Exotic Plant Study

Cooper Lake Project (FERC No. 2170)

Final Report

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Prepared for
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STUDY PARTICIPANTS

This study was led by Anne Leggett of HDR Alaska, Inc. The following contributed to field work or analysis, or both, of the surveys that comprise this study: Michael Witter of HDR Engineering, Inc.; Dominique Collet of Biota; Brandy Bland, Jen Dillon Sivils, Amy Hansen, and Aaron Anderson of HDR Alaska, Inc.; and Michael Duffy of Michael Duffy Biological Consulting Services.

Exotic Plant Study
Cooper Lake Project (FERC No. 2170)

INTRODUCTION AND BACKGROUND

Study Purpose

The Cooper Lake Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 2170, is owned and operated by Chugach Electric Association, Inc. (Chugach). The Project was originally licensed by FERC in May 1957, and the current license term expires at the end of April 2007. To retain its status as owner and operator of the Project, Chugach must file a final license application with FERC no later than April 30, 2005. As part of the process of developing an application to relicense the Project, Chugach has undertaken a program of studies designed to determine the ongoing and potential future effects of the Project on environmental resources.

This document reports the results from the Exotic Plant Study. The purpose of this study is to develop the information necessary for the USDA Forest Service (USFS) to meet its goals and objectives related to exotic plant species. Specifically, this study was intended to determine the locations, abundance, and distribution of exotic plants in the Project area. The primary objectives of this study were twofold: (1) to understand the degree to which existing and potential future Project components and activities have promoted or could promote establishment of exotic species; and (2) to understand the degree to which such exotic species are becoming established in adjacent undisturbed areas. Because this study is focused on meeting USFS objectives, the study was limited to lands managed by the USFS. This study is qualitative and was not intended to provide quantitative information or conclusions.

The fieldwork for this study was conducted during 2003 and 2004. In addition to an exotic plant survey of major project components (Cooper Lake shoreline, Project access roads, and electrical transmission line), this survey used data from the Sensitive Plant Survey (HDR 2004). Various parts of the surveys were conducted by biologists on staff at HDR Alaska, Inc., HDR Engineering, Inc., Biota, and Michael Duffy Biological Consulting Services. The study approach was initially described in the Sensitive and Exotic Plants Survey Final 2003 Study Plan (HDR 2003), which was developed in consultation with resource agencies and other relicensing participants. Modifications to the protocols described in the study plan are described below (in the Methods section).

Description of the Project

Location and Project Lands

The Project dam and powerhouse are located within the Kenai Peninsula Borough, southcentral Alaska, approximately 55 miles south of Anchorage. The closest community to the Project dam and powerhouse is Cooper Landing, approximately 4 miles north of Cooper Lake. Project

facilities are located on Cooper Creek, Cooper Lake, and Kenai Lake. In addition, the 90-mile-long Project transmission line between the Quartz Creek Substation (near Cooper Landing) and Anchorage crosses land located in both the Kenai Peninsula and Anchorage boroughs. Lands occupied by the Project are owned and/or managed by the USFS, Alaska Department of Natural Resources, and private landowners. The Project area, licensed Project boundary, and ownership/management of Project-area lands are shown in Figure 1.

Project Components

Cooper Lake Dam was constructed in 1957–1959 on Cooper Creek, approximately 4.8 river miles from the mouth of the creek at the outlet of Cooper Lake. The dam raised the elevation of Cooper Lake to provide increased storage capacity for hydroelectric generation. Storage below the base of the dam (at elevation 1, 168 feet above mean sea level [MSL]) is provided by the natural lake; storage above that level to the top of the Cooper Lake Dam spillway (elevation 1,210 feet MSL) is created by the dam. At its licensed normal maximum operating level of 1,210 feet MSL, Cooper Lake covers approximately 3,100 acres and has a mean depth of 187 feet.

The Project diverts water at the intake on Cooper Lake through the tunnel/penstock to the powerhouse on Kenai Lake. The Project powerhouse is located on the southwest shore of Kenai Lake, approximately 7 miles from the outlet of the lake. Cooper Creek and Kenai Lake both flow into the Kenai River.

The primary components of the Project are as follows:

- Cooper Lake Dam, a rock-and-fill structure across Cooper Creek at the outlet of Cooper Lake.
- Cooper Lake, a natural lake that has been increased in area to a maximum of approximately 3,100 acres by the dam (*Note*: the surface area of the reservoir at its current maximum operating level of 1,194 ft MSL is approximately 2,600 acres).
- An intake structure, located approximately 5 miles southeast of the dam on Cooper Lake. Elevation of the invert (base) of the opening to the tunnel/penstock is at 1,151 feet MSL (43 feet below the water surface at the normal maximum operating elevation of 1,194 feet MSL).
- A tunnel, conduit, and penstock extending 10,300 feet east from the intake structure on Cooper Lake to the Cooper Lake Powerhouse on Kenai Lake.
- Cooper Lake Powerhouse, containing two turbine/generator units, each rated at 9.69 MW (upgraded from 7.5 MW in 2000).
- A 6.3-mile-long 69-kV transmission line from the Cooper Lake Powerhouse to the Quartz Creek Substation in Cooper Landing.
- A single-phase 4.16-kV distribution line from the powerhouse to the intake structure.
- 69/115-kV step-up transformer and appurtenant facilities at the Quartz Creek Substation.
- A 90.4-mile-long 115-kV transmission line from the Quartz Creek Substation to the Anchorage Substation.

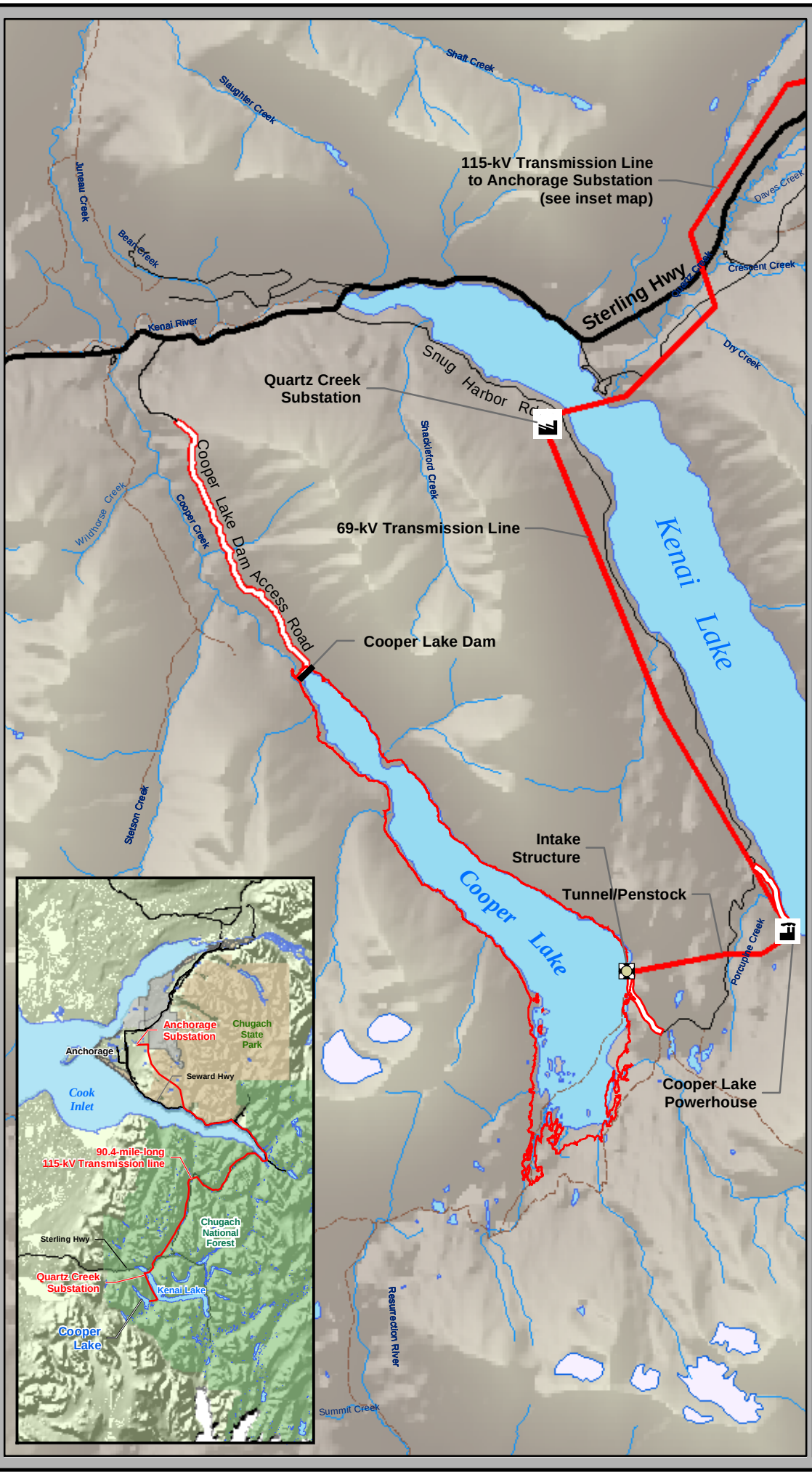

Figure 1

Project Components

Cooper Lake Project
FERC #2170

LEGEND

- Powerline
- 1210-ft Elevation
- Project Roads
- Highways
- Roads
- Trails
- Lakes
- Rivers & Streams
- Glacier

1. Mapping completed by HDR Alaska, Inc.
2. All data shown is projected in Alaska stateplane zone 4, North American datum of 1927

0.5 0.25 0 0.5 1 1.5 Miles

HDR Alaska

Date: 1/24/2004

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Project-related roads and access routes, as shown on Figure 1, are:

- Snug Harbor Road, an improved USFS easement across State-owned lands, extending from Cooper Landing to the vicinity of the Project powerhouse. This road was established to allow construction of the Project, but is open to the public and is now used for multiple purposes (including access to private homes along Kenai Lake and nearby recreation areas). Snug Harbor Road and spurs off this road provide access to the Project powerhouse and intake structure. The following spur roads off Snug Harbor Road are used primarily or solely for Project operations and maintenance, and are proposed for inclusion in the Project boundary under the new license:
    - Spur to the Project powerhouse
    - Spur from the Russian Lakes Trailhead to the intake structure on Cooper Lake
    - Spur road to the surge tank on the penstock.
    - Spur road to the lower portal of the tunnel
    - Spur road to the Quartz Creek Substation
    - Spur road to an old logging area (FDR 1030300)
    - Six access routes to the powerline between the powerhouse and the Quartz Creek Substation
- Cooper Lake Dam access road, an unimproved road from Cooper Landing up the Cooper Creek canyon. Most of this road is located on USFS land. This gated road is officially used solely for access to Cooper Lake Dam for the purpose of operations and maintenance related activities; however, it is also informally used by the public for hiking, off-road vehicle use, horseback riding, mountain biking, and snowmachine use. This road is proposed for inclusion in the Project boundary.
- Developed and undeveloped access routes to the 90-mile-long Quartz Creek to Anchorage transmission line. These routes are located on USFS and State-managed lands. All existing and potential future access routes that have been identified by Chugach for possible Project-related use during the next license term are proposed for inclusion in the Project boundary.

Overview of Project Operations

The Project stores all inflow to Cooper Lake and diverts the entire outflow from the reservoir through the tunnel/penstock to the powerhouse, which discharges into Kenai Lake. For the period 1985–2002, the diverted natural flow ranged on average from around 20 cfs during late winter / early spring to about 260 cfs during early summer snowmelt, based on calculated inflows to Cooper Lake. Average annual inflow to / discharge from the reservoir for the same period was approximately 74,000 acre-feet (Chugach 2002).

The licensed maximum normal operating elevation of Cooper Lake is 1,210 feet MSL. However, since the mid-1980s, the reservoir has been operated at a normal maximum level of 1,194 feet MSL; the upper 16 feet of licensed reservoir storage is reserved for flood surcharge to ensure that the theoretical probable maximum flood (PMF) can be passed through the spillway without overtopping the dam. The reservoir typically is drawn down during late fall – early spring, experiences its most rapid refilling during the period of late spring – summer snowmelt runoff, and continues to fill through early fall. Within any given year, the reservoir typically fluctuates (on average) within a zone of about 15 feet (Chugach 2002).

The absolute range of reservoir operations varies from year to year, but generally remains within a relatively consistent band. The extreme high reservoir level (i.e., in a wet year) is approximately 7 or 8 feet above the annual high-water level experienced in an average year. Similarly, the extreme low reservoir level (i.e., in a dry year) is about 7 or 8 feet below the lowest level experienced in an average year (Chugach 2002).

Electricity generated at the powerhouse (which averages approximately 50,500 megawatt-hours [MWh] per year) is transmitted to the Quartz Creek Substation, where it is transferred to the 90-mile-long Project transmission line to the Anchorage Substation and the non-Project transmission line to the Kasilof Substation. Electricity is also distributed to local communities located along the transmission line route.

Project-Related Resource Issues Addressed by this Study

Exotic plants, for the purposes of this study, are those that are not considered native to Alaska, as listed by the Alaska Exotic Plant Information Clearinghouse (Binnian and Shephard 2002). The plants considered to be "exotic" during this study are listed in Appendix 1. An exotic plant survey was requested by the USFS. The Chugach National Forest Land and Resource Management Plan (USFS 2002) cites as a goal to "prevent introduction and spread of exotic plants and reduce areas of current infestation," and as objectives to "identify infestations of exotic plant species" and "treat infestations with a high potential to spread" (page 3–4). It suggests incorporating exotic plant control into project planning and design (page 3–25), and conducting surveys to determine abundance and distribution of exotic plants, particularly in areas affected by management activities (page 5–8).

A subset of exotic plants is designated as "noxious weeds," which are plants that are especially destructive and difficult to control and are legally controlled under Alaska Administrative Code (Duffy 2003). USFS guidance directs the USFS to manage and control noxious weeds (USFS 1995).

Current Project operations are suspected of promoting the spread of exotic plants by ongoing disturbance of soil and travel of vehicles off of paved roads during normal operation and maintenance activities. Specific ongoing and potential future Project operations that might affect the status of exotic plants in the future on USFS lands include:

- Continued maintenance of the transmission line and access routes to the transmission line
- Designation and use of new access routes to the transmission line
- Maintenance and use of the Cooper Lake Dam access road
- Any potential future construction activities associated with the Project generation facilities or Cooper Creek

At the time the 2003 study plans were developed, Chugach was considering proposing modifications to the dam spillway that would allow the reservoir to be operated safely at an increased maximum normal level of 1,206 feet MSL. However, Chugach no longer plans to

propose any changes in reservoir operations in the relicensing proposal. Therefore, the potential effects of a future change in operating regime are not evaluated in this report.

STUDY AREA

The exotic plant study uses only data collected on lands owned and managed by the USFS because management authority over these species by any agency does not extend beyond these lands. Information on the distribution and abundance of exotic plants is derived from the results of two surveys (see Methods section below). The surveys were conducted in the vicinity of the following features, but only where Project components are located on USFS lands. These areas are depicted in Figures 2 and 3.

1. ***Cooper Lake.*** The margin of the reservoir was considered from the elevation of 1,178 ft MSL to 50 feet (horizontally) beyond the licensed normal maximum reservoir elevation of 1,210 feet MSL. The intake structure and informal parking and camping areas are not on USFS land.
2. ***Cooper Creek.*** The survey area encompassed the estimated floodplain of Cooper Creek under potential future flow conditions.
3. ***Cooper Lake Dam Access Road.*** The road corridor included the road and associated disturbed margin and adjacent areas within an approximately 100-foot-wide corridor centered on the road. (*Note*: Snug Harbor Road is not located on USFS land, so the study does not include data from surveys along that road.)
4. ***Quartz Creek to Anchorage Transmission Line and associated Access Routes.*** The study area included a corridor approximately 300 feet wide, centered on the transmission line. (*Note*: The power lines between Cooper Lake and Quartz Creek are not located on USFS land, so were not included in this study.)

Exotic plants are most likely to be found in areas where the substrate has been disturbed so that bare soil is exposed. Areas of focus for characterizing the distribution and abundance of exotic plants included the Quartz Creek to Anchorage transmission line right-of-way (ROW), the access roads to the transmission line, the Cooper Lake Dam access road, the Cooper Lake Dam area, Cooper Creek, and the Cooper Lake perimeter.

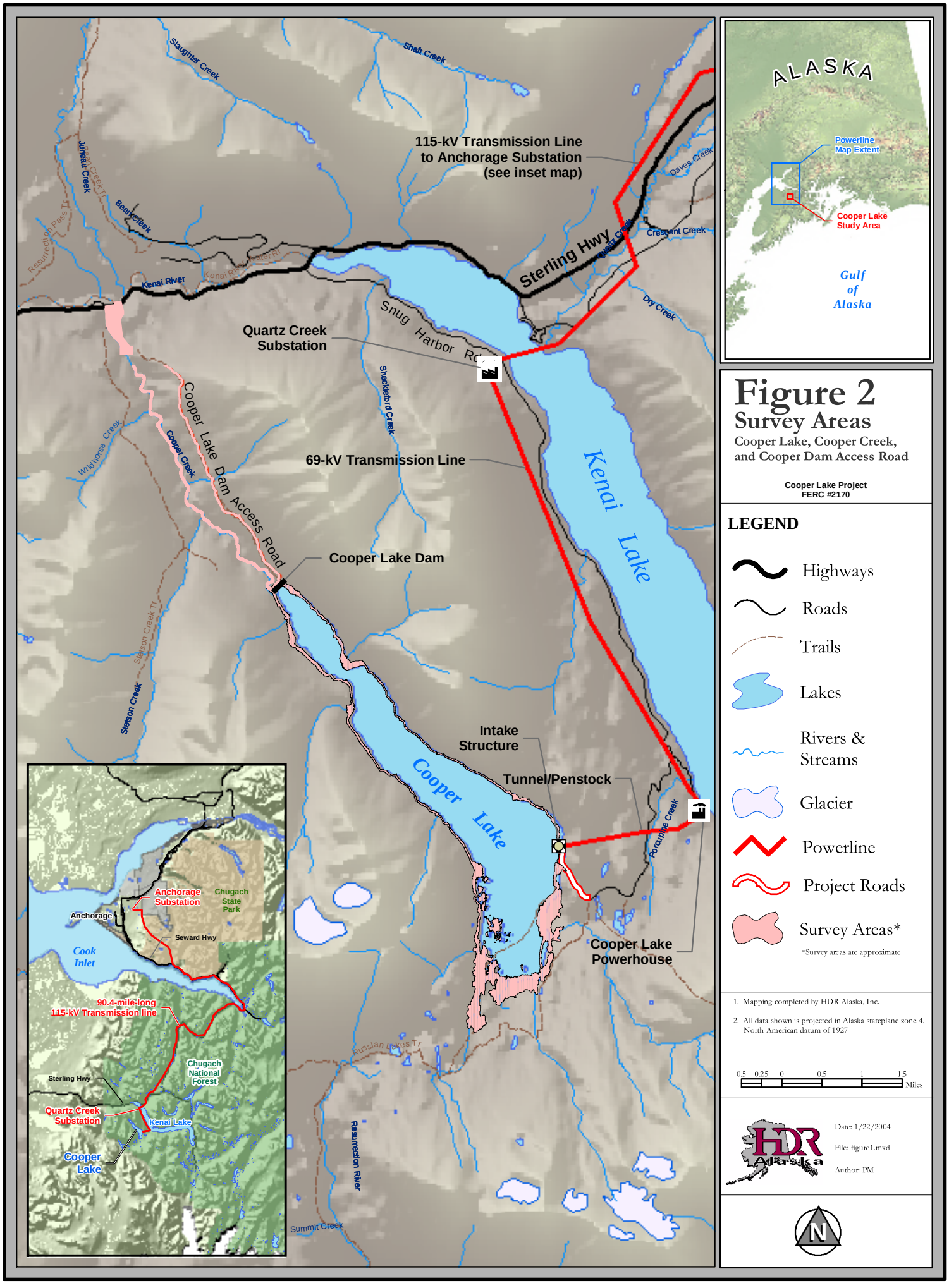

Figure 2
Survey Areas
Cooper Lake, Cooper Creek, and Cooper Dam Access Road

Cooper Lake Project
FERC #2170

LEGEND

- Highways
- Roads
- Trails
- Lakes
- Rivers & Streams
- Glacier
- Powerline
- Project Roads
- Survey Areas*

*Survey areas are approximate

1. Mapping completed by HDR Alaska, Inc.
2. All data shown is projected in Alaska stateplane zone 4, North American datum of 1927

0.5 0.25 0 0.5 1 1.5 Miles

HDR Alaska

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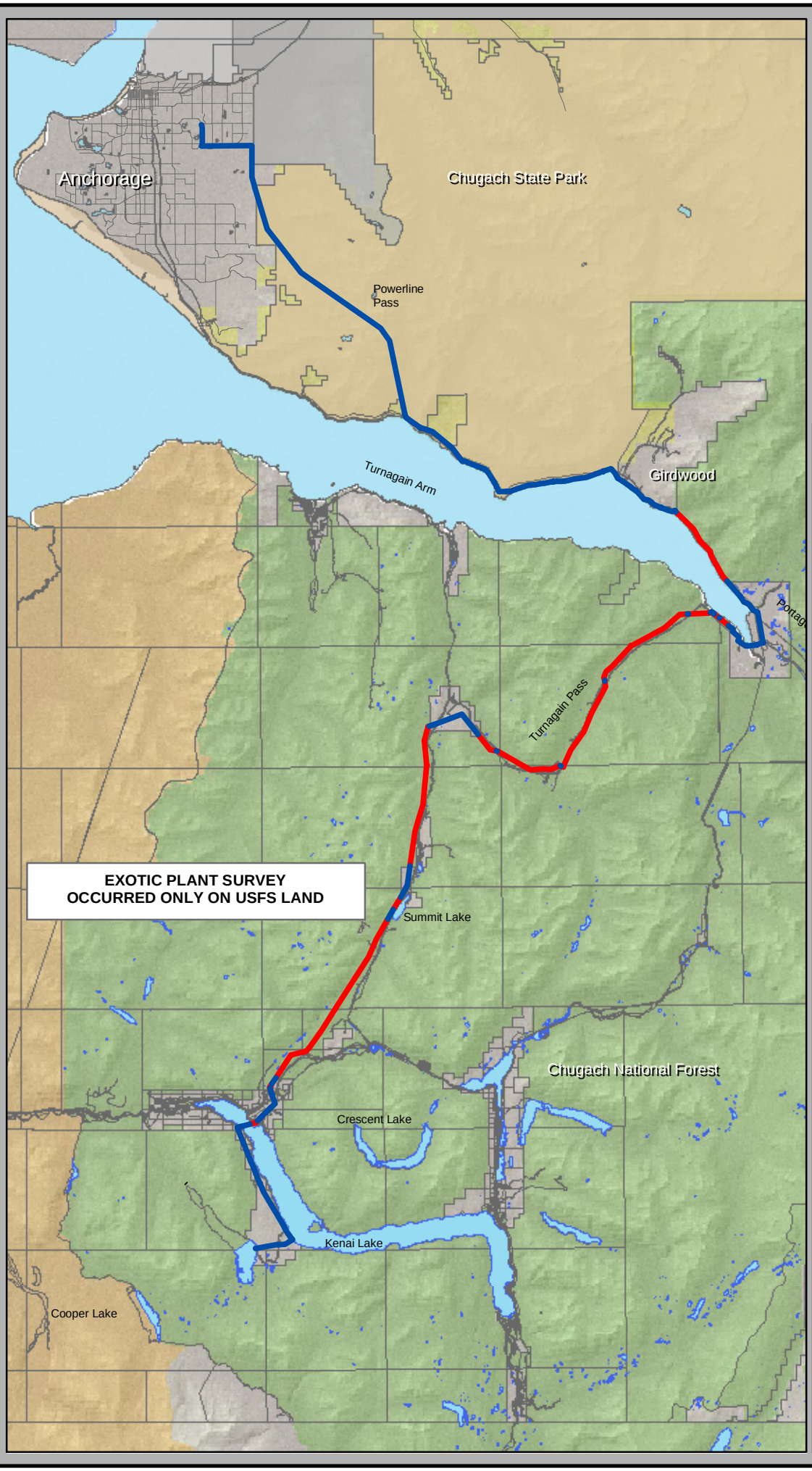

Figure 3

Survey Area
Electrical Power Line

Cooper Lake Project
FERC #2170

LEGEND

- Off USFS Lands
- On USFS Lands

1. Mapping completed by HDR Alaska, Inc.
2. All data shown is projected in Alaska stateplane zone 4, North American datum of 1927

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METHODS

The methods outlined in the final study plan for the exotic plants survey (HDR 2003) were focused on identifying the species and characterizing the abundance of exotic plants in disturbed areas representative of all major adjacent vegetation types and all Project components. The survey was to be qualitative, and the survey plots were to be subjectively selected as representative of the levels of establishment of exotic plants in existing or potential future Project-associated disturbed areas. The plan did not include elements to describe the spread of exotic species outside of disturbed areas associated with the Project. Interpretation of data collected during the sensitive plant survey with respect to distribution of exotic plants was added to this study later.

The methods used to characterize Project-related exotic plant distribution and abundance are presented below. A detailed description of the sensitive plant survey that contributed data to this study is presented in that report (HDR 2004).

Exotic Plant Survey of Project Components

The survey for exotic plant species consisted of collecting data from representative plots laid out in disturbed areas associated with each Project component on USFS land: the cleared transmission line corridor between Cooper Lake and Girdwood, transmission line access roads, the Cooper Lake Dam access road, the Cooper Lake Dam, and the Cooper Lake fluctuation zone. The study was not intended to be quantitative, but to be descriptive of the species and level of exotic plant establishment on Project-disturbed lands.

Transmission line access roads were identified as candidates for the survey if they were located on USFS land and if they appeared to be used primarily for powerline access. The approach for the access roads survey was to record data at a subjectively-selected plot approximately 50 m (164 feet) from the start of an access road and at a plot approximately 50 m from the end of the access road at the power line ROW. If the access road was over approximately 0.5 km (0.3 mile) long, a third plot would be established near the middle of the road's length. At the transmission line ROW, a plot would be surveyed at the intersection of the access road and the power line, along with another plot 50 m along the transmission line in one direction or the other. This last plot in the transmission line ROW would be done in the most disturbed part of the corridor—generally centered on a trail paralleling the power line. On the Cooper Lake Dam access road, data were collected at similar plots, with plots spaced approximately 1 km (0.6 mile) apart, beginning at the USFS boundary. At the Cooper Lake Dam, plots were examined in the center of both the top of the dam and its downhill face, and within an apparently disturbed area in the lake fluctuation zone. On the Cooper Lake shoreline, exotic plants were very patchily distributed; plot locations were chosen in areas colonized by exotic plants specifically to document representative species and level of establishment.

In 2003, each study plot was 5 m x 10 m (16 x 33 feet), with its long axis centered on and paralleling the disturbed feature (road, transmission line). The plot dimension was selected to match the plot size being used for an intensive survey of exotic species being done on Kenai Peninsula trails by the USFS (DeVelice 2003). Data collected at each plot included a descriptive location, GPS-collected latitude and longitude, location on aerial photo, description of

disturbance type and age (if not ongoing), adjacent undisturbed plant community type, percent cover of each plant species in the plot, and site photograph. Species that could not be identified on site were collected for later identification. Information suitable for inclusion in the Alaska Exotic Plant Information Clearinghouse (AKEPIC) database will be provided to that database. The 50 sq meter plot size used in 2003 is below the minimum polygon size required by the AKEPIC database; the size of plots characterized on the Cooper Lake shoreline in 2004 was increased to 1/10 acre to comply with AKEPIC database requirements.

The data were analyzed by qualitatively: (1) relating presence of exotic plants in a plot to the plot's disturbance regime; (2) comparing the number of occurrences of each exotic species among the plots to see which species are the most widespread; and (3) calculating total cover of exotic species relative to total plant cover ("relative cover") within each plot and relating the cover to the disturbance regime.

Use of Plant Lists from Sensitive Plant Survey

A survey was conducted for USFS-designated "sensitive" plants in the vicinity of Project components on USFS lands, which extend from Cooper Lake to Girdwood. For a more detailed description of the methods used in the sensitive plant survey, see the Sensitive Plant Survey, Cooper Lake Project (FERC No. 2170) Final Report (HDR 2005). That survey entailed intensive examination of Cooper Lake's potential inundation area and of the Cooper Creek floodplain (including the USFS Cooper Creek campground), and less intensive surveys of the transmission line and access routes to the Cooper Lake Dam and transmission line. Because this survey included recording all plant species observed in intensely searched areas, it would show what exotic species are present in searched areas (but no indication of infestation level), and records from the different surveyed areas would show how widely those plants are distributed. During the sensitive plant surveys, partial plant lists were also made in many areas during the search for habitat suitable for sensitive species. These partial plant lists were also used in this analysis. Sensitive plant surveyors were also asked to note the locations of intense infestations and complete AKEPIC data collection forms at those sites.

Sensitive plant survey data were analyzed by identifying which survey sites included and did not include exotic plants, counting how many survey lists contained each exotic plant, and determining the disturbance regime of each survey site that supported exotic plants.

RESULTS

Table 1 lists the 22 exotic plant species that were identified during the surveys described above in the area from Cooper Lake to Girdwood. Three of these were not found during USFS exotic plant surveys elsewhere on the Kenai Peninsula (Duffy 2003, DeVelice 2003).

Table 1. Exotic plant species found on two survey types.

Scientific Name	Common Name	# of Plots Where Found on Exotic Plant Survey[1]	# of Areas Where Found on Sensitive Plant Survey[2]	Not Found on Duffy or DeVelice Surveys[3]
Achillea millefolium	common yarrow	3	6	
Agrostis stolonifera	creeping bentgrass		1	X
Alopecurus pratensis	meadow foxtail		1	
Cerastium fontanum	larger mouse-eared chickweed	2	3	
Galeopsis bifida	splitlip hempnettle		1	
Linaria vulgaris	butter and eggs		1	
Matricaria discoidea	pineappleweed	6	5	
Myriophyllum spicatum	spike watermilfoil		1	X
Phalaris arundinacea	reed canarygrass		1	X
Phleum pratense	timothy	2	1	
Plantago major var. *major*	common plantain	5	6	
Poa annua	annual bluegrass	6	2	
Poa palustris	fowl bluegrass	2	3	
Poa pratensis	Kentucky bluegrass	6	7	
Poa trivialis	rough bluegrass		1	
Polygonum aviculare	prostrate knotweed		2	
Rumex acetosella	common sheep sorrel	2		
Rumex longifolius	common garden dock	1	2	
Spergularia rubra	purple sand spurry	3	1	
Taraxacum officinale	common dandelion	11	28	
Trifolium hybridum	Alsike clover		2	
Trifolium repens	white clover	3	3	

[1] Out of 22 disturbed sites surveyed
[2] Out of 81 partial or complete survey sites
[3] Duffy 2003, DeVelice 2003

Exotic Plant Survey of Project Components

A total of 22 sample plots were surveyed to characterize the abundance of exotic plants on lands disturbed by the Project, as listed in Table 2. Thirteen non-native plant species were observed at 18 sample plots during this study and are listed in Table 1. Dandelion was the most widely observed exotic species, with pineappleweed, annual bluegrass, and Kentucky bluegrass also commonly observed.

Table 2. Abundance of Exotic Plants Found in Plots, by Disturbance Type

Disturbance Type	Number of Plots Sampled	Number of Plots Containing Exotic Plants	Number of Exotic Plant Species Found	Average Relative Percent Cover of Exotic Plants in the Plots	Range of Relative Percent Cover of Exotic Plants in the Plots
Cooper Lake Dam access road	4	4	9	31	16-60
Cooper Lake Dam area	3	3	5	20	10-30
Cooper Lake fluctuation zone*	5	5	6	15	1-59
Cleared transmission line corridor	6	3	6	1	0-7
Transmission line access road	4	3	11	29	0-60

*These plots were selected to purposely include some exotic plants to characterize their abundance.

Half of the plots on the cleared transmission line corridor contained exotic plants, and up to 7% of those plots' plant cover was comprised of exotic species. All but one of the plots on access roads and at the dam included exotic plants, and the exotic species comprised a moderate portion of the plots' total plant cover. None of the exotic plant populations along the transmission line or access roads appeared to extend outside of the disturbed area.

Sensitive Plant Survey

A total of 21 exotic plant species were observed during the sensitive plant survey. These are listed in Table 3 along with an indication of the site's disturbance type, if any. *Achillea*, *Phleum*, *Spergularia*, and *Poa* were not always identified to species, so the occurrence of exotic species of these genera could be greater than is shown below. Dandelion was the most widespread species found, occurring on 28 of the 81 plant lists. Dandelion and Kentucky bluegrass were found during the sensitive plant survey in the zone around Cooper Lake that was cleared during Project construction but which is not presently within the lake fluctuation zone. Dandelion was observed south of the lake in areas that may have never been inundated or cleared for the Project. Five species of exotic plants were observed along Cooper Creek, outside of areas directly disturbed by the Project.

Table 3. Exotic plant species identified on sensitive plant survey and their presence in different disturbance types.

Scientific Name	Common Name	# of Sites Where it Occurred[1]	Cooper Lake fluctuation zone	Cooper Lake historical clearing area only	Cooper dam disturbance area	Cooper Creek, no physical disturbance	USFS Cooper Creek Campground[2]	T-line corridor clearing, with/without access road	T-line corridor but no clearing
Achillea millefolium	common yarrow	6	X			X		X	X
Agrostis stolonifera	creeping bentgrass	1				X			
Alopecurus pratensis	meadow foxtail	1						X	
Cerastium fontanum	larger mouse-eared chickweed	3				X	X	X	
Galeopsis bifida	splitlip hempnettle	1						X	
Linaria vulgaris	butter and eggs	1						X	
Matricaria discoidea	pineappleweed	5	X		X		X	X	
Myriophyllum spicatum	spike watermilfoil	1						X	
Phalaris arundinacea	reed canarygrass	1					X		
Phleum pratense	timothy	1			X				
Plantago major	common plantain	6	X		X		X	X	
Poa annua	annual bluegrass	2	X						
Poa palustris	fowl bluegrass	3	X					X	
Poa pratensis	Kentucky bluegrass	7	X	X	X	X			X
Poa trivialis	rough bluegrass	1				X			
Polygonum aviculare	prostrate knotweed	2	X						
Rumex longifolius	common garden dock	2						X	
Spergularia rubra	purple sand spurry	1	X						
Taraxacum officinale	common dandelion	28	X	X	X	X	X	X	
Trifolium hybridum	Alsike clover	2	X						X
Trifolium repens	white clover	3			X			X	

[1] Complete or partial plant lists were made at 81 areas during the sensitive plant survey.
[2]Surveyed because it is within the Cooper Creek floodplain; it is not part of the Hydroelectric Project.

ANALYSIS AND DISCUSSION

Both surveys indicate that exotic plant species are widespread in Project-disturbed areas. Dandelion was the most widespread exotic plant found on the two surveys. Kentucky bluegrass, annual bluegrass, common plantain, yarrow, and pineappleweed were each also found at several sites.

The limited survey specifically targeting exotic species found that most sites where the soil had been disturbed supported exotic species. The areal cover of exotic plants in plots disturbed only by powerline clearing (minimal soil disturbance) was relatively low—ranging up to 7% of the

total plant cover. Relative cover of exotic plants in plots that included transmission line access roads, the Cooper Lake Dam, and the dam access road was generally higher, ranging from 0% to 60%.

Exotic plants were found regularly on the sensitive plant survey and in every type of disturbance, including the Cooper Lake fluctuation zone. Very few exotic plants were observed during the sensitive plant survey outside of areas that have experienced some type of physical disturbance, with the exception of the Cooper Creek area. Except as noted below, the only exotic plants observed outside of areas that have clearly been physically disturbed are dandelions south of the south end of Cooper Lake.

Five species of exotic plants were observed along Cooper Creek, outside of areas directly disturbed by the Project. The plants may have been transported downstream in creek water from the dam area, where exotic plants are common. Some may have been transported downslope by avalanches; weedy species, including some exotics, were noted in avalanche runout zones along the creek. Each of these avalanche zones crosses the Cooper Lake Dam access road, which could serve as a source of exotic plants. The exposed creek banks and bars provide a suitable substrate for weedy plant establishment.

One substantial dandelion population was found along the transmission line during the sensitive plant survey. It seemed unusual because it was within an area of the transmission line corridor that was cleared, but without an access road. The dandelion cover was greater than had been observed elsewhere to date on such a site: approximately 5% over an area of 0.1 hectare.

Most noxious weeds are early successional species that prefer highly disturbed sites such as areas along rivers and streams, trails, trailheads, roadsides, building sites, and campgrounds (Sheley and Petroff 1999). Many exotic species share these habitat preferences. In fact, studies have shown that the presence of exotic plant species highly correlates with sunlit soil and frequent, severe disturbances, such as those resulting from road traffic and from road maintenance activities (i.e., grading) (Parendes and Jones 2000). In order for an area to become populated with weeds, the area must be exposed to a weed seed or propagule. If this happens where the natural vegetation has been disturbed, it is possible for the weed species to colonize and outcompete the native vegetation. Conditions along the edge of Cooper Lake and on Project-related access roads, and to a lesser degree under the transmission line, make these prime areas for invasion of exotic plants.

The surveys described in this study indicate that sites that have been physically disturbed often support exotic species, even if disturbance is just seasonal reservoir fluctuation. Reservoir fluctuation creates bare, unshaded ground that can support exotic plants that can tolerate inundation in some years or readily reestablish after flooding. In zones that are less frequently inundated, the flooding regime maintains low vegetation that is less likely to shade the generally sun-loving exotic plants. Regular clearing along the transmission line and initial and maintenance grading of access roads open substrate for invasion of exotic plants, and the vehicles and tools used for that work likely transport plant parts that can propagate new plants to those newly exposed sites.

Recreational and other users of the Project area now contribute to the spread of exotic plants in the vicinity of Project components. For example, hikers and commercial horseback tourists were observed using the Cooper Lake Dam access road. Both would be vehicles for spread of exotic plants. Recreationists that launch boats at Cooper Lake and who camp along the shore bring seeds and other plant parts from outside the Project area to where they can become established along Cooper Lake margins. Recreationists (hunters, campers, hikers) using transmission line access roads also disturb soils and transport plant propagules to Project features where they may establish.

While information does not exist to analyze whether exotic plant establishment has increased through the period of Project operation (after initial construction and its early years of operation), it is likely that exotic plant populations have increased over the years. Considerable soil remains exposed. Each new incident of disturbance (driving on a soft access road, a washout, maintenance clearing) re-exposes soil for further invasion. Increasing use of Project features by recreationists also brings disturbance and plant propagules.

It is likely that continued Project operations will contribute to an increasing prevalence of exotic species in the vicinity of all Project components. Where those components intersect naturally disturbed areas, such as streams, exotic plant establishment may spread beyond Project components. The somewhat longer clearing cycles (8–10 years) planned for ongoing maintenance of the transmission line corridor will slightly decrease the rate of establishment of exotic species. If new routes are developed for access to the transmission line, these will serve as new sites for incursion of exotic plants, with the degree of incursion depending on the means of developing and using those access points. Any new construction that would be required under a potential future scenario to establish an alternative flow and/or temperature regime in Cooper Creek would similarly serve to create new incursion sites.

Under the sponsorship of several federal agencies, the Alaska Natural Heritage Program is currently ranking weedy plant species according to their invasiveness (AKNHP 2004, Carlson et al. 2004). The invasiveness levels of the exotic plants found in this study are:

High:	*Myriophyllum spicatum*	Low:	*Matricaria discoidea*
	Phalaris arundinacea		*Plantago major*
	Phleum pratense		*Polygonum aviculare*
	Taraxacum officinale		*Rumex acetosella*
	Linaria vulgaris		*Rumex longifolius*
Medium:	*Trifolium repens*	Not ranked:	*Cerastium fontanum*
	Trifolium hybridum		*Poa annua*
	Poa pratensis		*Poa palustris*
	Galeopsis bifida		*Spergularia rubra*
	Achillea millefolium		
	Agrostis stolonifera		
	Alopecurus pratensis		

The more highly invasive species can be expected to spread the fastest. Of these, only dandelion (*Taraxacum officinale*) appears to already be widely distributed at Project components. The other mostly commonly observed species have moderate or low levels of invasiveness.

CONCLUSIONS

The exotic plant study analyzed data collected during two surveys: one that was focused on exotic plants, and a separate sensitive plant survey. Data discussed in this report were collected in the vicinity of Project components located on USFS lands, with the exception of the Cooper Creek campground which was surveyed as part of the Cooper Creek floodplain.

Exotic plants occurred in a preponderance of the disturbed sites that were surveyed. The most common exotic species in the Project area is the common dandelion, with Kentucky bluegrass, annual bluegrass, common plantain, pineappleweed, and yarrow also common. Exotic species have become established along Cooper Creek, even though its substrate has not been physically disturbed by the Project, because of the proximity of exotic plant populations, existence of natural means of transport of plant propagules to the creek, and the availability of suitable (bare soil) sites along the creek for plant establishment. Disturbance as light as clearing 50 years ago or infrequent inundation around Cooper Lake appears to be sufficient for establishment of some exotic species.

Continued Project operation and maintenance will likely contribute to an increase in the locations and intensity of exotic plant incursions. This will be particularly true where new access routes are established and wherever new construction might occur. Other users of the access roads and Cooper Lake also will continue to contribute to exotic plant establishment.

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Appendix 1

AKEPIC Alaska State Noxious Weed and Interim Invasive Alien Species List: Year 2002

USDA name code	Scientific name (Hulten 1968; or Kartesz*)	Common name	Family	USDA name (with additional synonyms sometimes for clarity)
ACMIM2	Achillea millefolium L. sens. str.	common yarrow	Asteraceae	A. m. var. m
ACPT	Achillea ptarmica L.	sneezeweed	Asteraceae	
ELRE4	Elymus repens (L.) Beauv.*	quackgrass	Poaceae	Agropyron repens, Elytrigia repens (L.) Desv. ex B.D. Jackson
PASM	Agropyron smithii Rydb.	western wheatgrass	Poaceae	Pascopyrum smithii (Rydb.) A. Löve
AGGI2	Agrostis gigantea Roth	creeping bentgrass, red top	Poaceae	A. alba auct non L., A. stolonifera L. ssp. gigantea (Roth) Schuebl. & Martens
AGST2	Agrostis stolonifera L.	creeping bentgrass, red top	Poaceae	
AGCA5	Agrostis tenuis Sibth.	colonial bentgrass	Poaceae	Agrostis capillaris L.
ALPE4	alliaria petiolata (Bieb.) Cavara & Grande	garlic mustard	Brassicaceae	
ALGE2	Alopecurus geniculatus L.	water foxtail	Poaceae	
ALPR3	Alopecurus pratensis L.	meadow foxtail	Poaceae	
AMRE	Amaranthus retroflexus L.	redroot pigweed	Amaranthaceae	
ANCO2	Anthemis cotula L.	mayweed	Asteraceae	
ANTI	Anthemis tinctoria L.	yellow chamomile	Asteraceae	
MIOR	Antirrhinum orontium L.	snapdragon	Scrophulariaceae	Misopates orontium (L.) Raf.
ASPR	Asperugo procumbens L.	catchweed, mudwort	Boraginaceae	
ASCI4	Astragalus cicer L.?*	chickpea milkvetch, cicer milkvetch	Fabaceae	
AVFA	Avena fatua L.	wildoats	Poaceae	
BICE	Bidens cernua L.	bur-marigold, nodding beggar-ticks	Asteraceae	
BRJU	Brassica juncea (L.) Czern.	indian mustard	Brassicaceae	
BRRA	Brassica rapa L.	field mustard	Brassicaceae	
BRHO2	Bromus hordeaceus L.	soft brome	Poaceae	
BRINI	Bromus inermis Leyss.	smooth brome	Poaceae	B. inermis Leyss. ssp. inermis
BRSE	Bromus secalinus	rye brome, cheat	Poaceae	
BRTE	Bromus tectorum L.	cheatgrass, downy brome	Poaceae	
CABU2	Capsella bursa-pastoris (L.) Medik.	shepherd's purse	Brassicaceae	
CABU2	Capsella rubella Reut.	shepherd's purse	Brassicaceae	C. bursa-pastoris (L.) Medik.
CADE9	Carex deweyana Schwein.	Dewey sedge	Cyperaceae	
CEBI2	Centaurea biebersteinii	Spotted knapweed	Asteraceae	
CEFO2	Cerastium fontanum Baumg. ssp. triviale (Link) Jalas	larger mouse-eared chickweed	Caryophyllaceae	Cerastium fontanum Baumg.

USDA name code	Scientific name (Hulten 1968; or Kartesz*)	Common name	Family	USDA name (with additional synonyms sometimes for clarity)
CHALA	Chenopodium album L.	lamb's quarters	Chenopodiaceae	Chenopodium album L. var. album
LEVU	Leucanthemum vulgare Lam.*	ox-eye daisy	Asteraceae	Chrysanthemum leucanthemum L.
CIAR4	Cirsium arvense (L.) Scop.	Canada thistle	Asteraceae	
COCO7	Cotula coronopifolia L.	Brass Buttons	Asteraceae	
CRTE3	Crepis tectorum L.	annual hawksbeard	Asteraceae	
CYSC4	Cytisis scoparius (L.) Link	Scotch Broom	Fabaceae	
DAGL	Dactylis glomerata L.	orchard grass	Poaceae	
DESO2	Descurainia sophia (L.) Webb ex Prantl	tansy mustard	Brassicaceae	
ELSI	Elymus sibiricus L.	Siberian wild rye	Poaceae	
ERGA	Erucastrum gallicum (Willd.) O.E. Schulz*	common dogmustard	Brassicaceae	Brassica erucastrum L.
ERCH9	Erysimum cheiranthoides L. subsp. cheiranthoides	wormseed mustard	Brassicaceae	Erysimum cheiranthoides L.
LOAR10	Festuca arundinacea (Schreb.) S.J. Darbyshire	tall fescue	Poaceae	
GABI3	Galeopsis bifida Boenn.	splitlip hempnettle	Lamiaceae	
GATE2	Galeopsis tetrahit L.	brittlestem hempnettle	Lamiaceae	
GEPU2	Geranium pusillum L.*	small geranium	Geraniaceae	
HEAN3	Helianthus annuus L.	annual (common) sunflower	Asteraceae	
HIUM	Hieracium umbellatum	Narrow-leaf Hawkweed	Asteraceae	
HYRA3	Hypochoeris radicata L.	cat's-ears	Asteraceae	Hypochaeris radicata L.
LASC	Lappula myosotis Moench	European beggar's lice	Boraginaceae	Lappula squarrosa (Retz.) Dumort.
LEAU2	Leontodon autumnalis L.	fall dandelion	Asteraceae	
LEDE	Lepidium densiflorum Schrad	common peppergrass	Brassicaceae	Lepidium densiflorum Schrad. var. densiflorum, var. elongatum (Rydb.) Thellung, var. macrocarpum Mulligan
LIVU2	Linaria vulgaris P. Mill.	butter and eggs	Scrophulariaceae	
LOPEM2	Lolium multiflorum Lam.	Italian rye grass	Poaceae	Lolium perenne L. ssp. multiflorum (Lam.) Husnot
LOPEP	Lolium perenne L.	perennial rye grass	Poaceae	Lolium perenne L. ssp. perenne
LUPOP4	Lupinus polyphyllus Lindl.	large-leaf lupine	Fabaceae	L. polyphyllus Lindl. ssp. polyphyllus var. polyphyllus
LUPOP4	Lupinus x pseudopolyphyllus*	Kenai lupine	Fabaceae	L. polyphyllus Lindl. ssp. polyphyllus var. polyphyllus
LYHY2	Lythrum hyssopifolia L.*	hyssop loosestrife	Lythraceae	
LYSA2	Lathrum salicaria	Purple Loosestrife	Lythraceae	
MADI6	Matricaria discoidea DC	pineappleweed	Asteraceae	M. matricarioides auct. non (Less.) Porter
MESAF	Medicago falcata L.	yellow alfalfa	Fabaceae	Medicago sativa L. ssp. falcata (L.) Arcang.
MELU	Medicago lupulina L.	black medic, hop clover	Fabaceae	
MESAS	Medicago sativa L.	alfalfa	Fabaceae	Medicago sativa L. ssp. sativa
SINO	Melandrium noctiflorum (L.) Fries	night-flowering catchfly	Caryophyllaceae	Silene noctiflora L.

USDA name code	Scientific name (Hulten 1968; or Kartesz*)	Common name	Family	USDA name (with additional synonyms sometimes for clarity)
MEAL12	Melilotus alba Medikus	white sweet clover	Fabaceae	Melilotus officinalis (L.) Lam.
MEOF	Melilotus officinalis (L.) Lam.	yellow sweet clover	Fabaceae	
MYSP2	Myriophyllum spicatum L. (sens. str.)*	Eurasian watermilfoil	Halagoraceae	
NEPA3	Neslia paniculata (L.) Desv.	ball mustard	Brassicaceae	
ONVI	Onobrychis viciifolia Scop.*	sainfoin, saintfoin	Fabaceae	
ONAC	Onopordum acanthium	Scotch Thistle	Asteraceae	
PANU3	Papaver nudicaule L.	Iceland poppy	Papaveraceae	
PHAR3	Phalaris arundinacea	Reed Canary Grass	Poaceae	
PHCA5	Phalaris canariensis L.	Canary grass	Poaceae	
PHPR3	Phleum pratense L.	Timothy	Poaceae	
PLLA	Plantago lanceolata L.	ribgrass, buckhorn, English plantain	Plantaginaceae	
PLMA2	Plantago major L. var. major	common plantain	Plantaginaceae	
POPRP2	Poa angustifolia L.	Kentucky bluegrass	Poaceae	Poa pratensis L. ssp. pratensis
POAN	Poa annua L.	annual bluegrass	Poaceae	
POCO	Poa compressa L.	Canada bluegrass	Poaceae	
POPR	Poa pratensis L.	bluegrass	Poaceae	
POPRI2	Poa subcoerulea Sm.	spreading bluegrass	Poaceae	P. pratensis L. ssp. irrigata (Lindm.) Lindb. f.; P. subcaerulea Sm.
POTR2	Poa trivialis L.	rough bluegrass	Poaceae	
POAV	Polygonum aviculare L.	knotweed	Polygonaceae	
POCO10	Polygonum convolvulus L.	black bindweed, wild buckwheat	Polygonaceae	
POCU6	Polygonum cuspidatum	Japanese knotweed	Polygonaceae	
POLA4	Polygonum lapathifolium L.	willow weed	Polygonaceae	
POPE3	Polygonum persicaria l.	lady's-thumb	Polygonaceae	
ARAN7	Potentilla anserina L.	silverweed	Rosaceae	Argentina anserina (L.) Rydb.
POGR9	Potentilla gracilis Dougl. ex Hook.	slender cinquefoil	Rosaceae	
RARE3	Ranunculus repens L.	creeping buttercup	Ranunculaceae	
RASA2	Raphanus sativus L.	cultivated radish	Brassicaceae	
ROSY	Rorippa sylvestris (L.) Bess.*	creeping yellowcress	Brassicaceae	
RUAC3	Rumex acetosella L. ssp. acetosella	sheep sorel	Polygonaceae	
RUAC3	Rumex acetosella L. ssp. angiocarpus (Murb.) Murb.	sheep sorel	Polygonaceae	Rumex acetosella L.
RUCR	Rumex crispus L.	curled dock	Polygonaceae	
RULO2	Rumex longifolius DC.	garden dock	Polygonaceae	
RUOB	Rumex obtusifolius L.	bitter dock	Polygonaceae	
SCMA8	Scirpus paludosus A. Nels.	bayonet grass	Cyperaceae	Schoenoplectus maritimus (L.) Lye
SEVU	Senecio vulgaris L.	common groundsel	Asteraceae	
SIAR4	Sinapsis arvensis L.	charlock	Brassicaceae	
SIAL2	Sisymbrium altissimum L.	tumbling	Brassicaceae	

USDA name code	Scientific name (Hulten 1968; or Kartesz*)	Common name	Family	USDA name (with additional synonyms sometimes for clarity)
		mustard		
SOAR2	Sonchus arvensis	Perennial Sowthistle	Asteraceae	
SPAR	Spergula arvensis L.	spurry	Caryophyllaceae	
SPRU	Spergularia rubra (L.) J.& K. Presl	purple sand spurry	Caryophyllaceae	
STME2	Stellaria media (L.) Vill.	common chickweed	Caryophyllaceae	
TAOF	Taraxacum officinale Weber	common dandelion	Asteraceae	T. officinale G.H. Weber ex Wiggers ssp. officinale, T. officinale G.H. Weber ex Wiggers ssp. vulgare (Lam.) Schinz & R. Keller
TALA2	Taraxacum scanicum Dahlst.	rock dandelion	Asteraceae	Taraxacum laevigatum (Willd.) DC.
THAR5	Thlaspi arvense L.	pennycress	Brassicaceae	
TRDU	Tragopogon dubius Scop.*	yellow salsify, goatsbeard	Asteraceae	
TRAU2	Trifolium aureum Pollich	golden clover	Fabaceae	
TRHY	Trifolium hybridum L.	alsike clover	Fabaceae	
TRPR2	Trifolium pratense L.	red clover	Fabaceae	
TRRE3	Trifolium repens L.	white clover	Fabaceae	
TRPE21	Tripleurospermum inodorum (L.) Schultz-Bip.	scentless mayweed	Asteraceae	Tripleurospermum perforata (Merat) M. Lainz
TRAE	Triticum aestivum L.	wheat	Poaceae	
VESES	Veronica serpyllifolia L. subsp. serpyllifolia	thyme-leaf speedwell	Scrophulariaceae	
VICRC	Vicia cracca L.	bird vetch, dog pea	Fabaceae	Vicia cracca L. ssp. cracca

Source: Binnian and Shephard 2002.

Appendix 2

Response to Comments on the February 2003 Draft Report

Revised summary of responses to comments on the draft report for the 2003 Exotic Plants Study.

Date of Letter/Email	Commenting Party [1]	Comment	Chugach Response
4/30/04	USFS	The Forest Service requests the following changes to this study:	
		1) On p. 5, change the statement, "The final study plan four the exotic plant survey (HDR 2003) was focused on characterizing the species and abundance of exotic plants…" to "The final study plan for the exotic plants survey (HDR 2003) was focused on identifying the species and characterizing the abundance of exotic plants…"	This edit has been made as requested. [See p. 9, 1st paragraph under Methods heading.]
		2) This study did not fully incorporate the requirements for data entry into the AKEPIC database, as requested by the Forest Service, apparently because of the distribution extend of certain species along road corridors. The study explains that the polygons and information requested by AKEPIC could not be provided given the size of the Cooper Reservoir study area. The Forest Service requests that the GPS locations and species of the established weed populations still be provided to the AKEPIC database or directly to the Forest Service.	GPS locations and species of the established weed populations will be provided; however, the data will not be in exactly the same format as AKEPIC database. Specifically, the 50 sq meter plot size is below the minimum polygon size required by the AKEPIC database. This plot size was chosen for the survey of access roads to match the plot size being used by the USFS for its Kenai trails survey. This clarification has been made in the revised text. [See 1st full paragraph on p. 10.] In 2004, the data collected for the qualitative exotic plant survey was from 1/10-acre plots to conform with AKEPIC standards.
		3) Several species not previously known on the Seward Ranger District (from the Duffy 2002 and the DeVelice 2003 surveys) were found in this study. Inclusion of the information from the terrestrial vegetation survey add little to this study, as only four species were reported, and these were reported from the other two studies. We are unclear why paired plots were used other than to provide qualitative results. The Forest Service's interests and requests for this study are that it identify presence, species, distribution, and size of exotic plant populations within the project area.	As the USFS observed, the vegetation survey adds little information to that obtained through the sensitive plant survey and the survey along access roads. For that reason, the results of that survey have been removed from this study. The paired plots used in the survey of the transmission line and access roads for exotic plants were intended to provide a qualitative indication of the spread of exotic species into adjacent undisturbed areas. There were far too few plots sampled to definitively state whether exotic plants are spreading beyond disturbed areas. To avoid implying that such a conclusion would be well founded on data, description of that element

Date of Letter/Email	Commenting Party [1]	Comment	Chugach Response
			of the exotic plant survey has been removed from this report. The USFS's original study request related to exotic plants (9/5/2002) was for a survey of specific portions of the Project area for the presence of exotic plants. The document referenced for survey methodology did not specify a method for survey – only for reporting of data to the database. In the original study request, the resource goals were not specified. It was expected that the survey "would identify the extent and magnitude of any …exotic plant concerns relating to the project." The study plan described a non-quantitative survey that would select representative sites for data collection within a variety of disturbance types and gross vegetation communities. It would not define the full extent of infestations. Based on comments received on the draft study plan, the plan appeared to be acceptable to the USFS. The plan was subsequently adjusted during the study by incorporating the information that would be gained during the sensitive plant survey. If exotic plant monitoring is proposed as a PME measure in the final license application, the monitoring methodology would be developed in consultation with the USFS to meet specific goals. [No changes to the report have been made in response to this comment.]
4/30/04	USFS	The Forest Service will be interested in the monitoring of the identified exotic species populations within the project area both to track their spread, and for implementing measures to decrease their presence.	Comment noted. Discussion of potential PME measures is included in the draft license application. PME proposals will be developed based on further analysis and discussion with agencies, for inclusion in the final license application. Any monitoring of sensitive plants that is included in the final license proposal would

Date of Letter/Email	Commenting Party [1]	Comment	Chugach Response
			be designed in consultation with USFS. [No change has been made to the report to address this comment.]

Note:
1. USFS = USDA Forest Service (Chugach National Forest).