Ship Creek Preliminary Habitat Survey

Alaska Railroad Corporation
Anchorage Terminal Reserve
U.S.EPA Docket No. CERCLA 10-2004-0065

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December 3, 2004 (rev. 7/1/2005)

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List of Acronyms

AOC	Administrative Order on Consent
ARRC	Alaska Railroad Corporation
CERCLA	Comprehensive Environmental Responsibility, Compensation, and Liability Act of 1981
EC	electrical conductivity
KAPP	Knik Arm Power Plant
MOA	Municipality of Anchorage
RCRA	Resource Conservation and Recovery Act
RETEC	The RETEC Group, Inc.
RI/FS	Remedial Investigation and Feasibility Study
the Site	Anchorage Terminal Reserve in Anchorage, Alaska (
SOW	Statement of Work
µS/cm	micro siemens per centimeter
U.S. EPA	United States Environmental Protection Agency

1 Introduction

This document was developed under a Comprehensive Environmental Responsibility, Compensation, and Liability Act of 1981 (CERCLA) Administrative Order on Consent (AOC) No. 10-2004-0065 between the United States Environmental Protection Agency (U.S. EPA), Region 10, and the Alaska Railroad Corporation (ARRC), under which ARRC has agreed to conduct a CERCLA/Resource Conservation and Recovery Act (RCRA) Remedial Investigation and Feasibility Study (RI/FS) at its Anchorage Terminal Reserve in Anchorage, Alaska (the Site). The AOC incorporates a Statement of Work (SOW) that includes an ARRC commitment to develop a work plan for field studies that can be implemented in 2004. Specifically, Section 2.2.2.1 of the SOW states as follows: "*The studies specified in the proposal may include Ship Creek sediment and detritus sampling, bioassays of benthic macroinvertebrate organisms, and/or other field work. Respondent will prepare an Interim Action work plan in accordance with the AOC and submit that to U.S. EPA following U.S. EPA's approval of the proposed field study."* ARRC submitted the work plan for this interim action to U.S. EPA on September 10, 2004. U.S. EPA approved the proposed field study covered by this work plan in its letter dated October 5, 2004.

In accordance with Section IX 42(a) of the AOC, this Preliminary Habitat Survey presents the results of the field sampling and investigations in partial fulfillment of requirements in SOW Section 2.2.2.1. The report focuses on qualitative field evaluation of Ship Creek to provide data that can be incorporated into the overall RI/FS.

2 Sampling, Analysis, and Data Quality

2.1 Rationale

Section 2.2.2.1 of the SOW required a literature survey to summarize existing data on contamination and biological impacts to Ship Creek, identify data gaps, and propose field studies to be completed in 2004 to address the data gaps.

The Ship Creek Literature Review was completed in July 2004 (Hart Crowser, 2004a). It concluded that a substantial body of data was available for Ship Creek. When this data was considered jointly with the interim sediment sampling conducted in early 2004 (Hart Crowser, 2004b) it was concluded that there is no evidence for extensive contamination or imminent risk to human health or the environment at Ship Creek. Localized or temporary impacts could not be excluded. A conclusion of the Literature Review was that additional water, sediment, or biota sampling was not recommended at this time. Current data gaps identified were related to sources, transport pathways, and overall current conditions in Ship Creek.

The objectives of the Ship Creek Preliminary Assessment were the following:

- Collect information on the overall ecological habitat at the Anchorage Reserve to allow development of a Site Conceptual Model for the upcoming Site-wide RI/FS.

- Collect basic data on Ship Creek in the project area to allow development of a Site Conceptual Model and evaluation of potential receptors and critical habitats.

- Collect data on sources and transport pathways of potential contamination to Ship Creek, including the origin of point sources identified previously.

A field investigation was conducted September 14-16, 2004. The following field studies were described in the Work Plan:

1. A preliminary habitat assessment of Ship Creek. The findings of this assessment will also be incorporated into the Site-wide ecological site assessment.

2. A site-wide qualitative ecological site assessment along the northern site boundary.

3. Conduct a follow-up study to identify the nature, source, and responsibility for point source features identified in the Point Source Reconnaissance Survey.

Task 1: Preliminary Habitat Survey of Ship Creek

Procedures

The habitat survey of the Ship Creek area was qualitative and confined to visual inspection and basic measurements, and consisted of a survey of Ship Creek from approximately ½ mile upstream of the Site boundary to the intertidal mixing area at the mouth (Figure 1).

The survey identified basic channel characteristics, streambed conditions, frequency of riffles and pools, bank stability, presence of backwaters, wetlands or other valuable sub-habitats, as well as qualitative riparian conditions. Data from the aquatic habitat were entered into a *Physical Characterization/Water Quality Data Sheet* (Form 1) of the *Rapid Bioassessment Protocols* (U. S. EPA, 2001). Plants were identified using Hitchcock, et al. (1959). Updated plant nomenclature was provided by Pojar and Mackinnon (1994).

Three subtasks were conducted as part of this task:

- Collection of basic water quality parameters (temperature, specific conductance, dissolved oxygen, oxidation-reduction potential, total dissolved solids, and pH), recorded with a field multi-meter at key locations.

- Identification of obvious anthropogenic influence (debris, garbage, inflows of visibly impacted water, etc.) that may affect aquatic life conditions in the creek.

- Identification of key riparian zone features (type of ground cover and trees, and signs of wildlife). Areas where development has largely eliminated riparian habitat (e.g., riprapping) were called out.

Key features were photographed (Appendix A). Field notes were maintained on large scale aerial photo maps of the area.

Variances

The survey was conducted per the Work Plan. Key features were noted not in a field notebook but on large-scale aerial photographs of the area.

Task 2: Habitat Survey, Upland Areas

Procedures

The habitat survey was qualitative and consisted of a site inspection, conducted by two The RETEC Group, Inc., (RETEC) biologists. The Site inspection focused on the North Bluff area of the property (Figure 1), as other parts of the property generally are in industrial or commercial use. Data from the survey was entered into an *U.S. EPA Ecological Checklist* applicable to Superfund sites (U. S. EPA, 1997). Plants were identified using Hitchcock, et al. (1959). Updated nomenclature was provided by Pojar and Mackinnon (1994).

Variances

The survey was conducted according to the Work Plan. Three areas of natural vegetation along the North Bluff (east of the large excavated zone, west of the large excavated zone, and along the bluff facing Ocean Dock Road and the Port of Anchorage (POA) in the far western portion of the Terminal Reserve) were included in this survey. The first two were visited and inspected per the Work Plan. The third area was not visited directly but was reviewed from the road below. This was because it was limited in size, could be observed in its entirety from below, and did not appear to possess any unique characteristics.

Field notes were kept on large-scale aerial photo maps instead of a notebook.

Bird observations were relatively unsuccessful. Few birds were present due to the lateness of the season. Migratory birds apparently had departed. However, identification of migratory birds will be included as part of the next field effort to determine special-status and common species.

Task 3: Investigation of Point Sources

This task identified the nature, source, and ownership of outfalls and other structures. This was accomplished by:

1. Review of ARRC utility maps.

2. Interviews with Mr. Scott Wheaton of Watershed Management Services of the Municipality of Anchorage (MOA, 2003), who supplied documents and a map of storm sewers and outfalls managed by his department.

3. Meetings with staff at the Alaska Department of Fish and Game Elmendorf Hatchery.

4. An inspection of each of the identified features. ARRC previously notified leaseholders of the work to be conducted in accordance with the lease agreements, in case site access would be required. All

outfalls were identified without intrusive inspection of lease properties.

Variances

This task was conducted in accordance with the Work Plan.

2.2 Comments from U.S. EPA

In the October 5, 2004 letter that approved the work plan for this survey, U.S. EPA raised several comments. U.S. EPA indicated that its comments were best addressed as part of this report and the upcoming site-wide risk assessment. The U.S. EPA comments are included as Appendix B. To the extent feasible, the comments have been addressed or incorporated in this report.

3 General Description of Ship Creek

Ship Creek originates at Ship Lake at the 2,700-foot level of the Chugach Mountains. The creek flows north then west for 25 miles to its mouth in Knik Arm of Cook Inlet (Figure 1). The watershed drains 117 square miles. The watershed includes alpine meadow, perennial snow fields, forest, wetlands, and urban areas. There is virtually no glacial input, and the creek flows clear except during spring runoff or heavy rains.

The upper 15 miles of the creek (above Glenn Highway) are pristine and largely untouched by development. The lower 10 miles have been affected by development. For eight miles, Ship Creek flows through Fort Richardson and Elmendorf Air Force Base. Three dams are located on this reach of Ship Creek. Ship Creek receives stormwater inflow from the military facilities and from suburban development in this reach.

At Reeve Boulevard, Ship Creek enters the ARRC Terminal Reserve. The reaches between Reeve Boulevard and the mouth of the creek have been channelized, and the land use is industrial. Stormwater from the ARRC railyard, commercial and industrial areas, and urban areas of the Municipality of Anchorage enters Ship Creek from multiple outfalls in these reaches. A dam constructed in 1953 is located ½ mile from the mouth. The dam provided a cooling water source for Knik Arm Power Plant (KAPP). The power plant is no longer active. The dam divides Ship Creek into a lower reach, which is influenced by tides, and upper reaches that are freshwater. A fish ladder allows passage of the annual runs of salmon through the dam.

The entire Ship Creek valley at one time consisted of riparian wetlands and woodlands. Encroachment from building of the railroad in the 1920s and subsequent industrial development since the 1950s has resulted in a large decline in riparian habitat. Most of the riparian habitat present today appears to be of recent origin, as the creek itself has been channelized and modified.

3.1 Channel Morphology

As a result of development of large portions of the historic floodplain of Ship Creek, the course of the creek has been channelized into a fraction of its past extent. When Anchorage was originally founded, Ship Creek and its associated tidal wetlands and riparian marshes occupied most of the valley currently occupied by the railroad and surrounding industrial areas. By 1920, to allow development of the railroad on the north side of the creek, Ship Creek was routed along the southern bluff of the valley. As development along both banks continued over the ensuing decades, the creek channel was progressively more constrained to a defined channel, and the extent of floodplains reduced.

Figure 2 shows the changing channel of Ship Creek as determined from aerial photographs. The extent of current riparian habitat in the active floodplain is also shown. Note that the aerial photographs were not orthogonal photos and, consequently, some distortion in features is inevitable. Some features, therefore do not align perfectly.

The oldest available channel outline is from around 1920. At that time the channel had already been diverted towards the southern side of the valley and followed a course roughly similar to the current course. However, the stream meandered more extensively to the south, including the area currently occupied by the ARRC depot.

By 1950, extensive development on the south side of Ship Creek had resulted in the elimination of the south side loops, although the former channel could still be noted as a marshy backwater in what is currently a truck yard north of the ARRC depot. The central reach had been partly channelized. The KAPP dam and cooling pond were constructed in the early 1950s, and the Ship Creek channel, which previously flowed where the KAPP pond is now located, was diverted to the south side of the pond berm. In 1950, a large loop through what is currently filled land at the northwest corner of Viking Drive and Reeve Boulevard was visible.

In 1961, the marshy backwater north of the ARRC depot is still visible. In the upper reaches, the stream channel had shifted north, now running adjacent to the then Standard Steel site as a result of industrial fill south of the creek. By 1989, the channel of Ship Creek had essentially acquired its current conformation.

3.2 Ship Creek Reaches

For purposes of this habitat survey, Ship Creek in the area of the Site will be considered as five distinct reaches, of which the uppermost (Reach U) is upstream of the Site and will be considered the reference stream condition. The division into reaches is based on broad similarities in channel morphology and hydrology noted in the field. Figure 1 shows the extent of the reaches.

Reach U - Upstream reference area

The upstream reference area is the segment from approximately ½ mile upstream of the Site boundary to the Reeve Boulevard bridge. This reach is suburban and influenced by human activities. The reach is characterized by generally steep vegetated banks. The reach includes the Elmendorf Hatchery dam, a structure with two consecutive spillways with a vertical change in channel elevation of nearly 20 feet.

Key features in this reach are several stormwater discharges, the Elmendorf Hatchery water intakes and return flows, and the Elmendorf Air Force Base golf course along the south shore.

This reach is also affected by discharges from Elmendorf Air Force Base and the Fort Richardson U.S. Army base located further upstream.

Reach 1 – Reeve Boulevard to Sitka Street

Reach 1 is considered the stretch from Reeve Boulevard Bridge downstream approximately 0.6 mile to Sitka Street. This area is characterized by moderate meanders, frequent riffle/run sequences, and fairly extensive riparian zones. Although partly canalized, Ship Creek in this reach has its most "natural" appearance. The riparian area provides good overhanging vegetation and shelter for migrating fish.

Reach 2 – Sitka Street to upper Railroad Bridge

Reach 2 is the stretch from Sitka Street to the upper railroad bridge. In this reach, Ship Creek has been strongly straightened, and flows within a channel defined by rip-rap and other reinforced slopes that create highly channelized flow. Riparian habitat is limited. The high velocity flow combined with few riffles and low shoreline complexity decrease the habitat quality of this reach.

Reach 3 – Upper Railroad Bridge to KAPP Dam

Reach 3 extends from the upper railroad bridge to the KAPP dam. This reach is the most complex segment. The degree of channelization is less than in Reach 2, although extensive sections of rip-rap are present, particularly along the south bank. A few riffle/run sequences are present.

Along the north bank, extensive areas of riparian floodplain are present. Two constructed water retention ponds are present, with associated marshy areas. In the lower segment, behind the KAPP dam, old river flats currently covered in secondary willow growth and scrub/shrub vegetation (and some relict channels and backwaters) are present. These flats appear to be remains of tidal flats isolated from Cook Inlet when KAPP dam was constructed 1950-1953.

Reach 4 – KAPP Dam to mouth

Reach 4 extends from the KAPP dam to the mouth. Ship Creek is tidal below the dam. The stream channel is broad and flat, and both banks are constructed rip-rap or concrete. Beyond the culvert under the lower railroad bridge the stream flows through tidal mudflats to Cook Inlet. Due to the high tidal range (up to 30 feet) the channel is deeply downcut into the mudflats. The entire reach is scoured daily by tidal fluxes. The banks are urbanized and little or no riparian habitat is present. The mudflats are largely unvegetated, with only small pockets of salt marsh.

3.3 Riparian Habitat

Ship Creek riparian habitat (Reach 1 to 3) is dominated by riparian woodland and scrub-shrub communities. Most of the riparian habitat consists of wooded areas on historic meanders within the remaining active floodplain of the creek. The riparian community spans the floodplain and is bounded by artificial berms marking the edge of the fill for developed land. The berms define the boundary between the riparian community and developed/commercial areas. Vegetated riparian areas are generally wider on the north side of the creek than the south; however, the riparian strip decreases to less than 10 meters on both sides in some areas. Vegetated areas extend up to 100 meters on the north side, but not greater than 50 meters to the south. A recently constructed bike path on the south side of the creek has resulted in the disappearance of parts of the south bank riparian strip. Where industrial development reaches the Ship Creek channel itself, constructed rip-rap barriers to constrain stream migration are present, and riparian strips absent or minimal.

The most prevalent riparian community consists of a canopy of willows (*Salix* sp.), quaking aspen (*Populus tremuloides*), and alder (*Alnus viridis* ssp. *sinuata*). Along the channel's edge, dense thickets are often formed by Sitka willow (*Salix sitchensis*) and Pacific willow (*Salix lasiandra*). The understory is dominated by common horsetail (*Equisetum arvense*), coltsfoot (*Petasites palmatus*), purple-leaved willowherb (*Epilobium ciliatum*), and colonial bentgrass (*Agrostis capilalris*). Other species noted in the understory include wood fern (*Dryopteris expansa*), fireweed (*Epilobium angustifolium*), large-leaf avens (*Geum macrophyllum*), common timothy (*Phleum pretense*), Nootka rose (*Rosa nutkana*), pink clover (*Trifolium pretense*), and stinging nettle (*Urdica dioica*). A complete list of plants identified along Ship Creek is provided in Table 1.

Coltsfoot (*Petasites palmatus*) and purple-leaved willowherb (*Epilobium ciliatum*) were most common in the riparian communities in the upper and middle sections of Ship Creek. In the area just above the dam, the densities of coltsfoot decreased and common horsetail was much more prevalent.

The KAPP dam normally prevents saltwater from passing upstream of the dam, however, saltmeadow cordgrass (*Spartina patens*) was identified along the creek channel about 200 feet upstream from the dam. This is a species tolerant of brackish conditions, but no other indications of saltwater tolerant species were noted above the dam.

Below the dam (Reach 4), little or no vegetated riparian areas are present. Each bank is composed of rip-rap or concrete between the dam and the mudflat area that begins about ½ mile downstream from the dam. Additional discussion of the estuarine area can be found in Section 4.2.

4 Ship Creek Aquatic Habitat

Ship Creek

Ship Creek itself is perennial and characterized as a riffle-run environment. Substrate in all freshwater reaches consists of gravel and cobbles with few fines. The KAPP dam, about ½ mile from the mouth of the creek, forms a boundary between tidal waters and freshwater stream. Riffle frequency, vegetative protection, riparian width, channel characteristics, and bank stability do vary between reaches (and indeed are a basis for the division into reaches). Figure 3 shows the key features.

Benthic invertebrates were not specifically evaluated in this qualitative survey, but it was noted that caddis flies (order Trichoptera) were particularly abundant at the time of the survey.

Backwaters, Relict Channels, and Marshes

Several areas along Ship Creek contain backwaters that appear to be remains of relict side-channels that no longer conduct any flow except during very high flows. However, the lower elevations of some of these channels allow water to flow back, creating small backwater areas. Several of the relict side-channels have been cut off from the main channel and are characterized by low-lying areas saturated or inundated by standing water. These areas generally contain up to 1 foot of fine-grained organic muck over the historic sand and gravel layers deposited from the former river channel. The areas separating the low-lying areas and the main channel generally consist of historic areas of deposition, consisting mostly of gravel and sand.

Three distinct marshy areas are present: a wooded marsh area in Reach 1 along the south bank, in areas affected by the many groundwater seeps along Reeve Boulevard; an open marsh on the north bank in Reach 1 west of Steel Fabricators (LP-056); and a partially wooded marshy area in Reach 3 on the north bank south of Whitney Road. The marsh west of Steel Fabricators appears to be the result of seepages from the fill bank along North Post Road and the absence of a defined outfall to Ship Creek (there are several seeps in the gravel berm separating the marsh from Ship Creek). The third marsh will be discussed further below.

Ponds

Two ponds were identified during the survey near the creek: the KAPP pond and the constructed pond south of Whitney Road and the Criterion General (LP-078) and Patrick Hickey (LP-052) lease properties. Both of these ponds are in hydrologic contact with Ship Creek.

The origin of the pond south of the lease properties on Whitney Road is uncertain. It is clearly artificial, as distinct berms surround it. In a photo from

1950, the pond is present in its current configuration. At that time a second pond was also present between the existing pond and the creek (Figure 2 for 1950 channel). This second pond has been allowed to fill in, however, and currently is a well-developed marsh. There is some indication that the pond may originally have been a water intake pond for industrial facilities along Whitney Road, such as the inferred power plant located where Suburban Propane (LP-139) currently is sited. The presence of two old wooden cribs that may have housed pump intakes may point to this use (Photo 1)

The pond currently receives stormwater influx from the railyard and the bluff north of the yard via the ARRC B-2 outfall. Reports from ARRC staff indicate that beaver dams blocked the pond outlet causing flooding of surrounding properties. The beaver dams have been breached and are abandoned (Photo 2), and a gravity drain installed by the railroad currently assists drainage into the Creek (Photos 3 and 4). The aquatic habitat is densely colonized by aquatic vegetation and dominated by bog St. John's wort (*Hypericum anagalloides*). The northeast portion contains a large section of emergent vegetation dominated by beaked sedge (*Carex rostrata*). Vegetation on the east, south, and west borders consist of herbaceous communities dominated by colonial bentgrass (*Agrostis capillaris*).

The KAPP cooling pond (Photo 5) in the lower portion of Reach 3 was built around 1950 for use by the KAPP. It is connected to Ship Creek by a weir (Photo 6). The pond was maintained as a recirculating pond. A pump house is present in the northwestern corner. It drains via a constructed outfall under the KAPP dam. This is a long, narrow pond (750 feet by 90 feet, or about 1.5 acres). Pondweed (*Potamogeton* sp.) and Eurasian water milfoil (*Myriophyllum spicatum*) are the dominant aquatic species. Whitney Road bounds the north shore, and the south shore runs along the woodland riparian area adjacent to the creek, as discussed in the previous section. Two beaver lodges were present along the south shore (Photo 7). The berm isolating the pond from Ship Creek has been eroded in some areas, and Ship Creek water likely flows freely into the pond during high flows.

Tidal Zone

Below the dam, approximately ½ mile of the creek is under tidal influence. Tidal range is high and can exceed 30 feet. The final section of the creek before entering Knik Arm flows through largely unvegetated mudflats in the low intertidal zone (Photo 8). As shown in Photo 9, the creek bed at low tide is steeply downcut, as a result of creek erosion and scour during low tide. Vegetation is limited along the channel borders, although more abundant at higher intertidal levels. Lyngby's sedge (*Carex lyngbyei*) and seaside arrowgrass (*Triglochin maritime*) comprise the community, subject to tidal influence. A small salt marsh at the upper intertidal zone contains the above vegetation and Pacific silverweed (*Potentilla anserina*) (Photo 10).

4.1 Aquatic Physical Habitat

Habitat assessment field data sheets are contained in Appendix C. These sheets describe field observations of physical parameters of each reach.

4.1.1 Reach U

Reach U is characterized by high velocities with low sediment deposition. Substrate consists mostly of cobble and gravel with occasional boulder-sized rocks. Very little fine-grained sediment is present. The reach contains all four velocity/depth regimes (slow-deep, slow-shallow, fast-deep, and fast-shallow), and riffles are frequent (Photo 11). This is due, in part, to a set of two spillways that serves the state salmon hatchery (Photo 12). A deep, slow area is present prior to the spillway where water is taken in for the hatchery.

The banks along several meanders have eroded, and these banks have been fortified with rip-rap geotextile fabric (Photo 13). The majority of the reach is relatively stable, however. There is little channel alteration and more than 90 percent of each bank is stabilized by vegetation. The riparian zone extends up to 10 meters on the north bank and is slightly thinner on the south side due to the presence of a golf course on the bluff. The canopy of this reach is relatively open and most of each bank is shaded. Approximately half of the length of each bank contains overhanging vegetation (Photo 14), and snags and other large woody debris is present in about 10 percent of the reach (Photo 15).

The upstream reach of Ship Creek is similar to the on-site reaches, in most respects, and would appear suitable as a reference stretch.

4.1.2 Reach 1

Reach 1 extends from the Reeve Boulevard Bridge downstream approximately 0.6 mile to Sitka Street. This area is characterized by several meanders, and contains few artificial channel alterations (Photo 16). It has high velocities and riffle areas that are present in approximately 70 percent of the reach. All four velocity depth regimes are present. Substrate consists of gravel and cobble with occasional boulder-sized rocks.

The shoreline contains a mix of snags, submerged logs, and undercut banks, providing good cover for fish (Photo 17). Each of the banks along the creek is stabilized with overhanging vegetation. No other artificial stabilizing material is present along the shoreline of this reach. Several of the meanders contained gravel bars with side-channels, which increases the complexity of this reach. These characteristics, along with the frequency of riffles and unimpacted shoreline, create excellent habitat for fish.

4.1.3 Reach 2

Reach 2 is the relatively linear length of stream from Sitka Street to the railroad trestle. This section is influenced by rip-rap and other reinforced slopes that create highly channelized flow (Photo 18). Approximately 80 percent of the south bank was protected with native vegetation, but only 60 percent of the north bank was vegetated. The remainder of these areas was occupied by rip-rap or chunks of cement used to reinforce the banks (Photo 19). A newly constructed bike trail passes close to the southern shore of the creek for approximately 100 meters. Little or no shoreline vegetation is present along this stretch.

No sharp meanders are present, creating a flow environment characterized as run. Very few riffles were observed along this reach. The shoreline consists of little snags and large woody debris. Few logs or other woody material remain in this reach due to the high velocities unmitigated by the linear channel. No side-channels or gravel bars were observed in this section.

Substrate consists of gravel and cobble with occasional boulder-sized rocks. The substrate in this area contained a much larger density of attached algae than the other reaches. Cobble and gravel were relatively slick and covered with a thin, greenish brown covering, which are most likely diatoms.

4.1.4 Reach 3

Reach 3 extends from the railroad trestle to the KAPP dam. This section contains some channel meanders, with a backwater pool area at the dam (Photo 20). The meanders are not sharp like those in Reach 1, but serve to provide variety to the velocity and depth regime of the reach. Some areas of the bank appear to have been reinforced with rip-rap and debris. The area seen in Photo 21 (apparently intended to protect the unidentified pump installation described further in Section 6) contains concrete, rebar, and remains of railcar undercarriages and couplings. The majority of the reach is characterized as run, with riffles present in approximately a third of the reach. At the dam, water flow is slow and deep, creating an ideal pool environment.

Several gravel bars were present along this reach, and gravel and sand beaches were exposed in a greater portion of this reach than Reaches 1, 2, and 3. However, all areas except for the rip-rapped banks contain stream bank surfaces protected with trees, shrubs, or herbaceous vegetation. The majority of the riparian area and floodplains, with the exception of the area near the dam, is colonized by dense thickets of willows. The northern riparian area extends about 15 meters, but the southern riparian width averages less than 5 meters.

Stream width in this reach ranges from approximately 15 to 25 meters. The wetted width at the dam encompasses the entire floodplain and spans the width of the dam (approximately 60 meters). The floodplain in this area is

between 10 and 20 meters wider than any of the floodplains in Reaches 1, 2, and 3. The lower area is characterized by unvegetated gravel beaches due, in part, to the annual flooding that builds up at the dam. An embayment is created from backflow on the north side of the channel that extends approximately 20 meters.

Substrate in the entire reach is composed of gravel and cobble with infrequent boulders. Sand dominates in the pool behind the KAPP dam. Several gravel bars were present in this reach. In the pooled area at the dam, embeddedness is approximately 25 percent due to the deposition of fine-grained sediment in areas of slower velocities.

4.1.5 Reach 4

Reach 4 extends from the dam to the mouth of Ship Creek. This area is tidal. Large amounts of fine-grained material are deposited in this area, but the main channel generally flows with great enough velocity to flush any fines downstream (Photo 22). The channel is up to 70 meters wide just below the dam. The wetted width at low tide was approximately 10 meters. The stream thalweg migrate throughout the braided channel. At high tide, the entire width of the channel is inundated with brackish water that extends to a depth of several feet deep at the dam (Photo 23).

All areas of the floodplain, except for the wetted channel, contain deposits of fines. Embeddedness of the gravel and cobble substrate is greater than 80 percent in the non-wetted areas. Occasional Lyngby's sedge (*Carex lyngbyei*) are rooted in the deposits in the middle of the floodplain just below the dam.

The entire length of each bank below the dam to the lower railroad culvert is either rip-rap or concrete, creating a highly channelized flow pattern. Less than 5 percent of the banks are vegetated and no overhanging vegetation is present (Photo 24).

Below the lower railroad culvert, the area is characterized by mudflats of almost entirely clay (Photo 25). The channel has deeply incised the clay, as shown in Photo 26, and meanders sharply several times. The banks in this area to the mouth are unvegetated. Low tide creek flows, and presumably incoming tide fluxes, scour the channel, leaving gravel and cobble exposed with limited fine-grained sediment deposition. The channel narrows to between 10 and 15 meters in this section. At high tide, water depths in the channel reach 30 feet.

4.2 Biota observations

Wildlife

Beaver (*Castor canadensis*) were common throughout the creek. Beaver lodges were identified in Reach U along the creek and in Reach 3 in each of

the ponds (Photo 7). Extensive areas of intense beaver activity (Photos 27 and 28) were noted, particularly on the north bank in Reach 3.

A red fox (*Vulpes vulpes*) was spotted in Reach 1 shortly after dawn, and prints of beaver (*Castor canadensisis*) were observed throughout the creek. Droppings from moose (*Alces alces*) and prints of deer (*Odocoileus* sp.) were also observed in the riparian areas of several reaches.

Bird observations were relatively few, as migratory birds largely had left the area by the time of the survey. Common resident urban birds, such as magpies and crows, were common. Several species of gull and tern were noted.

Table 2 shows a list of bird species that may be expected at the ARRC Terminal Reserve. The list shows common birds only.

Fish

Ship Creek is an active recreational fishery (Photo 29). It is listed as a "water important for spawning, rearing, or migration of anadromous fish," as stream 247-50-10060 (ADFG, 1990). Fish Habitat Permits are necessary for construction in such waters, per Alaska Statutes Sec. 16.05.870. The Elmendorf Hatchery produces Chinook salmon (*Oncorhynchus tschawtshca*) and Coho salmon (*O. kisutch*) for release around south central Alaska. Typically around 105,000 Chinooks of average size 16 grams and 65,000 Cohos of average size 22 grams are released to Ship Creek annually (ADFG, 1992). Approximately 6,000 Chinook and 2,000 Coho return annually (MOA, 1991).

These salmon are intensively fished by sport fishermen, particularly in Reach 4 below the KAPP dam. The reaches above KAPP dam are off limits to fishing. The salmon transit the KAPP dam by means of a fish ladder on the north side.

During the survey, abundant full-size Coho salmon were noted in Reach U and Reach 1, where they congregated near the hatchery return flow and in the undercut banks in Reach 1. Abundant adult salmon also were noted both above and below KAPP dam. Dead salmon were seen in several locations (Photo 30).

In addition to the anadromous Salmonids mentioned above, Ship Creek also supports a population of resident Dolly Varden (*Salvelinus malma*) (ADFG, 2002)

Threatened and Endangered Species

Table 3 is a listing of species listed as endangered or of Special Concern by the State of Alaska or listed under the Federal Endangered Species Act for the

area. Further evaluation of potential on-site presence of these species will be undertaken as part of the Site-wide risk assessment.

5 Ship Creek Discharges and Features

The habitat survey included location and identification of water discharges to Ship Creek. Discharges may include established outfalls and diffuse seepages and discharges. In addition, other features of interest were noted and mapped. Figure 4 shows the location of the identified features. Subdrainages were identified using information provided by Scott Wheaton of the Watershed Management Services of the MOA, and data in MOA (2003).

5.1 Water Discharges

Reach U (Upstream)

Ship Creek was surveyed for about ½ mile upstream of the Site boundary at Reeve Boulevard bridge. This area is considered the reference area for Ship Creek. However, it has a number of stormwater and other drainages and water intakes. Note also that, upstream of this area, there are additional municipal and military facility outfalls. Identification codes refer to Figure 4A and Table 4.

- **Outfall U-1**. This storm drain is located above the Elmendorf Hatchery dam. It drains the railroad right-of-way (Photo 31) and also seeps along the North Bluff. Water quality sample WQ-19 was collected from this drainage.

- **Outfall U-2**. Several outfalls (Photos 32 and 33) are return flows from the Alaska Fish and Game Elmendorf Hatchery located on the north bank. The discharges have a strong fish odor. Water quality sample WQ-15 was collected from the drainage ditch immediately east of Reeve Boulevard.

- In addition to the specific outfalls identified above, there are a number of seepages from the golf course (Photo 15) and a ditch (Photo 34) along the south bank, presumably associated with the nearby golf course and the marshy woodland present in the area.

Reach 1

Reach 1 receives discharge from MOA stormwater subdrainages 830, 831, 832, 834, 835, and 836. In addition, the Elmendorf Air Force Base OU-5 discharge point is located in this reach (Figure 4B).

- **OU-5 Discharge** (Photo 35). An 18-inch outfall onto a bed of rocks, this appears to be the highest volume discharge to Ship Creek. It discharges treated return flow from the OU-5 treatment system on the North Bluff and flows beneath Post Road past the

east boundary of Standard Steel to the creek. Note that additional flow from seepages in the North Bluff area are also present. A portion of those seepages reach the creek via the ARRC storm water system

- **MOA 830/832**. A small (12-inch) culvert (Photo 36) is the mouth of a shallow drainage ditch (Photo 37) that appears to capture runoff from lease property industrial areas between Ship Creek and Post Road. This outfall was dry.

- **Seep S1-1**. This south shore subdrainage (MOA 836) includes Reeve Boulevard and the marshes and bogs east of the road. Discharges are diffuse and emerge as a series of seepages along the Reeve Boulevard bank. The seeps form marshy areas along the creek and enter Ship Creek in several locations along the bank.

- **MOA 834**. This subdrainage encompasses industrial properties north and south of Viking Drive as well as Reeve Boulevard itself. The outfall is located in the berm immediately east of Pruhs Corp. (LP-083). It then flows in a shallow ditch about 100 feet through riparian habitat to Ship Creek. A culvert under the new trail is present. It was flowing at the time of the survey.

- **MOA 835**. Large (3-foot) south bank outfall at Sitka Street (Photo 38). Drains a large municipal subdrainage, including industrial areas south of Ship Creek, which include ARRC property and other areas.

- **Ditch S1-2**. Site documents for the former Standard Steel plant indicate a drainage ditch from the Site running southwest to Ship Creek. This ditch was located and evaluated. It currently is relatively shallow and partly filled with silt (Photo 39). It did not contain standing water, but saturated conditions suggest it serves as a runoff conduit for the surrounding riparian area. Excavations in the silt did not reveal any indications of sheens or odors.

- **Ditch/Seep S1-3**. Several water seeps along the fill edge below Commercial Truck Services (LP-029) drain via a 150-foot ditch (Photo 40) to a well-developed marsh area (Marsh S1-4). This marsh is described in more detail elsewhere. The marsh has no outlet, but appears to drain via several seeps in the bar along the creek (Photo 41). There are iron- related stains at this location.

Reach 2

On the north bank, Reach 2 receives discharges from subdrainages MOA 831 and 837 (Figures 4B and 4C). On the south side, subdrainage MOA 833 drains to Ship Creek.

- No defined outfalls are present along the north shore. The two subdrainages (MOA 831 and 837) covering the lease properties between Post Road and the creek appear to drain diffusely to the creek.

- **MOA 833A**. Small outfall. Appears to drain Viking Drive area within subdrainage 833.

- **MOA 833B**. A large (3-½-foot) outfall (Photo 42) drains this extensive industrial subdrainage north of 3rd Avenue, which includes ARRC lease properties and off-site areas. As noted below, there was evidence of sheens in the water exiting the outfall.

Reach 3

Reach 3 is the receiving water for drainage from large areas of the ARRC railyard, Elmendorf Air Force Base, ARRC lease properties, and industrial, commercial, and residential areas of Anchorage (Figures 4C and 4D). On the south side, municipal subdrainages MOA 826, 812, and part of 811 have outfalls to the creek. On the north side, municipal subdrainages MOA 829 and ARRC railyard drainages E-1 and A-2 have outfalls to Ship Creek.

- **MOA 826**. An outfall (Photo 43) drains this industrial subdrainage north of 3rd Avenue. The drainage area includes mostly industrial land within ARRC lease properties, including the Municipal Power and Light (LP-022) facility, and off-site industrial areas. The outfall is to a short ditch that reaches Ship Creek. This outfall has evidence of hydrocarbon odors, as described further below.

- **MOA 812A**. Outfall for portions of subdrainage 812. This outfall was dry at the time of the survey and appears to be active only during runoff events (Photo 44).

- **MOA 812B**. Industrial and open space subdrainage north of 3rd Avenue and west of Ingra Street. Outfall is active (Photo 45).

- **ARRC E-1**. The eastern portions of the railyard and bluff drainage from Elmendorf Air Force Base drain to Ship Creek via an outfall to a ditch located at the intersection of Viking Drive and Post Road (Photo 46). The ditch runs along the railroad tracks (Photo 47) and joins Ship Creek at the location of the upper railroad bridge. There is at least one subsidiary outfall to this ditch, apparently draining impervious surfaces at the Hayden Warehouse (LP-098) facility. The ditch is heavily vegetated. Due to the many interconnections in the railyard stormwater system, it is likely that some of the North Bluff groundwater seepage flows

to this outfall, as may some municipal flow from the Government Hill area.

- **ARRC A-2**. The central portions of the railyard, as well as runoff from storm drainage on portions of Government Hill and from Elmendorf Air Force Base reach Ship Creek via an outfall located south of Whitney Road next to Black Gold Express (LP-123). The outfall is a wooden structure (Photo 48). The discharge drains via the pond to Ship Creek, entering the creek at the gravity outfall of the pond drain (Photo 49).

Reach 4

Reach 4 includes the lower subdrainages: MOA 811, 809, and 808 on the south side, and ARRC A-1, B-1, and C-1 on the north side (Figure 4D).

- **MOA 811**. Subdrainage on both sides of Cordova Street, north of 3rd Avenue. An outfall is located in the berm just below the KAPP dam (Photo 50).

- **MOA 809**. Large subdrainage including commercial areas on the south bank and portions of downtown Anchorage. There are two adjacent outfalls on the south bank near the covered bridge (Photo 51 and 52).

- **Marsh S4-1**. A small marsh and pond located on the south shore just east of North C Street. This marsh appears to receive runoff from surrounding impervious areas. It drains via a small culvert under the shoreline trail to Ship Creek.

- **Marsh S4-2**. A small wooded marsh immediately west of the ARRC office building. It appears to receive runoff from nearby parking lots, and drains via a small culvert under the shoreline trail to Ship Creek.

- **MOA 808**. Three-foot galvanized culvert. Partly crushed and battered from ice movement (Photo 53). Drains subdrainage including ARRC depot and neighboring residential areas.

- **KAPP Cooling Pond**. The KAPP cooling pond was constructed in 1950-1953 as a water intake pond for the KAPP. Most of its water appears to be Ship Creek water entering via diffuse flow through the berm around the pond. A weir also exists, but is kept closed. It drains via a culvert to an outfall just below the KAPP dam (Photo 54, on the right).

- **ARRC B-1/MOA 825**. Outfall draining large portions of railyard, KAPP, and Whitney Roads. It is also connected to municipal drains from portions of Government Hill (Photo 54, on the left).

- **ARRC A-1**. Outfall draining western portions of railyard in ARRC storm drain system A, also collecting seeps from the bluff at the north boundary of the railyard (Photo 55, bottom).

- **MOA 820 / Alaska Department of Transportation**. Outfall adjacent to ARRC A-1 that drains the highway and bridge right-of-way and adjacent areas. Managed jointly by MOA and ADOT (Photo 55, top).

- **ARRC C-1**. Outfall draining westernmost portions of railyard. May be inactive (Photo 56).

- **Marsh S4-3**. A small salt marsh located just west of New Western Drive and north of the marina. This salt marsh is submerged during high tide and drains diffusely to the Ship Creek channel during low tide (Photo 57).

5.2 Other Features of Interest

Other features of interest were noted as part of the survey. These features are listed and discussed below and shown on Figure 4.

Reach U

- U-10 Crossing overhead pipe, 2-foot diameter, uninsulated (Photo 58).
- U-11 Crossing buried pipe, corrugated, rusted and broken. Unknown identity.

Reach 1

- 1-10 Undercut banks. Bank undercut adjacent to DiTomaso (LP-074) sheltered numerous Coho Salmon.
- 1-11 Seepages from marsh 1-1. These iron-stained seeps (Photo 41) drain the marsh present in the riparian area.
- 1-12 Debris fill. The fill along the south boundary of the properties along the south side of Post Road are constructed from slabs of concrete and other debris.

Reach 2

- 2-10 Crossing 18-inch cast iron pipe on creek bottom (Photo 59). Appears to be a sanitary sewer pipe based on belled slip-joint construction.

- 2-11 Bank fill below Post Road Co. (LP-127). Parts of old culverts used as fill. Despite appearance of being a pipe, close inspection reveals debris fill (Photo 19).

Reach 3

- 3-10 Wooden crib on north bank of creek. This wooden crib (Photo 60), 5 foot by 5 foot. Such boxes were previously (1940s) used to shore the sides of valve pits, or possibly to house pump intakes.
- 3-11 Wooden crib in pond (Photo 1). An identical wooden crib to 3-10.
- 3-12 Metal debris. Partially buried metal debris in the marsh appears to consist of undercarriages and couplings of railcars. Similar metal structures can be seen in several areas of the creek bank, including next to crib 3-10.
- 3-13 Concrete box. A 5x12 concrete box partially embedded in south bank (Photo 61). Abandoned. May have been a surface water intake
- 3-14 Iron pipe. A 6-½-inch diameter iron pipe emerges from the north bank (Photo 62). It is cut about 1 foot from bank. The pipe has thick walls (1/2 inch) and is consistent with petroleum pipes. No other indications of source or destination could be found.
- 3-15 Metal debris. The north bank contains metal debris which appears to consist of railcar couplings (Photos 63 and 64).

Reach 4

- 4-1 Seepages on bank. Numerous seepages along north bank below Wrightway Auto (LP-049) (Photo 65). Seepages are iron stained.
- 4-2 Pipe. A cut, 4-inch cement asbestos pipe high in the bank (Photo 66). The source and purpose of this pipe could not be determined. There was no indication of any recent discharges from the pipe.

6 Environmental Observations

6.1 Water Quality Data

Field water quality data was collected at various locations as part of the field survey. Parameters included electrical conductivity (EC), temperature, dissolved oxygen, oxidation-reduction potential, total dissolved solids/salinity, turbidity, and pH. Any unusual color or odor was noted. The objective of the data collection was to provide basic baseline information on the water in Ship Creek, and is not intended as an evaluation of potential contamination.

Features of interest where measurements were conducted included the main channel, selected stormwater outfalls, backwaters, and ponds. Table 5 shows the results. Figure 4 shows the location of the sample points.

The most variable parameter was EC. Three EC regimes can be discerned in the data, which may be useful for future evaluation of water sources. These are:

1. Surface water (runoff and main channel): Sample locations dominated by surface water sources, i.e., the main channel of Ship Creek and backwaters and pond areas dominated by surface water or rainwater inflow had low EC, around 200 µS/cm. Ship Creek itself has an EC of about 190 µS/cm in the upstream reach, increasing slightly to a little over 200 µS/cm above the KAPP dam. This indicates that marine influence is minimal above the dam.

2. Surface water below KAPP dam: The KAPP dam forms the upper boundary of the tidal influence. In the tidal area, the EC fluctuates from 210 µS/cm at low tide (i.e., freshwater only) to 1900 µS/cm at high tide, indicating brackish water (but surprisingly low salinity in view of the spring tide conditions at the time of measurement).

3. Water bodies dominated by groundwater seepage and flow: Those storm drains that were measured had EC values between 450 and 550 µS/cm. This is measurably higher than Ship Creek itself and may serve as a useful indicator of water source. Water bodies, such as the ponds and backwaters, which are influenced by both groundwater or seep influx and Ship Creek water had intermediate EC values.

6.2 Environmental Concerns

As part of the habitat assessment, any indications of environmental problems, such as evidence of contamination or structures that may represent sources of contamination, were noted. The following listing summarizes the observations:

- **Possible hydrocarbon contamination.** (Figure 3). A ditch located behind Commercial Truck Service (LP-029)[1] drains several groundwater seeps present in the fill and rubble berm behind the property. This ditch (Photo 67) is approximately 125 feet long and flows into a marshy area along the north side of Ship Creek. The marsh is isolated from Ship Creek by a gravel and cobble bar and does not have a defined channel into Ship Creek. It appears to drain to the creek via a series of seeps in the creek bank. The marsh was vegetated with sedges, with standing water up to a foot deep overlying over a foot of silt and muck. Relict stream channels (dry) are frequent in this riparian area.

  Immediately below the Commercial Truck Service property, the ditch was covered in a black muck with a strong hydrocarbon odor (Photo 68). However, there was only limited sheening on the water surface when disturbed. The muck extended about 15 feet down the ditch, and odors were noticeable for about 100 feet. This material is of unknown origin, but might be similar to highly weathered, used motor oil.

  There was no visual or olfactory evidence that the marshy area or the seeps to Ship Creek were affected, but this cannot be determined conclusively without additional investigation.

- **Sheening from storm drain.** Storm outfall MOA 833 drains municipal subdrainage 833. This stormwater subdrainage includes extensive industrial areas on the south side of the creek, most (but not all) of which are located outside ARRC property. Minor hydrocarbon sheens were visible in the water flowing from the outfall. Similar sheens were also noted during the creek survey in March 2004.

- **Hydrocarbon odor from storm drain**. Storm outfall MOA 826 drains municipal subdrainage 826. This stormwater subdrainage drains industrial properties along the south shore, including the MPL facility. The outfall (Photo 69) opens into a small ditch that flows about 30 feet to the current Ship Creek channel (Photo 70). A strong hydrocarbon odor is evident along the ditch and next to the outfall. No sheening or discoloration of the discharge was noted. Strong odors were also reported during the March 2004 creek survey.

[1] LP-029 is listed in some sources as Polar Equipment, which is a former leasee. The neighboring lease, LP-017, is also listed as Polar Equipment. The street address for LP-029 is 2014 Post Road, and is actually Commercial Truck Service, (a sublease to the current leasee), as also indicated by a large sign.

- **Possible hydrocarbon sheening in pond.** Sheens of limited extent were present along the eastern arm of the pond located south of Whitney Road. This pond is described in more detail elsewhere. Small sheens were noted on the water surface (Photo 71). Closer examination at the eastern end of the pond revealed some additional sheening, although it appeared to be natural, non-hydrocarbon sheens (Photo 72). The nature of the sheens seen on the open water surface was not determined. Disturbing the sediment in the pond did not release any sheening. The possibility of hydrocarbon sheening in this area cannot be discounted, as the pond is located downgradient of several potential sources (e.g., storm sub-drainage ARRC A-2 and the contamination present around Arctic Cooperage (LP-991).

- **Unidentified pumping structures.** Remains of a pumping structure were located in the riparian woods immediately south of Dean's Automotive (LP-056) in Reach 3. This structure was not identified in the Site Background Report. The structure consists of an abandoned pump house (Photo 73), a 12 x 12-foot pit, about 4 feet deep, with structures of unknown purpose (Photos 74 and 75), pipes emerging from the ground (Photo 76), and some additional structures (Photo 77).

  There was no evidence of contamination in the surrounding soil or in the pit itself. The function of the structure appears to have been a pump house. Older photographs show that a roadway to the area existed from at least 1920 to sometime before 1961. The facility may have been connected to a suspected power plant mentioned in older records, or associated with the diversion of Ship Creek as part of the construction of the KAPP dam in the early 1950s. It is likely the structure was a water pumping installation, in which case environmental concerns may not be significant.

- **Abandoned tanks.** Several discarded rail tank cars and other junked equipment (e.g., refrigerators) are present along the south boundary of York Steel Company (LP-042) (Photo 78). There was no direct evidence of contamination or releases, however.

- **Abandoned fuel tank in Ship Creek.** An empty tank is located in Reach 3 (Photo 78). It appears clean with no evidence of contamination.

No other features associated with environmental contamination were noted in the Ship Creek habitat area.

7 North Bluff Area

7.1 Description of Habitat

Habitat in the North Bluff area is dominated by second- or third-growth native vegetation with segments denuded of vegetation due to excavation or industrial activity. Figure 5 shows the location of the developed and industrial railyard section, as well as the North Bluff assessment area. The bluff is mostly wooded, but contains an open area where the bluff has been partially cut back to prepare for expansion of the railyard (Photos 79 and 80).

Small, linear marshy areas along the foot of the bluff (Photo 81, 82) are common in the eastern and central forested area, arising from numerous groundwater seeps with iron-related stained soil (Photo 83). A shallow ditch along the access road below the bluff captures most of this runoff and directs it to the ARRC storm water system. Data sheets (Appendix D) were completed in the field to characterize the terrestrial bluff habitat, pond, and wetland fringe.

The North Bluff borders the entire north boundary of the railyard. The elevation of the bluff appears to be about 50 to 90 feet over the level of the railyard. The wooded strip generally covers the slopes of the bluff, except where they have been cleared or excavated. The width of the strip varies with the slope, from about 100 feet at its narrowest (in the far west portion of the railyard) to 360 feet at its widest (immediately west of the "cut" in the central part of the railyard). Multiple seeps along most of the bluff are present. The flow from these seeps collect in small wetlands along the base of the bluff, or flow into a ditch along the access roadway. In one small area with plentiful seeps and runoff from the bluff, the presence of a small berm has caused the appearance of a marshy area that is developing into a spruce bog. Ultimately the flow is captured by the railroad storm drainage system and reaches Ship Creek via several of the outfalls (E-1, A-1, and B-1).

The linear wetlands along the base of the bluff contain standing water and range from 1 to 3 meters wide. Sediment in the wetlands consisted of reduced, black sulfidic silt. The wetlands contain a thick herbaceous layer of beaked sedge, bluejoint reedgrass, mare's tail (*Hippuris vulgaris*), Nootka rose, hardstem bulrush (*Scirpus tabernaemontanii*), and cattail (*Typha latifolia*). Weedy vegetation also lines the wetland edge on the railyard, including yarrow (*Achillea millefolium*), fireweed (*Epilobium angustifolium*), red fescue (*Festuca rubra*), perennial sow-thistle (*Sonchus arvensis*), dandelion (*Taraxacum officinale*), and pink clover (*Trifolium pretense*). One area just west of the grassy, cleared area contained a small marsh composed of beaked sedge and hardstem bulrush. A complete list of vegetation identified in the North Bluff area is shown in Table 6.

The forested area on the bluff slopes (Photo 84) contains a canopy mostly composed of quaking aspen (*Populus tremuloides*) with smaller percentages of paper birch (*Betula papyrifera*), Sitka alder, and black cottonwood (*Populus trichocarpa*). Average canopy height ranges from 10 to 20 meters. The understory is characterized by shrubs and herbaceous vegetation dominated by coltsfoot, purple-leaved willowherb, trailing black currant (*Ribes laxiflorum*), and giant horsetail. Smaller proportions of Greene's mountain ash, Indian plum (*Oemleria cerasiformis*), spreading wood fern, and Nootka rose are also present. (Photos 85 and 86)

Three discontinuous areas of vegetated bluffs are present (see Figure 1):

- A western segment along the bluff below Government Hill, north of East Loop Rd. and east of Ocean Dock Road. This segment is narrow, with sparse recent growth. It would not be expected to contain significant or valuable habitat. This strip is narrow, averaging a little over 100 feet, and steep. Wooded areas further north can be seen on Figure 1, although these areas are located entirely within Elmendorf Air Force Base and Port of Anchorage land.

- A central segment along the bluff between the railyard and Elmendorf Air Force Base, from East Loop Road to the large "cut." This segment is the widest area of habitat (up to 360 feet wide just west of the "cut") and has value as a shelterbelt. Seepages and one surface-drainage coming down the bluff have created a spruce marsh.

- An eastern segment east of the "cut" to beyond the eastern end of the railyard. This strip varies in width from 300 feet to less than 150 feet. Numerous seeps form the linear marsh features described above. The strip is interrupted by clearings and ponds constructed as part of the Elmendorf OU-5 treatment systems.

7.2 Features of Interest

OU-5 Treatment Area

The OU-5 treatment system is managed by Elmendorf Air Force Base and is not discussed in detail for this survey. It includes pump stations, recovery systems east and west of the treatment pond (Photo 87), and a large treatment pond (Photo 88). The pond contains open water colonized by relatively dense mats of green algae with emergent vegetation such as cattails and beaked sedge along the shallower borders. The system drains via storm drains to Ship Creek. North of the pond, the bluff has been clear-cut to the fenceline along the Air Force Base boundary and is currently covered in grass.

Below the pond, there is a railroad spur which originally was used as a fuel unloading station for Elmendorf Air Force Base. Portions of fuel racks, piping, and distribution boxes remain at the spur (Photos 89 and 90).

The Cut

As part of planned railyard expansion, a large portion of the bluff has been excavated recently as part of the railroad expansion. All vegetation in the cut area has been removed, and the area is unvegetated. This area does not represent ecological habitat. Several seeps are present along the base of the bluff.

Snowmelt Stream

In the area immediately west of the cut, a shallow ditch is present (Photo 91), descending steeply in a notch west of Elm Street on Government Hill. Running water is present in the ditch, which appears to receive runoff from the Government Hill area (in addition to several seeps). Municipality records note that the area at the top of the bluff is a snow dump in winter. The presence of abundant debris and garbage in the ditch indicates that melting, plowed snow is a major source of flow. Bare gravel in the narrow creek bottom suggested that heavy scouring is present at times, and although the main portion of the channel was dry in the middle to upper section of the bluff, other side-channels appeared to be charged from seeps draining from the hillside and have contributed to flow in the lower portion.

This feature and other seeps along the base of the bluff discharge into a bog-like area on the flat along the bottom of the bluff. An earthen berm prevents surface flow to the drainage ditch located along the access road. This area was characterized by a thick and moist duff layer that swayed when walked on. The vegetation in this low-lying area consisted of a thick stand of 10- to 15-foot tall Sitka spruce (*Picea sitchensis*). The seeps flowing from the hillside appear to migrate via this wetland area and reach a small channelized wetland, approximately 1 meter wide, adjoining the drainage ditch adjacent to the railyard access road. Some small areas of standing water and saturated soil were present in this area also.

7.3 Wildlife

There were few direct observations of wildlife. Scat from moose and deer were present. Portions of the bluffs are large enough to serve as shelterbelts, and the vegetation is undisturbed enough that populations of smaller wildlife (e. g., shrews, rabbits, mice, etc.) can be present. However, the cut and the East Loop Road are barriers to migration.

Birds were few due to the lateness of the season, and no particular identifications were made. Table 2 shows common birds in the area.

7.4 Environmental Issues

No transport pathways from the railyard to the North Bluff area were evident. The entire bluff area is generally upgradient from the railyard source areas. No structures, sources, or signs of contamination were found.

The eastern portion of the North Bluff (including the ponds) is managed as part of the OU-5 treatment system. In this area, there is the additional potential source area represented by the abandoned fuel transfer facility. However, this facility is the responsibility of Elmendorf Air Force Base. No evidence of contamination was noted, however.

The snowmelt ditch clearly carries with it debris and garbage contained in the plowed snow. However, this material comes from sources not associated with ARRC and is not site related. Apart from the garbage, there was no evidence of contamination.

8 Summary and Recommendations

8.1 Ship Creek

The following summarizes the findings of this preliminary Ship Creek habitat survey:

- Ship Creek in its reaches through the ARRC Terminal Reserve is a modified and urban influenced stream. However, most sections have good-to-excellent habitat conditions for aquatic life.

- The Ship Creek channel is fairly stable, as it has been channelized and the riparian floodplain has been much reduced over the last half century

- Ship Creek is a high energy stream, and few areas of deposition of sediment are present either in the upper reaches or the lower, tidally influenced, reach. However, in those few areas where deposition does occur further evaluation is recommended.

- There is no overt evidence of degraded in-stream conditions due to contamination, although several potential sources of contamination were identified.

- Potential sources not related to contaminant releases from the ARRC Terminal Reserve included urban stormwater runoff from areas within and outside the ARRC Terminal Reserve, and return flows from other facilities such as the Elmendorf Hatchery and Elmendorf Air Force Base. Any evaluation of in-stream conditions must take into account not only potential on site sources but also the many potential sources located off site.

- The riparian zone is reduced to those areas of the floodplain not developed for industrial purposes. Some of these areas are large enough to represent fair to good habitat for wildlife.

- Several areas of marshes, backwaters, and ponds are present. These generally are the result of berms, pond excavation and other construction activities. However, they are fairly undisturbed now and have developed a rich biological community.

- An abandoned industrial facility, apparently a pumping facility of some kind, was noted in the riparian zone. No signs of contamination were noted, but it may represent a source area.

- Two areas of marshy backwaters and ponds are present. There are some indications of potential sources of contamination to these areas, neither of which has been investigated in the past.

- The biological community, as a whole, generally appears diverse and healthy. No specific biological investigations are recommended at this time, pending results from additional investigations into sources and accumulations of potential contamination.

On the basis of the Ship Creek habitat survey, it is recommended that the upcoming remedial investigation incorporate the following tasks:

1. Additional investigation of the abandoned pumping facility located in Reach 3 (See Figure 4C). The investigation should identify the nature of the facility and, if potential contaminants could be present, evaluate soil and sediment conditions.

2. Focused investigation of sediment and water quality in two areas of potentially affected marshland on the north side of the creek (in Reach 1 and 3). These areas are (a) Marsh S1-2 (see Figure 3B) affected by seepages from the area south of Commercial Trucking Services, and (b) Marsh S3-1 and the adjoining pond and riparian area south of Whitney Road in Reach 3 (see Figure 3C).

3. Additional sediment analysis in the limited areas where substantial deposition may have occurred.

4. It is not recommended to conduct biological sampling (benthic community structure, tissue analysis or toxicity bioassays) pending the outcome of the tasks identified above. The absence at this time of confirmed sources and transport pathways to Ship Creek from the ARRC Terminal Reserve, and the presence of several non-ARRC related sources, indicate that such studies would not be able to differentiate between effects on site and off site sources.

8.2 North Bluff

The following are the findings of the North Bluff survey:

- The North Bluff area is the only area of the upland portions of the ARRC Terminal Reserve with significant ecological habitat.

- The central and eastern portions of the North Bluff contain healthy second growth woodland habitat of value as a shelterbelt and habitat for small animals. However, the westernmost portion of the North Bluff near the Port of Anchorage is small and of limited value.

- Abundant water sources in the form of seeps may serve as drinking water sources for wildlife.

- There was no evidence for site-related contamination, and the entire area is located upgradient of ARRC activities.

- Potential sources in the eastern part of the bluffs are associated with the Elmendorf OU-5 ongoing treatment system, or are associated with the fuel transfer facility also under the responsibility of Elmendorf Air Force Base.

On the basis of the habitat survey, additional data collection or ecological risk assessment of the North Bluff area is not recommended as part of this site investigation, although some impact from seepage or runoff from third party sources cannot be excluded.

9 References

ADFG, 1990. Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes, Southcentral Region. Alaska Dept. of Fish and Game Habitat Division. September 29, 1990.

ADFG, 1992. Federal Aid in Sport Fish Restoration: Elmendorf Hatchery. Alaska Dept. of Fish and Game, FRED D-J Report F-27-R.

ADFG, 2002. Letter from R. Bosworth, ADFG to L. Schanche, Municipality of Anchorage, November 29, 2002 regarding Multi Use Trail Construction and Bridge Replacement Fish Habitat Permit FG-99-II-0176.

Hart-Crowser, 2004a. *Ship Creek Literature Review, Alaska Railroad Corporation*. April 2004. Document 8877, prepared July 2004.

Hart-Crowser, 2004b. Ship Creek Water and Sediment Assessment Report, Anchorage, Alaska. May 2004.

Hitchcock, C.L., A. Cronquist, M. Ownbey, and J.W. Thompson. 1959. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle.

MOA, 1991. Ship Creek Bridge and North "C" Street Realignment. Final Environmental Assessment. Prepared by Peratrovich, Nottingham & Drage, Inc. for Municipality of Anchorage. August 1991.

MOA, 2003. Anchorage Watershed Catalog Series: Ship Creek – Draft. Municipality of Anchorage Watershed Management Services, Document No. APg03003. October 2003.

Pojar, J. and A. MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine Publishing, Redmond, Washington and Vancouver, British Columbia.

RETEC, 2004. Ship Creek Initial Habitat Assessment Interim Action Work Plan. Prepared for ARRC, September 2004.

U. S. EPA, 1997. *Ecological Risk Assessment Guidelines for Superfund.*

U. S. EPA, 2001. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition*.

Tables

Table 1 Plants Noted in Ship Creek Area
ARRC Anchorage Terminal Reserve, Anchorage, AK

Scientific Name	**Common Name**	**Freshwater (Fr) or Estuarine (Es)**	**Native / Introduced**
Agrostis capillaris	Colonial bentgrass	Fr	N
Agrostis scabra	Rough bentgrass	Fr	N
Alnus viridis ssp. sinuata	Sitka alder	Fr	N
Betula papyfera	Paper birch	Fr	N
Calamagrostis canadensis	Bluejoint reedgrass	Fr	N
Carex lyngbyei	Lyngby's sedge	Es	N
Carex rostrata	Beaked sedge	Fr	N
Dryopteris expansa	Wood fern	Fr	N
Equisetum arvense	Common horsetail	Fr	N
Epilobium angustifolium	Fireweed	Fr	N
Epilobium ciliatum	Purple-leaved willowherb	Fr	N
Geum macrophyllum	Large-leaf avens	Fr	N
Hypericum anagalloides	Bog St. John's wort	Fr	N
Petasites palmatus	Coltsfoot	Fr	N
Phleum pratense	Common timothy	Fr	N
Plantago lanceolata	English plantain	Fr	I
Potentilla anserina	Pacific silverweed	Es	N
Rosa nutkana	Nootka rose	Fr	N
Rubus idaeus	Red raspberry	Fr	N
Salix lasiandra	Pacific willow	Fr	N
Salix scouleriana	Scouler willow	Fr	N
Salix sitchensis	Sitka willow	Fr	N
Sorbus scopulina	Greene's mountain ash	Fr	N
Spartina patens	Saltmeadow cordgrass	Es	N
Trifolium pratense	Pink clover	Fr	N
Triglochin maritime	Seaside arrowgrass	Es	N
Urdica dioica	Stinging nettle	Fr	N

Table 2 Common Bird Species Expected at ARRC Terminal Reserve
ARRC Anchorage Terminal Reserve, Anchorage, AK

Scientific Name	Common Name	Creek/Riparian habitat	Woodland habitat	Urban habitat	Beach/Coastal habitat
Podiceps auritus	Horned grebe	X			X
Podiceps grisegena	Red-necked grebe	X			X
Ardea herodias	Great blue-heron	X			X
Branta Canadensis	Canada goose	X		X	X
Anas crecca	Green-winged teal	X			X
Anas Platyrhynchos	Mallard	X		X	X
Anas acuta	Northern pintail	X	X		X
Anas clypeata	Northern shoveler	X	X		X
Anas americana	American wigeon	X	X		X
Aythya marila	Greater scaup	X			X
Bucephala clangula	Common goldeneye	X			X
Falcipennis canadensis	Spruce grouse		X		
Lagopus lagopus	Willow ptarmigan	X	X		
Charadrius semipalmatus	Semipalmated plover				X
Tringa melanoleuca	Greater yellowlegs	X			X
Tringa flavipes	Lesser yellowlegs	X			X
Actitis macularia	Spotted sandpiper				X
Calidris mauri	Western sandpiper				X
Calidris minutilla	Least sandpiper				X
Limnodromus griseus	Short-billed dowitcher	X	X		X
Gallinago gallinago	Common snipe	X	X		X
Phalaropus lobatus	Red-necked phalarope	X			X
Larus philadelphia	Bonaparte's gull	X			X
Larus canus	Mew gull	X			X
Larus glaucescens	Glaucous-winged gull	X		X	X
Sterna paradisaea	Arctic tern	X			X
Columba livia	Rock dove			X	
Tachycineta bicolor	Tree swallow	X	X		X
Tachycineta thalassina	Violet-green swallow	X	X		
Pica pica	Black-billed magpie	X	X		
Corvus corax	Common raven	X	X	X	X
Poecile atricapillus	Black-capped chickadee	X	X		
Poecile hudsonicus	Boreal chickadee	X	X		
Regulus calendula	Ruby-crowned kinglet	X	X		
Catharus ustulatus	Swainson's thrush	X	X		
Catharus guttatus	Hermit Thrush	X	X		
Turdus migratorius	American robin	X	X	X	
Ixoreus naevius	Varied thrush	X	X		
Anthus rubescens	American pipit	X	X		
Vermivora celata	Orange-crowned warbler	X	X		
Dendroica coronata	Yellow-rumped warbler	X	X		
Passerculus sandwichensis princeps	Savannah sparrow	X	X	X	
Passerella iliaca	Fox sparrow	X	X		
Melospiza lincolnii	Lincoln's sparrow	X	X		
Zonotrichia atricapilla	Golden-crowned sparrow	X	X		
Zonotrichia leucophrys	White-crowned sparrow	X	X		
Junco hyemalis	Dark-eyed junco	X	X		
Calcarius lapponicus	Lapland longspur				X
Euphagus carolinus	Rusty blackbird	X	X		
Carduelis flammea	Common redpoll	X	X		

Table 3 Listed Species of the Anchorage Area
ARRC Anchorage Terminal Reserve, Anchorage, AK

Common Name	Scientific Name	State of Alaska T&E	Federal Listing	Alaska Species of Special Concern	Expected in ARRC Terminal Reserve?
BIRDS					
Eskimo curlew	*Numenius borealis*	E	E		NO
Short-tailed albatross	*Diomedea albatrus*	E	E		NO
Elder, spectacled	*Somateria fischeri*		T	S	NO
Elder, Steller's (AK breeding pop.)	*Polysticta stelleri*		E	S	NO
Aleutian Canada goose	*Branta canadensis leucopareia*	D		S	
American peregrine falcon	*Falco peregrinus anatum*	D		S	
Arctic peregrine falcon	*Falco peregrinus tundrius*	D		S	NO
Northern goshawk (Southeast Alaska population)	*Accipiter gentilis laingi*			S	NO
Olive-sided flycatcher4	*Contopus cooperi*			S	
Gray-cheeked thrush	*Catharus minimus*			S	
Townsend's warbler	*Dendroica townsendi*			S	
Blackpoll warbler	*Dendroica striata*			S	
MAMMALS					
Whale, Humpback	*Megaptera novaeangliae*	E	E		NO
Whale, Right	*Eubalaena glacialis*	E			NO
Whale, Blue	*Balaenoptera musculus*	E			NO
Whale, bowhead	*Balaena mysticetus*		E		NO
Whale, Finback	*Balaenoptera physalus*		E		NO
Whale, Northern Pacific Right	*Eubalaena japonica*		E		NO
Whale, Sperm	*Physeter macrocephalus*		E		NO
Whale, Sei	*Balaenoptera borealis*		E		NO
Whale, Beluga Cook Inlet population	*Delphinapterus leucas*			S	NO
Whale, Bowhead	*Balaena mysticetus*			S	NO
Brown bear Kenai Peninsula population	*Ursus arctos horribilis*			S	NO
Sea-lion, Steller (western pop.)	*Eumetopias jubatus*		E	S	NO
Sea-lion, Steller (eastern pop.)	*Eumetopias jubatus*		T	S	NO
Harbor seal	*Phoca vitulina*			S	NO
Sea Otters	*Enhydra lutris*			S	NO
FISH					
Salmon, Snake River Fall Chinook	*Onchorhynchus tshawytscha*		T	S	NO
REPTILES					
Sea turtle, leatherback	*Dermochelys coriacea*		E		NO
Sea turtle, loggerhead	*Caretta caretta*		T		NO
Sea turtle, green	*Chelonia mydas*		T		NO
PLANTS					
Fern, Aleutian shield	*Polystichum aleuticum*		E		

Table 4 Water Discharges to Ship Creek
ARRC Anchorage Terminal Reserve, Anchorage, AK

Outfall ID	Identification	Location	Bank	Reach	Flow	Description	Environmental Issues Noted in Field
MOA 808	Municipal outfall	E of railroad embankment	Left (South)	4	Dry	Corrugated metal. Ice dented. Near high tide level. Drains railorad areas south of Ship Creek including depot, and residential and commercial areas nearby	None
Marsh S4-3	Spontaneous surface drainage	W of C Street, N of marina	Right (North)	4	Draining	Drains small salt marsh W of C street	None
Marsh S4-2	Spontaneous surface drainage	NW of ARRC office	Left (South)	4	Draining	Indistinct channel, drains marshy area. Surface runoff and high tide flow	None
ARRC C-1	ARRC Managed outfall	C Street	Right (North)	4	Dry	24" corrugated pipe. Drains far western portion of railyard (storage areas).	None
Marsh S4-1	Spontaneous surface drainage	E of C street	Left (South)	4	Draining	Indistinct channel, drains marshy area. Surface runoff and high tide flow	None
MOA 809A/B	2 municipal outfalls	E of covered bridge	Left (South)	4	Active	Drains industrial and cpommercial neigborhoods along W Ship Creek Ave, north of 3rd Ave.	None
MOA 820/ADOT	Municipal outfall	Just E of highway bridge	Right (North)	4	Active	Drains highway ROW and portions of Government Hill	None
ARRC A-1	ARRC managed outfall	Just E of highway bridge	Right (North)	4	Active	Drains western portion of railyard	None
MOA 811	Municipal outfall	W of KAPP dam	Left (South)	4	Active	Drains Cordova St. area north of 3rd Ave.	None
ARRC B-1/MOA 825	ARRC and municipal outfall	Just E of KAPP dam	Right (North)	4	Active	Drains KAPP, central railyard, seepags along North Bluffs and portions of Government Hill	None
KAPP pond drain	Outfall	Just E of KAPP dam	Right (North)	4	Active	KAPP pond drainage	None
MOA 812B	Municipal outfall	Ship Creek Ave. 1	Left (South)	3	Active	Recently reconstructed due to trail constrcution. Drains to ditch 150 ft ditch leading to active channel	None
MOA 812A	Municipal outfall	Ship Creek Ave. 2	Left (South)	3	Dry	Small outfall. Connected to manhole on Ship Creek Ave.	None
MOA 826	Municipal outfall.	Ingra St.	Left (South)	3	Active	Outfall drains to short (30 ft) ditch leading to main channel. Drains industrial areas along Ingra St.	Strong hydrocarbon odor. No sheening.
ARRC A-2B	Constructed outfall for pond	Across from Ingra St.	Right (North)	3	Active	Gravity standpipe connected by PVC pipe to SW portion of pond. Good condition. Recent construction.	None
ARRC A-2A	ARRC and municipal outfall	Just E of Black Gold Express	Right (North)	3	Active	Wooden discharge box, to ditch that flow to old pond through marshy area. Drains eastern and central parts of railyard and conncected to Government Hill area.	None
ARRC E-1	ARRC Managed outfall and surface drain ditch	RR Bridge	Right (North)	3	Active	Outfall to ditch at Post and Whitney. Ditch about 1500 ft long. Ditch also receives small outfall from N side, inactive. Drains eastern portions of railyard, parts of North Bluffs. Interconnected with est of railyard drains.	None
MOA 833B	Municipal outfall	Post Rd. bridge	Left (South)	2	Active	Drains extensive industrial areas north of 3rd Ave.	Slight sheening present
MOA 833A	Municipal outfall. Not on MOA list	300 ft E of Post Rd. bridge	Left (South)	2	Active	Small outfall. Appears to drain shallow diches along Viking Driver and near Orca St.	None
MOA 835	Municipal outfall	Sitka St.	Left (South)	2	Active	Drains industrial neighborhoods south of Viking Drive	None
Ditch S1-3	Shallow drainage ditch	W of west end of Railroad Ave.	Right (North)	1	Active	Appears to drain seepages along berm behind Commercial Trucking Services to marsh S1-4. Marsh lacks delineated drain to river, and appears to drain via seepages (seep S1-5).	Strong HC odor, ditch muck has appearance of very aged motor oil. Minimal sheen.
MOA 834	Municipal outfall	Wrangell St.	Left (South)	1	Active	Recently reconstructed due to trail constrcution. Drains to 200 ft ditch leading to active channel. Drains areas near Viking Dr. and Reeve Blvd.	None
Ditch S1-2	Inactive ditch	SW of Bob Benson Trucking	Right (North)	1	Dry at time	500 ft ditch from SW corner of old Standard Steel. Ditch inactive and filling in with silt.	None
MOA 830/832	Stormwater outfall	Yakutat St.	Right (North)	1	Dry at time	Small outfall, drains shallow drainage ditch along Yakutat St.	None
OU-5	Outfall	W of Yakutat St.	Right (North)	1	Active	Drains the OU-5 treatment system along the North Bluffs	None
Seeps S1-1	Spontaneous surface drainage	W of Reeve Blvd. (MOA 836)	Left (South)	1	Active	Many seeps in bank. Small channels spontaneously form channels to Ship Creek	None
U-2	Drainage ditch and outfalls	Reeve Blvd	Right (North)	UP	Active	Several outfalls from the hatchery on the north side of the creek	Strong fish odor
U-1	Stormwater outfall	Upstream of Hatchery Dam	Right (North)	UP	Active	Outfall drains runoff recovery system along tracks at far eastern end of railyard area	None

Table 5 Water Quality Observations
ARRC Anchorage Terminal Reserve, Anchorage, AK

Station	Location	Reach	Type	Date/Time	pH	Electrical Conductance	Turbidity	Dissolved Oxygen	Temperature	Total Dissolved Solids	Oxidation-Reduction Potential	Observations	Comments
					(units)	(uS/cm)	(NTU)	(mg/L)	(^{o}C)	(mg/L)	(mV)		
WQ-1	C street	4	Main channel, high ti	9/9/04, 9:30AM	5.5	1900	25.3	11.8	6.7	1100	+803	No unusual conditions	High tide sample
WQ-2	Covered bridge	4	Main channel, low tid	9/9/04, 3PM	6.3	210	14.3	14.6	9.3	140	+245	No unusual conditions	Low tide sample
WQ-3	Above KAPP dam	3	Main channel	9/9/04, 9AM	5.8	210	18.5	12.2	7.0	140	+288	No unusual conditions	
WQ-4	KAPP Pond	3	Pond area	9/9/04. 8:30AM	5.1	360	24.2	8.4	7.8	250	+287	No unusual conditions	
WQ-5	MOA 826/Ingra St.	3	Storm sewer	9/8/04, 5PM	6.6	556	15.8	11.2	11.5	360	+230	No unusual conditions	
WQ-6	Old pond	3	Pond area	9/8/04, 4PM	6.7	inst. Error	16.1	12.3	11.5	330	+258	No unusual conditions	Conductivity sample failed
WQ-7	ARRC A-2	3	Storm sewer	9/8/04, 4:30PM	6.5	503	15.4	12.8	11.4	320	+279	No unusual conditions	
WQ-8	RR Bridge	3	Drainage ditch	9/8/04, 9:30AM	5.8	460	15.4	13.1	11.5	190	+324	No unusual conditions	
WQ-9	Postr Rd. backwater	2	Backwater	9/8/04, 10AM	6.7	293	19.5	8.4	10.8	190	+296	Stagnant, sulfide smell	
WQ-10	Pond drain	3	Drainage ditch	9/8/04, 3:30PM	6.5	510	16.4	10.2	10.5	330	+289	No unusual conditions	
WQ-11	Post Rd. bridge	2	Main channel	9/8/04, 9AM	5.1	206	18.5	15.3	7.7	130	+294	No unusual conditions	
WQ-12	ARRC E-1	3	Storm sewer	9/8/04, 10:30AM	5.3	464	18.3	13.8	8.8	300	+322	No unusual conditions	
WQ-13	OU-5 discharge	1	Storm sewer	9/7/04, 2PM	6.8	530	17.2	13.3	8.6	340	+241	No unusual conditions	
WQ-14	Reeve Blvd bridge	1	Main channel	9/7/04, 1PM	6.6	195	15.9	14.0	10.3	130	+271	No unusual conditions	
WQ-15	Hatchery drain	UP	Drainage ditch	9/7/04, 1:30PM	6.5	190	16.3-127	12.1	13.1	120	+257	Strong fish odor	Turbidity variable
WQ-16	Below hatchery dam	UP	Main channel	9/9/04, 11AM	6.4	193	16.3	9.8	9.4	130	+278	No unusual conditions	
WQ-17	Backwater below hatchery dam	UP	Drainage ditch	9/9/04, 11:30AM	5.9	291	16.6	11.2	6.8	190	+315	No unusual conditions	
WQ-18	Pond above hatchery dam	UP	Backwater	9/9/04, 10AM	6.6	293	18.5	14.2	6.2	190	+275	No unusual conditions	
WQ-19	Drain from bluff	UP	Storm sewer	9/9/04, 10:30AM	6.3	524	12.9	10.5	5.6	340	+375	No unusual conditions	

Table 6 Plants Noted in North Bluff Area
ARRC Anchorage Terminal Reserve, Anchorage, AK

Scientific Name	**Common Name**	**Native / Introduced**
Alnus sinuata	Sitka alder	N (U, W)
Achillea millefolium	Yarrow	N (W)
Betula papyrifera	Paper birch	N (U)
Calamagrostis canadensis	Bluejoint reedgrass	N (W)
Carex rostrata	Beaked sedge	N (W)
Dryopteris expansa	Spreading wood fern	N (U)
Epilobium angustifolium	Fireweed	N (W)
Epilobium ciliatum	Purple-leaved willowherb	N (U)
Equisetum telmateia	Giant horsetail	N (U)
Festuca rubra	Red fescue	N (W)
Hippuris vulgaris	Mare's tail	N (W)
Oemleria cerasiformis	Indian plum	N (U)
Petasites frigidus	Colt's foot	N (U)
Picea sitchensis	Sitka spruce	N (U)
Populus tremuloides	Quaking aspen	N (U)
Populus trichocarpa	Black cottonwood	N (U)
Ribes laxiflorum	Trailing black currant	N (U)
Rosa nutkana	Nootka rose	N (U)
Rosa nutkana	Nootka rose	N (W)
Sorbus scopulina	Greene's mountain ash	N (U)
Salix lasiandra	Pacific willow	N (W)
Salix sitchensis	Sitka willow	N (W)
Scirpus tabernaemontanii	Hardstem bulrush	N (W)
Sonchus arvenis	Perennial sow-thistle	I (W)
Taraxacum officinale	Dandelion	I (W)
Trifolium pratense	Pink clover	N (W)
Typha latifolia	Cattail	N (W)

(W = wetland area, U = upland area)

Appendix D

North Bluff Ecological Checklist

CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

I - SITE DESCRIPTION			
1	Site Name	Ship Creek	
	Location		
	County		
	City	Anchorage	
	State	Alaska	
2	Latitude	61 13.639	
	Longitude	149 49.831	
3	Approximate Area		
4	Is this the First Site Visit?	Yes	
	Dates of Previous Visits		
	(attach trip reports)		
5	USGS Topographic map attached?		
6	Are aerial or site photos available	Yes	
	Please attach		
7	Land use of Site, in %		
	Urban		
	Rural		
	Residential		
	Industrial (light or heavy?)		
	Agricultural (indicate crops)		
	Recreational (describe)		
	Undisturbed		100
	Other (describe)		
	Surrounding Land Use, in %		
	Urban		10%
	Rural		
	Residential		
	Industrial (light or heavy)		80
	Agricultural (indicate crops)		
	Recreational (describe)		10
	Undisturbed		
	Other (describe)		
8	Has any soil movement taken place at the site?	Yes	
	Identify likely cause		Construction of earthen berms to north and south. Reinforced and channelized riprap banks. Ice flows in winter.
9	Do any "sensitive areas" exist adjacent or proximate to site?		
	Sources of information for sensitive areas		
10	Type of facility		
11	Suspected or known contaminants?		PCBs, petroleum products, metals

I - SITE DESCRIPTION			
11	Approximate Maximum concentrations?		
12	Potential Routes of off-site migration		
	Swales		
	Depressions		
	Runoff	X	
	Drainage ditches		
	Particulates (wind)		
	Vehicular Traffic		
	Other (specify)	X	Creek flow
13	Depth to water table (if known)		
14	Is surface runoff apparent?	Yes	Runoff from adjacent sites flows into Ship Creek
	If yes, where does discharge go:		
	Surface water	X	
	Groundwater		
	Sewer		
	Impoundment		
15	Is there a navigable waterbody or tributary?		No
16	Is there a waterbody in vicinity? Distance?		Yes, Cook Inlet
	If yes complete Section III or IV		
17	Evidence of flooding?		Yes
	If yes, complete Section V (note: wetlands may not be obvious!)		
18	References, guidebooks and time spent identifying fauna		2 days
19	Are there T&E species known in area?	Yes	
	Has this been verified with USFWS and State resource agency?		
20	Weather conditions at time of visit		
	Date:		Sept 14-16
	Temperature:		Avg 55 d
	Wind:		Slight
	Cloud cover:		Mostly sunny
	Normal daily high:		60 d
	Precipitation:		None
21	Summary		

CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

II - TERRESTRIAL HABITAT			
IIA WOODED			
1	Are there wooded areas at the site? If no go Section IIB	Yes	
2	Percentage of site wooded? Indicate on site map (attached) Identify information used to determine area	90%	
3	Dominant type of woody vegetation? (Evergreen/Deciduous/Mixed)		Deciduous
	Dominant species, if known		Quaking aspen
4	Predominant size as d.b.h.? (0-6", 6-12", >12")		6-12"
5	Specify type of understory present		Shrub and herbaceous, dominated by willow-herb and coltsfoot
IIB SHRUB/SCRUB			
1	Is shrub/scrub present? If no go to Section IIC		Yes
2	Percentage of site shrub/scrub? Indicate on site map (attached) Identify information used to determine area		40%
3	Dominant type of shrub/scrub vegetation?		Deciduous
	Dominant species, if known		Willow-herb and coltsfoot
4	Predominant height? (0-2ft, 2-5 ft, >5ft)		2-5 ft
5	Estimate density of shrub/scrub (Dense/Patchy/Sparse)		Patchy
IIC OPEN FIELD			
1	Are there open, bare or barren areas? *If yes, indicate type:* (prairie/savannah/old field/other)		Yes
2	Percentage open field? Indicate on site map (attached)		20%
3	What are dominant plants?		Grasses, herbaceous vegetation
4	Approximate height of average plant		2 ft
5	Vegetation cover? (dense/patchy/sparse/barren)		dense
IID MISCELLANEOUS			
1	Any other types of terrestrial habitat?		
	Presence of animals?		

II - TERRESTRIAL HABITAT			
2	*Insects?*	Yes	Bees, mosquitos
	Fish?		
	Birds?	Yes	
	Mammals?	Yes	Moose/elk
	Reptiles/Amphibians?		
	Other?		
	Describe observations and methods		
3	Additional habitat data needs for the site		

CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

III - AQUATIC HABITAT: NON FLOWING SYSTEMS			
1	Is there open, non-flowing water on or adjacent to the site?	Yes	
2	Natural? (lake/pond) Artificial (lagoon, canal, impoundment) What is the name of the waterbody?		Impoundments
3	What are uses for waterbody? (Navigation/Recreation/etc.)		Former cooling pond, unknown for other
4	Approximate size of waterbody (acres)		2 waterbodies, each <1 acre
5	Is aquatic vegetation present? (Emergent/Submergent/Floating/ Encrusting). Specify approximate distribution		Yes - cooling pond, Yes - impoundment
6	Approximate water depth?		Unknown
7	General substrate composition?		
	Bedrock		
	Boulder (>10")		
	Cobble (2.5-10")		Underlying cobble and gravel with silt above
	Gravel (0.1-2.5")		
	Sand (coarse)		
	Silt (fine)		
	Marl (shells)		
	Clay (slick)		
	Muck (fine/black)		
	Debris		
	Detritus		
	Concrete		
	Other		
8	Source of water?		
	River/stream		
	Groundwater	X	
	Industrial discharge		
	Surface Runoff	X	Stormwater runoff
	Other (specify)		
9	Is there discharge from site to waterbody? Describe the pathway	Yes	Runoff from nearby areas via surface and groundwater
10	Is there discharge from the waterbody? Identify the location (on or offsite) and distance of applicable discharge	Yes	Discharge to the creek
	River/stream/creek		
	Groundwater		
	Wetland		
	Impoundment		
	Water Quality Observations		
	Area		

III - AQUATIC HABITAT: NON FLOWING SYSTEMS			
11	*Depth*		
	Temperature (surface and/or depth)		
	pH		
	DO		
	Salinity/TDS		
	Turbidity/Secchi depth		
	Conductivity		
	Other		
12	Color and coloration		Turbid, greenish and brown
13	Mark on site map		
14	Observations on biota		
	Fish		
	Benthic biota		
	Amphibians or reptiles		
	Aquatic invertebrates		
	Birds		
	Mammals	X	Beaver
	Other		

IV - AQUATIC HABITAT: FLOWING SYSTEMS			
1	Type of flowing system present at or adjacent to site?		
	River	X	
	Stream		
	Creek/Brook		
	Dry Wash / Arroyo		
	Intermittent Stream		
	Channelized stream		
	Artificial ditch/channel		
2	Name of waterbody?		Ship Creek
3	In natural systems, indicate if altered. Describe alterations (debris, riprap, channelization, lining)		Scattered debris, armored riprap banks throughout creek
4	Substrate composition		
	Bedrock		
	Boulder (>10")		<1
	Cobble (2.5-10")		40
	Gravel (0.1-2.5")		45
	Sand (coarse)		<10
	Silt (fine)		<5
	Marl (shells)		
	Clay (slick)		
	Muck (fine/black)		
	Debris		
	Detritus		
	Concrete		
	Other		
5	Bank conditions?		
	Height		
	Slope		
	Vegetation cover		
	Undercutting?		
	Material		
6	Is system tidal? Describe evidence	Yes	Area receives tidal influence below dam with infrequent tidal influence above dam.
7	Is flow intermittent? Describe evidence	No	Flow is perennial
8	Is there site discharge to waterbody? Describe discharge pathway	Yes	The creek discharges to the Cook Inlet via a lower section that is very sinuous and down cut at low tide due to high tidal fluctuations.
9	Is there discharge from waterbody? Indicate where discharge occurs, if on- or off-site , and distance	Yes	Upstream reservoir adjacent to a golf course
10	Water Quality observations		
	Width		10 - 25 meters
	Depth		max 6 ft, average 1.5 ft
	Velocity		
	Profile		
	Temperature		

IV - AQUATIC HABITAT: FLOWING SYSTEMS			
10	*pH*		
	DO		
	Salinity/TDS		
	Conductivity		
	Turbidity/Secchi depth		
	Other		
11	Observations on biota		
	Fish	Yes	Coho salmon, likely other salmon species
	Benthic biota	Yes	Trichoptera, green algae, diatoms
	Amphibians or reptiles		
	Aquatic invertebrates	Yes	Trichoptera
	Birds	Yes	
	Mammals	Yes	Fox, raccoon, beaver
	Other		

CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

	V - WETLAND HABITAT		
1	Based on known information, are designated wetlands **definitely** present?	Yes	Riverine, estuarine, palustrine due to wetland hydrology, presence of wetland vegetation, and hydric soils
	Provide sources for conclusions		
2	Based on location (near waterbody, in floodplain) **and** site conditions (standing water, hydric soils, mud cracks, water/debris marks, are wetlands suspected? If yes, proceed	Yes	
3	Type of wetland vegetation?		
	Submergent	X	
	Emergent	X	
	Wooded	X	
	Scrub/shrub	X	
	Other (specify)		
4	General description of vegetation (height, color). Include photos.		Riparian forested areas with scrub/shrub and herbaceous understory. Areas of emergent and submerged vegetation near palustrine ponds.
5	Is standing water present?		Yes
	(fresh/brackish/salt/soda)		Fresh
	Approximate area?		Several ponds each <1 acre
	Complete Section III too		
6	Is there evidence of flooding at site?		
	Buttressing		
	Debris lines	Yes	
	Water marks	Yes	
	Mud cracks	Yes	
	Other (specify)	Yes	wetland vegetation
7	Source of water in wetland?		
	Stream/river/lake/pond	X	
	Groundwater	X	
	Surface runoff	X	
	Flooding	X	
	Industrial discharge		
8	Is there a site discharge to a wetland? Describe path	Yes	Stormwater outflows into ponds and creek
9	Is there discharge from the wetland (surface stream/groundwater/lake/marine)	Yes	groundwater, surface stream
10	Describe soil in wetland area		Reduced, black and sulfidic silt
	Color (blue/gray/brown/black/mottled)		Black
	Water content (dry/moist/wet/saturated)		Saturated
11	Mark suspected wetlands on site map		
	Observations on biota		
	Vegetation		See plant list
	Insects/Invertebrates		Mosquitos, tricoptera

V - WETLAND HABITAT			
11	*Amphibians or reptiles*		
	Birds		
	Mammals		Fox, raccoon, beaver
	Other		coho salmon

CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

III - AQUATIC HABITAT: NON FLOWING SYSTEMS			
1	Is there open, non-flowing water on or adjacent to the site?	Yes	
2	Natural? (lake/pond)		Mix of natural seeps and artificial canals and impoundments
	Artificial (lagoon, canal, impoundment)		
	What is the name of the waterbody?		Wetlands at base of bluff
3	What are uses for waterbody? (Navigation/Recreation/etc.)		
4	Approximate size of waterbody (acres)		1 pond < 1 acre, several small linear ponds
5	Is aquatic vegetation present? (Emergent/Submergent/Floating/ Encrusting). Specify approximate distribution		Yes, approximately 100% emergent or submergent in linear ditches, and slightly less than 100% in impoundment
6	Approximate water depth?		< 2 ft ditches, unknwon for impoundment
7	General substrate composition?		
	Bedrock		
	Boulder (>10")		
	Cobble (2.5-10")		
	Gravel (0.1-2.5")		
	Sand (coarse)		
	Silt (fine)		Silt
	Marl (shells)		
	Clay (slick)		
	Muck (fine/black)		
	Debris		
	Detritus		
	Concrete		
	Other		
8	Source of water?		
	River/stream		
	Groundwater	X	
	Industrial discharge		
	Surface Runoff	X	Stormwater runoff
	Other (specify)		
9	Is there discharge from site to waterbody? Describe the pathway	Yes	Runoff from nearby areas via surface and groundwater
10	Is there discharge from the waterbody? Identify the location (on or offsite) and distance of applicable discharge	Yes	Groundwater
	River/stream/creek		
	Groundwater	X	
	Wetland		
	Impoundment		
	Water Quality Observations		

III - AQUATIC HABITAT: NON FLOWING SYSTEMS			
11	*Area*		
	Depth		
	Temperature (surface and/or depth)		
	pH		
	DO		
	Salinity/TDS		
	Turbidity/Secchi depth		
	Conductivity		
	Other		
12	Color and coloration		Turbid, greenish and brown
13	Mark on site map		
14	Observations on biota		
	Fish		
	Benthic biota		
	Amphibians or reptiles		
	Aquatic invertebrates		
	Birds	Yes	
	Mammals		
	Other		

CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

	V - WETLAND HABITAT		
1	Based on known information, are designated wetlands **definitely** present?	Yes	Palustrine
	Provide sources for conclusions		
2	Based on location (near waterbody, in floodplain) **and** site conditions (standing water, hydric soils, mud cracks, water/debris marks, are wetlands suspected? If yes, proceed	Yes	Wetland hydrology, wetland vegetation, hydric soils
3	Type of wetland vegetation?		
	Submergent	X	
	Emergent	X	
	Wooded	X	
	Scrub/shrub	X	
	Other (specify)		
4	General description of vegetation (height, color). Include photos.		Emergent vegetation on fringe of standing water and in saturated areas with some submerged species. Scrub-shrub adjacent to standing water areas.
5	Is standing water present?		Yes
	(fresh/brackish/salt/soda)		Fresh
	Approximate area?		Several linear ponds each <1 acre
	Complete Section III too		
6	Is there evidence of flooding at site?		
	Buttressing		
	Debris lines		
	Water marks		
	Mud cracks		
	Other (specify)	Yes	standing water
7	Source of water in wetland?		
	Stream/river/lake/pond		
	Groundwater	X	Seeps from bluff
	Surface runoff	X	
	Flooding		
	Industrial discharge		
8	Is there a site discharge to a wetland? Describe path	Yes	Seeps from bluff consolidated into a pipe in some areas.
9	Is there discharge from the wetland (surface stream/groundwater/lake/marine)	Yes	groundwater
10	Describe soil in wetland area		Reduced, black and sulfidic silt
	Color (blue/gray/brown/black/mottled)		Black
	Water content (dry/moist/wet/saturated)		Saturated
11	Mark suspected wetlands on site map		
	Observations on biota		
	Vegetation		See bluff wetland plant list
	Insects/Invertebrates		Mosquitos, spiders

V - WETLAND HABITAT			
11	*Amphibians or reptiles*		
	Birds	Yes	
	Mammals		
	Other		