	3.17%		
Sellaphora hustedtii	1	0.17%		
Sellaphora nigri	8	1.33%		
Sellaphora pupula	1	0.17%		
Sellaphora saugerresii	9	1.50%		
Sellaphora seminulum	3	0.50%		
Staurosira construens v. venter	5	0.83%		
Staurosirella leptostauron	4	0.67%		
Ulnaria ulna	2	0.33%		broken valves

Sample Count 900

RAI No.: SW17CHP005 **Sta. Name:** Willow Creek Marsh
Client ID: WC-05
Date Coll.: 9/20/2017 **No Jars:** 1 **STORET ID:** WC-05
Sample Notes: Periphyton Area 3cm x 25cm (skunk cabbage stem)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	238	63.47%	238	
Cryptophyta				
Cryptomonas sp.	1	0.27%	1	
Cyanophyta				
Leptolyngbya sp.	61	16.27%	1708	
Diatoms				
Bacillariophyta				
Achnanthidium minutissimum	35	5.83%		
Achnanthidium rivulare	3	0.50%		
Amphora copulata	2	0.33%		
Amphora pediculus	42	7.00%		
Aulacoseira italica	2	0.33%		
Caloneis bacillum	2	0.33%		1 girdle view
Cocconeis placentula sensu lato	223	37.17%		
Diatoma vulgaris	1	0.17%		
Diploneis smithii	1	0.17%		
Eunotia rushforthii	3	0.50%		1 girdle
Fragilaria vaucheriae	2	0.33%		
Gomphonema angustatum	4	0.67%		
Gomphonema parvulum	5	0.83%		1 girdle view
Halamphora coffeaeformis	4	0.67%		
Mayamaea atomus	2	0.33%		
Melosira lineata	8	1.33%		
Meridion circulare	1	0.17%		
Navicula sp.	2	0.33%		girdle view
Navicula cryptocephala	3	0.50%		
Navicula gregaria	4	0.67%		
Navicula lanceolata	1	0.17%		broken valve
Navicula reichardtiana	1	0.17%		
Nitzschia acidoclinata	1	0.17%		
Nitzschia desertorum	2	0.33%		
Nitzschia dissipata	8	1.33%		
Nitzschia fonticola	1	0.17%		
Nitzschia frustulum	1	0.17%		
Nitzschia inconspicua	9	1.50%		
Nitzschia linearis	6	1.00%		
Nitzschia palea	3	0.50%		
Pinnularia rupestris	4	0.67%		3 girdle views
Planothidium dubium	1	0.17%		
Planothidium frequentissimum	34	5.67%		
Planothidium haynaldii	3	0.50%		
Planothidium lanceolatum	121	20.17%		

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP005

RAI No.: SW17CHP005
Sta. Name: Willow Creek Marsh
Client ID: WC-05
Date Coll.: 9/20/2017
No Jars: 1
STORET ID: WC-05
Sample Notes: Periphyton Area 3cm x 25cm (skunk cabbage stem)

Taxonomic Name	Count	PRA	Cell Count	Comment
Platessa hustedtii	4	0.67%		
Rhoicosphenia abbreviata	15	2.50%		
Rhopalodia gibberula	2	0.33%		
Rhopalodia musculus	1	0.17%		
Sellaphora atomoides	8	1.33%		
Sellaphora nigri	3	0.50%		
Sellaphora pupula	1	0.17%		
Sellaphora saugerresii	5	0.83%		
Sellaphora seminulum	6	1.00%		
Stauroneis kriegeri	1	0.17%		
Staurosira construens v. venter	2	0.33%		1 girdle view
Staurosirella leptostauron	2	0.33%		girdle view
Surirella angusta	1	0.17%		
Ulnaria ulna	4	0.67%		

Sample Count 900

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP006

RAI No.: SW17CHP006 **Sta. Name:** Upper Willow Creek
Client ID: WC-06
Date Coll.: 9/20/2017 **No Jars:** 1 **STORET ID:** WC-06
Sample Notes: Periphyton Area 8cm x 4.5cm (cobble)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	54	62.79%	54	
Cyanophyta				
Leptolyngbya sp.	7	8.14%	56	
Diatoms				
Bacillariophyta				
Achnanthidium exiguum	1	0.17%		
Achnanthidium gracillimum	5	0.83%		
Achnanthidium minutissimum	34	5.67%		
Amphora pediculus	28	4.67%		
Aulacoseira italica	2	0.33%		1 broken valve
Cocconeis placentula sensu lato	315	52.50%		Mostly broken valve
Fragilaria capucina v. gracilis	2	0.33%		
Gomphonema angustatum	2	0.33%		
Gomphonema parvulum	2	0.33%		
Gomphonema productum	1	0.17%		
Mayamaea atomus	2	0.33%		
Melosira lineata	1	0.17%		
Navicula cryptocephala	4	0.67%		1 broken valve
Navicula cryptotenella	10	1.67%		
Navicula reichardtiana	1	0.17%		
Nitzschia dissipata	2	0.33%		
Nitzschia frustulum	1	0.17%		
Nitzschia inconspicua	7	1.17%		
Nitzschia linearis	5	0.83%		
Nitzschia palea	2	0.33%		broken valve
Pinnularia decrescens	1	0.17%		P. decrescens
Planothidium frequentissimum	16	2.67%		
Planothidium haynaldii	3	0.50%		
Planothidium lanceolatum	82	13.67%		
Reimeria sinuata	3	0.50%		
Rhoicosphenia abbreviata	26	4.33%		
Rossithidium pusillum	4	0.67%		
Sellaphora atomoides	14	2.33%		
Sellaphora nigri	10	1.67%		
Sellaphora pulchra	1	0.17%		
Sellaphora saugerresii	5	0.83%		
Sellaphora seminulum	2	0.33%		
Stauroneis kriegeri	1	0.17%		
Staurosira construens v. venter	2	0.33%		
Staurosirella pinnata	2	0.33%		
Ulnaria ulna	1	0.17%		broken valve

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP006

RAI No.: SW17CHP006
Sta. Name: Upper Willow Creek
Client ID: WC-06
Date Coll.: 9/20/2017
No Jars: 1
STORET ID: WC-06
Sample Notes: Periphyton Area 8cm x 4.5cm (cobble)

Taxonomic Name	Count	PRA	Cell Count	Comment
Sample Count	661			

Taxa Listing

Project ID: SW17CHP
RAI No.: SW17CHP007

RAI No.: SW17CHP007
Sta. Name: Upper Shellebarger Creek
Client ID: WC-07
Date Coll.: 9/20/2017
No Jars: 1
STORET ID: WC-07
Sample Notes: Periphyton Area 8cm x 5.5cm (cobble)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	92	90.20%	92	
Diatoms				
Bacillariophyta				
Achnanthidium minutissimum	2	0.33%		
Achnanthidium rivulare	1	0.17%		
Amphora pediculus	8	1.33%		
Cocconeis placentula sensu lato	505	84.17%		Mostly broken valves
Navicula cryptocephala	1	0.17%		
Navicula cryptotenella	2	0.33%		
Nitzschia sp.	1	0.17%		broken valve
Nitzschia inconspicua	3	0.50%		
Placoneis clementis	1	0.17%		
Planothidium frequentissimum	7	1.17%		
Planothidium lanceolatum	57	9.50%		
Reimeria sinuata	3	0.50%		
Rhoicosphenia abbreviata	4	0.67%		
Sellaphora seminulum	1	0.17%		
Staurosira construens v. venter	3	0.50%		
Ulnaria ulna	1	0.17%		
Sample Count	692			

Metrics Report

Project ID:	SW17CHP
Sample ID:	SW17CHP001
Station Name:	Puget Sound
Client ID:	WC-01
STORET ID:	WC-01
Date Collected:	9/20/2017
Count Of Taxon:	25
Sum Of Count:	600

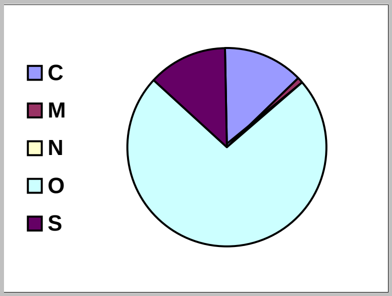
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	3.468	Excellent	Good
Species Richness	25	Good	Fair
Native Taxa Percent	2.33%		
Cosmopolitan Taxa Percent	45.50%		
Mountains Rare Taxa Percent	2.33%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	20.67%	Excellent	Excellent
Sediment			
Siltation Taxa Percent	46.67%	Fair	Excellent
Motile Taxa Percent	32.50%		
Mountains Brackish Taxa Percent	5.17%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	2.112	Good	Good
Nitrogen Heterotroph Taxa Percent	10.50%		
Polysaprobous Taxa Percent	32.00%		
Low DO Taxa Percent	0.00%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	27.33%		
Eutraphentic Taxa Percent	38.00%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	0.00%		
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	0.17%		
Abnormal Cells Percent	0.00%	Excellent	

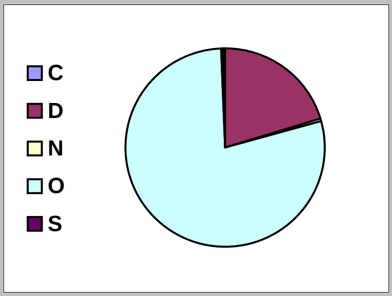
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Fair
MTP	Montana DEQ Plains (Bahls 1992)	Fair

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	15.67%	31.92%
Mountains Metals Increasers Taxa Percent	0.33%	3.14%
Mountains Nutrient Increasers Taxa Percent	0.33%	4.46%
Mountains Sediment Increasers Taxa Percent	15.67%	36.32%



Metric	Value	Prob.
Plains General Decreasers Taxa Percent	20.67%	46.81%
Plains General Increasers Taxa Percent	0.33%	0.89%



Dominant Taxa

Category	A	PRA
Tabularia fasciculata	124	20.67%
Navicula abunda	108	18.00%
Nitzschia inconspicua	63	10.50%
Cocconeis scutellum v. parva	53	8.83%
Navicula perminuta	50	8.33%
Gomphonema pumilum v. rigidum	47	7.83%
Navicula salinicola	46	7.67%
Amphora pediculus	29	4.83%
Planothidium delicatulum	25	4.17%
Achnanthidium rivulare	14	2.33%

Tuesday, February 06, 2018

Metrics Report

Project ID:	SW17CHP
Sample ID:	SW17CHP002
Station Name:	Lower Willow Creek
Client ID:	WC-02
STORET ID:	WC-02
Date Collected:	9/20/2017
Count Of Taxon:	19
Sum Of Count:	600

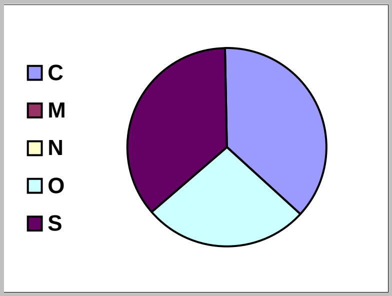
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	2.286	Good	Fair
Species Richness	19	Fair	Poor
Native Taxa Percent	0.00%		
Cosmopolitan Taxa Percent	71.17%		
Mountains Rare Taxa Percent	0.00%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	55.00%	Fair	Fair
Sediment			
Siltation Taxa Percent	90.00%	Poor	Poor
Motile Taxa Percent	72.67%		
Mountains Brackish Taxa Percent	0.17%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	1.956	Fair	Good
Nitrogen Heterotroph Taxa Percent	58.83%		
Polysaprobous Taxa Percent	61.50%		
Low DO Taxa Percent	2.67%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	6.33%		
Eutraphentic Taxa Percent	65.00%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	0.00%		
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	0.33%		
Abnormal Cells Percent	0.00%	Excellent	

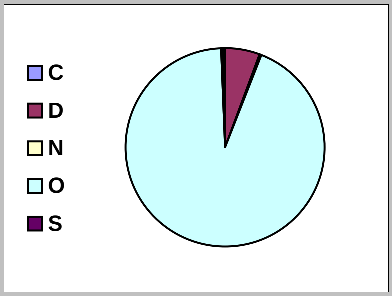
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Poor
MTP	Montana DEQ Plains (Bahls 1992)	Poor

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	57.67%	95.35%
Mountains Sediment Increasers Taxa Percent	57.67%	99.38%



Metric	Value	Prob.
Plains General Decreasers Taxa Percent	6.00%	80.51%
Plains General Increasers Taxa Percent	0.17%	0.87%



Dominant Taxa

Category	A	PRA
Nitzschia inconspicua	330	55.00%
Navicula abunda	118	19.67%
Navicula perminuta	36	6.00%
Nitzschia frustulum	21	3.50%
Amphora coffeaeformis	20	3.33%
Opephora mutabilis	17	2.83%
Navicula gregaria	14	2.33%
Planothidium delicatulum	11	1.83%
Nitzschia amplectens	10	1.67%
Navicula paul-schulzii	6	1.00%

Tuesday, February 06, 2018

Metrics Report

Project ID:	SW17CHP
Sample ID:	SW17CHP003
Station Name:	Willow Creek Marsh
Client ID:	WC-03
STORET ID:	WC-03
Date Collected:	9/20/2017
Count Of Taxon:	46
Sum Of Count:	314

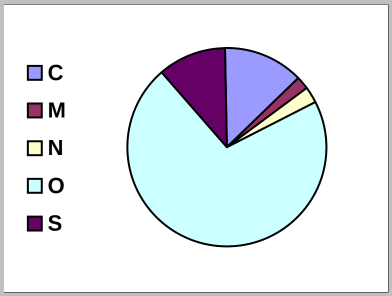
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	4.511	Excellent	Excellent
Species Richness	46	Excellent	Excellent
Native Taxa Percent	1.27%		
Cosmopolitan Taxa Percent	75.48%		
Mountains Rare Taxa Percent	0.00%		
Plains Rare Taxa Percent	0.64%		
Dominant Taxon Percent	16.88%	Excellent	Excellent
Sediment			
Siltation Taxa Percent	34.39%	Good	Excellent
Motile Taxa Percent	39.17%		
Mountains Brackish Taxa Percent	73.25%		
Plains Brackish Taxa Percent	2.23%		
Organic Nutrients			
Pollution Index	2.534	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	9.55%		
Polysaprobous Taxa Percent	33.12%		
Low DO Taxa Percent	3.50%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	67.83%		
Eutraphentic Taxa Percent	49.04%		
Rhopalodiales Percent	0.32%		
Metals			
Disturbance Taxa Percent	6.69%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	14.01%		
Abnormal Cells Percent	0.00%	Excellent	

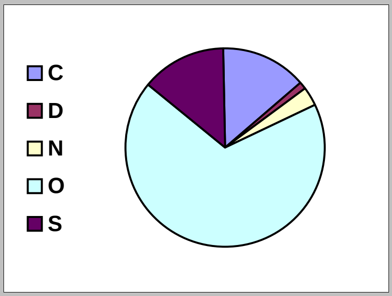
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Good
MTP	Montana DEQ Plains (Bahls 1992)	Excellent

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	15.92%	32.64%
Mountains Metals Increasers Taxa Percent	2.23%	4.18%
Mountains Nutrient Increasers Taxa Percent	3.18%	6.55%
Mountains Sediment Increasers Taxa Percent	13.69%	31.21%



Metric	Value	Prob.
Plains General Decreasers Taxa Percent	1.91%	86.86%
Plains General Increasers Taxa Percent	16.56%	11.31%



Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	53	16.88%
Planothidium lanceolatum	38	12.10%
Achnanthidium minutissimum	21	6.69%
Navicula cryptocephala	20	6.37%
Pinnularia saprophila	19	6.05%
Planothidium frequentissimum	16	5.10%
Sellaphora atomoides	15	4.78%
Nitzschia inconspicua	14	4.46%
Amphora pediculus	12	3.82%
Navicula tripunctata	10	3.18%

Tuesday, February 06, 2018

Metrics Report

Project ID:	SW17CHP
Sample ID:	SW17CHP004
Station Name:	Willow Creek Marsh
Client ID:	WC-04
STORET ID:	WC-04
Date Collected:	9/20/2017
Count Of Taxon:	49
Sum Of Count:	600

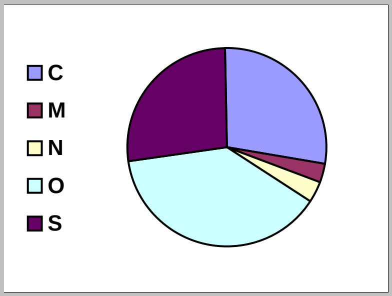
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	3.683	Excellent	Good
Species Richness	49	Excellent	Excellent
Native Taxa Percent	0.33%		
Cosmopolitan Taxa Percent	91.83%		
Mountains Rare Taxa Percent	0.33%		
Plains Rare Taxa Percent	0.33%		
Dominant Taxon Percent	34.00%	Good	Good
Sediment			
Siltation Taxa Percent	20.50%	Good	Excellent
Motile Taxa Percent	51.83%		
Mountains Brackish Taxa Percent	87.67%		
Plains Brackish Taxa Percent	0.67%		
Organic Nutrients			
Pollution Index	2.547	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	8.17%		
Polysaprobous Taxa Percent	33.67%		
Low DO Taxa Percent	5.33%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	83.83%		
Eutraphentic Taxa Percent	71.00%		
Rhopalodiales Percent	0.17%		
Metals			
Disturbance Taxa Percent	9.17%	Excellent	Excellent
Acidophilous Taxa Percent	0.17%		
Metals Tolerant Taxa Percent	20.33%		
Abnormal Cells Percent	0.00%	Excellent	

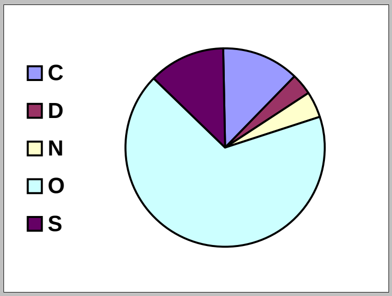
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Good
MTP	Montana DEQ Plains (Bahls 1992)	Good

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	42.33%	81.59%
Mountains Metals Increasers Taxa Percent	4.00%	5.37%
Mountains Nutrient Increasers Taxa Percent	5.33%	8.38%
Mountains Sediment Increasers Taxa Percent	41.50%	92.22%



Metric	Value	Prob.
Plains General Decreasers Taxa Percent	4.00%	83.65%
Plains General Increasers Taxa Percent	15.50%	10.03%



Dominant Taxa

Category	A	PRA
Amphora pediculus	204	34.00%
Planothidium lanceolatum	105	17.50%
Achnanthidium minutissimum	55	9.17%
Planothidium frequentissimum	28	4.67%
Cocconeis placentula sensu lato	25	4.17%
Rhoicosphenia abbreviata	20	3.33%
Sellaphora atomoides	19	3.17%
Navicula cryptocephala	12	2.00%
Nitzschia frustulum	12	2.00%
Nitzschia dissipata	9	1.50%

Metrics Report

Project ID:	SW17CHP
Sample ID:	SW17CHP005
Station Name:	Willow Creek Marsh
Client ID:	WC-05
STORET ID:	WC-05
Date Collected:	9/20/2017
Count Of Taxon:	49
Sum Of Count:	600

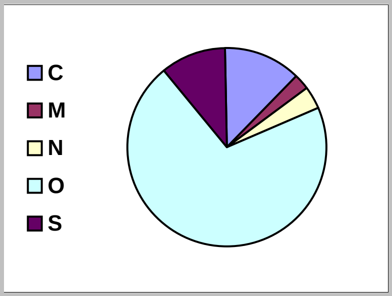
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	3.453	Excellent	Good
Species Richness	49	Excellent	Excellent
Native Taxa Percent	0.67%		
Cosmopolitan Taxa Percent	91.17%		
Mountains Rare Taxa Percent	0.50%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	37.17%	Good	Good
Sediment			
Siltation Taxa Percent	11.33%	Excellent	Excellent
Motile Taxa Percent	19.83%		
Mountains Brackish Taxa Percent	90.00%		
Plains Brackish Taxa Percent	0.83%		
Organic Nutrients			
Pollution Index	2.549	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	5.67%		
Polysaprobous Taxa Percent	34.67%		
Low DO Taxa Percent	4.33%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	88.50%		
Eutraphentic Taxa Percent	76.83%		
Rhopalodiales Percent	0.50%		
Metals			
Disturbance Taxa Percent	5.83%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	23.50%		
Abnormal Cells Percent	0.00%	Excellent	

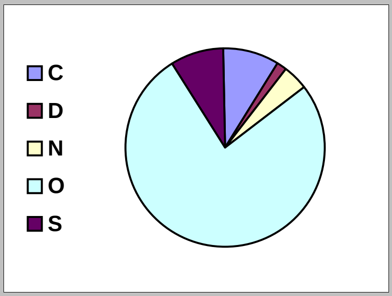
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Good
MTP	Montana DEQ Plains (Bahls 1992)	Good

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	15.33%	31.56%
Mountains Metals Increasers Taxa Percent	3.17%	4.75%
Mountains Nutrient Increasers Taxa Percent	4.17%	7.35%
Mountains Sediment Increasers Taxa Percent	13.33%	30.50%



Metric	Value	Prob.
Plains General Decreasers Taxa Percent	2.17%	86.43%
Plains General Increasers Taxa Percent	10.50%	5.05%



Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	223	37.17%
Planothidium lanceolatum	121	20.17%
Amphora pediculus	42	7.00%
Achnanthidium minutissimum	35	5.83%
Planothidium frequentissimum	34	5.67%
Rhoicosphenia abbreviata	15	2.50%
Nitzschia inconspicua	9	1.50%
Nitzschia dissipata	8	1.33%
Sellaphora atomoides	8	1.33%
Melosira lineata	8	1.33%

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Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP006
Station Name: Upper Willow Creek
Client ID: WC-06
STORET ID: WC-06
Date Collected: 9/20/2017
Count Of Taxon: 36
Sum Of Count: 600

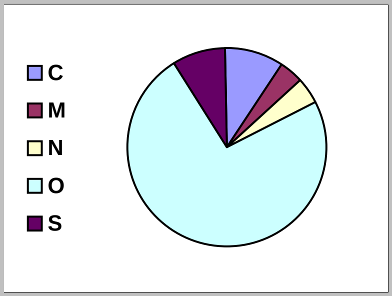
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	2.814	Good	Fair
Species Richness	36	Excellent	Good
Native Taxa Percent	0.17%		
Cosmopolitan Taxa Percent	93.83%		
Mountains Rare Taxa Percent	0.00%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	52.50%	Fair	Fair
Sediment			
Siltation Taxa Percent	11.00%	Excellent	Excellent
Motile Taxa Percent	13.83%		
Mountains Brackish Taxa Percent	94.00%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	2.697	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	5.17%		
Polysaprobous Taxa Percent	22.33%		
Low DO Taxa Percent	3.50%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	88.83%		
Eutraphentic Taxa Percent	80.83%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	5.67%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	15.33%		
Abnormal Cells Percent	0.00%	Excellent	

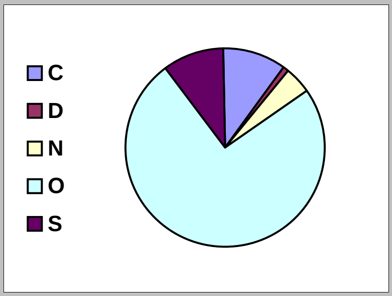
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Fair
MTP	Montana DEQ Plains (Bahls 1992)	Fair

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	11.83%	25.46%
Mountains Metals Increasers Taxa Percent	4.67%	5.82%
Mountains Nutrient Increasers Taxa Percent	5.00%	8.08%
Mountains Sediment Increasers Taxa Percent	10.83%	24.83%



Metric	Value	Prob.
Plains General Decreasers Taxa Percent	1.00%	88.10%
Plains General Increasers Taxa Percent	12.33%	6.55%



Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	315	52.50%
Planothidium lanceolatum	82	13.67%
Achnanthidium minutissimum	34	5.67%
Amphora pediculus	28	4.67%
Rhoicosphenia abbreviata	26	4.33%
Planothidium frequentissimum	16	2.67%
Sellaphora atomoides	14	2.33%
Navicula cryptotenella	10	1.67%
Sellaphora nigri	10	1.67%
Nitzschia inconspicua	7	1.17%

Metrics Report

Project ID:	SW17CHP
Sample ID:	SW17CHP007
Station Name:	Upper Shellebarger Creek
Client ID:	WC-07
STORET ID:	WC-07
Date Collected:	9/20/2017
Count Of Taxon:	16
Sum Of Count:	600

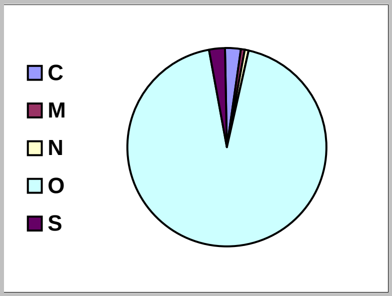
Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	1.000	Poor	Poor
Species Richness	16	Fair	Poor
Native Taxa Percent	0.17%		
Cosmopolitan Taxa Percent	99.50%		
Mountains Rare Taxa Percent	0.17%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	84.17%	Poor	Poor
Sediment			
Siltation Taxa Percent	1.50%	Excellent	Excellent
Motile Taxa Percent	3.33%		
Mountains Brackish Taxa Percent	99.00%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	2.878	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	0.67%		
Polysaprobous Taxa Percent	11.67%		
Low DO Taxa Percent	0.17%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	98.67%		
Eutraphentic Taxa Percent	96.33%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	0.33%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	9.67%		
Abnormal Cells Percent	0.00%	Excellent	

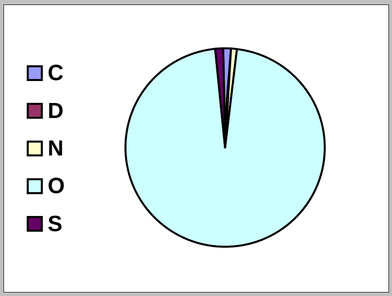
BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Poor
MTP	Montana DEQ Plains (Bahls 1992)	Poor

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	2.67%	12.92%
Mountains Metals Increasers Taxa Percent	0.67%	3.29%
Mountains Nutrient Increasers Taxa Percent	0.67%	4.65%
Mountains Sediment Increasers Taxa Percent	2.67%	10.75%



Metric	Value	Prob.
Plains General Increasers Taxa Percent	1.50%	1.10%



Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	505	84.17%
Planothidium lanceolatum	57	9.50%
Amphora pediculus	8	1.33%
Planothidium frequentissimum	7	1.17%
Rhoicosphenia abbreviata	4	0.67%
Nitzschia inconspicua	3	0.50%
Staurosira construens v. venter	3	0.50%
Reimeria sinuata	3	0.50%
Achnanthidium minutissimum	2	0.33%
Navicula cryptotenella	2	0.33%

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APPENDIX H. PILCHUCK AUDUBON SOCIETY STUDY

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ED.001
Boardwalk
BNSF
No longer being used
ED.007
BNSF Overlook
ED.006
Athletic
ED.004
Hatchery West
ED.002
Unocal
ED.005
Hatchery
East
ED.003
Condo Overlook

AVIAN HABITAT USE MONITORING AT EDMONDS MARSH – DATA SHEET

DATE:

START TIME:

END TIME:

OBS. CIRCLE #:

DIRECTION OF TRAVEL: ☐ clockwise ☐ counterclockwise

TEMP. AT START:

WIND SPEED:

CLOUD COVER (%):

PRECIPITATION:

WATER LEVEL:

DISTURBANCE LEVEL:

OBSERVERS PRESENT:

1.)

2.)

3.)

4.)

TIME	SPECIES NAME	SPECIES CODE	# OF BIRDS (TALLY)	LOCATION	BEHAVIOR CODE	NOTES

ADDITIONAL INPUT LINES AND ALL CODES FOR DATA ENTRY ARE LISTED ON THE BACK OF THIS DATA SHEET

PAGE TWO: ADDITIONAL INPUT LINES

TIME	SPECIES NAME	SPECIES CODE	# OF BIRDS (TALLY)	LOCATION	BEHAVIOR CODE	NOTES

BEHAVIOR CODES

BEHAVIOR CATEGORY	**BEHAVIOR**	**BEHAVIOR CODE**	**DESCRIPTION**
Foraging	Hunting	H	Includes raptors cruising above the marsh
	Feeding	F	shorebirds probing, ducks dabbling/diving, fly-catching, probing at vegetation, hummingbirds at bloom, drinking, foraging
Refuging	Sleeping/Roosting	SL	Tucked head, relaxed and stationary
	Resting	R	Alert but not moving (Head is not tucked, , perched, minimal locomotion such as walking/hopping in same general area.)
	Preening	P	Grooming, Roust (fluffing feathers/flapping wings, scratching)
	Prey Abatement/Alarm Calling	PA	Hiding, running away, flushing/taking flight, escaping, alarm calls
	Harassing	HA	Mobbing, chasing, diving at or harassing.
Breeding	Courtship/Song	SO	Singing (songbirds), Pairing behavior (such as male protecting mate), courtship displays
	Contact Calling	CA	Chip calling, contact calls, generally while foraging
	Territorial	T	Protecting territory such as chasing/returning, aggression displays
	Breeding Confirmed	BC	Copulation, nest building, carrying food to young or presence of young
Locomotion	Fly-over	FOV	Species needs to be notated
	Fly-in	FLI	Bird flies in and lands
	Fly-out	FEX	Bird flies out from perch, or, bird flushes
	Swimming	SWI	
	Walking	WA	Walking from place to place, not foraging
Other	Other	OO	Anything not coded, please record in notes

Notes:

WIND SCALE (BEAUFORT)

FORCE	**WIND IN KNOTS**		**AT SEA**	**ON LAND**
0	LESS THAN 1	CALM	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	LIGHT AIR	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	LIGHT BREEZE	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	GENTLE BREEZE	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	IF THE WIND IS STRONGER THAN LEVEL 3, CONDITIONS ARE NOT SUITABLE FOR THIS SURVEY			

LOCATION CODES

FH	Forest Canopy
FM	Forest Mid Canopy
FL	Forest Understory
SB	Shrub and Bush
GG	Grass or Groundcover
BE	Beach
IM	Intertidal Mud
WE	Water's edge/Wading Territory
WA	Water
RE	Reed Bed/Cattails
UR	Urban Impacted
A	In the air
O	Other- Include in Notes

DISTURBANCE CODES

NO	NOISE TO GENTLE WIND
N1	NOISE TO HEAVY TRAFFIC LEVEL
N2	NOISE TO FRIEGHT TRAIN IN DISTANCE LEVEL
N3	NOISE TO FRIEGHT TRAIN IN NEAR PROXIMITY LEVEL
DL	DOGS ON LEASH
DO	DOGS OFF LEASH
RP	RAPTOR PERCHED
RF	RAPTOR FLYOVER
PR	PREDITOR DETECTED IN MARSH
HD	HUMAN(S) DETECTED WITHIN MARSH BOUNDARY
OD	OTHER DISTURBANCE – PLEASE DESCRIBE IN NOTES

PRECIPITATION CODES

N = NONE	**F** = FOG	**M** = MIST	**D =** DRIZZLE	**R** = RAIN	**S =** SNOW

Avian Habitat Use Monitoring at Edmonds Marsh Data

Date	Start Time	End Time	Obs. Circle	Location	Direction of Travel	Temp.	Wind	Cloud %	Precip.	Water Level	Disturb. 1	Disturb. 2	Observer 1	Observer 2	Observer 3	Obs. Time	Species	Birds Present	Location 1	Location 2	Behavior 1	Behavior 2	Notes
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1008	GBHE	1	FH		R		
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1009	GWTE	4	WA		F		
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1010	SOSP	1	RE		FL		
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1010	KILL	1	WE		FL		
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1010	AMCR	1	A		FO		
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1011	AMCR	1	UR		F		On the fence
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1012	MALL	1	A		FO		
12/8/2018	1008	1017	ED.001	BOARDWALK	CLOCKWISE	42	1	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1013	MAWR	1	RE		F		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1017	BCCH	3	SB		F		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1412	BCCH	2	SB		F		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1412	AMCR	1	FH		PA		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1414	AMCR	1	A		FLI		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1418	BEWR	1	SB		F		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1419	BCCH	2	FH		F		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1419	AMCR	1	A		FLI		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1421	SOSP	1	SB		FLI		
12/8/2018	1412	1422	ED.003	CONDO	CLOCKWISE	43	0	95	N		N1		SCOTT MARKOWITZ			1422	AMCR	1	FH		FLI		
12/8/2018	745	755	OLD BNSF	BNSF	CLOCKWISE	41	2	80	N		N0		SCOTT MARKOWITZ	CYNTHIA EASTERSON		745	MALL	20	A		FEX		
12/8/2018	745	755	OLD BNSF	BNSF	CLOCKWISE	41	2	80	N		N0		SCOTT MARKOWITZ	CYNTHIA EASTERSON		745	MALL	98	IM		R		
12/8/2018	745	755	OLD BNSF	BNSF	CLOCKWISE	41	2	80	N		N0		SCOTT MARKOWITZ	CYNTHIA EASTERSON		747	MALL	27	WA		SWI		
12/8/2018	745	755	OLD BNSF	BNSF	CLOCKWISE	41	2	80	N		N0		SCOTT MARKOWITZ	CYNTHIA EASTERSON		750	GWTE	4	IM		P		
12/8/2018	745	755	OLD BNSF	BNSF	CLOCKWISE	41	2	80	N		N0		SCOTT MARKOWITZ	CYNTHIA EASTERSON		750	GBHE	1	IM		R		
12/8/2018	745	755	OLD BNSF	BNSF	CLOCKWISE	41	2	80	N		N0		SCOTT MARKOWITZ	CYNTHIA EASTERSON		753	GWGU	1	A		FEX		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		825	AMRO	1	FL		FEX		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		825	MAWR	1	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		826	SPTO	1	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		826	MALL	8	A		FEX		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		827	SOSP	3	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		828	MAWR	2	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		830	SPTO	1	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		831	MAWR	1	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		832	SOSP	1	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		833	BEWR	1	SB		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		834	DOWO	1	FH		F		
12/8/2018	825	835	ED.004	HATCH-W	CLOCKWISE	41	0	50	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		834	VIRA	3	SB		T		
12/8/2018	858	908	ED.005	HATCH-E	CLOCKWISE	41	0	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		858	AMRO	1	FH		R		
12/8/2018	858	908	ED.005	HATCH-E	CLOCKWISE	41	0	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		859	ORJU	1	SB		F		
12/8/2018	858	908	ED.005	HATCH-E	CLOCKWISE	41	0	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		859	SOSP	1	GG		F		
12/8/2018	858	908	ED.005	HATCH-E	CLOCKWISE	41	0	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		901	BCCH	7	FH		F		
12/8/2018	858	908	ED.005	HATCH-E	CLOCKWISE	41	0	90	N		N1		SCOTT MARKOWITZ	CYNTHIA EASTERSON		908	SOSP	1	SB		F		
12/8/2018	950	1001	ED.006	ATHLETIC	CLOCKWISE	42	0	90	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		950	BEWR	1	RE		F		
12/8/2018	950	1001	ED.006	ATHLETIC	CLOCKWISE	42	0	90	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		950	MAWR	2	RE		F		
12/8/2018	950	1001	ED.006	ATHLETIC	CLOCKWISE	42	0	90	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		951	SOSP	4	RE		F		
12/8/2018	950	1001	ED.006	ATHLETIC	CLOCKWISE	42	0	90	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		959	GCKI	5	FC		F		
12/8/2018	950	1001	ED.006	ATHLETIC	CLOCKWISE	42	0	90	N		N2		SCOTT MARKOWITZ	CYNTHIA EASTERSON		1000	AMCR	2	FC		R		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			811	AMWI	17	WE		F		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			811	GWTE	3	IM		F		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			813	MEGU	1	A		FOV		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			814	GWTE	5	IM		SWI		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			816	MALL	52	WA		SWI		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			817	MALL	5	A		FOV		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			817	WGWH	1	IM		R		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			817	CAGO	2	A		FOV		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			817	BCCH	3	SB		F		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			819	WGWH	1	A		FOV		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			819	BCCH	1	RE		F		
12/28/2018	811	821	ED.001	BOARDWALK	CLOCKWISE	42	1	100	M		N1		SCOTT MARKOWITZ			820	MAWR	1	RE		F		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			942	SOSP	1	SB		CA		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			943	MAWR	1	RE		F		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			943	SOSP	4	SB		CA		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			946	MAWWR	1	RE		G		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			947	GCSP	2	SB		CA		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			948	SOSP	4	RE		F		
12/28/2018	942	982	ED.004	HATCH-W	CLOCKWISE	42	0	100	M		N1		SCOTT MARKOWITZ			949	VIRA	3	RE		CA		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M		N2		SCOTT MARKOWITZ			925	RTHA	1	FH		R		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M		N2		SCOTT MARKOWITZ			925	AMCR	2	FH		HA		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M		N2		SCOTT MARKOWITZ			926	BCCH	4	SB		F		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M		N2		SCOTT MARKOWITZ			926	SAVS	1	SB		CA		

12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M	N2	SCOTT MARKOWITZ	927	SOSP	3	SB	F		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M	N2	SCOTT MARKOWITZ	929	RCKI	2	SB	F		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M	N2	SCOTT MARKOWITZ	932	GCSP	1	FM	CA		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M	N2	SCOTT MARKOWITZ	934	AMGO	30	A	FEX		
12/28/2018	925	935	ED.005	HATCH-E	CLOCKWISE	42	0	100	M	N2	SCOTT MARKOWITZ	935	ORJU	1	SB	F		
12/28/2018	831	841	ED.006	ATHLETIC	CLOCKWISE	42	1	100	M	N1	SCOTT MARKOWITZ	834	VIRA	1	RE	CA		
12/28/2018	831	841	ED.006	ATHLETIC	CLOCKWISE	42	1	100	M	N1	SCOTT MARKOWITZ	834	BCCH	3	FM	F		
12/28/2018	831	841	ED.006	ATHLETIC	CLOCKWISE	42	1	100	M	N1	SCOTT MARKOWITZ	836	SOSP	2	FL	CA		
12/28/2018	831	841	ED.006	ATHLETIC	CLOCKWISE	42	1	100	M	N1	SCOTT MARKOWITZ	838	GCSP	1	SB	CA		
12/28/2018	831	841	ED.006	ATHLETIC	CLOCKWISE	42	1	100	M	N1	SCOTT MARKOWITZ	839	SOSP	1	SB	F		
12/28/2018	831	841	ED.006	ATHLETIC	CLOCKWISE	42	1	100	M	N1	SCOTT MARKOWITZ	841	MAWR	1	RE	F		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1000	SOSP	2	SB	CA		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1001	BCCH	4	FM	F		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1003	GBHE	2	A	FOV		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1005	AMCR	2	A	FOV		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1007	GCKI	2	FH	F		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1007	ANHU	2	SB	HA		
12/28/2018	1000	1010	ED.003	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ	1009	SOSP	2	SB	CA		
12/28/2018	1000	1010	ED.002	CONDO	CLOCKWISE	44	1	100	N	N1	SCOTT MARKOWITZ							NOT ACCESSIBLE DUE TO PERMISSIONS
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1030	CAGO	22	A	FOV		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1030	KILL	1	WE	R		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1032	GWTE	2	WA	P		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1034	KILL	1	IM	F		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1035	KILL	1	WE	R		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1039	GWGU	2	A	FOV		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1039	ANHU	1	SB	CA		
1/11/2019	1030	1040	ED.001	BOARDWALK	COUNTERCLOCKWISE	48	0	90	N	N2	SCOTT MARKOWITZ	1040	MAWR	1	RE	CA	F	
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1007	SOSP	2	RE	CA		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1007	RWBL	1	RE	CA		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1007	RSNF	1	SB	CA		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1008	SOSP	2	SB	CA		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1008	WCSP	4	GG	F		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1009	SOSP	1	GG	F		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1009	GCSP	1	SB	CA		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1011	AMCR	2	FM	CA		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1011	ORJU	11	SB	F		
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1012	MAWR	1	RE	CA	F	
1/11/2019	1007	1018	ED.006	ATHLETIC	COUNTERCLOCKWISE	47	0	80	N	N2	SCOTT MARKOWITZ	1015	SOSP	1	SB	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	848	PIWO	1	FH	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	848	VIRA	3	RE	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	848	AMCR	7	A	PA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	849	RTHA	1	FH	PA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	850	AMRO	11	FH	FLI		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	851	RWBL	1	RE	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	849	WGWH	1	A	PA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	852	BCCH	1	SB	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	852	SOSP	3	SB	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	853	AMRO	2	FM	CA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	853	AMRO	1	FL	PA		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	855	RWBL	45	FH	R	CA	
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	855	BCCH	4	SB	F		
1/11/2019	848	858	ED.004	HATCH-W	COUNTERCLOCKWISE	42	0	80	N	N1	SCOTT MARKOWITZ	858	ORJU	1	FM	F		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	908	SOSP	1	SB	CA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	908	AMCR	3	FH	R		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	908	AMRO	2	FH	FEX		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	908	AMRO	1	FC	FLI		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	909	SOSP	1	SB	CA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	909	GCKI	3	SB	F		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	910	CBCH	6	SB	F		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	910	STJA	1	SB	CA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	911	BCCH	3	FH	F		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	912	AMRO	1	FM	CA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	914	SOSP	1	SB	SO		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	916	AMCR	2	FH	HA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	918	AMCR	4	FH	HA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	917	RTHA	1	FH	PA		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	913	BEWR	1	SB	F	CA	
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	918	ANJU	1	SB	F		
1/11/2019	908	918	ED.005	HATCH-E	COUNTERCLOCKWISE	44	0	70	N	N1	SCOTT MARKOWITZ	918	BEWR	1	SB	T		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2	SCOTT MARKOWITZ	822	AMRO	6	FH	R	CA	
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2	SCOTT MARKOWITZ	822	SOSP	4	SB	CA		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2	SCOTT MARKOWITZ	822	ANHU	1	SB	CA		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2	SCOTT MARKOWITZ	824	ANHU	1	A	FEX		

1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	825	BCCH	3	FH	CA	F	
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	825	BCCH	1	FH	CA		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	826	AMRO	4	FH	R		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	826	AMRO	1	SB	PA		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	827	RSNF	1	FH	F		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	827	SOSP	1	SB	CA		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	829	AMRO	1	FH	R		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	830	AMRO	1	FH	FLI		
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	830	ANHU	1	A	T		Flying J pattern territorial display
1/11/2019	822	830	ED.007	CONDO	COUNTERCLOCKWISE	43	0	90	N	N2		SCOTT MARKOWITZ	831	ANHU	1	SB	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1019	MAWR	2	RE	F		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N		2	SCOTT MARKOWITZ	1019	AMCR	3	FH	CA	R	
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1019	SOSP	3	FL	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1020	NSFL	1	FM	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1021	RWBL	1	FU	SO		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1022	SOSP	1	RE	F		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1022	RWBL	2	RE	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1023	SOSP	1	RE	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1024	SOSP	1	RE	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1025	SOSP	1	SB	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1025	SPTO	1	SB	CA		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1029	MAWR	1	RE	F	CA	
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1029	CBCH	6	FM	SO		
1/21/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	45	0	70	N	N1		SCOTT MARKOWITZ	1029	VIRA	2	RE	CA		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	850	MALL	2	WE	R		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	850	GADW	3	WE	R		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	850	GWTE	5	WE	R		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	850	KILL	2	IM	F		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	850	ORJU	1	SB	CA		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	851	MAWR	3	RE	CA		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	851	GBHE	1	FH	FLI		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	852	ANHU	1	SB	CA		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	853	HEGU	1	A	FEX		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	856	AMWI	4	A	FEX		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	856	MAWR	1	RE	FLI		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	857	MAWR	1	RE	CA		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	859	RWBL	1	RE	CA		
1/21/2019	850	900	ED.001	BOARDWALK	CLOCKWISE	42	0	90	N	N1		SCOTT MARKOWITZ	859	BAEA	1	FH	R		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	911	BCCH	4	FH	CA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	911	SOSP	2	SB	CA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	911	MAWR	1	RE	CA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	912	SOSP	1	RE	F		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	912	ANHU	1	A	HA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	912	RUKI	1	SB	F		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	912	AMCR	2	FH	CA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	914	SOSP	1	SB	CA	SO	
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	914	MAWR	1	RE	CA	F	
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	915	GCSP	1	SB	CA	SO	
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	916	BEWR	1	SB	F		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	917	SPTO	1	SB	F	CA	
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	918	AMCR	10	A	HA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	918	RTHA	1	A	PA		
1/21/2019	911	921	ED.006	ATHLETIC	CLOCKWISE	43	0	95	N	N1		SCOTT MARKOWITZ	919	RWBL	2	A	FM		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	816	AMRO	4	FH	R		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	816	RTHA	1	FH	R		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	816	SOSP	2	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	816	AMRO	2	FH	PA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	817	AMRO	1	A	FLI		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	817	VIRA	1	RE	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	818	SOSP	1	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	819	BCH	2	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	819	ANHU	1	SB	HA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	820	AMRO	5	FH	R		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	821	SPTO	2	SB	F		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	820	RUKI	1	SB	F	CA	
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	821	RSNF	1	FH	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	822	SOSP	1	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	823	SAVS	1	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	824	STJA	1	SB	F		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	824	RUKI	1	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	824	ORJU	3	SB	CA		
1/21/2019	816	826	ED.003	CONDO	CLOCKWISE	41	0	80	N	N1		SCOTT MARKOWITZ	826	AMCR	1	FH	CA		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ	958	BEWR	2	SB	T		

1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			959	SOSP	4	SB		CA		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1001	RWBL	2	RE		CA		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1001	AMCR	1	FH		R	CA	
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1002	ORJU	5	SB		F		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1002	SPTO	1	SB		F		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1004	GCSP	1	SB		CA	SO	
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1004	ANHU	2	SB		T	HA	
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1007	SOSP	1	SB		SO		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1008	SPTO	2	SB		F		
1/21/2019	958	1008	ED.005	HATCH-E	CLOCKWISE	45	0	80	N	N1		SCOTT MARKOWITZ			1008	SOSP	1	GG		F		
2/8/2019	732	742	ED.004	HATCH-W	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	732	MAWR	2	RE		CA		
2/8/2019	732	742	ED.004	HATCH-W	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	733	SOSP	1	RE		SO		
2/8/2019	732	742	ED.004	HATCH-W	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	736	AMCR	1	A		FEX		
2/8/2019	732	742	ED.004	HATCH-W	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	738	RWBL	18	RE		FEX		
2/8/2019	732	742	ED.004	HATCH-W	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	737	VIRA	1	RE		CA		Contact Call? Or Territorial?
2/8/2019	732	742	ED.004	HATCH-W	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	739	AMRO	2	FH		R		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	807	ORJU	6	FL		F		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	807	RCKI	1	FH		F		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	808	SOSP	1	FM		CA	SO	
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	809	AMCR	8	FH		FLI	R	
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	810	ANHU	1	FH		F		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	810	BRCR	1	FM		F		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	811	RWBL	7	A		FLI		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	812	AMRO	6	FH		R	FLI	
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	816	BEWR	1	FL		CA		
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	817	BCCH	2	FM		F	CA	
2/8/2019	807	817	ED.005	HATCH-E	COUNTERCLOCKWISE	31	1	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	818	PAWR	1	FL		SO		
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	848	AUWA	1	FM		F		
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	848	SOSP	1	FM		SO	F	
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	849	RWBL	1	RE		SO	F	
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	850	ORJU	2	GG		F		
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	850	AMCR	3	A		FLI		
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	855	SPTO	1	SB		R	F	
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	856	MALL	4	A		FLI		
2/8/2019	848	859	ED.006	ATHLETIC	COUNTERCLOCKWISE	33	2	100	S	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	857	SOSP	2	GG		F		
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	907	RWBL	3	FH		R	CA	
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	907	AMCR	4	FH		R	F	
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	908	BCCH	1	FM		F		
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	912	GWGU	1	A		FOV		
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	912	GBHE	2	FM		R		
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	914	ANHU	1	SB		CA		
2/8/2019	907	917	ED.001	BOARDWALK	COUNTERCLOCKWISE	33	2	100	N	N1	DO	LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	916	KILL	2	A		CA	FEX	
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	935	ORJU	6	GG	SB	F		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	936	SPTO	2	GG	SB	F		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	937	SOSP	1	SB		SO		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	940	GCSP	1	GG		F		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	941	RWBL	1	RE		CA		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	942	RSNF	1	FH		CA		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	943	BCCH	1	SB		F		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	944	ANHU	1	SB	A	SO		
2/8/2019	935	945	ED.003	CONDO	COUNTERCLOCKWISE	33	2	100	N	N1		LAURA BROU	SHERRILL MILLER	REG REISENBICHLER	945	BAEA	1	FH		R		
2/16/2019	923	933	ED.001	BOARDWALK	CLOCKWISE	38	0	100	D	N0		LISA WEBER	DOUG RESNIK		926	AMCR	1	UR		R		On the power transmission wire
2/16/2019	923	933	ED.001	BOARDWALK	CLOCKWISE	38	0	100	D	N0		LISA WEBER	DOUG RESNIK		926	RWBL	1	RE		SO		Heard only
2/16/2019	923	933	ED.001	BOARDWALK	CLOCKWISE	38	0	100	D	N0		LISA WEBER	DOUG RESNIK		926	GWTE	14	WA		F		
2/16/2019	923	933	ED.001	BOARDWALK	CLOCKWISE	38	0	100	D	N0		LISA WEBER	DOUG RESNIK		927	MAWR	1	RE		F		
2/16/2019	923	933	ED.001	BOARDWALK	CLOCKWISE	38	0	100	D	N0		LISA WEBER	DOUG RESNIK		928	GBHE	3	WE		R		
2/16/2019	923	933	ED.001	BOARDWALK	CLOCKWISE	38	0	100	D	N0		LISA WEBER	DOUG RESNIK		928	GBHE	1	FH		R		Perched on snag
2/16/2019	938	948	ED.002	ATHLETIC	CLOCKWISE	39	0	100	D	N2	N1	LISA WEBER	DOUG RESNIK		938	SPTO	1	FM		FLI		Flew from branch to ground
2/16/2019	938	948	ED.002	ATHLETIC	CLOCKWISE	39	0	100	D	N2	N1	LISA WEBER	DOUG RESNIK		941	MAWR	1	RE		SO		
2/16/2019	938	948	ED.002	ATHLETIC	CLOCKWISE	39	0	100	D	N2	N1	LISA WEBER	DOUG RESNIK		941	RWBL	1	RE		SO		Heard only
2/16/2019	938	948	ED.002	ATHLETIC	CLOCKWISE	39	0	100	D	N2	N1	LISA WEBER	DOUG RESNIK		942	RCKI	2	FM		F		
2/16/2019	938	948	ED.002	ATHLETIC	CLOCKWISE	39	0	100	D	N2	N1	LISA WEBER	DOUG RESNIK		943	BCCH	1	FM		F		
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1019	BEWR	1	FH		SO		Heard only
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1019	SOSP	2	FH		F		
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1019	RCKI	1	FH		F		
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1020	PAWR	1	FH		SO		Heard only
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1020	RSNF	1	FH		CA	T	
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1025	AMCR	1	FH		FEX		
2/16/2019	1019	1029	ED.005	HATCH-E	CLOCKWISE	38	0	100	R	N1		LISA WEBER	DOUG RESNIK		1027	PAWR	1	FH		CA		Heard only
2/16/2019	1048	1059	ED.004	HATCH-W	CLOCKWISE	38	0	100	R	N1	N2	LISA WEBER	DOUG RESNIK		1048	AMRO	20	FH		FEX		
2/16/2019	1048	1059	ED.004	HATCH-W	CLOCKWISE	38	0	100	R	N1	N2	LISA WEBER	DOUG RESNIK		1048	RSNF	2	FH		CA	T	1 CALLING;1 QUIET
2/16/2019	1048	1059	ED.004	HATCH-W	CLOCKWISE	38	0	100	R	N1	N2	LISA WEBER	DOUG RESNIK		1052	SOSP	1	FM		F		
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK		1115	SOSP	1	FM		CA		Heard only

2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1115	AMCR	1	FH		R		Heard only
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1118	BEWR	1	U		CA		
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1118	SPTO	5	SB		R		Heard only
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1120	RWBL	1	RE		SO		In bramble
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1120	ANHU	1	FH		T		Heard only
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1125	SOSP	1	FM		F		Possible T - checking us out
2/16/2019	1115	1125	ED.003	CONDO	CLOCKWISE	39	0	100	R	N1		LISA WEBER	DOUG RESNIK	1125	STJA	1	U		SO		Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	814	AMRO	1	FH		SO		Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	816	ANHU	1	U		U		
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	818	SOSP	1	U		U		Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	815	UPCH	4	FH		SO	F	Unidentified Poecile Chicadee
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	815	DOWO	1	FH		F		
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	816	RCKI	1	FM		U	F	Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	816	AMCR	2	FH		U		Flying over from branch to branch
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	819	ORJU	1	U		U		Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	820	RWBL	1	U		U		Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	820	PUFI	1	FH		SO		Heard only
3/23/2019	814	824	ED.005	HATCH-E	CLOCKWISE	45	0	100	N	N1	N2	LISA WEBER	DOUG RESNIK	820	TOWA	1	FM		F		
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	846	AMCR	6		R			
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	846	MAWR	3	RE	F			
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	851	RSNF	2	FH	SO	CA		
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	851	AUWA	1	FH	F	F		
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	855	UNSW	1	A	F	F		Unidentified swallow
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	843	AMCR	15		HA	PA		Harassing Red-tailed Hawk
3/23/2019	846	856	ED.004	HATCH-W	CLOCKWISE	45	0	100	N	N2	PR	LISA WEBER	DOUG RESNIK	843	RTHA	1		PA			Being harrassed by 15x AMCR
3/23/2019	910	920	ED.002	UNOCAL	CLOCKWISE	45	0	100	N	N0	PR	LISA WEBER	DOUG RESNIK	911	BEWR		U		U		Heard only
3/23/2019	910	920	ED.002	UNOCAL	CLOCKWISE	45	0	100	N	N0	PR	LISA WEBER	DOUG RESNIK	911	AMRO	1	FM		R		
3/23/2019	910	920	ED.002	UNOCAL	CLOCKWISE	45	0	100	N	N0	PR	LISA WEBER	DOUG RESNIK	916	AUWA	1	FH		G		
3/23/2019	910	920	ED.002	UNOCAL	CLOCKWISE	45	0	100	N	N0	PR	LISA WEBER	DOUG RESNIK	917	HOFI	1	U		U		Heard only
3/23/2019	910	920	ED.002	UNOCAL	CLOCKWISE	45	0	100	N	N0	PR	LISA WEBER	DOUG RESNIK	917	BRCR	1	FM		SO	F	
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	956	ANHU	1	A		T		Male doing the J flight display
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	946	SOSP	2	U		U		Heard only
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	946	AMRO	3	FH	SB	F		
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	948	BEWR	1	U		U		
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	947	AMCR	2	FH		F		
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	948	BCCH	1	U		U		Heard only
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	952	UNSW	2	A		F		
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	953	RSNF	2	A		R		
3/23/2019	946	956	ED.003	CONDO	CLOCKWISE	48	0	100	N	N1	PR	LISA WEBER	DOUG RESNIK	953	AMGO	3	FM		R		
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1015	GBHE	5	WE		R		One in reedbed
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1016	GADW	6	WE		R		
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1016	RWBL	1	RE		R		
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1016	AMCR	1	A		FEX		Going all over
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1015	TRES	2	A		F		
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1015	SOSP	1	RE		R		On nest box
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1015	MALL	1	RE		R		
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1016	MAWR	2	U		U		Heard only
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1017	RWBL	1	SB		SO	CA	
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1018	GADW	2	WA		FLI	SWI	
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1016	GBHE	1	RE		F		
3/23/2019	1014	1024	ED.001	BOARDWALK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1019	TRES	3	UR		R		Perched on phone wire
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1034	KILL	1	WE		FLI		
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1034	GADW	4	WA		F		
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1035	BCCH	2	FH		F		
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1035	BEWR	1			SO		Heard only
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1037	MALL		WA		R	F	
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1037	VGSW	2	A		F		
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1041	AMRO	1	GG		F		
3/23/2019	1034	1044	ED.007	BNSF OVERLOOK	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1042	RUKI	1	FH		F		
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1051	MAWR	1	RE		CA	F	
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1051	RWBL	2	U		CA		
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1052	BEWR	1	SB		R		
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1052	AMCR	2	FM		FLI		
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1056	AMRO	2	GG		F		
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1058	SPTO	1	GG		F		
3/23/2019	1051	1101	ED.006	ATHLETIC	CLOCKWISE	51	3	100	N	N3		LISA WEBER	DOUG RESNIK	1058	AUWA	1	FM		F		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		909	SOSP	4	SB		SO		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		909	SPTO	2	SB		CA		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		909	AMRO	1	FM		PA		Alarm call and flight
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		909	ORJU	1	SB		SO		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		910	AMCR	1	FH		FLI	CA	
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		911	ORJU	1	SB		SO		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1		SCOTT MARKOWITZ		912	SPTO	1	SB		F		

4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	913	CBCH	2	FH		F		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	914	SOSP	2	SB		SO		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	914	ORJU	1	FL		SO		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	915	ANHU	1	SB		CA	T	
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	917	STJA	1	FC		FLI		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	917	AMRO	2	GG		F		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	917	AMRO	1	SB		SO		
4/7/2019	909	919	ED.003	CONDO	COUNTERCLOCKWISE	47	0	90	N	N1	SCOTT MARKOWITZ	917	BEWR	1	SB		SO		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	940	BUSH	6	SB		F		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	940	RUKI	2	SB		F	CA	
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	942	AUWA	3	FM		F		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	943	SOSP	1	SB		SO		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	943	AMCR	1	FH		CA		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	943	ORJU	1	SB		CA		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	943	RTHA	1	FH		R		Perched on snag
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	944	MAWR	2	RE		SO		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	945	BEWR	1	SB		SO		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	945	RWBL	1	RE		SO		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	946	GBHE	1	A		FLI		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	947	SOSP	1	FM		F		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	947	PUFI	1	FM		SO		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	948	BCCH	1	FH		F		
4/7/2019	939	949	ED.002	UNOCAL	COUNTERCLOCKWISE	49	0	100	N	N1	SCOTT MARKOWITZ	948	RSNF	1	FM		F		Perched on snag
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1019	MAWR	5	RE		SO		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1019	SPTO	2	FL		SO		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1019	SOSP	4	SB		SO		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1021	ORJU	1	FM		F		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1021	VIRA	1	RE		CA		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1022	ORJU	2	SB		SO		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1023	SOSP	1	FM		SO		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1024	ANHU	1	FM		CA	T	
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1024	AMCR	1	FH		CA		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1026	BCCH	2	FM		CA		
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1026	BUSH	5	FM		F	CA	Counted 5 individuals but there were more
4/7/2019	1019	1029	ED.005	HATCH-E	COUNTERCLOCKWISE	46	0	95	N	N1	SCOTT MARKOWITZ	1028	VIRA	1	FL		CA		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	959	RTHA	2	FH		R		Perched in snag
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	959	MAWR	4	RE		SO		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1000	RWBL	2	RE		SO		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1000	ANHU	1	FM		FLI		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1002	SOSP	4	FL		F		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1002	MAWR	2	RE		SO		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1002	BUSH	2	SB		F		
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1008	RBSA	2	FH	FLI	F	SO	Feeding on Snag, Mated Pair behavior
4/7/2019	959	1009	ED.004	HATCH-W	COUNTERCLOCKWISE	47	0	95	N	N1	SCOTT MARKOWITZ	1009	TRES	2	A		FOV		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	837	VGSW	7	A		FOV	F	
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	838	AMCR	4	RE	GG	F	CA	
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	838	MAWR	1	RE		SO		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	838	WCSP	1	UR		SO		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	839	TRES	3	A		FOV	F	
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	840	MALL	1	WA		SWI		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	840	GBHE	1	GG	RE	F		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	841	ORJU	1	UR		SO		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	841	MAWR	2	RE		SO		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	842	SPTO	1	UR		SO		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	843	RWBL	2	RE		SO		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	844	RWBL	4	FC		R		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	845	RWBL	4	RE		T	HA	
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	846	GBHE	2	FH		R		
4/7/2019	837	847	ED.001	BOARDWALK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	847	RWBL	2	RE	A	T	HA	
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	817	MALL	4	WA		SWI		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	817	AMWI	19	WE		R		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	817	GWFG	1	RE	GG	R		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	817	AMCR	17	A	FM	HA	CA	Socializing
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	822	GADW	4	WA		R	SWI	
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	823	MAWR	1	RE		SO		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	823	RWBL	2	RE		SO	CA	
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	825	AMCR	1	RE	GG	R		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	826	RWBL	5	RE		FEX		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	826	SOSP	3	GG		F		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	827	MAWR	1	RE		SO		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	828	WCSP	1	SB		SO		
4/7/2019	817	827	ED.007	BSNF OVERLOOK	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	829	MAWR	1	RE		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ	759	MAWR	3	RE		SO		

4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		759	SOSP	2	SB		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		800	RWBL	3	RE		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		801	SOSP	2	SB		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		801	SOSP	3	GG		F		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		802	MAWR	1	RE		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		802	COYE	2	SB		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		802	BCCH	2	FM		F	CA	
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		803	AMCR	4	FC		CA		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		804	MAWR	1	RE		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		804	SPTO	1	GG		F		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		805	RWBL	4	RE		CA		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		806	RWBL	1	RE		PA	HA	
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		806	SOSP	1	RE		PA		Escaping
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		806	AMCR	3	UR		CA		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		807	GBHE	1	RE		FEX		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		807	SOSP	1	FM		R		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		808	BCCH	2	SB		SO		
4/7/2019	759	809	ED.006	ATHLETIC	COUNTERCLOCKWISE	46	0	100	N	N1	SCOTT MARKOWITZ		809	ORJU	1	SB		SO		
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	630	GBHE	2	FH		R		Two in a tree
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	630	BCCH	2	FM		U		Heard only
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	630	AMCR	1	A		FOV		
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	630	SPTO	1	FL		CA		Heard only
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	630	RBNU	1	FM		CA		Heard only
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	630	RSNF	1	FH		CA	PR	In a tree
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	638	CAGO	1	A		FOV		
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	638	SOSP	1	FL		CA		Heard only
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	638	AMRO	1	A		FOV		
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	639	SOSP	1	FL		CA		Heard only
4/17/2019	630	640	ED.005	HATCH-E	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	640	GBHE	4	FL		FLI	FOV	Two flew over, two flew in
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	718	MAWR	2	FL		CA		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	718	RSNF	1	FM		R		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	718	BCCH	1	FM		CA		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	718	RBNU	1	FM		CA		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	723	WGWH	1	A		FOV		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	723	AMCR	1	A		FOV		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	723	SOSP	2	FL		CA		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	723	AMRO	2	FM		U		
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	723	GBHE	1	FH		BC		Carrying nesting material
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	715	RTHA	2	FH		R	PA	Flew before survey, chased by crows
4/17/2019	718	728	ED.004	HATCH-W	CLOCKWISE	48	2	50	N	N1	LAURA BROU	DAVE RICHMAN	725	PIWO	1	FH		F		Outside of survey time window
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	740	SOSP	1	FL		CA		Heard only
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	740	GBHE	3	FH		BC		In and around nests
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	740	AMCR	1	A		CA		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	AMCR	1	FH		CA		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	AMCR	1	FH		CA		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	MAWR	1	FL		CA		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	AMCR	5	A		FLI		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	SOSP	1	FL		CA		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	RSNF	1	A		FOV		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	CAGO	2	A		CA		
4/17/2019	740	750	ED.002	UNOCAL	CLOCKWISE	48	2	70	N	N1	LAURA BROU	DAVE RICHMAN	742	BCCH	1	FM		CA		
4/17/2019	809	819	ED.003	CONDO	CLOCKWISE	50	2	90	N	N1	LAURA BROU	DAVE RICHMAN	809	CBCH	2	FL		F		
4/17/2019	809	819	ED.003	CONDO	CLOCKWISE	50	2	90	N	N1	LAURA BROU	DAVE RICHMAN	809	SOSP	1	FL		F		
4/17/2019	809	819	ED.003	CONDO	CLOCKWISE	50	2	90	N	N1	LAURA BROU	DAVE RICHMAN	809	AMCR	1	A		FOV		
4/17/2019	809	819	ED.003	CONDO	CLOCKWISE	50	2	90	N	N1	LAURA BROU	DAVE RICHMAN	809	AMRO	2	FM		R		Possibly visiting nest
4/17/2019	809	819	ED.003	CONDO	CLOCKWISE	50	2	90	N	N1	LAURA BROU	DAVE RICHMAN	809	SPTO	1	FL		F		
4/17/2019	809	819	ED.003	CONDO	CLOCKWISE	50	2	90	N	N1	LAURA BROU	DAVE RICHMAN	809	ANHU	1	FH		R		
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	GADW	7	WA		F	SWI	
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	AMWI	10	WA		F	SWI	
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	GWTE	7	WA		SWI	F	
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	MALL	5	WA	A	SWI	FEX	
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	CAGO	2	WA		SO		Courtship display
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	AMGO	3	A		FLI		
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	RWBL	3	RE		CA		
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	HOFI	1	SB		CA		
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	EUST	1	UR		R		
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	ORJU	1	SB		FLI		
4/17/2019	831	841	ED.001	BOARDWALK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	831	MAWR	1	RE		CA		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	AMWI	10	WA	WE	SWI	R	
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	GADW	12	WA		SWI		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	GWTE	7	WA		SWI	F	
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	MALL	4	A		FOV		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	CAGO	2	GG		R		

4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	SOSP	1	SB		SO		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	RWBL	1	RE		CA		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	WGWH	1	A		FOV		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	AMRO	2	SB		R		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	ORJU	1	SB		F		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	HOFI	1	SB		SO		
4/17/2019	849	859	ED.007	BNSF OVERLOOK	CLOCKWISE	50	2	100	N	N1	LAURA BROU	DAVE RICHMAN	849	AMCR	3	A		FOV		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	GBHE	6	FH		BC	On nests	
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	WGWH	1	A		FOV		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	MAWR	1	RE		CA		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	RWBL	2	RE		CA		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	AMCR	1	A		FOV		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	AMCR	3	GG		R		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	ROPI	3	A		FOV		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	MALL	2	A		FOV		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	ANHU	1	SB		F		
4/17/2019	905	915	ED.006	ATHLETIC	CLOCKWISE	50	3	100	N	N1	LAURA BROU	DAVE RICHMAN	905	SPTO	1	SB		R		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		651	ANHU	1	SB		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		651	BEWR	1	SB		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		651	SOSP	3	SB		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		651	AMCR	1	FH		CA		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		653	CBCH	1	SB		CA		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		653	AMRO	3	FH		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		654	WCSP	1	UR		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		654	AMCR	2	A		FEX		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		655	BCCH	1	FM		CA	SO	
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		656	BEWR	1	FL		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		656	AMCR	6	FH		PA		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		657	CBCH	3	FM		CA	F	
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		657	ORJU	5	SB		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		657	ANHU	1	SB		CA		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		659	SOSP	1	UR		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		700	MAWR	1	RE		SO		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		701	AMCR	3	A		FEX		
4/17/2019	651	701	ED.003	CONDO	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		701	SOSP	1	FL		SO		
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		710	PSFL	3	FH		CA	F	
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		710	BEWR	3	SB		SO		
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		710	SOSP	3	FL		SO		
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		713	AMRO	2	FM		SO		
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		716	AMRO	1	FH		CA	F	
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		717	GBHE	1	A		FOV		Heading East
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		718	SOSP	1	SB		SO		
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		718	RSNF	1	FH		CA		
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		719	COYE	1	SB		SO	CA	Short incomplete/imm. song
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		719	COHA	1	FM	A	FLI	FEX	flew in, perched in survey area until minute 9
4/17/2019	710	720	ED.002	UNOCAL	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		720	ANHU	1	SB		SB	CA	
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		729	MAWR	3	RE		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		729	ORJU	1	FM		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		730	AMCR	2	A		FEX		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		731	SOSP	1	FL		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		732	AMCR	2	A		FOV		Heading west
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		732	MAWR	1	RE		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		733	WGWH	1	A		FOV		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		733	OCWA	1	FL		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		734	AMRO	1	FM		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		734	GWGU	1	A		FOV		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		734	VIRA	2	RE		CA		One grunt call from each male
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		735	AMCR	2	A		FOV		Heading north
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		736	COYE	1	SB		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		737	GADW	2	A		FEX		Heading northwest
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		738	AMRO	1	FM		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		738	MAWR	1	RE		SO		
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		738	AMRO	2	A		PA	FEX	
4/17/2019	729	739	ED.004	HATCH-W	COUNTERCLOCKWISE	63	0	0	N	N1	SCOTT MARKOWITZ		739	RWBL	1	SB		SO		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		750	SOSP	2	FL		SO		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		750	AMRO	1	FM		SO		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		751	SOSP	1	SB		F		Investigating me
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		751	SOSP	2	FM		SO		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		753	AMRO	1	FH		R		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		753	AMRO	1	FM		PA		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		754	BRCR	1	FH		SO		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		754	AMRO	2	FM		SO		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ		754	PSFL	1	FM		SO		

4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ	755	AMCR	1	UR		CA		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ	756	BUSH	1	FL		F	BC	Flew into nest
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ	758	RBNU	1	FM		CA		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ	758	RWBL	2	SB		CA		
4/17/2019	750	800	ED.005	HATCH-E	COUNTERCLOCKWISE	68	0	0	N	N1	SCOTT MARKOWITZ	759	GCKI	1	FH		CA		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	827	BCCH	1	FM		F		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	827	MAWR	2	RE		SO		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	828	RWBL	2	SB		SO	CA	
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	829	COYE	1	RE		SO		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	829	BEWR	2	SB		HA		Chasing each other
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	830	MAWR	2	RE		SO		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	830	AMRO	2	FM		SO		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	830	AMCR	1	FH		CA		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	831	AMCR	1	GG		F		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	832	MALL	3	A		FOV		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	832	GBHE	1	FLI		R		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	832	PSFL	1	FH		SO		
4/17/2019	827	838	ED.006	ATHLETIC	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	835	GBHE	5	FH		R		Rookery in South end of marsh
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	841	GADW	3	WA		R		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	841	GWTE	1	WA		R		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	842	MAWR	3	RE		SO		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	842	COYE	2	SB		SO		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	842	AMRO	1	FM		SO		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	844	VIGS	5	A		FOV	F	
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	844	MAWR	1	RE		SO		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	845	AMCR	5	UR		CA		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	846	BARS	1	A		FOV	F	
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	847	TRES	2	UR		R		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	847	RWBL	1	FM		CA		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	849	GWTE	2	WA		R		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	849	EUST	1	WA		FOV		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	850	MALL	2	WA		R		
4/17/2019	841	852	ED.007	BNSF OVERLOOK	COUNTERCLOCKWISE	63	0	0	N	N2	SCOTT MARKOWITZ	851	RWBL	1	FH		F		In a snag
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	858	GWGU	2	WA	FLI	R		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	858	GADW	2	WA		R		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	858	KILL	1	A		FOV		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	859	WCSP	5	UR		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	859	COYE	3	SB		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	859	AMRO	1	FM		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	900	MAWR	2	RE		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	900	ORJU	1	SB		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	901	EUST	2	BE		R	F	
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	901	PUFI	2	FM		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	902	VGSW	4	A		FOV	F	
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	903	AMCR	2	FH		BC		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	903	TRES	2	A		FOV	F	
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	906	BARS	1	A		FOV	F	
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	906	RWBL	1	RE		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	906	SOSP	1	SB		SO		
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	907	NRWS	1	A		FOV	F	
4/17/2019	858	908	ED.001	BOARDWALK	COUNTERCLOCKWISE	65	1	0	N	N1	SCOTT MARKOWITZ	908	AMCR	1	A		FOV	BC	

APPENDIX I. COMMUNITY OBSERVATIONS AND PHOTOGRAPHS

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I1. Edmonds Marsh Madness (Flickr) Photos

Wildlife/Scenery

Photo No.:	**1**
Date:	Nov. 11, 2017

Description:
Bald eagle,
Edmonds Marsh
(Credit: David Richman)

Photo No.:	**2**
Date:	Jan. 14, 2019

Description:
Foggy morning
(Credit: Alanna Clare)

Photo No.:	**3**
Date:	Mar. 3, 2019
Description: Anna's hummingbird, Edmonds Marsh (Credit: David Richman)	

Photo No.:	**4**
Date:	Apr. 23, 2018
Description: Ladybug on horsetail, Willow Creek fish hatchery (Credit: Thai Do)	

Photo No.:	**5**
Date:	Apr. 29, 2018

Description:
Black-capped chickadee and cattail,
Edmonds Marsh
(Credit: Charlotte Byers)

Photo No.:	**6**
Date:	Aug. 1, 2018

Description:
Woodland skipper,
Edmonds Marsh
(Credit: David Richman)

Photo No.:	**7**
Date:	Aug. 23, 2018
Description: Juvenile eagle (Credit: Jennifer Love)	

Photo No.:	**8**
Date:	Oct. 6, 2018
Description: Northern harrier, Edmonds Marsh (Credit: Charlotte Byers)	

Photo No.:	**9**
Date:	Nov. 1, 2018
Description: Western tanager female in tree, Edmonds Marsh (Credit: David Richman)	

Photo No.:	**10**
Date:	Jan. 5, 2019
Description: Bushtit male, Edmonds Marsh (Credit: Charlotte Byers)	

Photo No.:	**11**
Date:	Feb. 5, 2019
Description: Snow in Edmonds Marsh (Credit: Charlotte Byers)	

Photo No.:	**12**
Date:	Feb. 5, 2019
Description: Edmonds Marsh and Point Edwards (Credit: Charlotte Byers)	

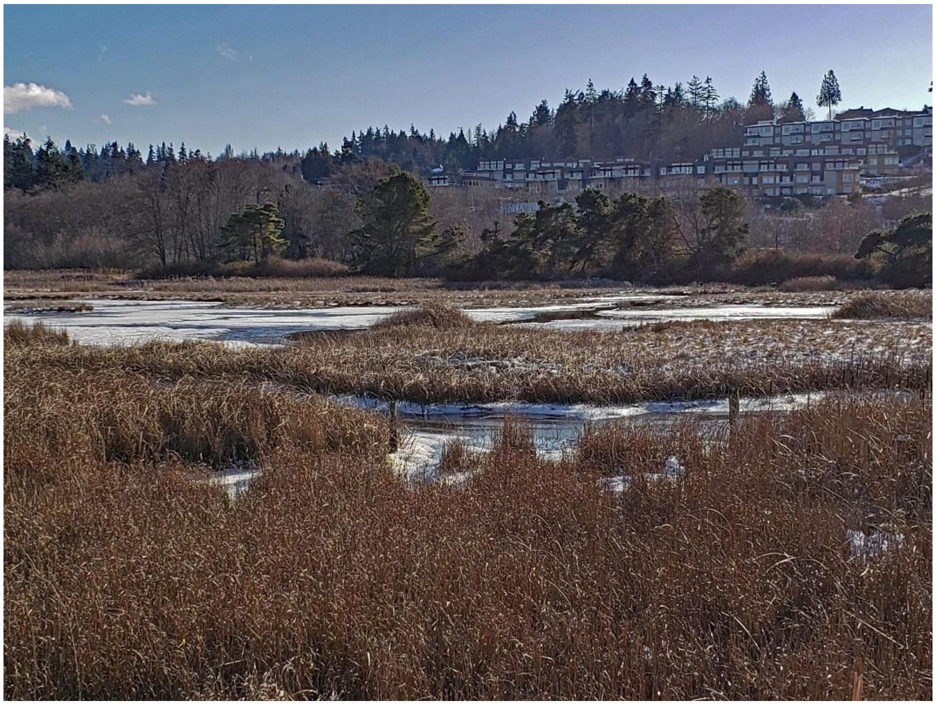


Photo No.:	**13**
Date:	Feb. 9, 2019

Description:
Edmonds Marsh in the snow
(Credit: Charlotte Byers)

Photo No.:	**14**
Date:	Feb. 20, 2019

Description:
Canada geese pair, Edmonds Marsh
(Credit: David Richman)

Photo No.:	**15**
Date:	Feb. 21, 2019

Description:
Downy woodpecker female,
Edmonds Marsh
(Credit: David Richman)

Photo No.:	**16**
Date:	Feb. 23, 2019

Description:
American robin on grass,
Edmonds Marsh
(Credit: David Richman)

Photo No.:	**17**
Date:	Mar. 14, 2019

Description:
Brown creeper
(Credit: Charlotte Byers)

Photo No.:	**18**
Date:	Mar. 21, 2019

Description:
Herons in Edmonds Marsh
(Credit: David Matthews)

Photo No.:	**19**
Date:	Mar. 21, 2019
Description: Hooded merganser, Edmonds Marsh (Credit: David Richman)	

Photo No.:	**20**
Date:	Mar. 25, 2019
Description: Mallard and Canada goose, Edmonds Marsh (Credit: David Richman)	

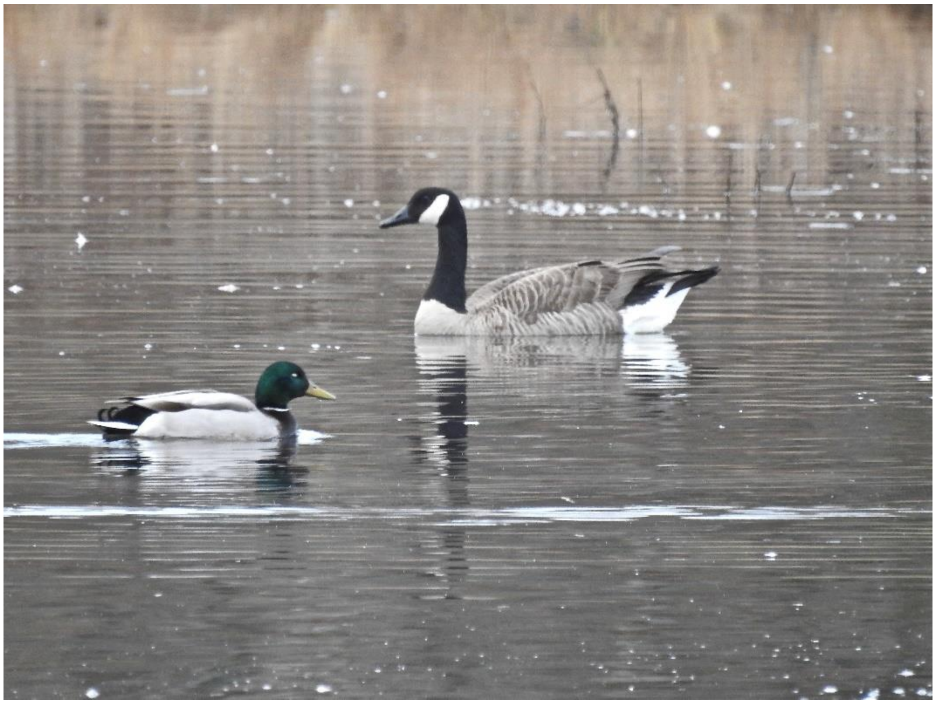


Photo No.:	**21**	
Date:	May 3, 2019	
Description: Dragonfly (Credit: David Richman)		

Photo No.:	**22**	
Date:	May 10, 2019	
Description: Common yellowthroat, male, Edmonds Marsh (Credit: David Richman)		

Photo No.:	**23**
Date:	May 10, 2019
Description: Butterfly (Credit: David Richman)	

Photo No.:	**24**
Date:	May 31, 2019
Description: Mallard ballet (Credit: Charlotte Byers)	

Photo No.:	**25**
Date:	Jun. 5, 2019
Description: Canada geese and brood, Edmonds Marsh (Credit: David Richman)	

Photo No.:	**26**
Date:	Jun. 6, 2019
Description: Mallard ducklings, Edmonds Marsh (Credit: David Richman)	

Photo Points

Photo No.:	**27**
Date:	Oct. 10, 2018

Description:

Photo point C looking east

(Credit: David Matthews)

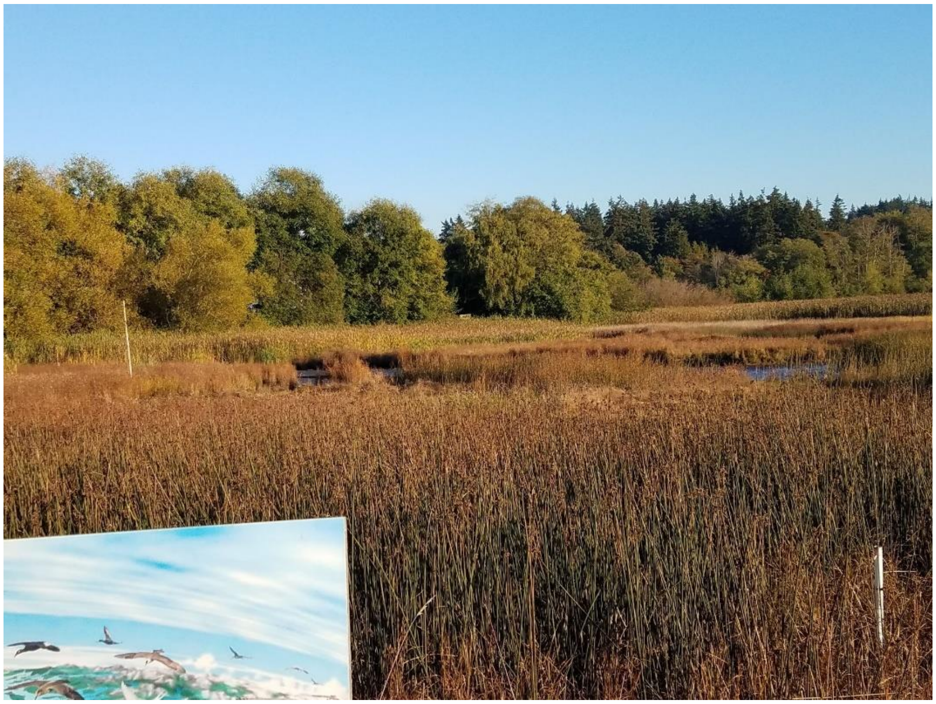


Photo No.:	**28**
Date:	Oct. 10, 2018

Description:

Photo point C looking southeast

(Credit: David Matthews)

Photo No.:	**29**
Date:	Oct. 10, 2018

Description:

Photo point C looking southwest

(Credit: David Matthews)

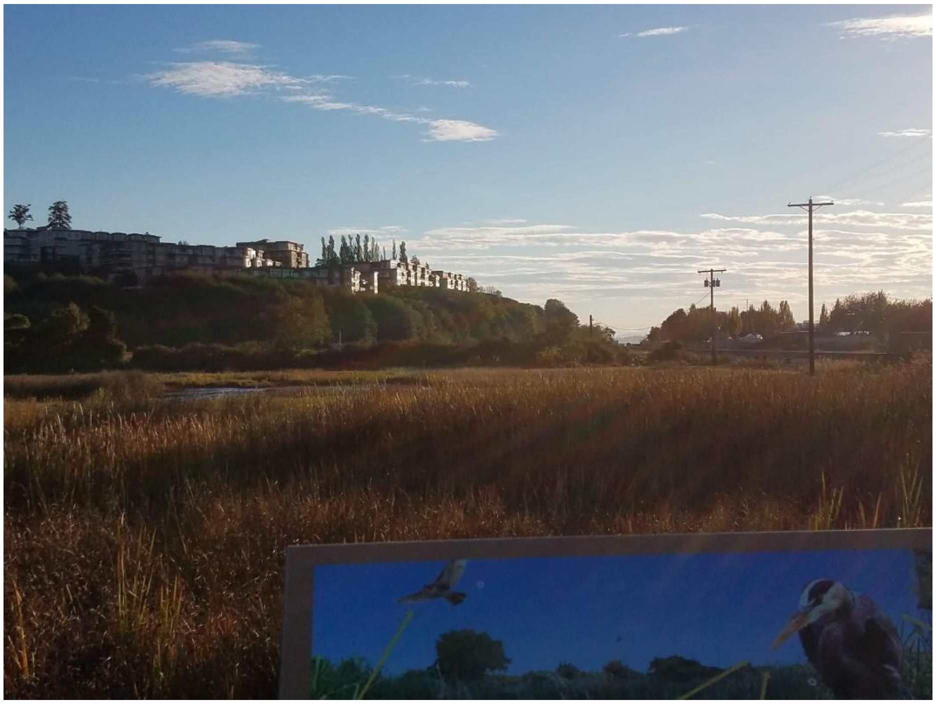


Photo No.:	**30**
Date:	Oct. 10, 2018

Description:

Photo point D looking southeast

(Credit: David Matthews)

Photo No.:	**31**
Date:	Oct. 10, 2018

Description:

Photo point D looking southwest

(Credit: David Matthews)

Photo No.:	**32**
Date:	Oct. 10, 2018

Description:

Photo point D looking southwest

(Credit: David Matthews)

Photo No.:	**33**
Date:	Oct. 10, 2018

Description:
Photo point D looking west
(Credit: David Matthews)

Photo No.:	**34**
Date:	Oct. 10, 2018

Description:
Photo point D looking west
(Credit: David Matthews)

Photo No.:	**35**
Date:	Oct. 10, 2018

Description:

Photo point E looking southeast

(Credit: David Matthews)

Photo No.:	**36**
Date:	Oct. 10, 2018

Description:

Photo point E looking southwest

(Credit: David Matthews)

Photo No.:	**37**
Date:	Oct. 10, 2018

Description:

Photo point F looking southeast

(Credit: David Matthews)

Photo No.:	**38**
Date:	Oct. 10, 2018

Description:

Photo point F looking southwest

(Credit: David Matthews)

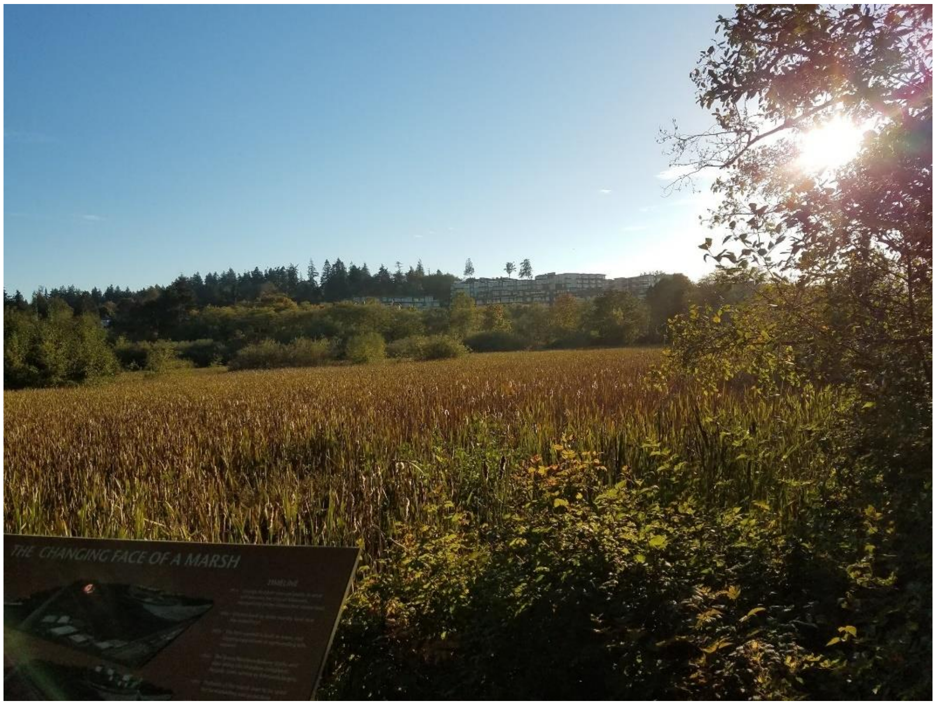


Photo No.:	**39**
Date:	Oct. 23, 2018
Description: Photo point C looking southwest (Credit: David Matthews)	

Photo No.:	**40**
Date:	Oct. 23, 2018
Description: Photo point C looking south (Credit: David Matthews)	

Photo No.:	**41**
Date:	Oct. 23, 2018
Description: Photo point C looking southeast (Credit: David Matthews)	

Photo No.:	**42**
Date:	Oct. 23, 2018
Description: Photo point D looking southwest (Credit: David Matthews)	

Photo No.:	**43**
Date:	Oct. 23, 2018

Description:

Photo point D looking south

(Credit: David Matthews)

Photo No.:	**44**
Date:	Oct. 23, 2018

Description:

Photo point D looking southeast

(Credit: David Matthews)

Photo No.:	**45**
Date:	Oct. 23, 2018

Description:

Photo point E looking southwest

(Credit: David Matthews)

Photo No.:	**46**
Date:	Oct. 23, 2018

Description:

Photo point E looking southeast

(Credit: David Matthews)

Photo No.:	**47**
Date:	Nov. 6, 2018

Description:

Photo point F looking southwest

(Credit: David Matthews)

Photo No.:	**48**
Date:	Nov. 6, 2018

Description:

Photo point F looking southeast

(Credit: David Matthews)

Photo No.:	**49**
Date:	Nov. 6, 2018
Description: Photo point D looking west (Credit: David Matthews)	

Photo No.:	**50**
Date:	Nov. 6, 2018
Description: Photo point E looking southeast (Credit: David Matthews)	

Photo No.:	51
Date:	Nov. 6, 2018
Description: Photo point D looking southwest (Credit: David Matthews)	

Photo No.:	52
Date:	Nov. 6, 2018
Description: Photo point D looking south (Credit: David Matthews)	

Photo No.:	**53**	
Date:	Nov. 6, 2018	
Description: Photo point D looking southeast (Credit: David Matthews)		

Photo No.:	**54**	
Date:	Nov. 6, 2018	
Description: Photo point C looking southwest (Credit: David Matthews)		

Photo No.:	**55**
Date:	Nov. 6, 2018

Description:

Photo point C looking south

(Credit: David Matthews)

Photo No.:	**56**
Date:	Nov. 6, 2018

Description:

Photo point C looking southeast

(Credit: David Matthews)

Photo No.:	**57**	
Date:	Jan. 11, 2019	
Description: Photo point C looking southeast (Credit: Alanna Clare)		

Photo No.:	**58**	
Date:	Feb. 5, 2019	
Description: Photo point F looking southeast (Credit: David Matthews)		

Photo No.:	**59**
Date:	Feb. 5, 2019
Description: Photo point F looking southeast (Credit: David Matthews)	

Photo No.:	**60**
Date:	Feb. 5, 2019
Description: Photo point F looking southwest (Credit: David Matthews)	

Photo No.:	**61**
Date:	Feb. 5, 2019
Description: Photo point C looking south (Credit: David Matthews)	

Photo No.:	**62**
Date:	Feb. 5, 2019
Description: Photo point C looking southeast (Credit: David Matthews)	

Photo No.:	**63**
Date:	Feb. 5, 2019

Description:
Photo point C looking east
(Credit: David Matthews)

Photo No.:	**64**
Date:	Feb. 5, 2019

Description:
Photo point E looking southwest
(Credit: David Matthews)

Photo No.:	**65**	
Date:	Feb. 5, 2019	
Description: Photo point E looking south (Credit: David Matthews)		

Photo No.:	**66**	
Date:	Feb. 5, 2019	
Description: Photo point E looking southeast (Credit: David Matthews)		

Photo No.:	**67**
Date:	Feb. 5, 2019
Description: Photo point D looking west (Credit: David Matthews)	

Photo No.:	**68**
Date:	Feb. 5, 2019
Description: Photo point D looking southwest (Credit: David Matthews)	

Photo No.:	**69**	
Date:	Feb. 5, 2019	
Description: Photo point D looking southeast (Credit: David Matthews)		

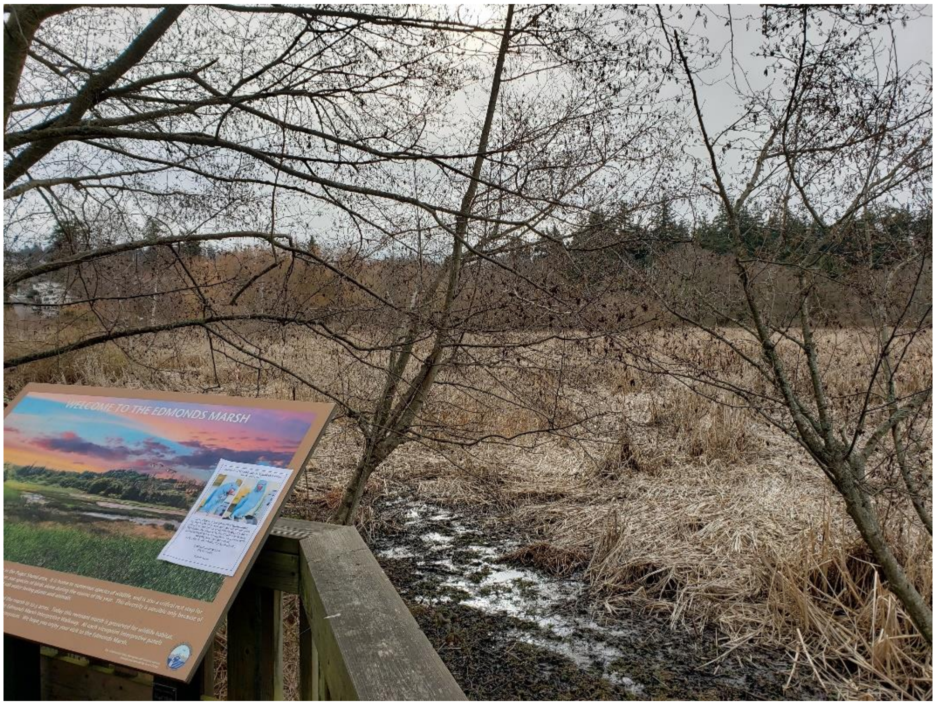
Photo No.:	**70**	
Date:	Mar. 14, 2019	
Description: Photo point F looking southeast (Credit: David Matthews)		

Photo No.:	**71**	
Date:	Mar. 14, 2019	
Description: Photo point F looking south (Credit: David Matthews)		

Photo No.:	**72**	
Date:	Mar. 14, 2019	
Description: Photo point F looking southwest (Credit: David Matthews)		

Photo No.:	**73**
Date:	Mar. 14, 2019
Description: Photo point E looking southeast (Credit: David Matthews)	

Photo No.:	**74**
Date:	Mar. 14, 2019
Description: Photo point E looking southwest (Credit: David Matthews)	

Photo No.:	**75**
Date:	Mar. 14, 2019
Description: Photo point S looking southeast (Credit: David Matthews)	

Photo No.:	**76**
Date:	Mar. 14, 2019
Description: Photo point D looking south (Credit: David Matthews)	

Photo No.:	**77**
Date:	Mar. 14, 2019

Description:

Photo point D looking southwest

(Credit: David Matthews)

Photo No.:	**78**
Date:	Mar. 14, 2019

Description:

Photo point C looking east

(Credit: David Matthews)

Photo No.:	**79**
Date:	Mar. 14, 2019
Description: Photo point C looking southeast (Credit: David Matthews)	

Photo No.:	**80**
Date:	Mar. 14, 2019
Description: Photo point C looking south (Credit: David Matthews)	

Photo No.:	81
Date:	May 10, 2019

Description:

Photo point D looking southwest

(Credit: David Matthews)

Photo No.:	82
Date:	May 10, 2019

Description:

Photo point D looking south

(Credit: David Matthews)

Photo No.: 83

Date: May 10, 2019

Description:

Photo point D looking southeast

(Credit: David Matthews)

Photo No.: 84

Date: May 10, 2019

Description:

Photo point E looking southwest

(Credit: David Matthews)

Photo No.:	**85**
Date:	May 10, 2019
Description: Photo point E looking south (Credit: David Matthews)	

Photo No.:	**86**
Date:	May 10, 2019
Description: Photo point F looking southwest (Credit: David Matthews)	

Photo No.:	**87**
Date:	May 10, 2019
Description: Photo point F looking southeast (Credit: David Matthews)	

I2. Wildlife and Marshscape Photos

All photos in this photolog were taken by Edmonds, Washington, photographer Bill Anderson and are included herein with his permission. All of the wildlife photos were taken between January 2018 and May 2019; the “marshscapes” photos, which show scenes from the Edmonds Marsh at different points in time, were taken in 2013, 2016, 2018, and 2019. The purpose of including photos of the Edmonds Marsh taken before initiation of the baseline study in 2018 is to help identify changes in the marshscape over time.

Birds

Photo No.:	**1**
Date:	Jan. 10, 2018

Description:

Pair of green-winged teals

(Credit: Bill Anderson)

Photo No.:	**2**
Date:	Jan. 10, 2018

Description:

Killdeer

(Credit: Bill Anderson)

Photo No.:	**3**
Date:	Jan. 12, 2018

Description:
Great blue heron, single
(Credit: Bill Anderson)

Photo No.:	**4**
Date:	Jan. 12, 2018

Description:
Great blue heron, group
(Credit: Bill Anderson)

Photo No.:	**5**
Date:	Jan. 18, 2018

Description:
Anna’s hummingbird
(Credit: Bill Anderson)

Photo No.:	**6**
Date:	Jan. 27, 2018

Description:
Canada geese in flight
(Credit: Bill Anderson)

Photo No.:	**7**	
Date:	Jan. 31, 2018	
Description: Female hooded merganser (Credit: Bill Anderson)		

Photo No.:	**8**	
Date:	Feb. 09, 2018	
Description: Juvenile Cooper's hawk (Credit: Bill Anderson)		

Photo No.:	**9**
Date:	Feb. 09, 2018

Description:
Red-tailed hawk
(Credit: Bill Anderson)

Photo No.:	**10**
Date:	Feb. 13, 2018

Description:
Ruby-crowned kinglet, Willow Creek Hatchery
(Credit: Bill Anderson)

Photo No.:	11
Date:	Feb. 15, 2018

Description:
Herons in flight
(Credit: Bill Anderson)

Photo No.:	12
Date:	Feb. 15, 2018

Description:
Yellow-rumped warbler, near tennis courts
(Credit: Bill Anderson)

Photo No.:	**13**
Date:	Feb. 22, 2018

Description:
Anna’s hummingbird
(Credit: Bill Anderson)

Photo No.:	**14**
Date:	Mar. 03, 2018

Description:
Merlin
(Credit: Bill Anderson)

Photo No.:	**15**
Date:	Mar. 03, 2018

Description:
Juvenile Cooper's hawk
(Credit: Bill Anderson)

Photo No.:	**16**
Date:	Mar. 03, 2018

Description:
Hooded mergansers
(Credit: Bill Anderson)

Photo No.:	**17**
Date:	Mar. 06, 2018

Description:
Bushtit
(Credit: Bill Anderson)

Photo No.:	**18**
Date:	Mar. 09, 2018

Description:
Dark-eyed junco
(Credit: Bill Anderson)

Photo No.:	**19**
Date:	Mar. 09, 2018
Description: Golden-crowned sparrow (Credit: Bill Anderson)	

Photo No.:	**20**
Date:	Mar. 09, 2018
Description: Bewick's wren (Credit: Bill Anderson)	

Photo No.:	**21**
Date:	Mar. 09, 2018
Description: Yellow-rumped warbler (Credit: Bill Anderson)	

Photo No.:	**22**
Date:	Mar. 10, 2018
Description: Marsh wren (Credit: Bill Anderson)	

Photo No.:	**23**
Date:	Mar. 15, 2018

Description:

Black-capped chickadee eating larva out of cattail

(Credit: Bill Anderson)

Photo No.:	**24**
Date:	Mar. 21, 2018

Description:

Anna’s hummingbird drinking from red-flowering currant

(Credit: Bill Anderson)

Photo No.:	**25**
Date:	Mar. 24, 2018

Description:
Song sparrow
(Credit: Bill Anderson)

Photo No.:	**26**
Date:	Mar. 24, 2018

Description:
Spotted towhee
(Credit: Bill Anderson)

Photo No.:	**27**
Date:	Mar. 24, 2018

Description:
Red-winged blackbird
(Credit: Bill Anderson)

Photo No.:	**28**
Date:	Mar. 27, 2018

Description:
Wilson’s snipe
(Credit: Bill Anderson)

Photo No.:	**29**
Date:	Mar. 30, 2018
Description: Marsh wren (Credit: Bill Anderson)	

Photo No.:	**30**
Date:	Mar. 31, 2018
Description: Marsh wren gathering fluff (Credit: Bill Anderson)	

Photo No.:	**31**
Date:	Apr. 02, 2018

Description:
Downy woodpecker
(Credit: Bill Anderson)

Photo No.:	**32**
Date:	Apr. 12, 2018

Description:
Bushtit gathering nest material
(Credit: Bill Anderson)

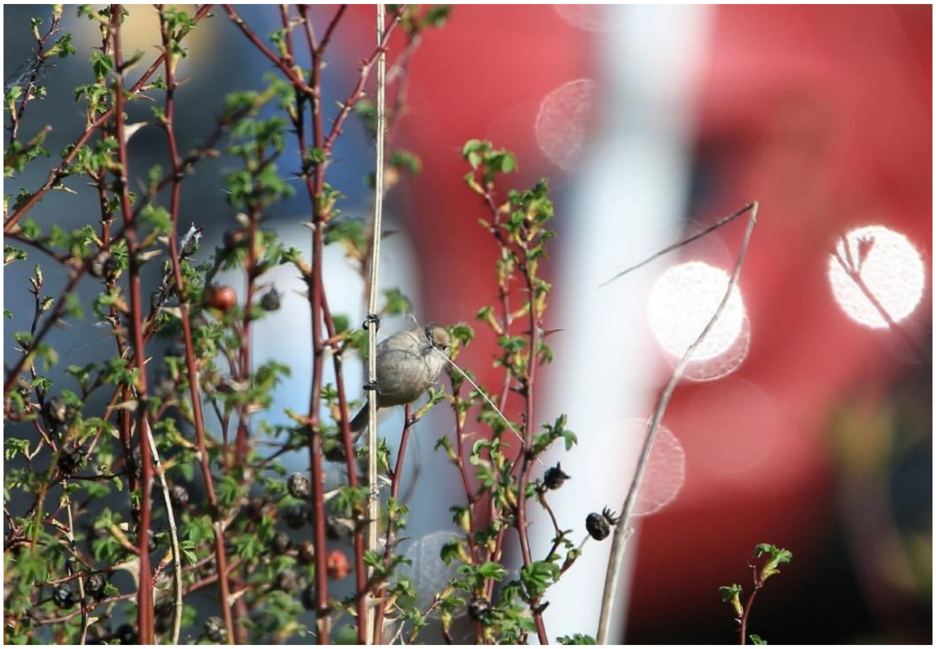


Photo No.:	**33**
Date:	Apr. 19, 2018
Description: Bushtit gathering cattail fuzz (Credit: Bill Anderson)	

Photo No.:	**34**
Date:	Apr. 23, 2018
Description: Least sandpipers and song sparrow (Credit: Bill Anderson)	

Photo No.:	**35**
Date:	Apr. 23, 2018
Description: Mother mallard with ducklings (Credit: Bill Anderson)	

Photo No.:	**36**
Date:	Apr. 23, 2018
Description: Marsh wren gathering nesting material (Credit: Bill Anderson)	

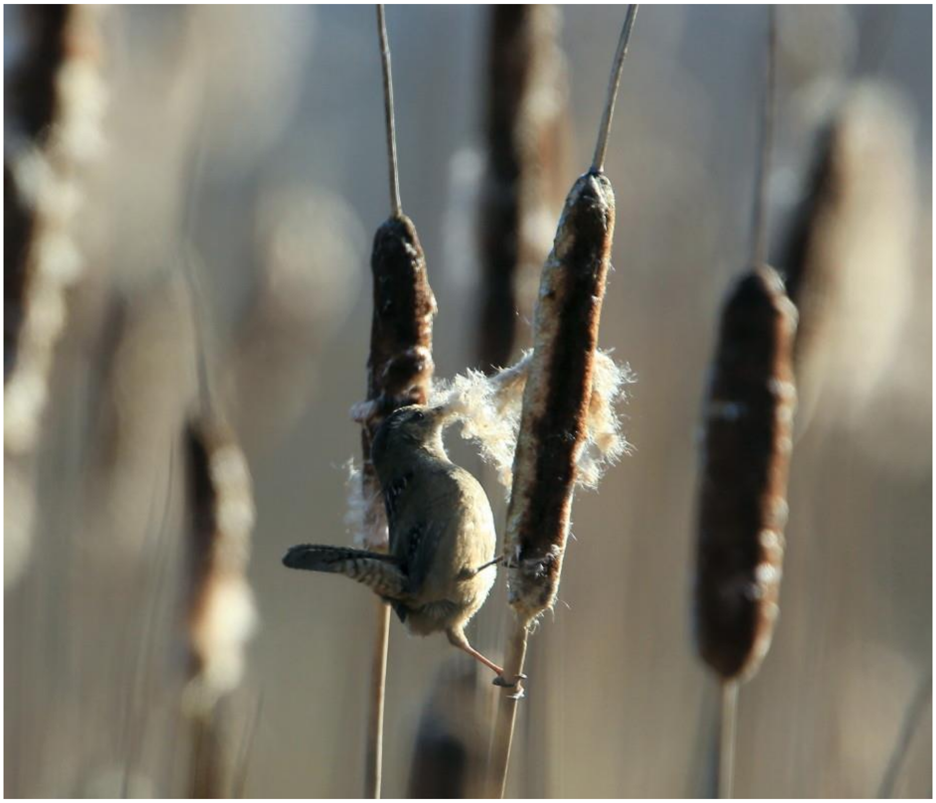


Photo No.:	**37**
Date:	Apr. 24, 2018
Description: Anna's hummingbird drinking from red-flowering currant in north buffer zone (Credit: Bill Anderson)	

Photo No.:	**38**
Date:	Apr. 27, 2018
Description: Sandpiper flock (Credit: Bill Anderson)	

Photo No.:	**39**
Date:	Apr. 27, 2018

Description:

Black-capped chickadee with larva on nest box

(Credit: Bill Anderson)

Photo No.:	**40**
Date:	Apr. 30, 2018

Description:

Crow on nest box

(Credit: Bill Anderson)

Photo No.:	**41**
Date:	May 06, 2018

Description:
Sandpipers and semi-palmated plovers
(Credit: Bill Anderson)

Photo No.:	**42**
Date:	May 06, 2018

Description:
Virginia rail
(Credit: Bill Anderson)

Photo No.:	**43**
Date:	May 12, 2018

Description:
Canada geese with goslings
(Credit: Bill Anderson)

Photo No.:	**44**
Date:	May 14, 2018

Description:
Wilson’s phalaropes
(Credit: Bill Anderson)

Photo No.:	**45**
Date:	May 18, 2018
Description: Blue-winged teal (Credit: Bill Anderson)	

Photo No.:	**46**
Date:	May 18, 2018
Description: Violet-green swallow pair at nest box (Credit: Bill Anderson)	

Photo No.:	**47**
Date:	May 18, 2018
Description: Black-capped chickadees at nest box (Credit: Bill Anderson)	

Photo No.:	**48**
Date:	May 18, 2018
Description: American goldfinches (Credit: Bill Anderson)	

Photo No.:	**49**
Date:	May 26, 2018

Description:
Rough-winged swallows
(Credit: Bill Anderson)

Photo No.:	**50**
Date:	May 26, 2018

Description:
Violet-green swallow at nest box
(Credit: Bill Anderson)

Photo No.:	51	
Date:	May 26, 2018	
Description: Mourning dove and cedar waxwings (Credit: Bill Anderson)		

Photo No.:	52	
Date:	Jun. 12, 2018	
Description: Robin with salmonberry (Credit: Bill Anderson)		

Photo No.:	**53**
Date:	Jun. 25, 2018

Description:

Juvenile red-winged blackbirds

(Credit: Bill Anderson)

Photo No.:	**54**
Date:	Jul. 04, 2018

Description:

Sandpipers

(Credit: Bill Anderson)

Photo No.:	55
Date:	Jul. 09, 2018
Description: Least sandpipers (Credit: Bill Anderson)	

Photo No.:	56
Date:	Jul. 10, 2018
Description: Least sandpiper, long-billed dowitcher, and pectoral sandpiper (left to right) (Credit: Bill Anderson)	

Photo No.:	**57**
Date:	Jul. 15, 2018
Description: Belted kingfisher (Credit: Bill Anderson)	

Photo No.:	**58**
Date:	Jul. 18, 2018
Description: Spotted sandpiper and chick (Credit: Bill Anderson)	

Photo No.:	**59**
Date:	Jul. 27, 2018
Description: Spotted sandpiper chick spreading wings (Credit: Bill Anderson)	

Photo No.:	**60**
Date:	Aug. 10, 2018
Description: Greater yellowlegs (Credit: Bill Anderson)	

Photo No.:	**61**
Date:	Aug. 11, 2018
Description: Marsh wren with cricket (Credit: Bill Anderson)	

Photo No.:	**62**
Date:	Aug. 12, 2018
Description: Cooper's hawk (Credit: Bill Anderson)	

Photo No.:	**63**
Date:	Aug. 21, 2018

Description:
Baird's sandpipers
(Credit: Bill Anderson)

Photo No.:	**64**
Date:	Sep. 16, 2018

Description:
American wigeons
(Credit: Bill Anderson)

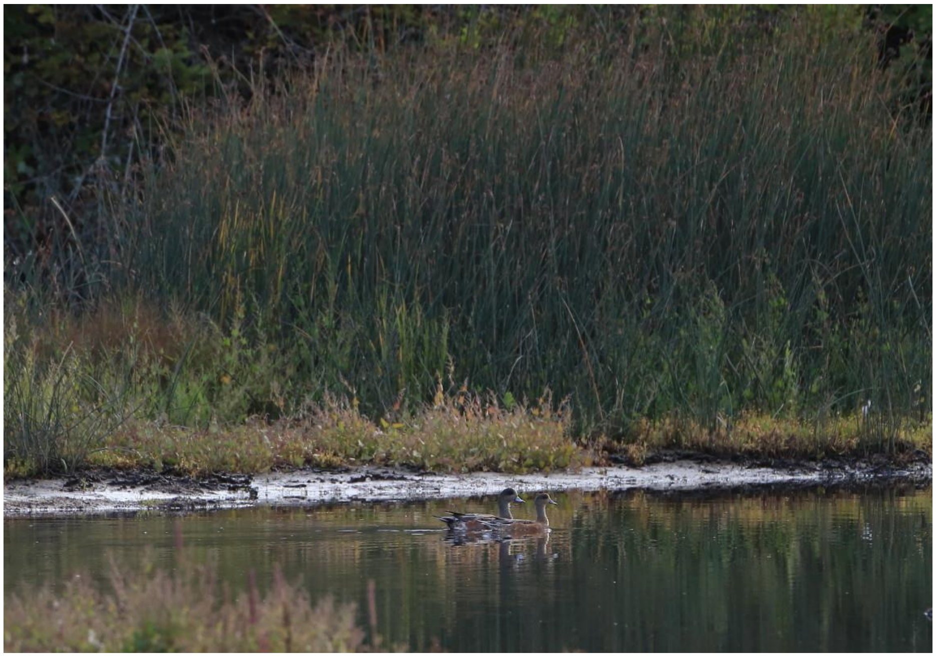


Photo No.:	**65**
Date:	Sep. 24, 2018

Description:
Savannah sparrow
(Credit: Bill Anderson)

Photo No.:	**66**
Date:	Sep. 25, 2018

Description:
Western scrub jay
(Credit: Bill Anderson)

Photo No.:	**67**
Date:	Oct. 04, 2018

Description:
Merlin hunting
(Credit: Bill Anderson)

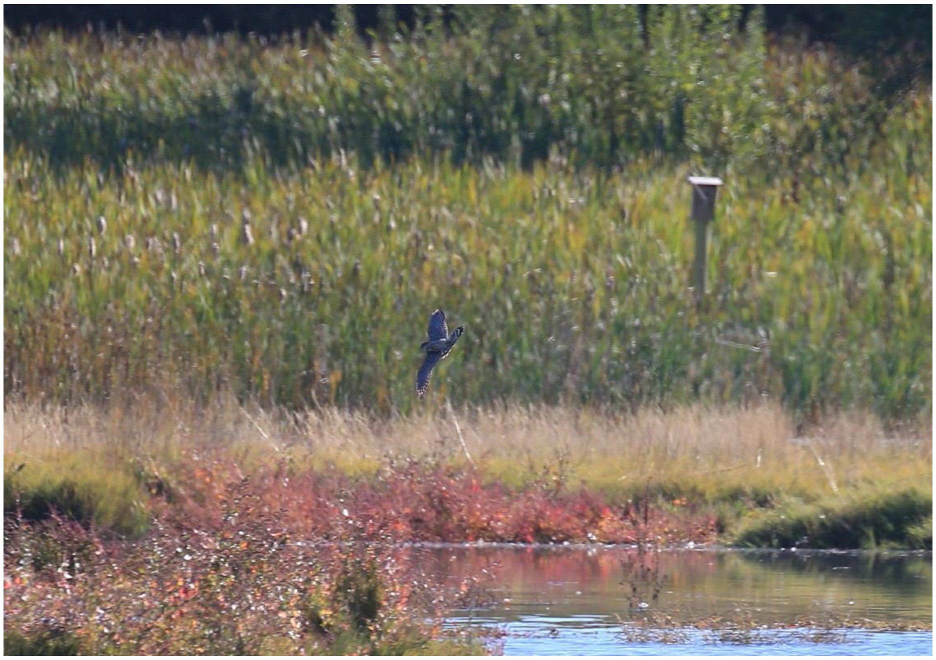


Photo No.:	**68**
Date:	Oct. 06, 2018

Description:
Northern harrier
(Credit: Bill Anderson)

Photo No.:	**69**
Date:	Oct. 06, 2018
Description: American goldfinch (Credit: Bill Anderson)	

Photo No.:	**70**
Date:	Oct. 7, 2018
Description: Bald eagle, Willow Creek Hatchery (Credit: Bill Anderson)	

Photo No.:	**71**
Date:	Oct. 12, 2018
Description: Yellow-rumped warbler (Credit: Bill Anderson)	

Photo No.:	**72**
Date:	Oct. 13, 2018
Description: Herons in north buffer zone trees (Credit: Bill Anderson)	

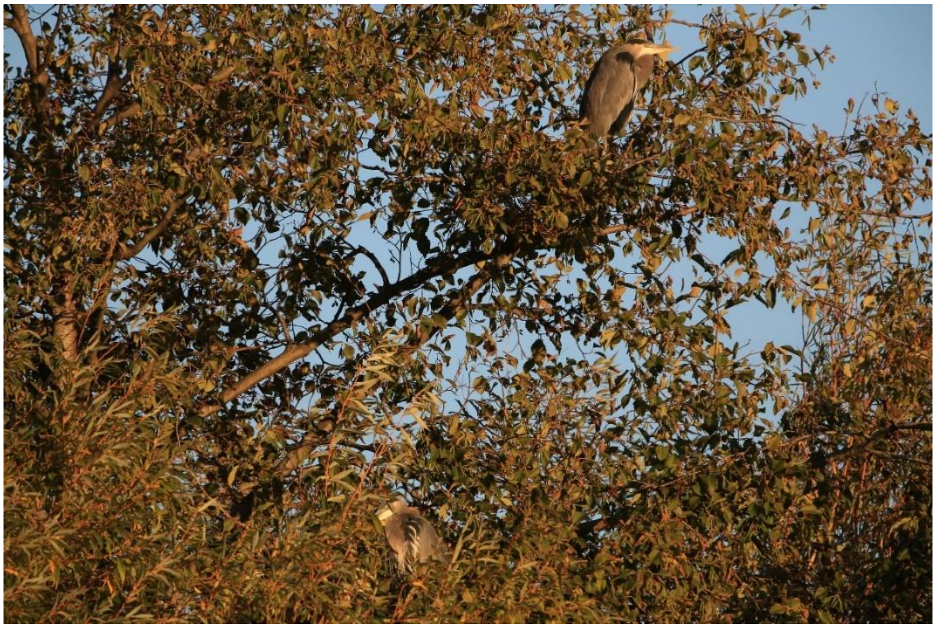


Photo No.:	**73**
Date:	Oct. 14, 2018
Description: Northern shrike (Credit: Bill Anderson)	

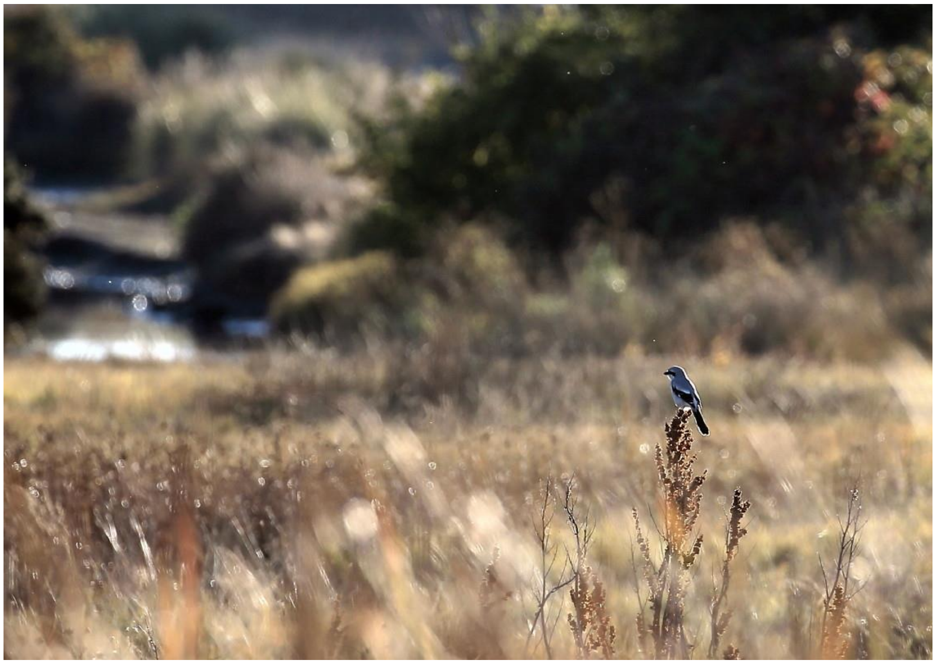


Photo No.:	**74**
Date:	Oct. 30, 2018
Description: Bald eagle coming in for landing (Credit: Bill Anderson)	

Photo No.:	**75**
Date:	Oct. 30, 2018
Description: Bald eagle taking a drink (Credit: Bill Anderson)	

Photo No.:	**76**
Date:	Oct. 31, 2018
Description: Wilson’s snipe (Credit: Bill Anderson)	

Photo No.:	**77**
Date:	Nov. 6, 2018
Description: Greater white-fronted goose (Credit: Bill Anderson)	

Photo No.:	**78**
Date:	Nov. 13, 2018
Description: Red-winged blackbirds eating pine cone seeds (Credit: Bill Anderson)	

Photo No.:	**79**
Date:	Nov. 14, 2018

Description:
Red-tailed hawk
(Credit: Bill Anderson)

Photo No.:	**80**
Date:	May 09, 2019

Description:
Tree swallow at nest box
(Credit: Bill Anderson)

Other Wildlife

Photo No.:	**80**
Date:	May 15, 2018
Description: Coyote (Credit: Bill Anderson)	

Photo No.:	**81**
Date:	May 15, 2018
Description: Coyote (Credit: Bill Anderson)	

Photo No.:	**82**
Date:	May 15, 2018 May 15, 2018

Description:
Coyote
(Credit: Bill Anderson)

Photo No.:	**83**
Date:	May 15, 2018

Description:
Coyote
(Credit: Bill Anderson)

Photo No.:	**84**
Date:	May 15, 2018
Description: Coyote (Credit: Bill Anderson)	

Photo No.:	**85**
Date:	May 15, 2018
Description: Coyote (Credit: Bill Anderson)	

Photo No.:	86
Date:	May 15, 2018

Description:
Coyote
(Credit: Bill Anderson)

Photo No.:	87
Date:	May 15, 2018

Description:
Coyote
(Credit: Bill Anderson)

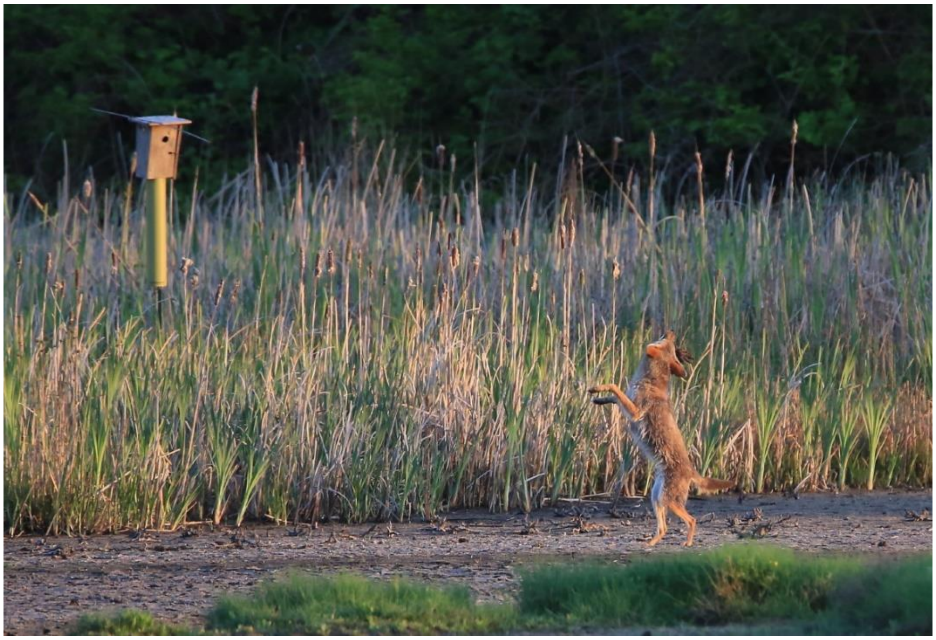


Photo No.:	**88**
Date:	May 15, 2018

Description:
Coyote
(Credit: Bill Anderson)

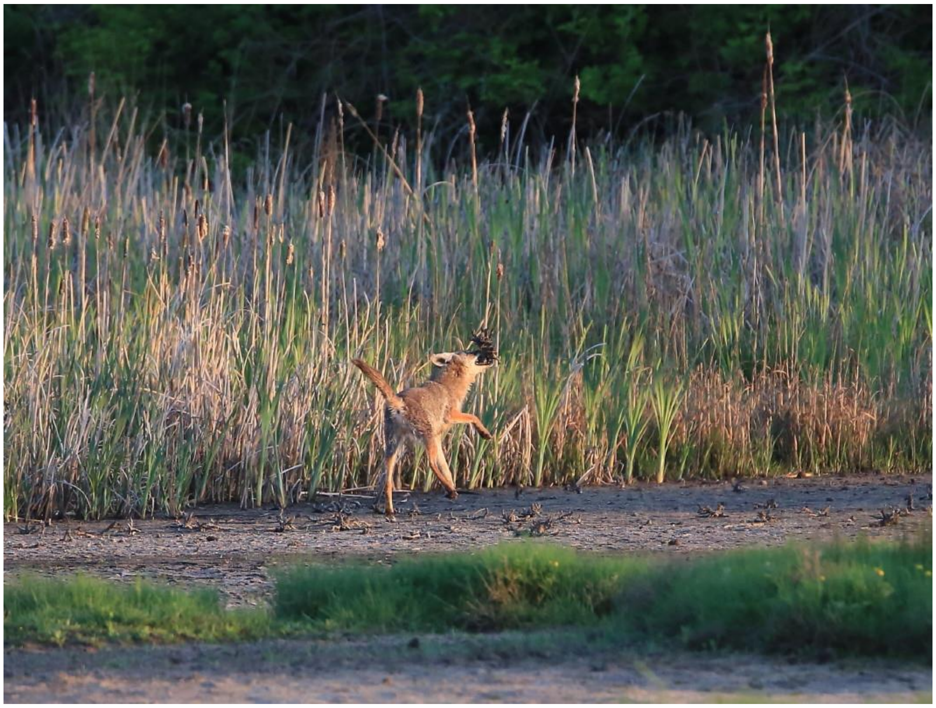


Photo No.:	**89**
Date:	May 15, 2018

Description:
Coyote
(Credit: Bill Anderson)

Photo No.:	**90**
Date:	May 15, 2018

Description:

Coyote

(Credit: Bill Anderson)

Marshscapes

Photo No.:	**91**
Date:	Dec. 08, 2013

Description:

Marshscape, view to the southeast showing marsh interior

(Credit: Bill Anderson)

Photo No.:	**92**
Date:	Dec. 08, 2013

Description:

Marshscape, view to the southwest from the marsh interior

(Credit: Bill Anderson)

Photo No.:	**93**
Date:	Dec. 08, 2013

Description:

Marshscape, view to the west from the marsh interior

(Credit: Bill Anderson)

Photo No.:	**94**
Date:	Dec. 08, 2013

Description:

Marshscape, view to the southwest of the marsh interior

(Credit: Bill Anderson)

Photo No.:	**95**
Date:	Dec. 08, 2013

Description:

Marshscape, view to the southwest showing the marsh interior in the foreground and Willow Creek in the background

(Credit: Bill Anderson)

Photo No.:	**96**
Date:	Nov. 11, 2016

Description:

Marshscape, view to the southeast showing the marsh interior and great blue herons

(Credit: Bill Anderson)

Photo No.:	**97**
Date:	Nov. 29, 2016
Description: Marshscape, view to the southeast (zoomed-in view of Photo No. 96) (Credit: Bill Anderson)	

Photo No.:	**98**
Date:	Nov. 29, 2016
Description: Marshscape, view to the southeast (Credit: Bill Anderson)	

Photo No.:	**99**
Date:	Nov. 29, 2016
Description: Marshscape, view to the south-southeast (Credit: Bill Anderson)	

Photo No.:	**100**
Date:	Nov. 29, 2016
Description: Marshscape, view to the south (Credit: Bill Anderson)	

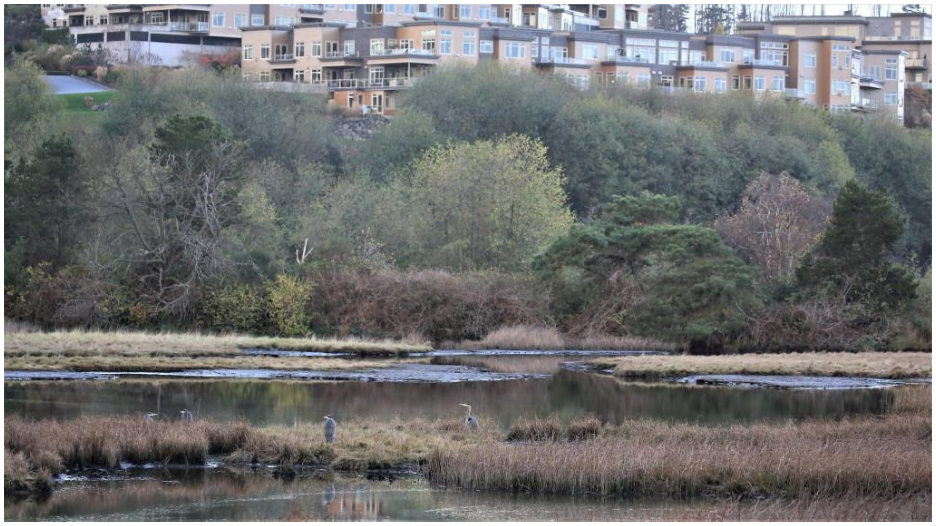


Photo No.:	**101**
Date:	Nov. 30, 2016

Description:

Marshscape, view to the southeast

(Credit: Bill Anderson)

Photo No.:	**102**
Date:	Nov. 30, 2016

Description:

Marshscape, view to the southeast showing much of the marsh interior

(Credit: Bill Anderson)

Photo No.:	**103**
Date:	Nov. 30, 2016

Description:

Marshscape, view to the southeast showing much of the Marsh interior

(Credit: Bill Anderson)

Photo No.:	**104**
Date:	Nov. 30, 2016

Description:

Marshscape, view to the southeast showing much of the Marsh interior

(Credit: Bill Anderson)

Photo No.:	**105**
Date:	Nov. 30, 2016

Description:

Marshscape, view to the east showing Marsh interior and group of great blue herons

(Credit: Bill Anderson)

Photo No.:	**106**
Date:	Dec. 03, 2016

Description:

Marshscape, view to the southwest showing the Marsh interior in the foreground and Willow Creek in the background

(Credit: Bill Anderson)

Photo No.:	**107**
Date:	Dec. 03, 2016

Description:

Marshscape, view to the southwest from the north buffer zone

(Credit: Bill Anderson)

Photo No.:	**108**
Date:	Dec. 03, 2016

Description:

Marshscape showing vegetation patches and group of great blue herons

(Credit: Bill Anderson)

Photo No.:	**109**	
Date:	Dec. 03, 2016	
Description: Marshscape, view to the south (Credit: Bill Anderson)		

Photo No.:	**110**	
Date:	Dec. 03, 2016	
Description: Marshscape, view to the east (Credit: Bill Anderson)		

Photo No.:	**111**
Date:	Dec. 09, 2016

Description:

Marshscape, view to the southeast from wooden boardwalk lookout

(Credit: Bill Anderson)

Photo No.:	**112**
Date:	Dec. 09, 2016

Description:

Marshscape, view to the east-southeast

(Credit: Bill Anderson)

Photo No.:	**113**
Date:	Dec. 09, 2016

Description:

Marshscape, view to the south

(Credit: Bill Anderson)

Photo No.:	**114**
Date:	Dec. 09, 2016

Description:

Marshscape, view to the east

(Credit: Bill Anderson)

Photo No.:	**115**
Date:	Dec. 09, 2016

Description:

Marshscape, view to the south

(Credit: Bill Anderson)

Photo No.:	**116**
Date:	Dec. 09, 2016

Description:

Marshscape, view to the southeast of the northern portion of the Marsh

(Credit: Bill Anderson)

Photo No.:	**117**
Date:	Dec. 09, 2016
Description: Marshscape, view to the southwest (Credit: Bill Anderson)	

Photo No.:	**118**
Date:	Dec. 09, 2016
Description: Marshscape, view to the southwest from the north buffer zone (Credit: Bill Anderson)	

Photo No.:	**119**
Date:	Dec. 09, 2016
Description: Marshscape showing Marsh interior in background and north buffer zone in foreground (Credit: Bill Anderson)	

Photo No.:	**120**
Date:	Dec. 09, 2016
Description: Marshscape, view to the south (Credit: Bill Anderson)	

Photo No.:	**121**
Date:	Dec. 09, 2016

Description:
Marshscape, view to the southwest
(Credit: Bill Anderson)

Photo No.:	**122**
Date:	Dec. 09, 2016

Description:
Marshscape, view to the west showing Marsh interior in foreground and wooden boardwalk and railroad tracks in background
(Credit: Bill Anderson)

Photo No.:	**123**
Date:	June 30, 2018
Description: Marshscape showing northern portion of Marsh interior (Credit: Bill Anderson)	

Photo No.:	**124**
Date:	June 30, 2018
Description: Marshscape, view to the southeast (Credit: Bill Anderson)	

Photo No.:	**125**
Date:	Sept. 2, 2019

Description:

Marshscape showing northern portion of Marsh interior

(Credit: Bill Anderson)

Photo No.:	**126**
Date:	Sept. 2, 2019

Description:

Marshscape, view to the southeast

(Credit: Bill Anderson)

I3. Edmonds Marsh Bird Species

190 Bird Species of Edmonds Marsh
Submitted to Edmonds City Council August 2016

Attached is our list of bird species seen at the Edmonds marsh and surrounding areas that were once part of the original marsh, such as Harbor Square, Willow Creek Hatchery, the Unocal Site, and Point Edwards. Birds are drawn to the peripheral locations because those sites remain part of the marsh biozone, even in their degraded states. The Unocal Site is particularly critical to birds that need a savannah-type habitat to settle in for resting and feeding without disturbance.

Birds on the attached list represent sightings over the past 30 years. A small corps of regular Edmonds birders has maintained documentation of sightings. Those who have contributed sightings to this list look for birds in and around the marsh on an almost daily basis.

We have organized the list by three main categories: resident birds, migratory birds, and rare birds. Each category includes the traditional groupings of bird species. For example, Canada Goose and Mallard are shown under Waterfowl and Red-breasted Sapsucker and Northern Flicker are listed under Woodpeckers.

Residents are year-round birds or species that we can see 4-6 months of the year. Some birds pass through the marsh area as migrants from areas to the south in the Western Hemisphere. Other birds winter in the Puget Lowlands and then go to higher elevations in the mountains or head north to inland lakes to breed. Migratory birds include species that use this location as a rest-and-refuel stop on their way to breeding grounds as well as on their return to southern wintering grounds. Rare birds are not necessarily birds rare to the Puget Lowlands but are rare for this specific site. Rare birds also include species that are rare for Western Washington. These species may be seen infrequently during the year or not seen for multiple years. Some are single bird sightings.

Carol Riddell
Ted Peterson
Edmonds Area Residents
Co-Compilers, Edmonds City Bird Checklist

190 Bird Species of Edmonds Marsh
Submitted to Edmonds City Council August 2016

Resident Birds

Waterfowl

Canada Goose
Gadwall
Mallard
American Wigeon
Green-winged Teal
Ring-necked Duck
Bufflehead
Hooded Merganser

Gallinaceous Birds

California Quail (int)

Loons and Grebes

Pied-billed Grebe

Pelicans and Herons

Double-crested Cormorant
Great Blue Heron

Vultures and Raptors

Bald Eagle
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
Red-tailed Hawk

Rails and Cranes

Virginia Rail
American Coot

Shorebirds

Killdeer
Wilson's Snipe

Gulls and Terns

Glaucous-winged Gull

Doves and Pigeons

Rock Pigeon
Eurasian-collared Dove

Owls

Barred Owl

Hummingbirds

Anna's Hummingbird

Kingfisher

Belted Kingfisher

Woodpeckers

Red-breasted Sapsucker
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
Pileated Woodpecker

Falcons

Merlin
Peregrine Falcon

Vireos

Hutton's Vireo

Corvids

Steller's Jay
American Crow

Larks and Swallows

190 Bird Species of Edmonds Marsh
Submitted to Edmonds City Council August 2016

Purple Martin
Tree Swallow
Violet-green Swallow
Northern Rough-winged Swallow
Barn Swallow

Chickadees and Bushtit

Black-capped Chickadee
Chestnut-backed Chickadee
Bushtit

Nuthatches and Creeper

Red-breasted Nuthatch
Brown Creeper

Wrens

Marsh Wren
Bewick's Wren

Kinglets

Golden-crowned Kinglet
Ruby-crowned Kinglet

Thrushes

Swainson's Thrush
Hermit Thrush
American Robin
Varied Thrush

Starling

European Starling (int)

Longspurs and Warblers

Orange-crowned Warbler
Common Yellowthroat
Yellow-rumped Warbler
Townsend's Warbler
Wilson's Warbler

Sparrows and Tanagers

Spotted Towhee
Fox Sparrow
Song Sparrow
Lincoln's Sparrow
White-crowned Sparrow
Golden-crowned Sparrow
Dark-eyed Junco

Blackbirds and Orioles

Red-winged Blackbird

Finches

House Finch
Purple Finch
Pine Siskin
American Goldfinch
House Sparrow (int)

Migratory Birds

Waterfowl

Greater White-fronted Goose
Cackling Goose
Blue-winged Teal
Cinnamon Teal

Pelicans and Herons

Green Heron

Vultures and Raptors

Turkey Vulture
Osprey

Shorebirds

Semipalmated Plover
Spotted Sandpiper
Greater Yellowlegs

190 Bird Species of Edmonds Marsh
Submitted to Edmonds City Council August 2016

Lesser Yellowlegs
Whimbrel
Dunlin
Baird’s Sandpiper
Least Sandpiper
Pectoral
Semipalmated Sandpiper
Western Sandpiper
Short-billed Dowitcher
Long-billed Dowitcher

Gulls and Terns

Heermann’s Gull
Mew Gull
California Gull
Caspian Tern

Nighthawks and Swifts

Vaux’s Swift

Hummingbirds

Rufous Hummingbird

Flycatchers

Olive-sided Flycatcher
Western Wood-Pewee
Willow Flycatcher
Hammond’s Flycatcher
Pacific-slope Flycatcher

Vireos

Warbling Vireo

Pipits

American Pipit

Longspurs and Warblers

Yellow Warbler
Black-throated Gray Warbler

Sparrows and Tanagers

Savannah Sparrow
Western Tanager
Black-headed Grosbeak

Blackbirds and Orioles

Western Meadowlark
Brown-headed Cowbird
Bullock’s Oriole

Rare Birds

Waterfowl

Trumpeter Swan
Eurasian Wigeon
Northern Pintail
Canvasback
Redhead
Greater Scaup
Lesser Scaup
Common Merganser
Ruddy Duck

Pelicans and Herons

American Bittern
Great Egret
Snowy Egret

Vultures and Raptors

Broad-winged Hawk
Swainson’s Hawk
Rough-legged Hawk

Rails and Cranes

Sora
Sandhill Crane

Shorebirds

190 Bird Species of Edmonds Marsh
Submitted to Edmonds City Council August 2016

Black-necked Stilt
Black-bellied Plover
Solitary Sandpiper
Ruddy Turnstone
Surfbird
Stilt Sandpiper
Sanderling
Wilson’s Phalarope
Red-necked Phalarope

Gulls and Terns

Bonaparte’s Gull
Ring-billed Gull
Thayer’s Gull
Western Gull
Common Tern

Doves and Pigeons

Band-tailed Pigeon
Mourning Dove

Owls

Barn Owl
Snowy Owl
Short-eared Owl

Nighthawks and Swifts

Common Nighthawk
Black Swift

Hummingbirds

Black-chinned Hummingbird

Woodpeckers

Lewis’s Woodpecker

Falcons

American Kestrel
Prairie Falcon

Flycatchers

Greater Pewee
Gray Flycatcher
Dusky Flycatcher
Say’s Phoebe
Western Kingbird
Eastern Kingbird

Shrikes

Northern Shrike

Vireos

Cassin’s Vireo
Red-eyed Vireo

Corvids

California Scrub-Jay
Common Raven

Larks and Swallows

Horned Lark
Bank Swallow
Cliff Swallow

Chickadees and Bushtit

Mountain Chickadee

Wrens

House Wren

Thrushes

Townsend’s Solitaire

Mimids

Sage Thrasher

Northern Mockingbird

Longspurs and Warblers

Lapland Longspur
Nashville Warbler
MacGillivray’s Warbler
Palm Warbler

Sparrows and Tanagers

Chipping Sparrow
Brewer’s Sparrow
Swamp Sparrow
White-throated Sparrow
Harris’s Sparrow

Blackbirds and Orioles

Yellow-headed Blackbird
Brewer’s Blackbird

Finches

Red Crossbill
Common Redpoll
Evening Grosbeak

(int) = introduced species

I4. *A Report on the Insects and Arachnids of Edmonds Marsh* and Associated Photographs

Photo No.:	**1**
Date:	Sept. 5, 2016

Description:

Cross spider (*Araneus diadematus*)

(Credit: David Richman)

Photo No.:	**2**
Date:	July 3, 2017

Description:

Bee wolf wasp (*Philanthus* sp.) on Yarrow, Willow Creek Hatchery Demonstration Garden

(Credit: David Richman)

Photo No.:	**3**
Date:	June 4, 2019

Description:

Black-tailed bumblebee (*Bombus melanopygus*), Willow Creek Hatchery

(Credit: David Richman)

Photo No.:	**4**
Date:	June 11, 2017

Description:

Bubble nest of froghopper nymph (family Cercopidae)

(Credit: David Richman)

Photo No.:	**5**
Date:	May 27, 2019

Description:

Caterpillar of silver-spotted tiger moth (*Lophocampa argentata*)

(Credit: David Richman)

Photo No.:	**6**
Date:	Sept. 10, 2016

Description:

Common whitetail (*Plathemis Lydia*)

(Credit: David Richman)

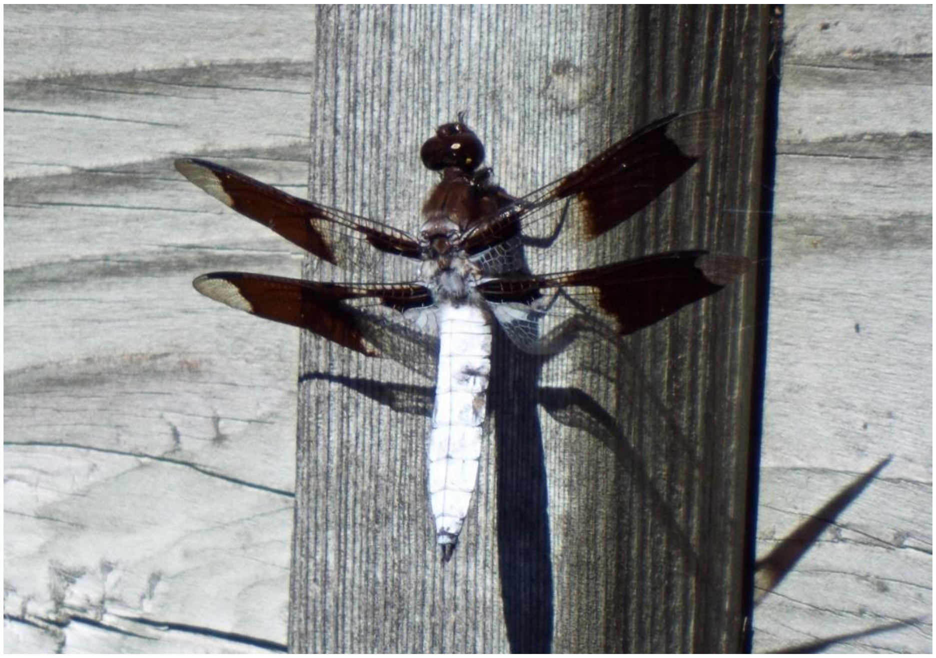


Photo No.:	**7**
Date:	Aug. 12, 2018

Description:

Great golden digger wasp (*Sphex ichneumoneus*)

(Credit: David Richman)

Photo No.:	**8**
Date:	May 27, 2019

Description*:*

Asian lady beetle (*Harmonia axyridis*) eating mealybugs, Willow Creek Hatchery

(Credit: David Richman)

Photo No.:	**9**	
Date:	May 9, 2019	
Description: Harvestman (species undetermined), Willow Creek Hatchery (Credit: David Richman)		

Photo No.:	**10**	
Date:	Aug. 3, 2017	
Description*:* Paddle-tailed darner, (*Aeshna palmata)* (Credit: David Richman)		

Photo No.:	**11**
Date:	June 25, 2017
Description*:* Western tiger swallowtail (*Papilio rutulus*) (Credit: David Richman)	

Photo No.:	**12**
Date:	July 20, 2018
Description*:* Yellow-faced bumblebee (*Bombus vosnesenskii*) on thistle (Credit: David Richman)	

Photo No.:	13
Date:	June 21, 2017

Description:

Zebra spider (*Salticus scenicus*)

(Credit: David Richman)

Photo No.:	14
Date:	July 6, 2013

Description:

Zephyr angelwing butterfly (*Polygonia zephyrus*)

(Credit: Alan Mearnes)

Photo No.:	**15**
Date:	July 12, 2018

Description:

Great golden digger wasp *(Sphex ichneumoneus*),

Willow Creek Hatchery

(Credit: David Richman)

Photo No.:	**16**
Date:	May 10, 2019

Painted lady butterfly (*Vanessa cardui*), Willow Creek Hatchery

(Credit: David Richman)

Photo No.:	**17**	
Date:	Oct. 13, 2018	
Description: Striped meadowhawk (*Sympetrum pallipes*) (Credit:Bill Anderson)		

A REPORT ON THE INSECTS AND ARACHNIDS OF EDMONDS MARSH

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Over the last three years I have been accumulating observations and photographs of the arthropods associated with the Edmonds Marsh. I have limited this inquiry to what I could observe so as to disturb the area as little as possible. This does pose some limitations and the documentation that I have done is thus very incomplete and totally dependent on chance. Despite this I hope to at least give some indication of the underlying complexity of this important phylum. I believe that a thorough census of the arthropod fauna would include at least 500 species, and my ca. 50 species is thus only about 10%. This is not an exaggeration as Frank E. Lutz found 1500 species of insects in his suburban yard in New York City (See: *A Lot of Insects* published in 1941). The arthropods found in the Marsh, Willow Creek, and nearby areas form part of the necessary basis of the food web that supports fish, reptiles, amphibians, birds and mammals. They also provide pollination services for the seed plants and these are also part of the vital food web of the Marsh. Thus the arthropods are far from unimportant to what we consider wildlife, and in fact are part of the wildlife of the Marsh. The more obvious and larger arthropods include dragonflies and damselflies, butterflies and moths, larger beetles, and larger wasps and bees, but the smaller arthropods such as flies, true bugs, small wasp, bees, ants, beetles and members of minor orders are probably more numerous. With the exception of dragonflies, damselflies and a few flies I did not observe insects that have aquatic immatures or adults, so there are no stoneflies, mayflies or caddisflies in the list and primitive arthropods such as springtails, are not included, although they are all likely present. A few showy insects that should be at the Marsh (I have found them in nearby areas in Edmonds) are also not listed. These include the West Coast Lady and Red Admiral butterflies, as well as the Ten-lined June Beetle.

Bumble Bees are numerous on easily accessible sides of the Marsh and, along with other bees and wasps, increase when nectar and pollen sources are available. As these are important pollinators it is gratifying to note that three species (and possibly more) are found in the area.

Identifications are based on photographs for the most part and are thus not always certain, as determinations in some groups require examination of the anatomy of a given specimen. Generally I identified the arthropod in the photos, but one a few occasions I had help from various people associated with inaturalist on the Internet. The Cardinal Meadowhawk was observed and photographed by Bill Anderson and the Zephyr Anglewing was observed and photographed by Alan Mearns. Both were identified by me.

Insects and Arachnids observed in the area of Edmonds Marsh, many of which were photographed.

Odonata

Paddle-tailed Darner, *Aeshna palmata*
California Darner, *Rhionaeschnia californica*
Common Whitetail, *Plathemis lydia*
Cardinal Meadowhawk, *Sympetrum illotum*
Striped Meadowhawk, *Sympetrum pallipes*
Pacific Forktail, *Ischnura cervula*
Tule Bluet, *Enallagma carunculatum*
Unidentified spreadwing damselfly (Lestidae)

Orthoptera

Spur-throat Grasshopper, *Melanoplus sanguinipes*
Small Katydid (found dead on path) (Tettigoniidae)

Hemiptera

Froghopper or Spittle Bug, family Cercopidae.
Mealy Bug (Unknown species)

Coleoptera

Asian Lady Beetle, *Harmonia axyridis*
Red Soldier Beetle, *Rhagonycha fulva*
Flower Long-horned Beetle, *Pidonia scripta*
Diurnal Firefly, *Ellychnia* sp.

Lepidoptera

Western Tiger Swallowtail, *Papilio rutulus*
Lorquin’s Admiral, *Limenitis lorquini*
Painted Lady, *Vanessa cardui*
Satyr Anglewing, *Polygonia satyrus*
Cabbage Butterfly, *Pieris rapae*
Lycaenid butterfly
Isabella Moth, *Pyrrharctia Isabella*
Silver-spotted Tiger Moth, *Lophocampa argentata*

Diptera

Small-headed Fly, *Eulonchus tristis*
Syrphid Fly, *Sericomyia chalcopyga*
Undetermined small Syrphid Fly (at least two species)
Unknown Calypterate Fly
Green Bottle Fly, *Lucilia sericata*
Large Tipulid fly
Chronomid flies (at least 1 species of midge)
Several other flies were seen or photographed, but not identified. Identification of flies is difficult and often requires obtaining specimens.

Hymenoptera

Rose Hip Torymid Wasp, *Megastigmus aculeatus*
Ichneumon Wasp, species undetermined.
European Paper Wasp, *Polistes dominula*
Yellow jacket, *Vespula* or *Dolichovespula*
Muddauber, *Sceliphron caementarium*
Beewolf, *Philanthus* sp.
Formicinae ant
Halictid Bee, *Agapostemon* sp.
Yellow-faced Bumble Bee, *Bombus vosnesenskii*
Fuzzy-horned Bumble Bee, *Bombus mixtus*
Black-tailed Bumble Bee, *Bombus melanopygus*
Western Honey Bee, *Apis mellifera*

Arachnida – Araneae

Bowl and Doily Spider, *Frontinella pyramitela*
Cross Spider, *Araneus diadematus*
Lycosidae – immature seen on platform
Zebra Spider, *Salticus scenicus*

Arachnida – Opiliones

2 species of Undetermined Harvestman.