

Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

TECHNICAL MEMORANDUM: LDW SANDPIPER PRESENCE AND HABITAT SURVEY RESULTS FINAL

For submittal to

The US Environmental Protection Agency

Region 10
Seattle, WA

The Washington State Department of Ecology

Northwest Regional Office
Bellevue, WA

August 27, 2004

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Table of Contents

1.0	INTRODUCTION	1
2.0	METHODS	1
2.1	HABITAT EVALUATION METHODS	1
2.2	SANDPIPER AND SHOREBIRD OBSERVATION METHODS	2
2.3	DEVIATIONS FROM THE METHODS TECHNICAL MEMORANDUM	2
3.0	RESULTS	3
3.1	ENVIRONMENTAL CONDITIONS	3
	Table 3-1. Daily tidal heights (ft) for the LDW at 8 th Ave South during the sandpiper survey	4
3.2	HABITAT SURVEY RESULTS	4
	Table 3-2. Sandpiper foraging and nesting habitat quality for each segment of LDW shoreline	4
	Table 3-3. Summary of habitat segments classified by nesting and foraging habitat quality	6
3.2.1	Nesting habitat	6
	Figure 3-2. High quality nesting habitat on the northern end of Kellogg Island	7
3.2.2	Foraging habitat	8
3.3	SANDPIPER AND SHOREBIRD SURVEY RESULTS	9
	Table 3-4. Observations of spotted sandpipers and other birds specified in the sandpiper survey methods technical memorandum (Windward 2004)	9
	Figure 3-4. Photograph of spotted sandpiper foraging in stream underneath 1 st Avenue South bridge	10
	Figure 3-5. Photograph of spotted sandpiper foraging in riprap at RM 2.3	11
	Figure 3-6. Photograph of a killdeer nest on Kellogg Island	13
4.0	REFERENCES	14
	OVERSIZE FIGURES	15
	Figure 3-1a. LDW sandpiper habitat segments classified for nesting and foraging, RM 0-2.5	16
	Figure 3-1b. LDW sandpiper habitat segments classified for nesting and foraging, RM 2.5-5	17
	Figure 3-3a. Map of LDW with all sightings (spotted sandpiper, killdeer, great blue heron, osprey, and eagle), RM 0-2.5	18
	Figure 3-3b. Map of LDW with all sightings (spotted sandpiper, killdeer, great blue heron, osprey, and eagle), RM 2.5-5	19
APPENDIX A.	SANDPIPER HABITAT FIELD FORMS	20
APPENDIX B.	SANDPIPER OBSERVATION FIELD FORMS	21
APPENDIX C.	FIELD NOTES	22

Acronyms

ERA	ecological risk assessment
GPS	global positioning system
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
MLLW	mean lower low water
QAPP	quality assurance project plan
RI	Remedial Investigation
RM	river mile
Windward	Windward Environmental LLC

1.0 Introduction

This memorandum summarizes the results of the sandpiper and shorebird presence and sandpiper habitat survey conducted June 3, 4, 7, and 11, 2004 in the Lower Duwamish Waterway (LDW). The primary objective of the survey was to identify potential habitat for spotted sandpipers throughout the LDW regardless of whether these birds were observed during the survey. A secondary objective was to observe the presence of spotted sandpipers throughout the LDW during a portion of their nesting period, which is from May through September (Seattle Audubon Society 2004). Data presented in this report were collected as part of the Phase 2 Remedial Investigation (RI) for the LDW site (Windward 2004a). This information will aid in estimating potential site-specific exposure of sandpipers to sediment associated chemicals for the ecological risk assessment (ERA), and will be considered in the placement of benthic community market basket tissue sampling locations as part of the Benthic Invertebrate Quality Assurance Project Plan (QAPP) and surface sediment sampling locations as part of the Surface Sediment QAPP. The field procedures used to conduct this survey are described in detail in the LDW sandpiper presence and habitat survey technical memorandum (Windward 2004b), and are also described briefly in Section 2 of this memorandum. Section 3 presents the results of the presence and habitat survey.

2.0 Methods

This section provides a brief description of the methods used to assess potential sandpiper habitat as well as sandpiper observation methods used during the survey. Detailed methods are presented in the LDW sandpiper presence and habitat survey technical memorandum (Windward 2004b). The habitat survey described in Section 2.1 was conducted simultaneously with the first two days (June 3 and 4, 2004) of the shorebird observation survey. The shorebird observation survey, described in Section 2.2, was also continued on June 7, and 11, 2004. Matthew Boyle (Grette Associates) acted as principal birder and habitat observer; Kevin Li (King County) and Matt Luxon (Windward) were additional birders.

2.1 HABITAT EVALUATION METHODS

Observations of potential sandpiper habitat were made by boat during low tide along intertidal areas of the LDW. The habitat survey took place on June 3 and 4, 2004 covering the eastern and western shorelines from RM 0.0 to RM 5.0. The shoreline was observed in sections (referred to as segments) containing areas of similar sandpiper habitat. New segments began at changes in bank type. In order to keep segments reasonably small, long stretches of similar habitat quality were broken into two or

more segments. Each segment surveyed was assigned a unique number. Each segment was evaluated for features that could provide nesting and/or foraging habitat for spotted sandpipers. Spotted sandpiper habitat field forms (Form 1) were completed for each segment and are presented in Appendix A.

2.2 SANDPIPER AND SHOREBIRD OBSERVATION METHODS

Observations of intertidal and shoreline habitat use by sandpipers were made by boat along the entire length of the LDW on four days to evaluate habitat use during low, medium, and high tidal stages. Although the focus of this survey was spotted sandpipers, the presence of other shorebirds was also noted. In addition, observations of great blue herons, ospreys, and bald eagles were recorded.

The sandpiper presence survey occurred simultaneously with the habitat survey on June 3 and 4, 2004. The eastern shoreline was surveyed on June 3 and the western shoreline was surveyed on June 3 and 4, 2004.¹ On both June 7 and 11, 2004, both the eastern and western shorelines of the LDW were observed in half-mile segments progressing upstream on June 7 and downstream on June 11. The following information was recorded on the sandpiper observation forms (Form 2) (see Appendix B):

- ◆ bird species
- ◆ number of birds
- ◆ location description
- ◆ behavior
- ◆ approximate distance from the boat
- ◆ direction of observation (compass bearing)
- ◆ characteristics of the habitat being used

Field notes are presented in Appendix C. A full set of photographs documenting the survey can be viewed on the Lower Duwamish Waterway Group (LDWG) website; go to <http://www.ldwg.org/PubDocArchive.htm>, scroll to the bottom of the page, and click Sandpiper Survey Photo Album. Photographs will also be submitted to EPA and Ecology on a CD.

2.3 DEVIATIONS FROM THE METHODS TECHNICAL MEMORANDUM

In response to a stakeholder request, listening for the presence of shorebirds along the LDW was added to the field protocol. During a phone conference among Matthew Boyle, Kevin Li, Berit Bergquist, Kathy Godtfredsen, and Matt Luxon on June 2, 2004,

¹ The western shoreline from RM 4.6 to RM 5 was surveyed on June 3, 2004. The rest of the western shoreline was surveyed on June 4, 2004.

it was agreed that when the survey crew was near areas that contained potential foraging or nesting habitat, the boat engine would be stopped for two minutes to listen for sandpiper calls. If calls were heard, observers would examine the shoreline in the vicinity of the call to attempt to locate the sandpipers. In practice, the ambient noise was generally louder than the boat engine and even distant sandpiper calls could be heard above the engine. Additionally, in all potential nesting habitat locations, all surveyors walked the shoreline. In mudflat locations, all habitat could be visually observed. Based on these factors, the engine was stopped only when unidentified bird calls were heard that were potentially from sandpipers.

On June 11th, the entire LDW shoreline was supposed to be surveyed during medium tide for the presence of sandpipers and shorebirds. However, Kellogg Island and the western shoreline of the LDW from RM 0.0 to 1.0 were not surveyed because: 1) light levels were diminishing rapidly, and 2) that segment of the LDW had been well characterized in walking surveys the previous three survey days, including at a similar medium tide on June 7, 2004.

Actual start times were delayed on June 3 by 7 minutes and on June 7 by 35 minutes as a result of transit time on the LDW and logistical constraints. In order to survey the entire LDW on June 7th, the survey was extended 83 minutes from 10:30 to 11:53 am. Therefore, sandpiper observations during this 1.5-hour period were made when the tide was below the targeted tidal level. The delay on June 7 contributed to approximately 1.5 hours of the survey being conducted outside of the desired tidal cycle. Observations during the last 1.5 hours on June 7 were from RM 3.5 to RM 5.0. These observations occurred during a plus 6 ft to plus 1 ft mean lower low water (MLLW) tidal elevation.

3.0 Results

3.1 ENVIRONMENTAL CONDITIONS

Weather on June 3 and 4, 2004 was clear with little wind and temperatures near 80°F. Weather on June 7 and 11, 2004 was cloudy with little wind and temperatures in the 50s to 60s with light rain showers on both days. Weather did not disrupt observations at any time. Actual corrected LDW tidal elevations that occurred during the survey are shown in Table 3-1 (NOAA 2004).

Table 3-1. Daily tidal heights (ft) for the LDW at 8th Ave South during the sandpiper survey

SAMPLING DATE	06/03/2004	06/04/2004	06/07/2004	06/11/2004
Survey start (time)	1.7 (08:52)	-2.1 (09:29)	8.4 (05:35)	5.4 (17:00)
Survey end (time)	3.6 (14:55)	6.2 (16:32)	3.4 (11:53)	7.5 (21:15)
Survey min (time)	-4.4 (11:30)	-4.3 (12:24)	1.1 (11:53)	4.1 (18:00)
Survey max (time)	3.6 (14:55)	6.2 (16:32)	10.0 (07:54)	7.5 (21:15)

3.2 HABITAT SURVEY RESULTS

Based on field observations of preferred sandpiper habitat types, the LDW was divided into 66 habitat segments: 29 segments on the eastern shoreline and 37 segments on the western shoreline (Table 3-2, Figures 3-1a and 3-1b; oversized figures at end of document). Each segment was classified separately for the quality of nesting and/or foraging habitat. Categories were none (no habitat), poor (some habitat attributes, but generally unsuitable), and high (suitable habitat).

Table 3-2. Sandpiper foraging and nesting habitat quality for each segment of LDW shoreline

SEGMENT NUMBER	LINEAL DISTANCE (ft)	INTERTIDAL CONDITIONS	FORAGING HABITAT QUALITY	NESTING HABITAT QUALITY
1	492	riprap	poor	poor
2	491	riprap	poor	none
3	1,775	riprap	poor	poor
4	688	mud, riprap	poor	poor
5	549	mud, marsh	high	poor
6	905	mud, riprap, marsh	high	poor
7	2,568	none	none	none
8	1,750	riprap	high	none
9	275	mud, riprap	poor	none
10	1,150	mud, riprap	poor	none
11	1,126	riprap	poor	none
12	732	mud	poor	none
13	696	mud, riprap	none	none
14	428	mud, riprap	none	none
15	2,518	none	none	none
16	2,113	riprap	none	none
17	1,240	mud, riprap	high	poor
18	1,256	none	none	none
19	551	mud	high	none
20	687	none	poor	none
21	2,540	mud, riprap	high	none
22	994	mud	high	none
23	1,464	mud, riprap	poor	none

SEGMENT NUMBER	LINEAL DISTANCE (ft)	INTERTIDAL CONDITIONS	FORAGING HABITAT QUALITY	NESTING HABITAT QUALITY
24	2,152	mud, riprap	high	none
25	1,968	none	none	none
26	937	mud, riprap	none	none
27	1,626	mud	high	none
28	513	mud	none	none
29	836	mud	none	none
30	503	mud, riprap	poor	poor
31	1,773	mud, marsh	high	high
32	868	none	none	none
33	416	riprap	poor	high
34	992	mud	high	high
35	698	mud, riprap	high	poor
36	1357	none	none	none
37	1,987	none	high	high
38	402	riprap	high	high
39	1,105	mud	high	high
40	1,750	mud, marsh	high	high
41	488	mud, riprap	high	poor
42	843	mud	high	poor
43	400	mud	high	high
44	870	marsh, mud	high	high
45	1,110	mud	high	high
46	701	mud, riprap	poor	high
47	1,959	none	none	none
48	1,810	mud, riprap	high	poor
49	1,467	none	none	none
50	1,207	riprap	poor	none
51	665	mud	high	none
52	650	mud	high	high
53	1,024	mud, riprap	none	none
54	450	mud	high	poor
55	748	mud	none	none
56	2,058	mud, riprap	poor	none
57	1,303	mud, riprap	poor	none
58	1,712	mud, riprap	poor	none
59	1,184	mud	none	none
60	1,901	mud	poor	none
61	614	mud	none	none
62	907	mud, riprap	none	none
63	538	mud	none	none
64	635	mud, marsh	high	high
65	865	mud, riprap	none	poor
66	336	mud, riprap	high	poor

The number of segments and proportion of the shoreline in each category is presented in Table 3-3. Lineal distance of shoreline was calculated from the digitized habitat data presented in Figures 3-1a and 3-1b which reflects the generalized path of the boat rather than the actual shoreline². The shoreline distance in Table 3-3 exceeds the total length of the LDW because of the irregularity of the shoreline caused by features such as slips, side channels, and Kellogg Island. Lineal distance data presented in Table 3-3 do not reflect the overall area of habitat associated with each survey segment. The survey segment data, in concert with aerial photos, will allow for identification of specific exposure areas in the ecological risk assessment that are associated with each level of sandpiper nesting and foraging habitat quality presented in Table 3-3.

Table 3-3. Summary of habitat segments classified by nesting and foraging habitat quality

NESTING HABITAT QUALITY	FORAGING HABITAT QUALITY	NUMBER OF SEGMENTS	LINEAL DISTANCE (ft)	PERCENT OF TOTAL SHORELINE LENGTH
None	none	20	24,497	33.4
	poor	12	14,105	19.2
	high	7	10,279	14.0
Poor	none	1	865	1.2
	poor	4	34,57	4.7
	high	9	7,318	10.0
High	none	0	0	0.0
	poor	2	1,117	1.5
	high	11	11,674	15.9
Total of all segments surveyed		66	73,313	100
Total foraging (poor + high)		45	47,950	65.3
Total nesting (poor + high)		27	24,431	29.3
Total non-habitat (none)		20	24,487	21.7

Note that the subtotals for number of segments and percent of shoreline length (total foraging segments and total nesting segments) do not sum to 66 and 100%, respectively, because several segments that offer both foraging and nesting habitat are included in each subtotal

3.2.1 Nesting habitat

For the purposes of the survey, a very conservative approach was applied to determine suitable nesting habitat. Sandpipers will normally nest in a shallow scrape on the ground in locations adjacent to shrub vegetation (for shade and cover), but may nest within dense vegetation to avoid predators (Oring et al. 1997). Spotted sandpiper nesting habitat is typified by habitat shown in Figure 3-2. Areas with physical attributes that would allow any nesting (shrubs, broad vegetation, slope) were

The path of the boat was tracked with the GPS. The actual path was simplified in the GIS to exclude convolutions in the path such as backtracking and diversions into small backwaters.

considered potential nesting areas. However, many of these locations would otherwise be labeled poor as a result of other factors, including surrounding use, human activity, and limited nesting area. The results of this survey indicate that nesting habitat is suitable over 33.4% of the LDW shoreline, with 17.4% of the LDW shoreline classified as high quality nesting habitat, and 15.9% of the LDW shoreline classified as poor quality nesting habitat.



Figure 3-2. High quality nesting habitat on the northern end of Kellogg Island
(Photograph by Matthew Boyle)

The following areas were observed to have the best quality nesting habitat

- ◆ the fringe of saltmarsh on the north side of Kellogg Island (RM 0.7 to 0.9)
- ◆ the T-105 restored salmon rearing channel (western shoreline RM 0.4)
- ◆ the Herring's House restored off-channel emergent marsh (western shoreline RM 0.5)
- ◆ the channel beneath 1st Avenue South Bridge (western shoreline RM 2.1)
- ◆ the Hamm Creek restoration site (western shoreline RM 4.3)

- ◆ the western shoreline of Turning Basin 3 (RM 4.6 to RM 4.9).

With the exception of Kellogg Island, nesting habitat in all of these locations is compromised to some extent by the presence of humans and their pets. In particular, the side channel at T-105 and Turning Basin 3 locations have public access that probably disrupts successful sandpiper nesting. While no information could be found in the scientific literature regarding flushing distance of sandpipers, birds were repeatedly alerted during the survey at distances greater than 50 ft, and it is reasonable to assume that the presence of humans, often with dogs on leash, would render areas immediately adjacent less suitable for nesting. The Herring's House restoration site (RM 0.5) also has public access, with a trail extending along the east bank of the marsh. Habitat is more extensive in this area, which may provide nesting opportunities farther from the trail.

Areas characterized as poor quality nesting habitat typically were of two general types. One poor nesting habitat type included areas of narrow shrubby vegetation above the intertidal zone, frequently consisting of an area of un-mown grass growing out of riprap bordered by shrubs or small trees and backed by paving or other development. The quality of these areas as nesting habitat is limited by lack of shade and level ground, and the overall narrowness of the area. The other poor nesting habitat type is represented by the southwestern shore of Kellogg Island, where nesting habitat quality is limited by abundant vegetation such as blackberry thickets, which are too thick for sandpipers, combined with a steep gradient. Some small areas within these thickets may provide suitable nesting habitat.

3.2.2 Foraging habitat

Foraging habitat within the LDW intertidal habitat was identified using characteristics described in Oring et al. (1997) from several sources as referenced. Spotted sandpipers mostly forage in open areas, on the ground within 200 m of the shoreline. They prefer sandy, firm substrate for probing and also pick aquatic insects and invertebrates off vegetation and debris. Within the LDW, habitat that provided sand or mud substrate with debris in an open area within the normal range of tidal elevations (e.g., mudflats) was considered well suited to foraging (high). Areas with limited sand or mud substrate, small spaces and steep debris (e.g., mudflat with frequent areas of riprap) were considered less suitable for foraging (poor). Those locations characterized by lack of sand or mud substrate, high activity, and structures (i.e., piers, bridges, scrap piles, etc.) were considered unsuitable for foraging (none).

Based on this survey, at low tide, 65.3% of the LDW intertidal habitat is suitable as foraging habitat for sandpipers: 25.4% is poor quality foraging habitat and 39.9% is high quality foraging habitat (Table 3-3; Figures 3-1a and 3-1b). High quality foraging habitat was assigned to those areas with large extents of mudflat. Areas of high quality foraging habitat occurred throughout the LDW, interspersed with areas of poor quality habitat and non-habitat. Areas with primarily vertical surface (e.g., bulkhead,

sheet piling) or coarse substrate (e.g., riprap) were judged to be poor quality habitat. In evaluating foraging habitat, it was initially assumed that riprap is not suitable. However, subsequent to habitat classification on June 3-4, 2004, sandpipers were observed four times foraging in the algal turf growing on riprap during high and medium tides (see Figure 3-5). Based on these observations, areas of mapped riprap were reclassified in Figures 3-1a and 3-1b as poor quality foraging habitat after the field survey.

3.3 SANDPIPER AND SHOREBIRD SURVEY RESULTS

There were 30 observations of sandpipers over the four days surveyed (Table 3-4, Figures 3-3a and 3-3b, oversized figures at end of document). The number of sightings does not necessarily reflect the number of birds observed. Many of the sightings were in the same general vicinity and were probably the same birds observed several times either on separate days or in nearby locations as the birds moved throughout the area being surveyed. In particular, individual spotted sandpipers were likely observed several times because the surveyors walked through areas of high quality sandpiper habitat attempting to enumerate the local population, and the birds were observed moving throughout the area being surveyed. For each observation shown in Figures 3-3a and 3-3b, global positioning system (GPS) location data were recorded for the location of the surveyor when the bird was seen. The actual location of the bird was determined relative to the GPS location from field notes. In some cases, direction information was not recorded on the field form. In these cases, the birds were adjacent to the observer on the near shore.

Table 3-4. Observations of spotted sandpipers and other birds specified in the sandpiper survey methods technical memorandum (Windward 2004)

SPECIES	NUMBER OF OBSERVATIONS				TOTAL
	6/3/04	6/4/04	6/7/04	6/11/04	
Shorebirds					
Spotted sandpiper	3	11	10	6	30
Killdeer	7	12	7	5	31
Other birds					
Bald eagle	2		5		7
Great blue heron	10	9	15	7	41
Osprey	5	3	7	1	16

Figures 3-4 and 3-5 are photos of spotted sandpipers observed along the LDW under the 1st Avenue South Bridge, and at RM 2.3 on the western shoreline, respectively. Twenty-two of the 30 spotted sandpiper observations were of sandpipers foraging on either mudflats or saltmarshes within the intertidal zone. Three observations were of sandpipers foraging in saltmarsh away from the waterline, and two were in unspecified habitat away from the waterline. Two observations were audio only, and

one observation was of a flying sandpiper. Most sandpipers were observed near high quality nesting habitat identified in the habitat survey. The farthest distance that a sandpiper was observed from high quality nesting habitat was 0.53 miles. Consistent with the generally lower quality nesting habitat on the eastern shoreline (Figures 3-1a and 3-1b), fewer spotted sandpipers were observed on the eastern than the western shoreline of the LDW. However, no distraction displays or other indications of nesting were observed. The only observed difference in sandpiper sightings relative to tidal cycle was that sandpipers were observed foraging in riprap four separate times during high and medium tides, but none were observed foraging in riprap at low tide.



**Figure 3-4. Photograph of spotted sandpiper foraging in stream underneath
1st Avenue South bridge**

(Photograph by Kevin Li)



Figure 3-5. Photograph of spotted sandpiper foraging in riprap at RM 2.3
(Photograph by Windward)

There were repeated observations of one to four sandpipers on and in the vicinity of Kellogg Island. These observations, plus the presence of high quality nesting habitat, indicate that there are at least four spotted sandpipers using the area between Herring's House and Kellogg Island. There were three separate observations of a single spotted sandpiper near the channel under the 1st Avenue South Bridge. A fourth observation of a single shorebird sighted on the western side of W. Marginal Way upstream on the side channel that enters the LDW underneath the 1st Avenue South Bridge (Figure 3-3a) was probably a sandpiper, but identification was uncertain. Repeated observations of sandpipers near the channel under the 1st Avenue South Bridge, and the identification of this area as high quality nesting habitat, suggest that one or more sandpipers may be nesting in the vicinity of this location. Similarly, there were repeated observations of a single sandpiper near Turning Basin 3, which was also identified as high quality nesting habitat, suggesting that one or more sandpipers may be nesting in the vicinity of this location.

Two other locations were identified as high quality nesting habitat: the T-105 restored side channel and the Hamm Creek habitat restoration site. No sandpipers were directly observed in either of these areas. One possible sandpiper call was heard that may have originated near the Hamm Creek site, and the birds observed in Turning Basin 3 could be nesting in the Hamm Creek restoration site, which has more extensive suitable nesting habitat than Turning Basin 3. Nesting success may be limited at the T-105 site as a result of human and off-leash dog activity at the site.

The only shorebirds observed other than spotted sandpipers were killdeer (Figures 3-3a and 3-3b), which were observed 31 times (Table 3-4). Killdeer were observed in the same general locations as spotted sandpipers, but killdeer were more numerous, with as many as 10 individuals seen in a single observation on the northeast shoreline of Kellogg Island. Killdeer were confirmed to nest on Kellogg Island through observation of a killdeer leaving its nest (Figure 3-6). Killdeer were generally observed foraging near the water's edge. They were observed foraging exclusively on or near mudflats and in the tall saltmarsh on the northern end of Kellogg Island. Killdeer observations did not appear to be strongly influenced by tidal stage, although the most observations were June 4 during low tide (Table 3-4).



Figure 3-6. Photograph of a killdeer nest on Kellogg Island
(Photograph by Kevin Li)

Birds most frequently seen throughout the LDW were starlings; crows; Canada geese; violet green, barn, and tree swallows; house, song, and white-crowned sparrows; rock pigeons; American robins; great blue herons; double crested cormorants; seagulls; and mallards. Other less common ducks included several gadwall and common mergansers. The species most frequently observed foraging in intertidal habitat were starlings, crows, and Canada geese, which were all ubiquitous. The receptor of concern (ROC) species most frequently observed was great blue heron (Table 3-4). Heron were observed throughout the entire LDW resting on manmade structures and foraging along the water's edge on shallow beaches of any substrate. Figures 3-3a and 3-3b shows all locations where great blue herons were sighted. Additionally, a single river otter (a mammalian ROC) was sighted on the east bank at the water line at RM 4.4.

Bald eagles and ospreys were also frequently observed throughout much of the LDW. Four observations of bald eagles occurred between RM 0 to 1.4 and one eagle was observed at RM 4.2. Eagles were mostly observed flying overhead, but one was

observed on the mudflat on the southeastern shore of Kellogg Island. An active bald eagle nest is known to be in the greenbelt just southwest of T-105, near RM 0.3 on the west side of West Marginal Way, but this nest was not observed during the survey (Stofel 2004).

Four osprey nest platforms were identified throughout the LDW (Figures 3-3a and 3-3b), with young observed in each nest. Adult ospreys were frequently observed on tall structures near the nest platforms. At the end of the survey day on June 7, two ospreys and two peregrine falcons were observed resting on Plant 2 while an eagle flew overhead.

4.0 References

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Oversize Figures

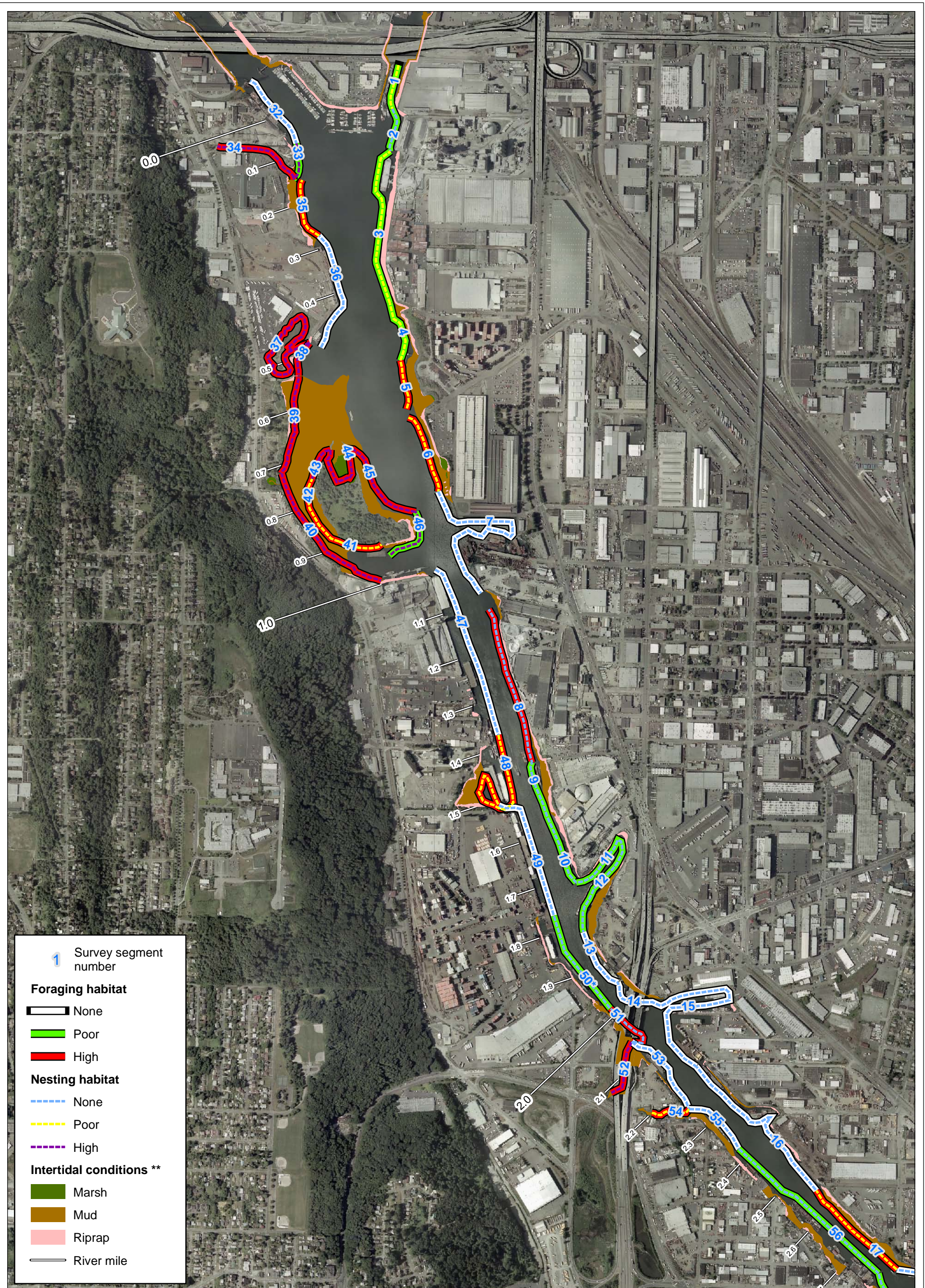


Figure 3-1a. LDW sandpiper habitat segments classified for nesting and foraging RM 0-2.5

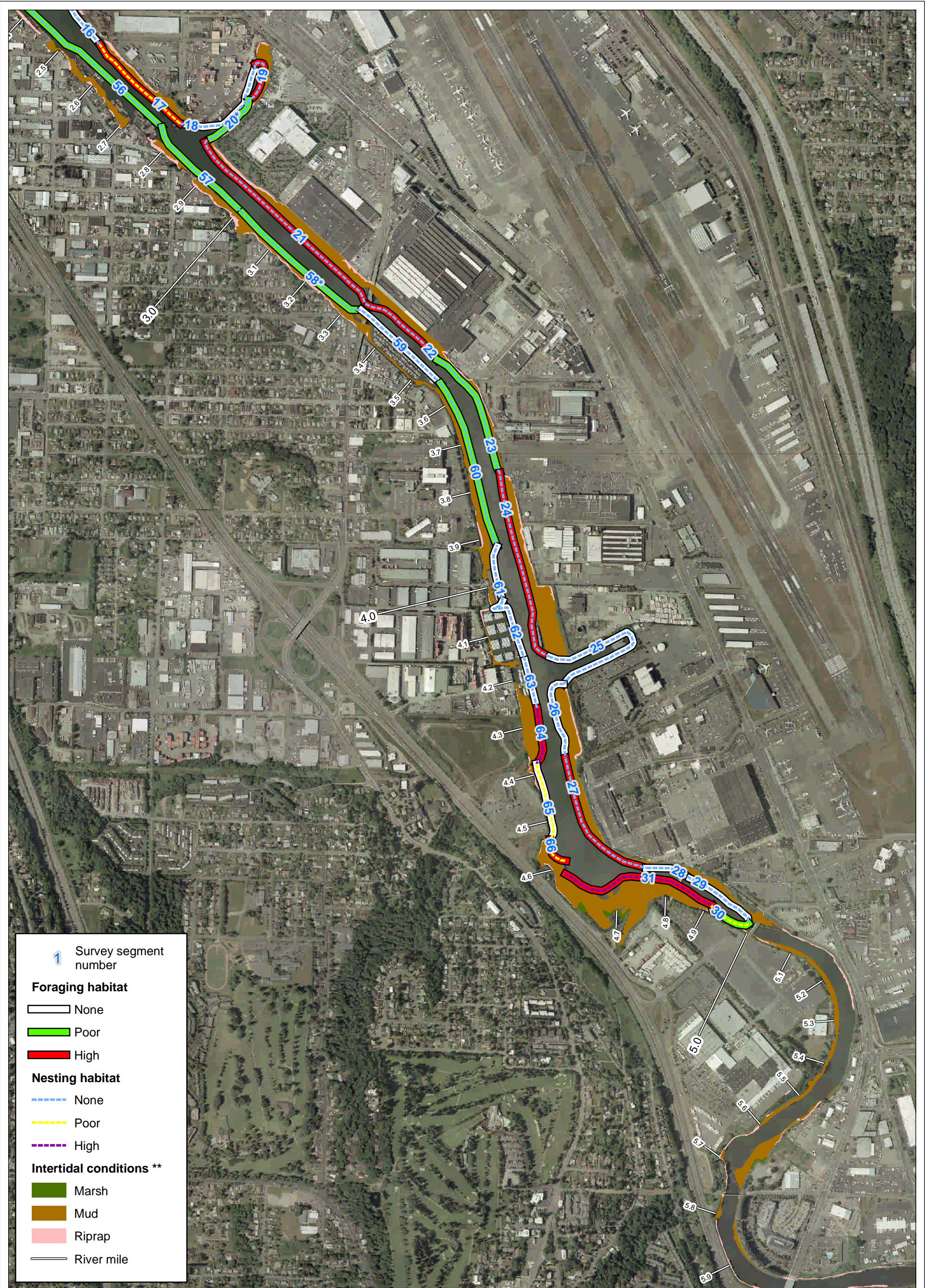


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Prepared by RAC 06/30/04 Map 1410

* Reclassified due to presence of riprap

** Locations where no intertidal condition is shown have no intertidal area (i.e. sheetpiling or bulkhead drops off to deep water)



1 Survey segment number

Foraging habitat

- None
- Poor
- High

Nesting habitat

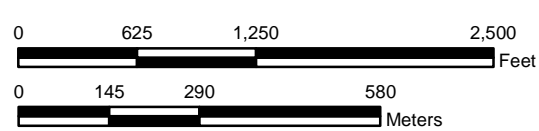
- None
- Poor
- High

Intertidal conditions **

- Marsh
- Mud
- Riprap

— River mile

Figure 3-1b. LDW sandpiper habitat segments classified for nesting and foraging RM 2.5-5.0



Prepared by RAC 06/30/04 Map 1416

* Reclassified due to presence of riprap
 ** Locations where no intertidal condition is shown have no intertidal area (i.e. sheetpiling or bulkhead drops off to deep water)

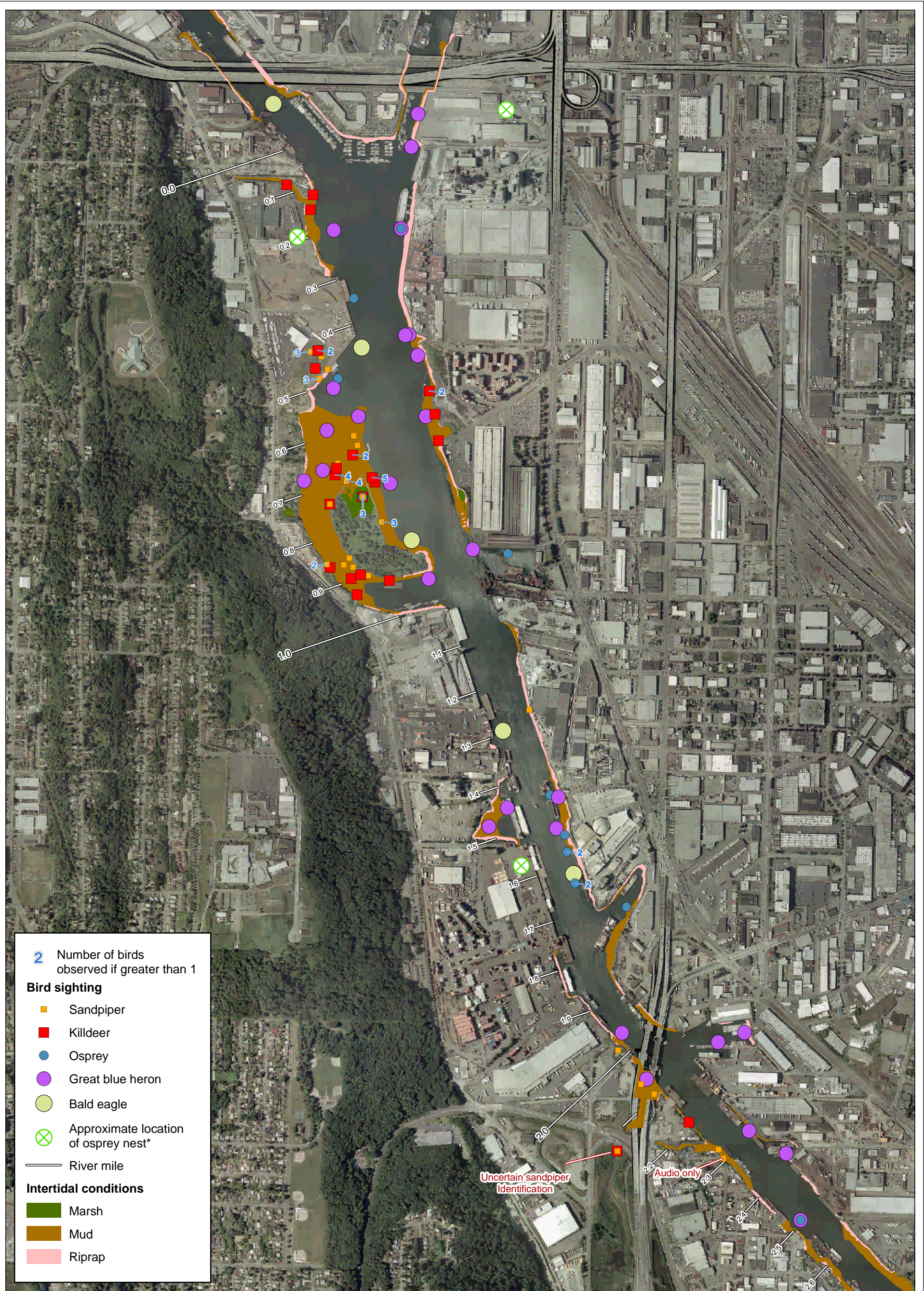
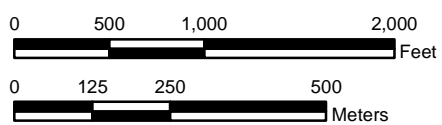
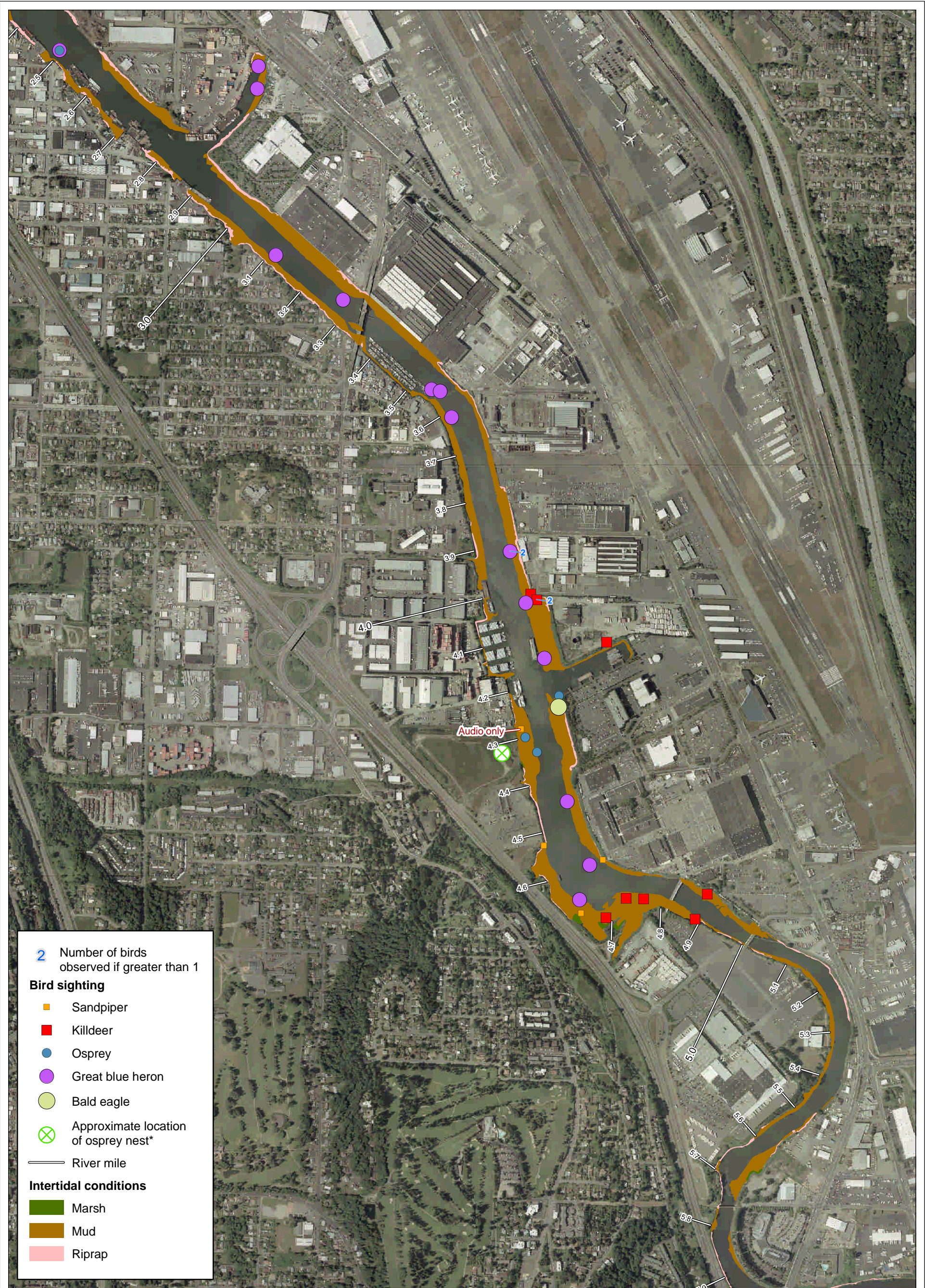


Figure 3-3a. Bird observations in the LDW RM 0-2.5



* Ed Schultz of USGS has recorded additional osprey nest locations in the vicinity of the LDW



2 Number of birds observed if greater than 1

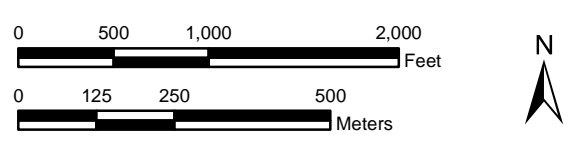
Bird sighting

- Sandpiper
- Killdeer
- Osprey
- Great blue heron
- Bald eagle
- ⊗ Approximate location of osprey nest*
- River mile

Intertidal conditions

- Marsh
- Mud
- Riprap

Figure 3-3b. Bird observations in the LDW RM 2.5-5.0



Prepared by CEJ 07/01/04 Map 1423

* Ed Schultz of USGS has recorded additional osprey nest locations in the vicinity of the LDW

Appendix A. Sandpiper Habitat Field Forms

(Separate PDF file)

Appendix B. Sandpiper Observation Field Forms

(Separate PDF file)

Appendix C. Field notes

(Separate PDF file)