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WHC-EP-0448

Fiscal Year 1991 100 Areas CERCLA Ecological Investigations

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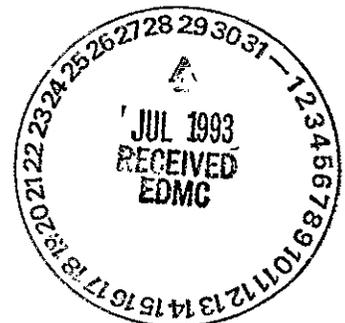
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Office of Environmental Restoration
and Waste Management



Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930



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M. R. Sackschewsky
D. S. Landeen

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**Westinghouse
Hanford Company**

P.O. Box 1970
Richland, Washington 99352

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Document Title: Fiscal Year 1991 100 Areas CERCLA Ecological Investigations

Prepared by: D. S. Landeen 3-19-92
D. S. Landeen, Senior Scientist Date
Environmental Restoration

M. R. Sackschewsky 3-23-92
M. R. Sackschewsky, Senior Scientist Date
Environmental Restoration

Reviewed by: S. Weiss 3-19-92
S. Weiss, Scientist Date
Environmental Restoration

Approved by: J. C. Sonnichsen 3-19-92
J. C. Sonnichsen, Manager Date
Environmental Restoration

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FISCAL YEAR 1991 100 AREAS CERCLA ECOLOGICAL INVESTIGATIONS

EXECUTIVE SUMMARY

The status of the ecological investigations conducted by Westinghouse Hanford Company during Fiscal Year 1991 at operable units 100-HR-3 and 100-BC-5 associated with 100- H, D, DR, B and C reactors in the 100 Areas is reported here. These ecological investigations provide a basic description of the flora and fauna that inhabit the operable units, emphasizing species that have been given special status under existing state and/or federal laws. The 1991 Westinghouse Hanford Company field investigations have concentrated on the following: (1) bird surveys, (2) mammal and insect surveys, (3) vegetation surveys, and (4) vegetation sampling. Work being conducted as part of the vegetation surveys includes a biological assessment of threatened and endangered plants, which is being prepared as a separate document. Similar ecological investigations will be conducted at 100- N, K, and F operable units in 1992.

Pacific Northwest Laboratory was contracted by Westinghouse Hanford Company to contribute to certain phases of the ecological investigations. Pacific Northwest Laboratory is responsible for writing a bald eagle management plan and a biological assessment of threatened and endangered wildlife species. Pacific Northwest Laboratory is also responsible for the periphyton and macroinvertebrate sampling in the Columbia River. The efforts performed by Pacific Northwest Laboratory are not included in this status report.

Bird and mammal surveys were conducted during all seasons at the operable units. Bird species observed that are classified as federal and/or state 'threatened' and 'endangered' species included the bald eagle, white pelican, ferruginous hawk, and sandhill crane. Several other species of concern that are classified as 'federal candidate', 'state monitor', and 'state candidate' species were also observed.

Mammal and insect surveys were conducted at individual waste sites associated with each operable unit. Evidence of burrowing by small mammals or harvester ants was documented.

Vegetation surveys were conducted at each operable unit. Major vegetation types were characterized, and species lists were compiled. Trees and riparian zones were also characterized and mapped.

Vegetation samples (asparagus, reed canarygrass, and tree leaves) were collected at seven locations upriver and downriver of the operable units of interest. All of these samples were sent to an offsite laboratory for analysis of radionuclide and inorganic waste constituents.

Recommendations for similar efforts that will be conducted in 1992 at other operable units in the 100 Areas are also discussed. These recommendations include collecting soil samples of excavated material that has been brought to the surface by burrowing animals and harvester ants on some of the waste sites of concern.

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1.0 INTRODUCTION

The ecological investigations conducted during 1991 at 100-HR-3 and 100-BC-5 operable units associated with 100- H, D, DR, B, and C reactors were composed of the following subtasks: (1) data compilation, (2) preliminary ecological investigations report, (3) field activities, (4) laboratory analysis, and (5) data evaluation.

The ecological investigations for these operable units are being conducted by Westinghouse Hanford Company (Westinghouse Hanford) and Pacific Northwest Laboratory (PNL) with Westinghouse Hanford as the lead contractor. Westinghouse Hanford is responsible for conducting the terrestrial and aquatic literature surveys and terrestrial field investigations. These involve conducting biotic surveys and inventories of major wildlife and plant species as well as sampling the terrestrial community components such as soil, plants, and animals. Pacific Northwest Laboratory is responsible for writing the bald eagle management plan, a biological assessment for threatened and endangered wildlife species, and for conducting the aquatic sampling for periphyton and macroinvertebrates. This report summarizes the status of the field work, the terrestrial field investigations, performed under subtask 3. When all the subtasks have been completed a final report will summarize the results of the ecological field investigations. The following sections provide details on the terrestrial field methodologies and a summary of the data collected to date by Westinghouse Hanford.

The 100-HR-3 and 100-BC-5 designations of these operable units refer to the 100- H, D, DR, B, and C nuclear reactors located along the Columbia River in the 100 Areas of the Hanford Site, which have been shut down since the early 1970's. The first phase of this project was spent compiling past documentation of work and studies conducted in the 100 Areas since the early 1940's with an emphasis on biotic transport and uptake of radionuclides and other inorganic waste constituents. An earlier document, WHC-MR-0272 (WHC 1991a), reported on the data compilation subtask of these ecological investigations.

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2.0 SCOPE OF WORK

2.1 OBJECTIVES

These ecological field investigations identify possible contaminant transport pathways (terrestrial and aquatic) and evaluate existing concentrations of contaminants in biota associated with the operable units. The contaminants of concern are those that have been detected in groundwater and springs and those that have been released to disposal facilities overlying the operable units.

These investigations also provide a basic description of the flora and fauna that inhabit the operable units, emphasizing species that have been given special status under existing state and/or federal laws. Such a description may allow for the identification of indicator species that can be monitored to assess the effectiveness of corrective actions.

2.2 FIELD INVESTIGATIONS

Field investigations have concentrated on the following: (1) bird surveys, (2) mammal and insect surveys, (3) vegetation surveys, and (4) sampling of various plant species for radionuclides and inorganic waste constituents analysis. Special attention is given to plant and wildlife species that have special classification status at state and/or federal levels. Table 2-1 lists and describes the various status codes for federal and state designations. The classifications of most concern are the federal and state threatened and endangered species lists. The state of Washington classification codes in Table 2-1 were taken from the 1991 wildlife species lists (Washington Department of Wildlife June 19, 1991) and plant species lists (Washington Natural Heritage Program 1990). The federal species designations were obtained from the Federal Register 50 CFR Part 17, which is updated several times each year. Both federal and state lists are under continual revision. The final report will include any revisions from these lists as they become available.

Table 2-1. Federal and State Status Codes for Special Plants and Animals. (sheet 1 of 2)

Code	Explanation
Federal (plants and animals)	
FE	Federal endangered. A species in danger of extinction throughout all or a significant portion of its range.
FT	Federal threatened. A species which is likely to become endangered within the foreseeable future.
FC ₂	Federal candidate, category 2. More information being sought.
FC ₃	Federal candidate, category 3. No longer considered seriously threatened.
State (wildlife)	
SE	State endangered. Species native to the state of Washington that are seriously threatened with extinction throughout all or a significant portion of their ranges within the state.
ST	State threatened. Species native to the state of Washington that are likely to become endangered within the foreseeable future throughout significant portions of their range within the state without cooperative management or the removal of threats.
SS	State sensitive. Wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their ranges within the state without cooperative management or the removal of threats. There are currently no species listed in this category. Species under review for listing are designated as candidate species.
SM	<p>State monitor. Wildlife species native to the state of Washington that are of special interest because they:</p> <ol style="list-style-type: none"> 1) Have significant popular appeal. 2) Require limited habitat during some portion of their life cycle. 3) Are indicators of environmental quality. 4) Require further field investigations to determine population status. 5) Have unresolved taxonomic problems which may bear upon status classification. 6) They may be competing with and impacting other species of concern. 7) They were at one time classified as endangered, threatened, or sensitive. Monitor species are designated in Wildlife Policy 4803.

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Table 2-1. Federal and State Status Codes for Special Plants and Animals. (sheet 2 of 2)

Code	Explanation
SC	State candidate. Wildlife species native to the state of Washington that the Department of Wildlife will review for possible listing as endangered, threatened, or sensitive. Candidate species are designated in Wildlife Policy 4802.
State (plants)	
SE	Endangered. This status is assigned to each vascular plant taxon in danger of becoming extinct or extirpated in the state of Washington within the near future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree.
ST	Threatened. A threatened vascular plant taxon likely to become endangered within the near future in the state of Washington if factors contributing to its population decline or habitat degradation or loss continue.
SS	Sensitive. A vascular plant taxon is labelled sensitive when it is vulnerable or declining and could become endangered or threatened in the state of Washington without active management or removal of threats.
EX	Possibly extinct or extirpated in the state of Washington. Based on recent field searches a number of plant taxa are considered to be possibly extinct or extirpated in the state of Washington. Taxa in this group are all high priorities for field investigation. If found, they will be assigned one of the above status categories.

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3.0 BIRD SURVEYS

3.1 WINTER SURVEYS

Winter wildlife surveys were conducted during December 1990 and January and February 1991. Although every species observed during these surveys was documented, the main purpose was to verify and document the species of special concern that use the operable units, such as the white pelican, bald eagle, and peregrine falcon. The bald eagle and the peregrine falcon are on the federal threatened and endangered species lists and on the state of Washington threatened and endangered species lists. The white pelican is listed as endangered in the state of Washington.

All bird species observed during these winter surveys are listed in Table 3-1. Some of the bird species commonly observed in the winter included Canada goose, horned lark, white-crowned sparrow, common raven, starling, great blue heron, and rock dove. Bald eagles and white pelicans were observed on all three surveys. Peregrine falcons were not observed during these surveys. However, peregrine falcons have been documented to fly through the Hanford Site during migration and have been sighted flying along the Columbia River (Landeem et al. 1990). More detailed information on the observations of the bald eagles and white pelicans is given below.

References and field guides that were used to name and identify bird species included Robbins et al. (1966); National Geographic Society (1989); and the American Ornithologists Union (1983).

3.1.1 Bald Eagles

Bald eagles are regular winter residents in the Pasco Basin and have used the trees along the Columbia River at the Hanford Site for roosting and cover for several years. They generally arrive at the Hanford Site in the latter part of November and depart by the end of March. The eagles forage mainly dead salmon during the winter months. The first survey in December 1990 documented 9 eagles (6 subadults, 3 adults); the January 1991 survey documented 14 eagles (6 subadults, 8 adults); and the February 1991 survey documented 8 eagles (3 subadults, 5 adults). Additional information on the bald eagle can be found in the *Bald Eagle Site Management Plan for the Hanford Site, South-Central Washington*, WHC-EP-0510.

3.1.2 White Pelicans

White pelicans were observed on the Columbia River during every survey. White pelicans were particularly common on an island near the 100-H Reactor but were observed at many different locations throughout the 100 Areas. Numbers of pelicans observed ranged from 20 (January 17, 1991) to 50 (December 4, 1990). White pelicans are becoming more common in the Pasco Basin with numbers increasing during the past three years. In the state of Washington, nesting has not been documented since 1926. White pelicans are presumably limited by the degree of isolation and lack of isolated nesting

Table 3-1. Bird Species Observed During Winter Field Surveys at the 100 Areas Operable Units.

Common name	Scientific name
Raptors and birds of prey	
bald eagle red-tailed hawk American kestrel great horned owl long-eared owl northern harrier	<i>Haliaeetus leucocephalus</i> <i>Buteo jamaicensis</i> <i>Falco sparverius</i> <i>Bubo virginianus</i> <i>Asio otus</i> <i>Circus cyaneus</i>
Waterfowl and aquatic birds	
common goldeneye bufflehead common merganser redhead Canada goose mallard northern pintail American white pelican common loon great blue heron double-crested cormorant scaup sp. ^a	<i>Bucephala clangula</i> <i>Bucephala albeola</i> <i>Mergus merganser</i> <i>Aythya americana</i> <i>Branta canadensis</i> <i>Anas platyrhynchos</i> <i>Anas acuta</i> <i>Pelecanus erythrorhynchos</i> <i>Gavia immer</i> <i>Ardea herodias</i> <i>Phalacrocorax auritus</i> <i>Aythya sp.</i>
Passerine birds	
California gull rock dove northern flicker horned lark black-billed magpie common raven European starling white-crowned sparrow dark-eyed junco red-winged blackbird house finch American goldfinch	<i>Larus californicus</i> <i>Columba livia</i> <i>Colaptes auratus</i> <i>Eremophila alpestris</i> <i>Pica pica</i> <i>Corvus corax</i> <i>Sturnus vulgaris</i> <i>Zonotrichia leucophrys</i> <i>Junco hyemalis</i> <i>Agelaius phoeniceus</i> <i>Carpodacus mexicanus</i> <i>Carduelis tristis</i>

^asp. = Species. Identification not done below genus level.

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islands free from human disturbance. Adequate concentrations of fish or salamanders in shallow waters within 30-50 miles of potential nesting sites may also be necessary in order for pelicans to breed successfully (Washington Department of Wildlife 1991). Additional information on white pelicans can be found in the *Biological Assessment for Threatened and Endangered Wildlife Species*, WHC-EP-0513.

3.2 SPRING, SUMMER, AND FALL SURVEYS

Bird surveys were conducted on several occasions within the 100-HR-3 and 100-BC-5 operable units. Surveys were conducted within one hour of sunrise, following Westinghouse Hanford procedure EII 5.3 (WHC 1991b), on April 5, May 6, May 24, May 29, June 7, June 11, and June 27, 1991. Other bird surveys conducted at various times during the day occurred on March 4, 8; April 16, 19, 22, 23, 24; May 14, 22, 24; June 27; and September 11, 20, 1991. Bird species observations were also recorded when other field work was being conducted on June 20; July 9, 10, 18, 24, 25; and August 6, 20, 1991. Surveys in the riparian zones along the Columbia River were conducted at all the reactors by walking within 50 meters of the high water mark along the river. Surveys were also conducted by walking and driving within the fenced areas at 100- B, C, H, D, and DR reactors. All bird species seen or heard on these occasions were recorded. No effort was made to quantify numbers of bird species inhabiting the operable units.

Table 3-2 lists all bird species seen to date on the operable units, including the birds seen during the winter surveys. Table 3-2 also indicates those birds observed in breeding and nesting activities. Game birds observed include mourning doves, ring-necked pheasants, California quail, and gray partridge. A noteworthy rare sighting was of a Clark's nutcracker in a tree near 100-D Area in October 1990. Other noteworthy sightings were of two male wood ducks at 100-H reactor slough on April 19, 1991 and two sandhill cranes foraging on the ground also at 100-H reactor slough on the same day. All birds recorded at the operable units during these surveys have been previously documented (Landeem et al. 1990). However, a black-necked stilt was recorded for the first time at the Hanford Site on May 21 and 22, 1991 at West Lake located near Gable Mountain.

Table 3-3 lists all the bird species observed that have special state or federal classification. These include the common loon, horned grebe, western grebe, white pelican, great blue heron, black-crowned night-heron, osprey, bald eagle, Swainson's hawk, ferruginous hawk, golden eagle, prairie falcon, sandhill crane, long-billed curlew, forster's tern, loggerhead shrike and sage sparrow. A brief description and status for each of these species is given in the following sections.

3.2.1 Common Loon

The common loon is classified as a state candidate species. One or two common loons were observed on the Columbia River near the operable units during January, April and May 1991. There are very few records of nesting by

Table 3-2. Birds Observed at 100 Areas Operable Units.
(sheet 1 of 4)

Family	Common name	Genus species	Status
Gaviidae	common loon	<i>Gavia immer</i>	Rw
Podicipedidae	pied-billed grebe ^a horned grebe western grebe	<i>Podilymbus podiceps</i> <i>Podiceps auritus</i> <i>Aechmophorus occidentalis</i>	Cr Uw Ur
Pelecanidae	American white pelican	<i>Erythrorhynchus pelecanus</i>	Cr
Phalacrocoracidae	double-crested cormorant	<i>Phalacrocorax auritus</i>	Rr
Ardeidae	great blue heron ^a black-crowned night-heron	<i>Ardea herodias</i> <i>Nycticorax nycticorax</i>	Cr Cr
Anatidae	Canada goose ^a mallard northern pintail blue-winged teal cinnamon teal northern shoveler gadwall American widgeon redhead ring-necked duck lesser scaup greater scaup common goldeneye bufflehead common merganser ruddy duck	<i>Branta canadensis</i> <i>Anas platyrhynchos</i> <i>Anas acuta</i> <i>Anas discors</i> <i>Anas cyanoptera</i> <i>Anas clypeata</i> <i>Anas strepera</i> <i>Anas americana</i> <i>Aythya americana</i> <i>Aythya collaris</i> <i>Aythya affinis</i> <i>Aythya marila</i> <i>Bucephala clangula</i> <i>Bucephala albeola</i> <i>Mergus merganser</i> <i>Oxyura jamaicensis</i>	Cr Cr Cw Us Us Cw Cw Cw Uw Uw Rw Uw Cw Cw Uw
Accipitridae	osprey bald eagle northern harrier ^a Swainson's hawk red-tailed hawk ferruginous hawk rough-legged hawk golden eagle	<i>Pandion haliaeetus</i> <i>Haliaeetus leucocephalus</i> <i>Circus cyaneus</i> <i>Buteo swainsoni</i> <i>Buteo jamaicensis</i> <i>Buteo regalis</i> <i>Buteo lagopus</i> <i>Aquila chrysaetos</i>	Um Cw Cr Us Cr Rs Rw Ur
Falconidae	American kestrel ^a merlin prairie falcon	<i>Falco sparverius</i> <i>Falco columbarius</i> <i>Falco mexicanus</i>	Cr Rr Ur

Table 3-2. Birds Observed at 100 Areas Operable Units.
(sheet 2 of 4)

Family	Common name	Genus species	Status
Phasianidae	gray partridge	<i>Perdix perdix</i>	Ur
	chukar	<i>Alectoris chukar</i>	Ur
	ring-necked pheasant ^a	<i>Phasianus colchicus</i>	Ur
	California quail ^a	<i>Callipepla californica</i>	Ur
Rallidae	American coot ^a	<i>Fulica americana</i>	Cr
Gruidae	sandhill crane	<i>Grus canadensis</i>	Um
Charadriidae	killdeer ^a	<i>Charadrius vociferus</i>	Cr
Scolopacidae	greater yellowlegs	<i>Tringa melanoleuca</i>	Um
	long-billed curlew	<i>Numenius americanus</i>	Cs
	common snipe	<i>Gallinago gallinago</i>	Ur
Laridae	ring-billed gull	<i>Larus delawarensis</i>	Cr
	California gull	<i>Larus californicus</i>	Cr
	caspian tern	<i>Sterna caspia</i>	Us
	Forster's tern	<i>Sterna forsteri</i>	Cs
Columbidae	rock dove ^a	<i>Columba livia</i>	Cr
	mourning dove ^a	<i>Zenaida macroura</i>	Cr
Tytonidae	common barn-owl	<i>Tyto alba</i>	Ur
Strigidae	great horned owl	<i>Bubo virginianus</i>	Ur
	long-eared owl ^a	<i>Asio otus</i>	Ur
Caprimulgidae	common nighthawk	<i>Chordeiles minor</i>	Cs
Trochilidae	calliope hummingbird	<i>Stellula calliope</i>	Um
Alcedinidae	belted kingfisher	<i>Ceryle alcyon</i>	Ur
Picidae	northern flicker	<i>Colaptes auratus</i>	Cr
Tyrannidae	western wood-pewee	<i>Contopus sordidulus</i>	Um
	willow flycatcher	<i>Empidonax traillii</i>	Rm
	Say's phoebe	<i>Sayornis saya</i>	Us
	western kingbird ^a	<i>Tyrannus verticalis</i>	Cs
	eastern kingbird ^a	<i>Tyrannus tyrannus</i>	Us
Alaudidae	horned lark ^a	<i>Eremophila alpestris</i>	Cr
Hirundinidae	northern rough-winged swallow	<i>Stelgidopteryx</i> <i>serripennis</i>	Us
	bank swallow	<i>Riparia riparia</i>	Us
	cliff swallow ^a	<i>Hirundo pyrrhonota</i>	Cs
	barn swallow ^a	<i>Hirundo rustica</i>	Cs

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Table 3-2. Birds Observed at 100 Areas Operable Units.
(sheet 3 of 4)

Family	Common name	Genus species	Status
Corvidae	black-billed magpie ^a	<i>Pica pica</i>	Cr
	common raven ^a	<i>Corvus corax</i>	Cr
	Clark's nutcracker	<i>Nucifraga columbiana</i>	Am
Paridae	black-capped chickadee	<i>Parus atricapillus</i>	Ur
Troglodytidae	marsh wren ^a	<i>Cistothorus palustris</i>	Ur
Muscicapidae	ruby-crowned kinglet	<i>Regulus calendula</i>	Uw
	American robin ^a	<i>Turdus migratorius</i>	Cr
	varied thrush	<i>Ixoreus naevius</i>	Uw
Bombycillidae	cedar waxwing	<i>Bombycilla cedrorum</i>	Ur
Laniidae	northern shrike	<i>Lanius excubitor</i>	Uw
	loggerhead shrike ^a	<i>Lanius ludovicianus</i>	Us
Sturnidae	European starling ^a	<i>Sturnus vulgaris</i>	Cr
Vireonidae	solitary vireo	<i>Vireo solitarius</i>	Um
	warbling vireo	<i>Vireo gilvus</i>	Um
Emberizidae	yellow warbler	<i>Dendroica petechia</i>	Us
	yellow-rumped warbler	<i>Dendroica coronata</i>	Cw
	Townsend's warbler	<i>Dendroica townsendi</i>	Um
	Wilson's warbler	<i>Wilsonia pusilla</i>	Um
	western tanager	<i>Piranga ludoviciana</i>	Um
	black-headed grosbeak	<i>Pheucticus melanocephalus</i>	Us
	vesper sparrow	<i>Pooecetes gramineus</i>	Rm
	lark sparrow	<i>Chondestes grammacus</i>	Rs
	sage sparrow	<i>Amphispiza belli</i>	Us
	savannah sparrow ^a	<i>Passerculus sandwichensis</i>	Us
	song sparrow	<i>Melospiza melodia</i>	Cr
	white-crowned sparrow	<i>Zonotrichia leucophrys</i>	Cr
	dark-eyed junco	<i>Junco hyemalis</i>	Cw
	red-winged blackbird ^a	<i>Agelaius phoeniceus</i>	Cr
	western meadowlark ^a	<i>Sturnella neglecta</i>	Cr
	yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	Cs
	Brewer's blackbird ^a	<i>Euphagus cyanocephalus</i>	Cr
brown-headed cowbird	<i>Molothrus ater</i>	Cr	
northern oriole	<i>Icterus galbula</i>	Cs	

Table 3-2. Birds Observed at 100 Areas Operable Units.
(sheet 4 of 4)

Family	Common name	Genus species	Status
Fringillidae	house finch	<i>Carpodacus mexicanus</i>	Cr
Passeridae	house sparrow	<i>Passer domesticus</i>	Cr

A status rating is given for abundance and seasonal occurrence for each species as follows:

Abundance:

C = common; often seen or heard in appropriate habitat.

U = uncommon; usually present but not always seen or heard.

R = rare; present in appropriate habitats only in small numbers, seldom seen or heard.

A = accidental; appeared once or twice, but well out of normal range.

Seasonal occurrence:

r = resident; present all year but abundance may vary seasonally.

s = summer visitor (includes spring and fall).

w = winter visitor (includes spring and fall).

m = migrant.

^aSpecies that were observed in breeding and nesting activities.

Table 3-3. Federal and State Classifications of Listed Animals Observed at the 100 Areas Operable Units.

Common name	Status ^a	
	Federal	State
Birds		
common loon		SC
horned grebe		SM
western grebe		SC
American white pelican		SE
great blue heron		SM
black-crowned night-heron		SM
osprey		SM
bald eagle	FT	ST
Swainson's hawk	FC ₃	SC
ferruginous hawk	FC ₂	ST
golden eagle		SC
prairie falcon		SM
sandhill crane		SE
long-billed curlew	FC ₃	SM
Forster's tern		SM
loggerhead shrike		SC
sage sparrow		SC
Amphibians		
Woodhouse's toad		SM

- ^aFT = federal threatened.
- FC₂ = federal candidate, category 2.
- FC₃ = federal candidate, category 3.
- SC = state candidate.
- SE = state endangered.
- SM = state monitor.
- ST = state threatened.

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common loons in eastern Washington; however, in 1978 nesting was documented by personnel from the U.S. Fish and Wildlife Service when an adult and one young were observed at White Bluffs slough.

3.2.2 Horned Grebe

The horned grebe is classified as a state monitor species. Two males were observed on April 19, 1991 on the Columbia River between White Bluffs slough and 100-H reactor.

3.2.3 Western Grebe

The western grebe is listed as a state candidate species. One western grebe was observed on the Columbia River May 24, 1991 near 100-H Area, and a pair of western grebes were observed on the Hanford Site above Vernita bridge on August 9, 1991.

3.2.4 Great Blue Heron

The great blue heron is classified as a state monitor species. Great blue herons are commonly observed at the Hanford Site and have been the subject of studies conducted by Pacific Northwest Laboratory concerning biological uptake of radionuclides and other contaminants (Rickard et al. 1978). Great blue herons have nested for several years at rookeries established along the Columbia River in the 100 Areas.

3.2.5 Black-Crowned Night-Heron

Black-crowned night-herons are classified as a state monitor species. Two black-crowned night-herons were observed in the riparian zone near 100-BC Area on April 19, 1991, and one bird was seen on May 22, 1991 near White Bluffs slough.

3.2.6 Osprey

The osprey is classified as a state monitor species. Ospreys are occasionally observed at the Hanford Site during the spring and fall. One osprey was observed at 100-H Area on April 19, 1991, and another individual was observed also at 100-H Area on September 11, 1991. There are no nesting records for the Hanford Site.

3.2.7 Swainson's Hawk

The Swainson's hawk is classified as a state and federal candidate species. One individual was observed on June 27, 1991 near 100-D Area. Swainson's hawks nest in many of the trees planted in the 1940's at the now-abandoned army bunker sites. As a result the Swainson's hawk appears to be a species that has benefitted from Hanford Site activities.

3.2.8 Ferruginous Hawk

The ferruginous hawk is classified as a federal candidate species and as a state threatened species. One individual was observed on August 24, 1991 on the buildings inside the fence at 100-D reactor. Recent studies by PNL (Fitzner and Newell 1989) indicate that this species is becoming more common at the Hanford Site and that there has been an increase in nesting attempts. This has resulted primarily from these hawks using transmission towers for nesting sites. No breeding pairs were observed at any of the 100 Areas operable units during the bird surveys conducted this year.

3.2.9 Golden Eagle

The golden eagle is classified as a state candidate species. Golden eagles are observed occasionally in all seasons at the Hanford Site, but nesting occurs in adjacent areas where high cliffs are present (Fitzner et al. 1981). One individual was observed near 100-H Area on June 11, 1991.

3.2.10 Prairie Falcon

Prairie falcons are classified as a state monitor species. A nesting pair was observed in the cliffs above Vernita bridge. The nesting pair was sighted off the Hanford Site but proximal to the Site boundary on April 9, 1991. Prairie falcons are known to forage on the Hanford Site. An individual falcon was seen at 100-H Area flying along the Columbia River on April 19, 1991. One individual was also observed at the old Hanford townsite on October 1, 1991. Prairie falcons have been documented to use some areas of the Hanford Site for nesting (Fitzner et al. 1981).

3.2.11 Sandhill Crane

The sandhill crane is classified as a state endangered species. Sandhill cranes are commonly observed migrating over the Hanford Site in the spring and fall. Sandhill cranes are known to use some of the islands in the Columbia River as loafing areas during migration. Sandhill cranes do not nest at the Hanford Site. Two individuals were observed on the ground at 100-H reactor slough on April 19, 1991.

3.2.12 Long-Billed Curlew

The long-billed curlew was reclassified as a federal candidate species FC₃ in November 1991, which means it is no longer considered seriously threatened, but is still listed as a state monitor species. Long-billed curlews nest every year in shortgrass and sagebrush habitats throughout the Hanford Site (Fitzner 1978; Allen 1980). Very few long-billed curlews were observed at the 100 Areas operable units; however, no effort was made to conduct specific long-billed curlew surveys to determine distribution or abundance.

3.2.13 Forster's Tern

The forster's tern is classified as a state monitor species. Forster's tern is a common breeding species at the Hanford Site (Hall 1985). These birds were commonly observed on the Columbia River during the spring and summer in the 100 Areas.

3.2.14 Loggerhead Shrike

The loggerhead shrike is classified as a federal candidate FC₂ and as a state candidate species. Loggerhead shrikes breed at the Hanford Site in grassland and sagebrush habitats. Loggerhead shrikes were observed on several occasions during the spring and summer.

3.2.15 Sage Sparrow

Sage sparrows are classified as a state candidate species. Sage sparrows nest in undisturbed sagebrush areas and use the Hanford Site for nesting. A few sage sparrows were observed early in the spring passing through the 100 Areas probably en route to the larger expanses of undisturbed sagebrush habitats that occur elsewhere at the Hanford Site.

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4.0 INSECT AND MAMMAL SURVEYS

All mammal species observed during field work activities such as vegetation surveys, bird surveys, sampling, and general site reconnaissance at the operable units were recorded. No effort was made to quantify numbers of mammals inhabiting these sites or to inventory bat species that might be present. Trapping was not conducted to determine the presence or absence of small mammal species. Harvester ant colonies were recorded at individual waste sites and burial grounds associated with 100- B, C, H, and D reactors.

4.1 MAMMALS

All mammals observed inhabiting the operable units were recorded. Signs of animal activity such as burrowing, tracks, and scat were taken as evidence that the animal was inhabiting or using a given area. For instance, badgers were never sighted, but ample evidence of burrowing activity in several areas indicated that badgers do inhabit or forage prey throughout the 100 Areas. Mammals observed on several occasions included coyotes, mule deer, blacktail jackrabbits, and porcupines. Evidence of small mammals such as the Great Basin pocket mouse and northern pocket gopher as determined from burrowing activities was also common. Table 4-1 gives a list of all the mammals observed during the study. Table 4-1 also indicates those mammals known to occur in the 100 Areas but not actually observed during the course of the study (Rickard et al. 1974). Mammals were identified and named using Burt and Grossenheider (1980).

4.2 MAMMAL AND INSECT SURVEYS AT INDIVIDUAL WASTE SITES

As previously mentioned, insect and mammal surveys were conducted at individual waste sites (trenches, cribs, burial grounds, etc.) associated with the reactors (Stone 1989). Burrowing activity by small mammals was looked for and recorded, as was the presence of any harvester ant mounds. Harvester ants are known to excavate materials and bring them to the surface from as far as 15-20 feet deep and have been implicated in bringing up contamination from some of the burial grounds in the 200 East Area (Conklin et al. 1985). At the Hanford Site they are probably the insect species of most concern and the species that is most likely to bring up any significant amounts of contaminated material. References and field guides used to identify insect species were Borror et al. (1976), Stebbins (1985), and Arnett and Jacques (1981).

It should be noted that the majority of the trenches, cribs, and burial grounds in these operable units have been covered with large amounts of cobble and treated with nonselective herbicides for several years. As a result of this practice, few of the waste sites have flora or fauna inhabiting them. Tumbleweeds are the predominant plants found at these sites. Results of these surveys at these waste sites are provided in Table 4-2.

Table 4-1. List of All the Mammals Observed and Known to Inhabit the 100 Areas Operable Units.

Common name	Scientific name
badger coyote Great Basin pocket mouse northern pocket gopher beaver blacktail jackrabbit bushytail woodrat mountain cottontail mule deer porcupine muskrat	<i>Taxidea taxus</i> <i>Canis latrans</i> <i>Perognathus parvus</i> <i>Thomomys talpoides</i> <i>Castor canadensis</i> <i>Lepus californicus</i> <i>Neotoma cinerea</i> <i>Sylvilagus nuttalli</i> <i>Odocoileus hemionus</i> <i>Erethizon dorsatum</i> <i>Ondatra zibethica</i>
Mammals known to inhabit areas near the Columbia River but not observed	
vagrant shrew pallid bat little brown myotis yuma myotis townsend ground squirrel western harvest mouse deer mouse sagebrush vole montane meadow mouse Norway rat house mouse racoon mink longtail weasel shorttail weasel otter striped skunk bobcat	<i>Sorex vagrans</i> <i>Antrozus pallidus</i> <i>Myotis lucifugus</i> <i>Myotis yumanensis</i> <i>Spermophilus townsendii</i> <i>Reithrodontomys megalotis</i> <i>Peromyscus maniculatus</i> <i>Lagurus curtatus</i> <i>Microtus montanus</i> <i>Rattus norvegicus</i> <i>Mus musculus</i> <i>Procyon lotor</i> <i>Mustela vison</i> <i>Mustela frenata</i> <i>Mustela erminea</i> <i>Lutra canadensis</i> <i>Mephitis mephitis</i> <i>Lynx rufus</i>

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Table 4-2. Insect and Mammal Surveys at 100- B, C, D, and H Operable Units. (sheet 1 of 2)

Operable unit	Waste site	Comments
BC	116-B-1 (trench)	All cobble, some tumbleweeds
BC	116-B-5 (crib)	Chain-link fence, big tumbleweeds, deer tracks, pocket mice activity
BC	116-B-7 (outfall structure)	Partial chain-link fence, lots of tumbleweeds
BC	116-B-8 (outfall structure)	Three ant mounds (2 large), deer tracks, pocket mice activity, cheatgrass, tumbleweeds, and rabbitbrush
BC	116-B-11 (retention basin)	Chain-link fence, all cobble, a few tumbleweeds
BC	116-C-5 (retention basin)	Two tanks, all cobble
BC	118-B-2 (burial ground)	All cobble and tumbleweeds
D	116-DR-1 (trench)	Cobble and tumbleweeds
D	116-DR-5 (outfall structure)	Some rabbitbrush, three ant mounds, rabbit sign
D	116-D-3 (french drain)	Cobble and tumbleweeds
D	116-D-4 (french drain)	Cobble and tumbleweeds
D	116-D-5 (outfall structure)	Some rabbitbrush, rabbit sign
D	116-D-7 (retention basin)	Chain-link fence, cobble and tumbleweeds
D	116-D-1A (trench)	Cobble and tumbleweeds
D	116-D-1B (trench)	Cobble and tumbleweeds
D	118-D-1 (burial ground)	All cobble, no vegetation
D	118-D-2 (burial ground)	Cobble and tumbleweeds
D	118-D-3 (burial ground)	Cobble and tumbleweeds
D	120-D-1 (ponds)	Some rabbitbrush, rabbit sign, 3 small ant mounds
D	128-D-1 (burn pit)	Tumbleweeds, not sprayed with herbicide, old garbage, concrete foundation, pocket mice, deer tracks

Table 4-2. Insect and Mammal Surveys at 100- B, C, D, and H Operable Units. (sheet 2 of 2)

Operable unit	Waste site	Comments
H	118-H-1 (burial ground)	Cobble and lots of tumbleweeds
H	118-H-2 (burial ground)	Cobble and tumbleweeds
H	118-H-3 (burial ground)	Cobble and tumbleweeds
H	118-H-4 (burial ground)	Cobble and tumbleweeds
H	118-H-5 (burial ground)	Cobble and tumbleweeds
H	116-H-1 (trench)	Cobble and tumbleweeds
H	116-H-2 (trench)	Some berm, tumbleweeds
H	116-H-7 (retention basin)	Chain-link fence, cobble and tumbleweeds
H	126-H-1 (ash pit)	Lots of small tumbleweeds, lots of coal slag, some pocket mice, few ants on perimeter
H	128-H-1 (burning pit)	Lots of small tumbleweeds, rabbitbrush, deer tracks, pocket mice
H	1607-H-2 (tile field)	Cheatgrass, pepper grass, geese foraging area, one old badger hole

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5.0 CONCLUSIONS AND RECOMMENDATIONS

Following are preliminary conclusions and recommendations that can be made regarding investigations relating to wildlife species based on the work conducted in 1991. These recommendations could be implemented in 1992 for similar efforts that will be conducted at other operable units in the 100 Areas. In some cases it is recommended that some biotic samples be collected. Any sampling of biota will be coordinated with personnel from Environmental Protection, which has jurisdiction in the 100 Areas. Final results and conclusions will be documented in late 1992 when all of the analytical data from the offsite laboratories have been evaluated.

5.1 BIRDS

Based on observations and literature searches it does not appear that intrusive activities such as well drilling will have any significant negative impact on birds residing in the operable units of concern. This is especially true where cleanup/remedial activities are scheduled to be conducted within the controlled fences at the various reactors. Specific recommendations for species having special state or federal classification status are found in the bald eagle management plan and the biological assessment of threatened and endangered species documents currently being prepared.

Based on the analytical results and future observations it may be necessary to sample swallow nests or raptor pellets at some of the operable units. Some raptor species residing in the 100 Areas in the early 1980's have been known to contain above background levels of radionuclides (Fitzner et al. 1981). Mud samples from swallow nests will definitely be sampled if it is shown that the aquatic insect community (caddisflies) has elevated levels of any radionuclides.

It is also recommended that in the appropriate habitats that long-billed curlew nesting surveys be conducted before cleanup activities begin. These surveys would only have to be conducted if cleanup activities were going to cause significant surface disturbances in areas where curlews forage and reside.

5.2 MAMMALS AND INSECTS

Samples associated with insect and mammal activity were not collected for analysis in 1991. At the waste sites investigated this year no major problems appear to exist; however, it is recommended that at some of the waste sites where burrowing by small mammals and/or harvester ants has been documented that some soil samples be collected of the excavated soil to determine if contaminants are being brought to the surface. Some candidates for such sampling are the outfall structures near the river associated with all of the reactors. Such an effort would probably require fewer than 50 samples. At the same time at selected waste sites tumbleweeds could be collected and analyzed for radionuclides. This effort would be coordinated with the 100 Areas Environmental Protection personnel to ensure that samples are collected at sites where there might be cause for concern.

It is also recommended that if any characterization work is scheduled at undisturbed sagebrush sites that pygmy rabbit surveys be conducted to verify the presence or absence of this species. Currently, surveys for this state threatened species are not planned because there is no characterization work scheduled for undisturbed sagebrush habitats.

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6.0 PLANT COMMUNITY ANALYSES

Plant communities near the Columbia River within the 100-HR-3 and 100-BC-5 operable units were surveyed during the spring and summer of 1991. The surveys consisted of searches for rare and endangered plant species, qualitative community delineations, the compilation of species lists within the different community types, and the identification and mapping of plants on or near the river shore that have a potential for a direct food chain link to man.

6.1 PLANT COMMUNITY DELINEATIONS

The plant communities within the 100-HR-3 and 100-BC-5 operable units have been broadly described as riparian immediately adjacent to the Columbia River, and as a cheatgrass community in areas away from the shoreline (Rogers and Rickard 1977). In a general sense, this system of classification is correct. On a smaller scale, however, finer delineations are possible. The community delineations described below were made by field reconnaissance and are strictly qualitative in nature. The delineations were made by visually determining the dominant plant species or vegetation types and are based on the species most apparent at the time of inspection. For the purposes of this report the delineations are simply needed to define the dominant species or associations of species that occur within different physiognomic, edaphic, or topographic units. It is possible that quantitative measurements of species frequency, abundance, and coverage could result in slightly different classifications. The surveys described below primarily cover the region from the shoreline to approximately 400 meters inland. Much of the rest of the area within the 100-HR-3 operable unit consists of old agricultural fields dominated by cheatgrass and tumbled mustard, with scattered abandoned orchards and pockets of big sagebrush and gray rabbitbrush.

A guide to the various communities delineated within the 100-HR-3 operable unit is provided in Figure 6-1. Species lists for these areas are provided in Tables 6-2 through 6-13. A guide to the specific areas covered by each species list is provided in Figures 6-2 and 6-3. While every attempt was made to identify all of the species located in each community, some were undoubtedly missed because of very low numbers or because they were not in an identifiable state at the time of the surveys. All species identifications were made following Hitchcock and Chronquist (1973).

6.1.1 100-BC Area

The region upstream from the 100-BC Area is dominated by a thick stand of willow, with interspersed patches of reed canarygrass, sedges, thickspike wheatgrass, and goldenrod. Several small wetland areas can be delineated in this vicinity. Downstream from the 100-BC Area is a cobble shoreline with relatively sparse vegetation. A number of white mulberries, elms, and junipers are present with an understory of scattered tumbled mustard and cheatgrass. A complete listing of species observed is provided in Table 6-1.

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Figure 6-1. Community Delineations in the 100-HR-3 Operable Unit of the Hanford Site. (sheet 1 of 2)

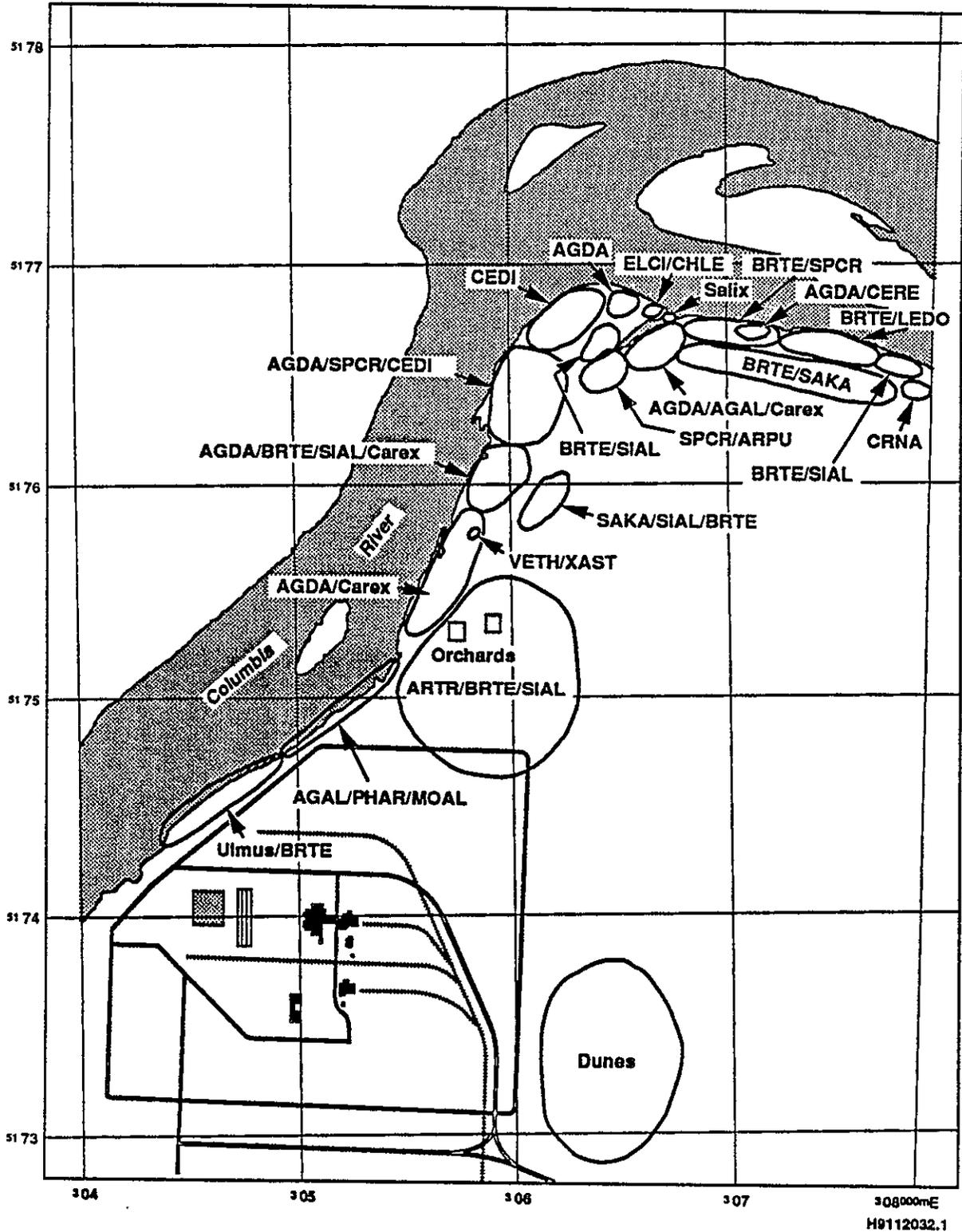
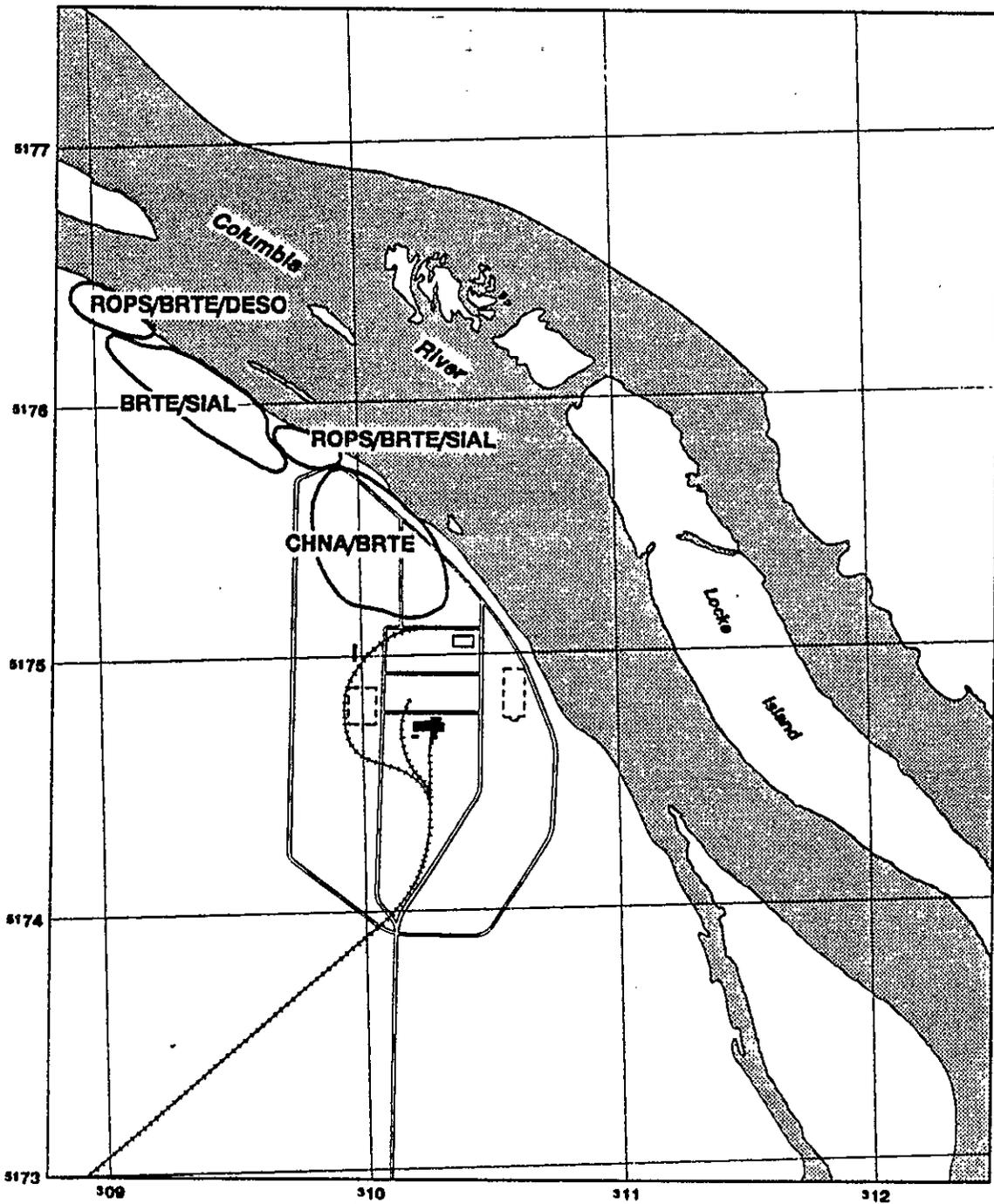


Figure 6-1. Community Delineations in the 100-HR-3 Operable Unit of the Hanford Site. (sheet 2 of 2)



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Explanation of Abbreviations:

BRTE = *Bromus tectorum*, ARTR = *Artemisia tridentata*, SIAL = *Sisymbrium altissimum*, AGDA = *Agropyron dasytachyum*, SAKA = *Salsola kali*, SPCR = *Sporobolus cryptandrus*, ARPU = *Aristata purpurea*, CEDI = *Centaurea diffusa*, CERE = *Centaurea repens*, LEDO = *Lesquerella douglasii*, ELCI = *Elymus cinereus*, VETH = *Verbascum thapsus*, XAST = *Xanthium strumarium*, CRNA = *Chrysothamnus nauseosus*, CHLE = *Chenopodium leptophyllum*, ROPS = *Robinia psuedo-acacia*, DESO = *Descurainia sophia*, AGAL = *Agrostis alba*.

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Figure 6-2. Map of Locations for Species Lists in Tables 6-2 through 6-9.

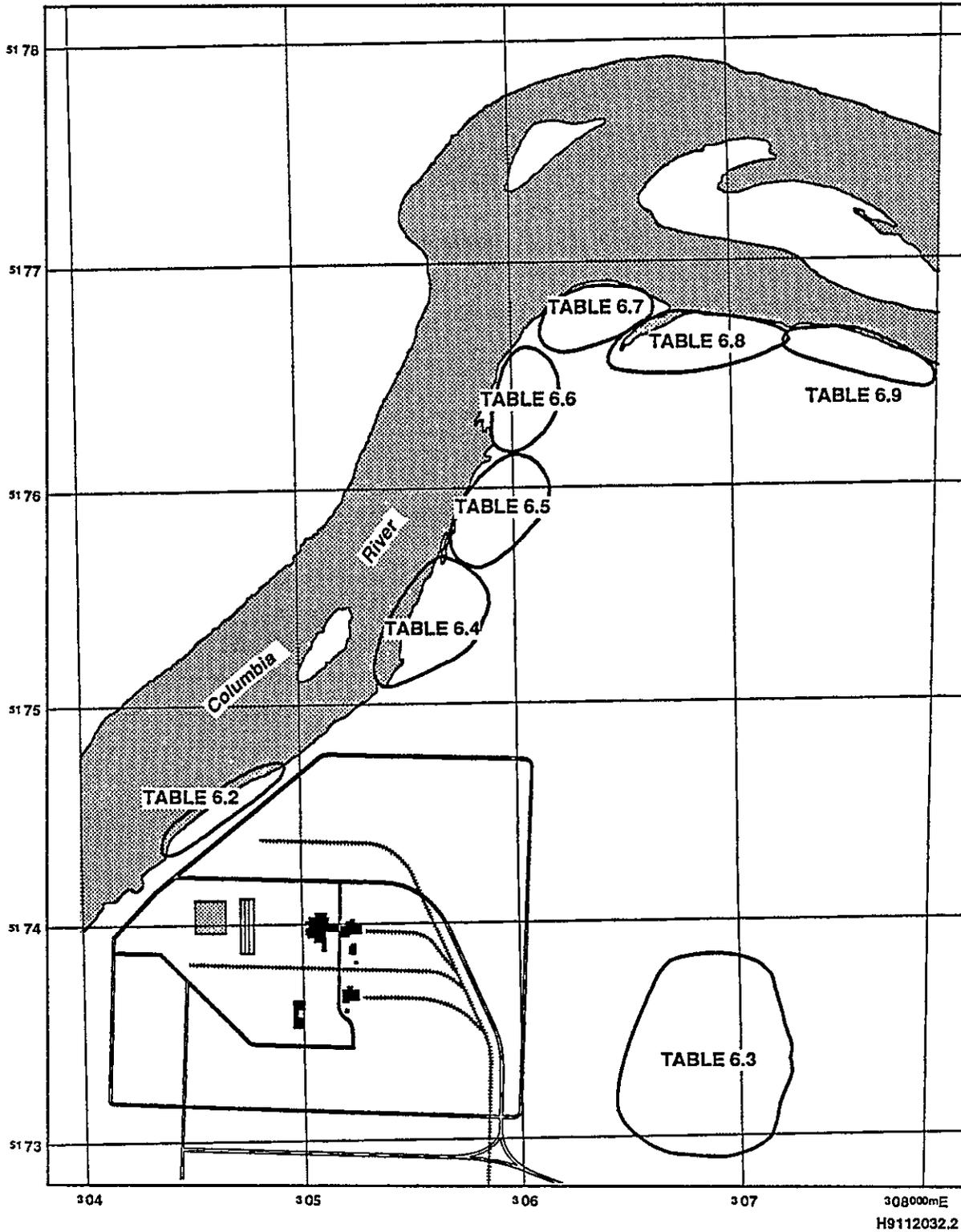
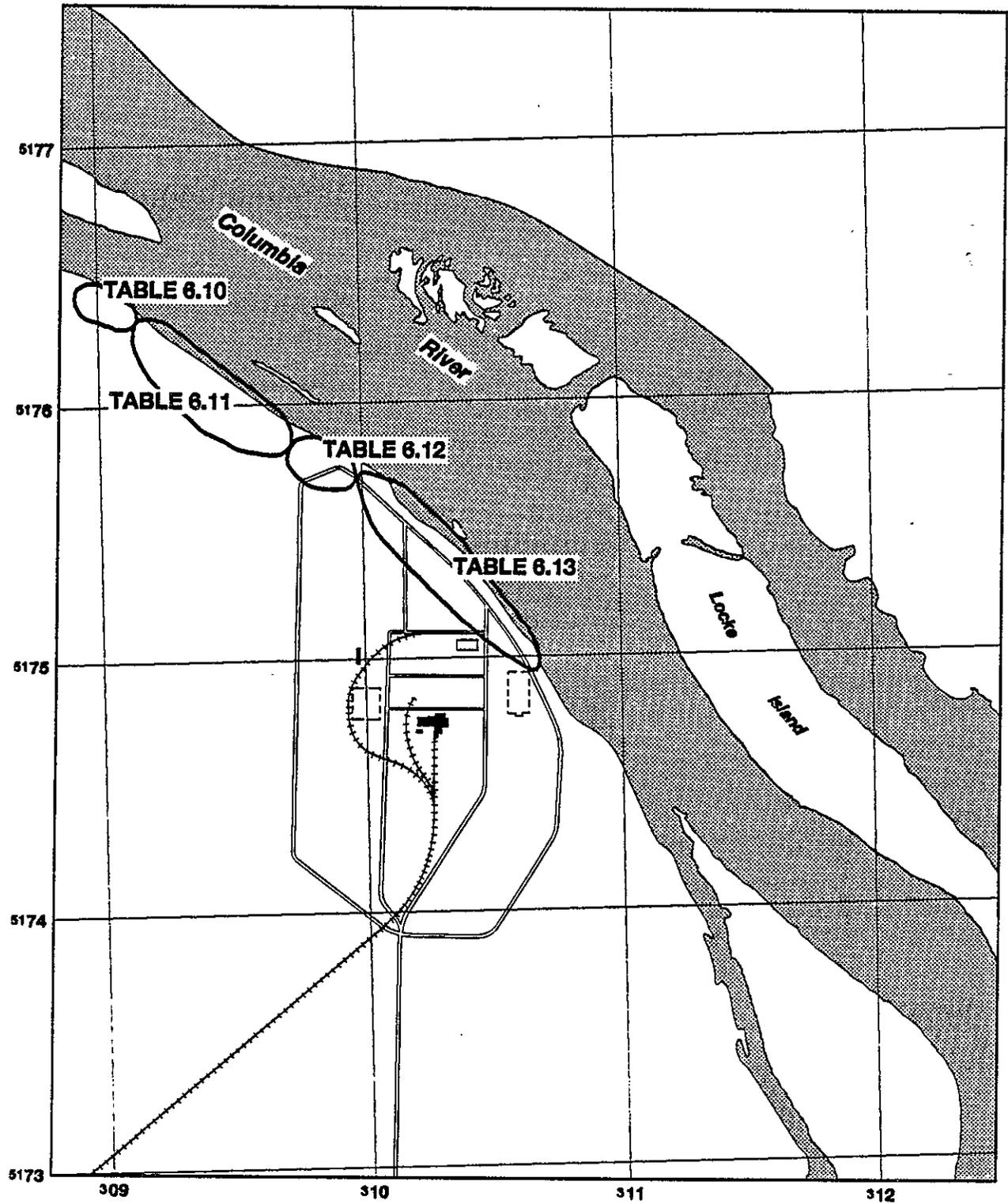


Figure 6-3. Map of Locations for Species Lists
in Tables 6-10 through 6-13.



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Table 6-1. Species Observed Along Shoreline in Vicinity of 100-BC Area
April 16, May 22, and August 9, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Poa sandbergii</i>	Poaceae	Sandberg's bluegrass
<i>Sitanion hystrix</i>	Poaceae	bottlebrush grass
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Artemisia ludoviciana</i>	Asteraceae	prairie sagebrush
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Centaurea repens</i>	Asteraceae	Russian knapweed
<i>Cirsium arvense</i>	Asteraceae	Canada thistle
<i>Gaillardia aristata</i>	Asteraceae	blanket flower
<i>Gnaphalium palustre</i>	Asteraceae	lowland cudweed
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Xanthium strumarium</i>	Asteraceae	cocklebur
<i>Helenium autumnale</i>	Asteraceae	sneezeweed
<i>Solidago occidentalis</i>	Asteraceae	western goldenrod
<i>Solidago canadensis</i>	Asteraceae	meadow goldenrod
<i>Grindelia columbiana</i>	Asteraceae	Columbia River gumweed
<i>Coreopsis atkinsoniana</i>	Asteraceae	Columbia tickseed
<i>Aster hesperius</i>	Asteraceae	western marsh aster
<i>Melilotus alba</i>	Fabaceae	white sweetclover
<i>Lupinus wyethii</i>	Fabaceae	Wyeth's lupine
<i>Amsinckia lycopsoides</i>	Boraginaceae	fiddleneck
<i>Erodium cicutarium</i>	Geraniaceae	storksbill
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Descurainia sophia</i>	Brassicaceae	flixweed

Table 6-1. Species Observed Along Shoreline in Vicinity of 100-BC Area
April 16, May 22, and August 9, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Rorippa columbiae</i>	Brassicaceae	Columbia yellowcress
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Lesquerella douglasii</i>	Brassicaceae	Columbia bladderpod
<i>Verbena bracteata</i>	Verbenaceae	bracted verbena
<i>Gratiola neglecta</i>	Scrophulariaceae	American hedge-hyssop
<i>Verbascum thapsus</i>	Scrophulariaceae	common mullein
<i>Collinsia parviflora</i>	Scrophulariaceae	small blue-eyed Mary
<i>Limosella aquatic (acaulis)</i>	Scrophulariaceae	southern mudwort
<i>Lindernia anagallidea</i>	Scrophulariaceae	false pimpernel
<i>Veronica peregrina</i>	Scrophulariaceae	purslane speedwell
<i>Polygonum persicaria</i>	Polygonaceae	heartweed
<i>Epilobium watsonii</i>	Onagraceae	Watson's willow herb
<i>Oenothera spp.</i>	Onagraceae	evening primrose
<i>Hypericum perforatum</i>	Hypericaceae	Klamath weed
<i>Juniperus scopulorum</i>	Cupressaceae	Rocky Mountain juniper
<i>Morus alba</i>	Moraceae	white mulberry
<i>Carex douglasii</i>	Cyperaceae	Douglas' sedge
<i>Carex spp.</i>	Cyperaceae	sedge
<i>Juncus spp.</i>	Juncaceae	rush
<i>Salix spp.</i>	Salicaceae	willow
<i>Ulmus pumila</i>	Ulmaceae	Siberian elm
<i>Cerastium viscosum</i>	Caryophyllaceae	sticky chickweed

spp. = species, more than one.

The plant community bounded by the 100-BC fence is almost entirely made up of the alien species of tumbledustard, Russian thistle, and cheatgrass. Modest stands of gray rabbitbrush are present, as well as a few scattered bunchgrasses (mostly sand dropseed).

6.1.2 100-D Area

Like the 100-BC Area, the community bounded by the 100-D Area fences is almost entirely made up of cheatgrass, Russian thistle and tumbledustard. Very few native species are present in this highly disturbed community.

The most obvious feature of the shoreline immediately adjacent to the 100-D Area is a large stand of mature elm trees consisting of approximately 100 individuals. This stand occurs on a sand/cobble bench above the normal high water mark. There is no understory component in much of this stand. Surrounding the stand of trees is a short-statured dryland community that includes a number of species but is dominated primarily by cheatgrass, sand dropseed, and tumbledustard. At least 40 species are present on this shelf including white mulberry, reed canarygrass, and 2 species of lupine. Overall, this area is delineated as an *Ulmus pumila/Bromus tectorum* community. A complete list of species found is provided in Table 6-2. Downstream from the elm-dominated bench is a riparian community dominated by reed canarygrass and bentgrass with a number of white mulberries.

At the northeast corner of 100-D Area is a mixed community dominated in parts by big sagebrush with an understory of cheatgrass and tumbledustard (Figure 6-1). There are two abandoned apricot orchards and a considerable amount of old-field vegetation in this area. Other readily apparent species include Munro's globemallow, yellow bee-plant, and gray rabbitbrush. Overall, this area is delineated as an *Artemisia tridentata/Bromus tectorum/Sisymbrium altissimum* community.

To the east of 100-D Area is a very sandy, dunes-type community dominated by sagebrush and rabbitbrush (Figure 6-1 "Dunes"). The understory consists of the native perennial bunchgrasses, indian ricegrass, bottlebrush grass and needle-and-thread grass along with two species of milkvetch and prickly-pear cactus. A complete list of species found is provided in Table 6-3.

6.1.3 Riparian Communities in the 100-HR-3 Operable Unit

The region in the vicinity of river mile 376.5, about 0.5 mile north of 100-D Area, is characterized by undulating topography and coarse sands. Many of the topographic depressions become saturated for varying periods of time. These swales are dominated by sedges, with smaller populations of rushes and clover-fern. Between the swales, the community is dominated by thickspike wheatgrass, bluegrass, and Russian thistle. At the northern edge of this zone is a distinct area dominated by woolly mullein and cocklebur. The species list for this zone, characterized as an *Agropyron dasytachyum/Carex* community is provided in Table 6-4. The shoreline itself is heavily dominated by reed canarygrass.

Table 6-2. Species Observed at Gravel/Cobble Shelf Below 100-D Area,
May 29, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Festuca arundinacea</i>	Poaceae	tall fescue
<i>Poa pratensis</i>	Poaceae	Kentucky bluegrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Poa sandbergii</i>	Poaceae	Sandberg's bluegrass
<i>Phalaris arundinacea</i>	Poaceae	reed canarygrass
<i>Sitanion hystrix</i>	Poaceae	bottlebrush grass
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Oryzopsis hymenoides</i>	Poaceae	indian ricegrass
<i>Erigeron linearis</i>	Asteraceae	desert yellow daisy
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Artemisia ludoviciana</i>	Asteraceae	prairie sagebrush
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Centaurea diffusa</i>	Asteraceae	tumble knapweed
<i>Centaurea repens</i>	Asteraceae	Russian knapweed
<i>Cirsium arvense</i>	Asteraceae	Canada thistle
<i>Taraxacum officinale</i>	Asteraceae	dandelion
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Lactuca serriola</i>	Asteraceae	prickly lettuce
<i>Gaillardia aristata</i>	Asteraceae	blanket flower
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Verbascum thapsus</i>	Scrophulariaceae	common mullein
<i>Lomatium grayi</i>	Apiaceae	Gray's desertparsley
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbled mustard
<i>Morus alba</i>	Moraceae	white mulberry
<i>Plantago lanceolata</i>	Plantaginaceae	English plantain
<i>Convolvulus arvensis</i>	Convolvulaceae	field bindweed
<i>Montia perfoliata</i>	Portulacaceae	miner's lettuce

Table 6-2. Species Observed at Gravel/Cobble Shelf Below 100-D Area,
May 29, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Asclepias speciosa</i>	Asclepiadaceae	showy milkweed
<i>Erodium cicutarium</i>	Geraniaceae	storksbill
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Ribes aureum</i>	Grossulariaceae	golden currant
<i>Elaeagnus angustifolia</i>	Elaeagnaceae	Russian olive
<i>Medicago sativa</i>	Fabaceae	alfalfa
<i>Medicago lupulina</i>	Fabaceae	black medick
<i>Lupinus wyethii</i>	Fabaceae	Wyeth's lupine
<i>Lupinus leucophyllus</i>	Fabaceae	velvet lupine
<i>Lupinus sericeus</i>	Fabaceae	silky lupine
<i>Ulmus pumila</i>	Ulmaceae	Siberian elm

Table 6-3. Species Observed at Sandy Area (Dunes) East of 100-D Area, April 22 and May 14, 1991.

Species	Family	Common name
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Oryzopsis hymenoides</i>	Poaceae	indian ricegrass
<i>Sitanion hystrix</i>	Poaceae	bottlebrush grass
<i>Stipa comata</i>	Poaceae	needle-and-thread grass
<i>Cryptantha leucophaea</i>	Boraginaceae	gray cryptantha
<i>Cryptantha circumscissa</i>	Boraginaceae	matted cryptantha
<i>Cryptantha fendleri</i>	Boraginaceae	Fendler's cryptantha
<i>Cryptantha pterocarya</i>	Boraginaceae	winged cryptantha
<i>Astragalus sclerocarpus</i>	Fabaceae	stalked-pod milkvetch
<i>Astragalus caricinus</i>	Fabaceae	buckwheat milkvetch
<i>Psoralea lanceolata</i>	Fabaceae	dune scurfpea
<i>Phacelia hastata</i>	Hydrophyllaceae	whiteleaf scorpionweed
<i>Phacelia linearis</i>	Hydrophyllaceae	threadleaf scorpionweed
<i>Erysimum asperum</i>	Brassicaceae	rough wallflower
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Phlox longifolia</i>	Polemoniaceae	longleaf phlox
<i>Cymopterus terebinthinus</i>	Apiaceae	turpentine springparsley
<i>Opuntia fragilis</i>	Cactaceae	brittle pricklypear
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Chrysothamnus viscidiflorus</i>	Asteraceae	green rabbitbrush
<i>Achillea millefolium</i>	Asteraceae	yarrow

Table 6-4. Species Observed Downstream from 100-D Area, Boat Launch to Midline Access Road, April 18 and May 20, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Agropyron caninum</i>	Poaceae	slender wheatgrass
<i>Oryzopsis hymenoides</i>	Poaceae	indian ricegrass
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Phalaris arundinacea</i>	Poaceae	reed canarygrass
<i>Poa pratensis</i>	Poaceae	Kentucky bluegrass
<i>Poa sandbergii</i>	Poaceae	Sandberg's bluegrass
<i>Juncus balticus</i>	Juncaceae	baltic rush
<i>Carex douglasii</i>	Cyperaceae	Douglas' sedge
<i>Carex aperta</i>	Cyperaceae	Columbia sedge
<i>Eleocharis palustris</i>	Cyperaceae	common spikerush
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbled mustard
<i>Rorippa curvisiliqua</i>	Brassicaceae	western yellowcress
<i>Draba verna</i>	Brassicaceae	spring whitlowgrass
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Lepidium virginicum</i>	Brassicaceae	tall pepperweed
<i>Marsilea vestita</i>	Marsileaceae	clover fern
<i>Equisetum arvense</i>	Equisetaceae	common horsetail
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Cirsium arvense</i>	Asteraceae	Canada thistle
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Xanthium strumarium</i>	Asteraceae	cocklebur
<i>Verbascum thapsus</i>	Scrophulariaceae	common mullein
<i>Collinsia parviflora</i>	Scrophulariaceae	small blue-eyed Mary
<i>Asparagus officinalis</i>	Liliaceae	asparagus

Table 6-4. Species Observed Downstream from 100-D Area, Boat Launch to Midline Access Road, April 18 and May 20, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Erodium cicutarium</i>	Geraniaceae	storksbill
<i>Amsinckia lycopsoides</i>	Boraginaceae	fiddleneck
<i>Myosotis micrantha</i>	Boraginaceae	blue forget-me-not
<i>Potentilla rivalis</i>	Rosaceae	brook cinquefoil
<i>Holosteum umbellatum</i>	Caryophyllaceae	jagged chickweed
<i>Psoralea lanceolata</i>	Fabaceae	dune scurfpea
<i>Lomatium grayi</i>	Apiaceae	Gray's desertparsley

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The area around river mile 376.25 is characterized by a relatively flat, cobble surface, with a large sand hill, approximately 3 meters tall and 100 meters long, located about 500 meters from the shoreline. The species list for this area is provided in Table 6-5. The sandhill itself is dominated by wheatgrass, with several individuals of giant wildrye. To the east of the sandhill, the community is dominated by Russian thistle, cheatgrass, tumbledustard, with very little else present. The area to the west of the sandhill is characterized by pockets of sedges, wheatgrass, cheatgrass, and tumbledustard. The Columbia tickseed is quite evident during the summer.

At river mile 376.0 the surface is relatively flat and rocky. The principal plant species are thickspike wheatgrass, sand dropseed, and diffuse knapweed. Cheatgrass and sedges dominate smaller areas. The species list for this area, designated as an *Agropyron dasytachyum/Sporobolus cryptandrus/Centaurea diffusa* community is provided in Table 6-6.

The river bends sharply to the east at approximately river mile 375.75. Several distinct communities can be delineated in this area. The plant list for the entire area is provided in Table 6-7. On the western half of this zone is an area consisting almost exclusively of diffuse knapweed. Just upriver from the knapweed community the surface is dominated by wheatgrass, and inland from both of these zones is a cheatgrass/Russian thistle community. Several sand mounds are located on the east side of the wheatgrass community. These mounds are dominated by giant wildrye and slimleaf goosefoot, with a lesser component of lupine (2 different species). The shoreline is dominated by reed canarygrass and bluegrass, with several small elms and white mulberries.

The next 0.5 mile stretch is also highly varied. The dominant feature is a backwash area that has standing water until mid summer. The soil substrate gradually changes from large cobbles at the south end of the backwash to smaller cobbles/sand farther east. At the east end of this section is a sand mound located approximately 25 meters from the shoreline. The overall plant species list for this section is provided in Table 6-8. A patch of willows dominates the mouth of the backwash, and little vegetation is present in the rest of the area having standing water. The edges of the standing water are dominated by sedges, bluegrass, and wheatgrass. At the south end of the backwash the large cobble surface is dominated by a mixture of sand dropseed and red three-awn. From the east side of the backwash to the sand mound the plant community is dominated by cheatgrass and sand dropseed. The mound itself is covered primarily with wheatgrass and Russian knapweed. Between the sand mound and the shoreline is a wetter, periodically saturated area with large components of horsetail, sedges, bluegrass, and yellow sweet clover.

From the sand mound to the east for 0.3 mile the community is primarily dominated by cheatgrass with a conspicuous Columbia daggerpod component. The daggerpod is common enough to delineate the area as a *Bromus tectorum/Lesquerella douglasii* community. Gray's deserts parsley is also very evident in this area. A complete species list is provided in Table 6-9. The next 0.25 mile is primarily cheatgrass and tumbledustard, with one conspicuous pocket of rabbitbrush at river mile 374.0. This entire stretch of the shoreline is relatively steep with a large cobble substrate. Very little vegetation is present in this section of the shoreline.

067514

Table 6-5. Species Observed 0.75 River Mile North of 100-D Area, Large Sand Hill and Vicinity, May 20, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Elymus cinereus</i>	Poaceae	giant wildrye
<i>Agropyron spicatum</i>	Poaceae	bluebunch wheatgrass
<i>Poa sandbergii</i>	Poaceae	Sandberg's bluegrass
<i>Poa nevadensis</i>	Poaceae	Nevada bluegrass
<i>Oryzopsis hymenoides</i>	Poaceae	indian ricegrass
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Holosteum umbellatum</i>	Caryophyllaceae	jagged chickweed
<i>Cerastium nutans</i>	Caryophyllaceae	nodding chickweed
<i>Coreopsis atkinsoniana</i>	Asteraceae	Columbia tickseed
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Gaillardia aristata</i>	Asteraceae	blanket flower
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Erigeron pumilus</i>	Asteraceae	shaggy fleabane
<i>Asclepias speciosa</i>	Asclepiadaceae	showy milkweed
<i>Lupinus lepidus</i>	Fabaceae	prairie lupine
<i>Amsinckia lycopsoides</i>	Boraginaceae	fiddleneck
<i>Asparagus officinalis</i>	Liliaceae	asparagus
<i>Marsilea vestita</i>	Marsileaceae	clover fern
<i>Erodium cicutarium</i>	Geraniaceae	storksbill

Table 6-5. Species Observed 0.75 Rivermile North of 100-D Area, Large Sand Hill and Vicinity, May 20, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Juncus balticus</i>	Juncaceae	baltic rush
<i>Carex douglasii</i>	Cyperaceae	Douglas' sedge

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Table 6-6. Species Observed 1.0 River Mile North of 100-D Area,
May 20, 1991.

Species	Family	Common name
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Poa bulbosa</i>	Poaceae	bulbous bluegrass
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Erigeron pumilus</i>	Asteraceae	shaggy fleabane
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Erodium cicutarium</i>	Geraniaceae	storksbill
<i>Asparagus officinalis</i>	Liliaceae	asparagus
<i>Lupinus lepidus</i>	Fabaceae	prairie lupine
<i>Carex douglasii</i>	Cyperaceae	Douglas' sedge
<i>Juncus balticus</i>	Juncaceae	baltic rush

Table 6-7. Species Observed 1.3 River Mile North of 100-D Area, at Bend in River, May 20, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Centaurea diffusa</i>	Asteraceae	tumble knapweed
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Xanthium strumarium</i>	Asteraceae	cocklebur
<i>Gaillardia aristata</i>	Asteraceae	blanket flower
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Oryzopsis hymenoides</i>	Poaceae	indian ricegrass
<i>Elymus cinereus</i>	Poaceae	giant wildrye
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Lupinus lepidus</i>	Fabaceae	prairie lupine
<i>Lupinus wyethii</i>	Fabaceae	Wyeth's lupine
<i>Psoralea lanceolata</i>	Fabaceae	dune scurfpea
<i>Lomatium grayi</i>	Apiaceae	Gray's desertparsley
<i>Lomatium macrocarpum</i>	Apiaceae	large-fruited lomatium
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Descurainia pinnata</i>	Brassicaceae	tansymustard
<i>Lesquerella douglasii</i>	Brassicaceae	Columbia bladderpod
<i>Microsteris gracilis</i>	Polemoniaceae	pink microsteris
<i>Amsinckia lycopsoides</i>	Boraginaceae	fiddleneck
<i>Myosotis micrantha</i>	Boraginaceae	blue forget-me-not
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot
<i>Erodium cicutarium</i>	Geraniaceae	storksbill

Table 6-7. Species Observed 1.3 River Mile North of 100-D Area, at Bend in River, May 20, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Asparagus officinalis</i>	Liliaceae	asparagus
<i>Equisetum arvense</i>	Equisetaceae	common horsetail
<i>Asclepias speciosa</i>	Asclepiadaceae	showy milkweed
<i>Rosa woodsii</i>	Rosaceae	Wood's rose
<i>Carex</i> spp.	Cyperaceae	Douglas' sedge

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Table 6-8. Species Observed at Vicinity of Inlet at Top of Reach, to Sand Mound, May 23, 1991. (sheet 1 of 3)

Species	Family	Common name
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Agropyron spicatum</i>	Poaceae	bluebunch wheatgrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Poa pratensis</i>	Poaceae	Kentucky bluegrass
<i>Poa sandbergii</i>	Poaceae	Sandberg's bluegrass
<i>Poa nevadensis</i>	Poaceae	Nevada bluegrass
<i>Aristida longiseta</i>	Poaceae	red three-awn
<i>Phalaris arundinacea</i>	Poaceae	reed canarygrass
<i>Koeleria cristata</i>	Poaceae	prairie Junegrass
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Solidago occidentalis</i>	Asteraceae	western goldenrod
<i>Machaeranthera canescens</i>	Asteraceae	hoary aster
<i>Centaurea diffusa</i>	Asteraceae	tumble knapweed
<i>Centaurea repens</i>	Asteraceae	Russian knapweed
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Artemisia dracunculus</i>	Asteraceae	tarragon
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Gaillardia aristata</i>	Asteraceae	blanket flower
<i>Chaenactis douglasii</i>	Asteraceae	hoary falseyarrow
<i>Xanthium strumarium</i>	Asteraceae	cocklebur
<i>Erigeron poliospermus</i>	Asteraceae	cushion fleabane
<i>Cirsium arvense</i>	Asteraceae	Canada thistle
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Lesquerella douglasii</i>	Brassicaceae	Columbia bladderpod

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Table 6-8. Species Observed at Vicinity of Inlet at Top of Reach, to Sand Mound, May 23, 1991. (sheet 2 of 3)

Species	Family	Common name
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Draba verna</i>	Brassicaceae	spring whitlowgrass
<i>Rorippa columbiae</i>	Brassicaceae	Columbia yellowcress
<i>Medicago lupulina</i>	Fabaceae	black medick
<i>Lupinus lepidus</i>	Fabaceae	prairie lupine
<i>Lupinus sericeus</i>	Fabaceae	silky lupine
<i>Equisetum arvense</i>	Equisetaceae	common horsetail
<i>Equisetum</i> spp.	Equisetaceae	horsetail
<i>Amsinckia lycopoides</i>	Boraginaceae	fiddleneck
<i>Myosotis micrantha</i>	Boraginaceae	blue forget-me-not
<i>Verbascum thapsus</i>	Scrophulariaceae	common mullein
<i>Collinsia parviflora</i>	Scrophulariaceae	small blue-eyed Mary
<i>Veronica anagallis-aquatica</i>	Scrophulariaceae	water speedwell
<i>Eriogonum compositum</i>	Polygonaceae	northern buckwheat
<i>Rumex crispus</i>	Polygonaceae	curly dock
<i>Ranunculus testiculatus</i>	Ranunculaceae	bur buttercup
<i>Collomia linearis</i>	Polemoniaceae	narrowleaf collomia
<i>Microsteris gracilis</i>	Polemoniaceae	pink microsteris
<i>Holosteum umbellatum</i>	Caryophyllaceae	jagged chickweed
<i>Verbena bracteata</i>	Verbenaceae	bracted verbena
<i>Marsilea vestita</i>	Marsileaceae	clover fern
<i>Cleome lutea</i>	Capparidaceae	yellow bee-plant
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Lomatium grayi</i>	Apiaceae	Gray's desertparsley
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Juncus tenuis</i>	Juncaceae	slender rush
<i>Juniperus scopulorum</i>	Cupressaceae	Rocky Mountain juniper
<i>Erodium cicutarium</i>	Geraniaceae	storksbill

Table 6-8. Species Observed at Vicinity of Inlet at Top of Reach, to Sand Mound, May 23, 1991. (sheet 3 of 3)

Species	Family	Common name
<i>Rosa woodsii</i>	Rosaceae	Wood's rose
<i>Cyperus aristatus</i>	Cyperaceae	awned flatsedge
<i>Salix</i> spp.	Salicaceae	willow
<i>Allium robinsonii</i>	Liliaceae	Robinson's onion
<i>Asparagus officinalis</i>	Liliaceae	asparagus

spp. = species, more than one.

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Table 6-9. Species Observed Upstream from Trees to Sand Mound at Top of Reach, April 18 and May 22, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Artemisia dracunculus</i>	Asteraceae	tarragon
<i>Artemisia ludoviciana</i>	Asteraceae	prairie sagebrush
<i>Centaurea diffusa</i>	Asteraceae	tumble knapweed
<i>Centaurea repens</i>	Asteraceae	Russian knapweed
<i>Cirsium arvense</i>	Asteraceae	Canada thistle
<i>Erigeron poliospermus</i>	Asteraceae	cushion fleabane
<i>Erigeron filifolius</i>	Asteraceae	threadleaf fleabane
<i>Gaillardia aristata</i>	Asteraceae	blanket flower
<i>Machaeranthera canescens</i>	Asteraceae	hoary aster
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Taraxacum officinale</i>	Asteraceae	dandelion
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Elymus cinereus</i>	Poaceae	giant wildrye
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Agropyron spicatum</i>	Poaceae	bluebunch wheatgrass
<i>Poa sandbergii</i>	Poaceae	Sandberg's bluegrass
<i>Stipa comata</i>	Poaceae	needle-and-thread grass
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbled mustard
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Lesquerella douglasii</i>	Brassicaceae	Columbia bladderpod
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Lepidium densiflorum</i>	Brassicaceae	prairie pepperweed
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow

Table 6-9. Species Observed Upstream from Trees to Sand Mound at Top of Reach, April 18 and May 22, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Asparagus officinalis</i>	Liliaceae	asparagus
<i>Lomatium grayi</i>	Apiaceae	Gray's desertparsley
<i>Erodium cicutarium</i>	Geraniaceae	storksbill
<i>Verbascum thapsus</i>	Scrophulariaceae	common mullein
<i>Equisetum arvense</i>	Equisetaceae	common horsetail
<i>Juniperus scopulorum</i>	Cupressaceae	Rocky Mountain juniper
<i>Eriogonum compositum</i>	Polygonaceae	northern buckwheat
<i>Lupinus wyethii</i>	Fabaceae	Wyeth's lupine
<i>Lupinus lepidus</i>	Fabaceae	prairie lupine

6.1.4 100-H Area

Two stands of trees occur at river miles 373.75 and 373.0. The plant species lists for these two stands are provided in Tables 6-10 and 6-12, respectively. The species present in the area between the stands of trees is provided in Table 6-11. The trees themselves are mostly black locust. The plant community within the stands of trees is best described as weedy. The dominant understory species is cheatgrass, with major components of flixweed in the upstream stand and tumbledustard in the downstream stand. Between the stands of trees is a cheatgrass/tumbledustard community with several large giant wildrye individuals. The shoreline in this area is dominated by reed canarygrass and bluegrass, with numerous white mulberries and several golden currant bushes at the downstream stand of trees.

Between the downstream stand of trees and the 100-H Area the community is primarily rabbitbrush and cheatgrass. Sand dropseed is prevalent adjacent to the roads. The shoreline is steeply sloped and dominated by reed canarygrass and bluegrass, with several white mulberries and golden currants. A species list is provided in Table 6-13.

There are no fences remaining around the 100-H Area, but most of the area that was included in the exclusion zone is highly disturbed, with many burial grounds, cribs, and old building sites evident. Much of the area is dominated by gray rabbitbrush and cheatgrass. The roadways are lined with sand dropseed and Russian thistle.

6.2 THREATENED AND ENDANGERED PLANT SPECIES

There are 12 species known to occur on or near the Hanford Site that are listed by the Washington State Natural Heritage Program (1990) as endangered, threatened, or sensitive. These species are listed in Table 6-14. The two state endangered and the two state threatened species on this list are also listed as candidates for federal protection under the *Endangered Species Act of 1973*. Special emphasis was placed on the search for all 12 species while conducting the community delineation and species inventory field work. In addition to these 12 species, 3 additional state sensitive species were reported by St. John and Jones (1928), and ERDA (1975) to occur in the local vicinity, but no recent collections of these species have been made. These species are *Astragalus arrectus*, *Nicotiana attenuata*, and *Collinsia sparsiflora* var. *bruciae*. An assessment of the impacts of characterization activities on threatened, endangered, and sensitive plant species is available in Sackschewsky (1991).

The persistent sepal yellowcress is found along the Hanford Reach from the Vernita bridge to the 300 Area (Sauer and Leder 1985). During the FY 1991 field surveys, it was located in the vicinity of 100-B Area, about 2 miles north of 100-D Area, and at the Hanford townsite. In the past it has been found near 100-D Area, White Bluffs, and on many of the Columbia River islands.

The southern mudwort and the false pimpinell were also located in the wetland area just west of the 100-B Area during the FY 1991 field activities. Although not positively identified during FY 1991, the dense sedge and the

Table 6-10. Species Observed Upstream of Stand of Trees,
May 23 and July 19, 1991.

Species	Family	Common name
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Elymus cinereus</i>	Poaceae	giant wildrye
<i>Phalaris arundinacea</i>	Poaceae	reed canarygrass
<i>Hordeum glaucum</i>	Poaceae	seagreen barley
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Descurainia sophia</i>	Brassicaceae	flixweed
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Rorippa obtusa</i>	Brassicaceae	bluntleaf yellowcress
<i>Rorippa curvisiliqua</i>	Brassicaceae	western yellowcress
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Centaurea repens</i>	Asteraceae	Russian knapweed
<i>Artemisia ludoviciana</i>	Asteraceae	prairie sagebrush
<i>Amsinckia lycopsoides</i>	Boraginaceae	fiddleneck
<i>Robinia psuedo-acacia</i>	Fabaceae	black locust
<i>Morus alba</i>	Moraceae	white mulberry
<i>Prunus armeniaca</i>	Rosaceae	apricot
<i>Hypericum perforatum</i>	Hypericaceae	Klamath weed
<i>Gilia minutiflora</i>	Polemoniaceae	smallflower gilia
<i>Polemonium micranthum</i>	Polemoniaceae	annual Jacob's ladder
<i>Polygonum convolvulus</i>	Polygonaceae	climbing bindweed
<i>Allium cernuum</i>	Liliaceae	nodding onion

Table 6-11. Species Observed at Area Between Stands of Trees, Northwest of 100-H Area, April 18 and May 23, 1991.

Species	Family	Common name
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Elymus cinereus</i>	Poaceae	giant wildrye
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Phalaris arundinacea</i>	Poaceae	reed canarygrass
<i>Solidago occidentalis</i>	Asteraceae	western goldenrod
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Chrysothamnus viscidiflorus</i>	Asteraceae	green rabbitbrush
<i>Centaurea diffusa</i>	Asteraceae	tumble knapweed
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Descurainia sophia</i>	Brassicaceae	flixweed
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot
<i>Chenopodium album</i>	Chenopodiaceae	lamb's quarters
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Sphaeralcea munroana</i>	Malvaceae	Munro's globemallow
<i>Morus alba</i>	Moraceae	white mulberry
<i>Cleome lutea</i>	Capparidaceae	yellow bee-plant
<i>Verbena bracteata</i>	Verbenaceae	bracted verbena
<i>Amsinckia tessellata</i>	Boraginaceae	devil's lettuce
<i>Plantago patagonica</i>	Plantaginaceae	indian wheat

Table 6-12. Species Observed Downstream of Stand of Trees, Northwest of 100-H Area, May 23, 1991.

Species	Family	Common name
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Robinia pseudo-acacia</i>	Fabaceae	black locust
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Descurainia sophia</i>	Brassicaceae	flixweed
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Chrysothamnus viscidiflorus</i>	Asteraceae	green rabbitbrush
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Solidago occidentalis</i>	Asteraceae	western goldenrod
<i>Holosteum umbellatum</i>	Caryophyllaceae	jagged chickweed
<i>Ribes aureum</i>	Grossulariaceae	golden currant
<i>Grayia spinosa</i>	Chenopodiaceae	spiny hopsage
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Chenopodium leptophyllum</i>	Chenopodiaceae	slimleaf goosefoot

Table 6-13. Species Observed at 100-H Reactor to Downstream Stand of Trees, April 18 and July 9, 1991. (sheet 1 of 2)

Species	Family	Common name
<i>Phalaris arundinacea</i>	Poaceae	reed canarygrass
<i>Sporobolus cryptandrus</i>	Poaceae	sand dropseed
<i>Bromus tectorum</i>	Poaceae	cheatgrass
<i>Agropyron dasytachyum</i>	Poaceae	thickspike wheatgrass
<i>Agrostis alba</i>	Poaceae	redtop bentgrass
<i>Lactuca serriola</i>	Asteraceae	prickly lettuce
<i>Xanthium strumarium</i>	Asteraceae	cocklebur
<i>Artemisia campestris</i>	Asteraceae	Pacific sage
<i>Artemisia tridentata</i>	Asteraceae	big sagebrush
<i>Chrysothamnus nauseosus</i>	Asteraceae	gray rabbitbrush
<i>Achillea millefolium</i>	Asteraceae	yarrow
<i>Taraxacum officinale</i>	Asteraceae	dandelion
<i>Tragopogon dubius</i>	Asteraceae	yellow salsify
<i>Cirsium arvense</i>	Asteraceae	Canada thistle
<i>Coreopsis atkinsoniana</i>	Asteraceae	Columbia tickseed
<i>Heterotheca villosa</i>	Asteraceae	hairy golden-aster
<i>Melilotus alba</i>	Fabaceae	white sweetclover
<i>Dianthus armeria</i>	Caryophyllaceae	grass pink
<i>Holosteum umbellatum</i>	Caryophyllaceae	jagged chickweed
<i>Verbascum thapsus</i>	Scrophulariaceae	common mullein
<i>Collinsia parviflora</i>	Scrophulariaceae	small blue-eyed Mary
<i>Rorippa islandica</i>	Brassicaceae	marsh yellowcress
<i>Draba verna</i>	Brassicaceae	spring whitlowgrass
<i>Lepidium perfoliatum</i>	Brassicaceae	clasping pepperweed
<i>Descurainia pinnata</i>	Brassicaceae	western tansymustard
<i>Sisymbrium altissimum</i>	Brassicaceae	Jim Hill's tumbledustard
<i>Montia perfoliata</i>	Portulacaceae	miner's lettuce
<i>Morus alba</i>	Moraceae	white mulberry

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Table 6-13. Species Observed at 100-H Reactor to Downstream Stand of Trees, April 18 and July 9, 1991. (sheet 2 of 2)

Species	Family	Common name
<i>Microsteris gracilis</i>	Polemoniaceae	pink microsteris
<i>Ribes aureum</i>	Grossulariaceae	golden currant
<i>Rosa woodsii</i>	Rosaceae	Wood's rose
<i>Salsola kali</i>	Chenopodiaceae	Russian thistle
<i>Cymopterus terebinthinus</i>	Apiaceae	turpentine springparsley
<i>Lomatium grayi</i>	Apiaceae	Gray's desertparsley
<i>Lycium halimifolium</i>	Solanaceae	matrimony vine
<i>Carex</i> spp.	Cyperaceae	sedge
<i>Juncus</i> spp.	Juncaceae	baltic rush
<i>Equisetum</i> spp.	Equisetaceae	horsetail
<i>Salix</i> spp.	Salicaceae	willow

spp. = species, more than one.

Table 6-14. Hanford Site Endangered, Threatened, and Sensitive Plant Species.^a

Scientific name	Common name	Family	Washington state status
<i>Rorippa columbiae</i> ^b Suksd. ex Howell	persistent sepal yellowcress	Brassicaceae	Endangered
<i>Artemisia campestris</i> L ssp. <i>borealis</i> (Pall.) Hall & Clem. var. <i>wormskioldii</i> ^b (Bess.) Cronq.	northern wormwood	Asteraceae	Endangered
<i>Astragalus columbianus</i> ^b Barneby	Columbia milk- vetch	Fabaceae	Threatened
<i>Lomatium tuberosum</i> ^b Hoover	Hoover's desert- parsley	Apiaceae	Threatened
<i>Cryptantha interrupta</i> (Greene)Pays.	bristly cryptantha	Boraginaceae	Sensitive
<i>Cryptantha leucophaea</i> Dougl. Pays	gray cryptantha	Boraginaceae	Sensitive
<i>Erigeron piperianus</i> Cronq.	Piper's daisy	Asteraceae	Sensitive
<i>Carex densa</i> L.H. Bailey	dense sedge	Cyperaceae	Sensitive
<i>Cyperus rivularis</i> Kunth	shining flatsedge	Cyperaceae	Sensitive
<i>Oenothera pygmaea</i>	dwarf evening primrose	Onagraceae	Sensitive
<i>Limosella acaulis</i> Ses.& Moc.	southern mudwort	Scrophulariaceae	Sensitive
<i>Lindernia anagallidea</i> (Michx.)Pennell	false pimpernel	Scrophulariaceae	Sensitive

^aAll of these species have been reported on or near the Hanford Site.

^bIndicates candidates on the 1990 Federal Register, Notice of Review.

shining flatsedge have been previously located in this same wetland habitat. The southern mudwort has also been previously located in the vicinity of 100-K Area. All four of these species could be found at a number of other locations along the Hanford Reach.

The gray cryptantha was observed in the dunes area to the east of the 100-D Area. This species is usually found among sand dunes, especially south of the Hanford townsite.

None of the other threatened, endangered, or sensitive plant species were observed in the 100 Areas during FY 1991. The bristly cryptantha and the dwarf evening primrose occur in Franklin County directly across the river from the 300 Area. Piper's daisy occurs on Umtanum Ridge on the western edge of the Hanford Site and was found during FY 1991 in the vicinity of B-Pond near the 200 East Area. Piper's daisy has been reported near 100-H Reactor. The Columbia milkvetch is found on the Yakima Firing Range and has been found on both sides of Umtanum Ridge just west of the Hanford Site. The bristly cryptantha, dwarf evening primrose, Piper's daisy, and the Columbia milkvetch could inhabit certain communities in the 100 Areas. Hoover's desert parsley inhabits steep talus slopes near Priest Rapids Dam at the western edge of the Hanford Site. It is not expected to be found in the 100 Areas.

The northern wormwood is one of the rarest plant taxa in the state of Washington. It is known from only two populations, both near the Columbia River. One population is near The Dalles Dam, and the other is located near Beverly, Washington, approximately 10 miles northeast of the Vernita bridge. Many plant communities along the Columbia River on the Hanford Site resemble those near Beverly, Washington. Because of the proximity of one of the known populations to the Hanford Site, the similarity of habitat, and the extreme rarity of the taxa, special emphasis has been placed on locating any populations of northern wormwood that may occur on the Hanford Site. As yet, no populations of the northern wormwood (*Artemisia campestris wormskioldii*) have been found on the Hanford Site; however, another variety of the same species (*Artemisia campestris scouleriana*) is common on the Hanford Site and occurs sympatrically with the population of var. *wormskioldii* near Beverly, Washington.

6.3 OTHER SPECIES OF INTEREST

Several plant groups are of interest in the course of these investigations because of the possibilities for short or direct pathways to man of radionuclides. The three monitored during FY 1991 were reed canarygrass, asparagus, and trees. The methods and results of direct vegetation sampling for radionuclides are provided in Section 6.0 of this report.

If radionuclides are taken up by plants, they could eventually reach the human population. This may result from direct consumption of contaminated plants by man, or indirectly through human consumption of animals that have eaten the contaminated vegetation. Direct pathways to man are possible through plants such as asparagus and mulberries. Indirect pathways can result

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from human consumption of deer or rabbits that have consumed contaminated asparagus, from deer that have consumed mulberries, or geese that have consumed reed canarygrass.

Besides asparagus and mulberries, there are at least 45 additional plant genera and/or species on the Hanford Site that can be considered edible (Table 6-15). Most of these species are known to exist in 100 Areas of the Hanford Site. There are probably a number of additional species that could be added to this list. Admittedly, some of these plants may not appear particularly appetizing, but they have been used as food sources by other cultures. The most highly sought after vegetation are asparagus and the fruits from the abandoned apple, pear, peach and apricot orchards along the Columbia River as well as the various berries. Most of the other species would only be sought by experienced natural-food enthusiasts. Soldat et al. (1990) have considered wild edible plants in evaluating potential radiation doses to people harvesting plants and wildlife in the 100 Areas.

The basic distributions of trees, asparagus, and reed canarygrass were determined in the 100-BC-5 and 100-HR-3 operable units during FY 1991. Reed canarygrass is extremely common all along the shore of the Columbia River. At many locations it can be considered the dominant species of shoreline vegetation. Asparagus is also widely distributed. It is normally represented by widely scattered clumps, and with one known exception does not constitute a major or dominant component of any community. The one exception is in a wet, muddy stand opposite the island just downstream from 100-D Area. At this particular 20 meter by 20 meter area, the vegetation is composed almost entirely of asparagus. Elsewhere, it inhabits a variety of soil substrates and levels of soil moisture and is found in most all communities between 100-D and 100-H Areas.

Trees along the shoreline were individually mapped from approximately 0.5 mile south of 100-H Area to the "bench" below 100-D Area, and from approximately 0.5 mile on each side of 100-B Area. The most prevalent species in the 100-HR-3 operable unit is white mulberry, with two major stands of black locust and one major stand of Siberian elms (below 100-D Area). Elms also occur scattered along the shore at a number of locations in both the 100-HR-3 and 100-BC-5 operable units. Other species observed in the 100-HR-3 region include golden currants, apricots, junipers, and willows. Upstream from the 100-B Area the most common tree is the willow, with a few scattered elms and white mulberries. There are relatively few trees downstream from 100-B Area; those present are evenly represented by white mulberry, elm, willow, and juniper. Shoreline maps showing the location and identity of all trees in the 100-HR-3 and 100-BC-5 operable units have been archived in field logbook #WHC-N-534.

Table 6-15. Hanford Site Edible Plants. (sheet 1 of 2)

Scientific name	Common name	Plant parts used
<i>Amaranthus</i> spp.	amaranth, pigweed	leaves, seeds
<i>Balsamorhiza</i> spp.	balsamroot	whole plant
<i>Galium aparine</i>	cleavers	shoots, seeds
<i>Lomatium</i> spp. ^a	biscuitroot	roots, seeds
<i>Rubus</i> spp.	blackberry, raspberry	fruits
<i>Pteridium aquilinum</i>	bracken fern	young leaves
<i>Orobanche</i> spp.	broomrape	whole plant
<i>Scirpus</i> spp. ^a	bulrush	roots, shoots, pollen, seeds
<i>Typha</i> spp. ^a	cattail	pollen, roots
<i>Cichorium intybus</i> ^a	chicory	leaves, roots
<i>Prunus</i> spp. ^a	cherries, peaches, etc.	fruit
<i>Pyrus</i> spp. ^a	pear, apple	fruit
<i>Rosa</i> spp. ^a	rose	rosehips, flowers
<i>Taraxacum officinale</i> ^a	dandelion	leaves, roots, flowers
<i>Rumex</i> spp. ^a	dock, sorrel	leaves
<i>Sambucus</i> spp.	elderberry	fruits
<i>Oenothera</i> spp. ^a	evening primrose	young roots
<i>Epilobium angustifolium</i>	fireweed	young shoots and leaves
<i>Ribes</i> spp. ^a	gooseberry, currant	fruit
<i>Crataegus</i> spp.	hawthorn	fruit
<i>Castilleja</i> spp.	indian paintbrush	flowers
<i>Aquilegia</i> spp.	columbine	flowers
<i>Juniperus</i> spp. ^a	juniper	"berries"
<i>Chenopodium album</i> ^a	lamb's quarters	leaves, young stems
<i>Calochortus</i> spp.	mariposa lily	bulbs
<i>Montia perfoliata</i> ^a	miner's lettuce	leaves
<i>Mentha</i> spp.	mint	leaves

spp. = species, more than one.

Table 6-15. Hanford Site Edible Plants. (sheet 2 of 2)

Scientific name	Common name	Plant parts used
<i>Allium</i> spp. ^a	onion	bulbs
<i>Lepidium</i> spp. ^a	clasping pepperweed	fruits, seeds
<i>Capsella bursa-pastoris</i> ^a	shepherd's purse	leaves, seeds
<i>Plantago</i> spp. ^a	plantain	leaves
<i>Opuntia</i> spp. ^a	prickly pear	fruits, stems
<i>Portulaca oleracea</i> ^a	common purslane	leaves, stems
<i>Tragopogon</i> spp. ^a	salsify, goatsbeard	roots
<i>Atriplex</i> spp.	saltbush	seeds
<i>Amelanchier</i> spp.	serviceberry	fruits
<i>Asclepias speciosa</i> ^a	showy milkweed	flowers, shoots
<i>Veronica americana</i> ^a	brooklime	leaves, stems
<i>Helianthus annuus</i>	common sunflower	seeds
<i>Cirsium</i> spp. ^a	thistle	peeled stems, roots
<i>Vicia</i> spp. ^a	vetch	fruits
<i>Asparagus officinalis</i> ^a	asparagus	young shoots
<i>Lactuca serriola</i> ^a	prickly lettuce	young leaves
<i>Morus alba</i> ^a	white mulberry	fruit
<i>Juglans nigra</i> ^a	black walnut	nuts
<i>Salix</i> spp. ^a	willow	bark, leaves
<i>Rorippa nasturtium-aquaticum</i> ^a	watercress	leaves
<i>Apocynum sibericum</i> ^a	indian hemp	bark
<i>Achillea millefolium</i> ^a	yarrow	leaves

^aIndicates species known to exist in the 100 Areas.
spp. = species, more than one.

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7.0 VEGETATION SAMPLING

Vegetation samples (reed canarygrass and tree leaves) were collected at seven sites associated with the operable units. Asparagus samples were also collected as close as possible to the sites where grass and tree leaves were collected. All of the vegetation samples were sent to an offsite laboratory for radionuclide and inorganic constituents analysis. Details of these sampling efforts are given below.

7.1 ASPARAGUS

Asparagus was collected during April 1991 at the sites depicted in Figure 7-1. A duplicate sample was collected at Site B. Control samples were collected above Vernita bridge and at Horn Rapids on the Yakima River. One-gallon-sized resealable freezer bags were filled as full as possible and placed on ice. Labels that included the sample number, time of collection and date were put on every bag. Wet weights were recorded, and the samples were kept frozen until they were shipped to an offsite laboratory. The samples are to be analyzed for total gamma radiation, strontium-90, technetium-99, and total CLP (e.g., chromium, copper, lead and iron).

7.2 REED CANARYGRASS AND TREE LEAVES

Reed canarygrass and tree leaves were collected during July, 1991 at all seven sites. The seven sites are (1) Site A - Control site above Vernita bridge, (2) Site B - Downriver from 100-D Reactor, (3) Site C - Bend in the river between 100-D and 100-H Reactors, (4) Site D - Below 100-H Reactor, (5) Site E - White Bluffs ferry landing, (6) Site F - Below 100-BC Reactor, Coyote Rapids, and (7) Site G - Above 100-H Reactor .5 mile. Site locations were chosen to correspond with the same locations where the periphyton and macroinvertebrate sampling effort was conducted (Figure 7-2). Six samples of reed canarygrass and two samples of tree leaves were collected at every site. Samples were collected at each site following a protocol identical to that described in EII 5.3 (WHC 1991b). A duplicate sample was collected at Site B. Samples of reed canarygrass were collected from locations 50 meters apart. Labels giving the sample number, time of collection, and date were placed on every bag. Wet weights of both grass and tree leaves were recorded. Tree leaves were first placed in plastic bags and then placed in paper bags before being stored on ice. All of the samples were sent to an offsite laboratory where they are being analyzed for the same constituents as the asparagus. The tree leaves are also being analyzed for tritium.

Figure 7-1. Sample Locations (A) for Asparagus Samples.

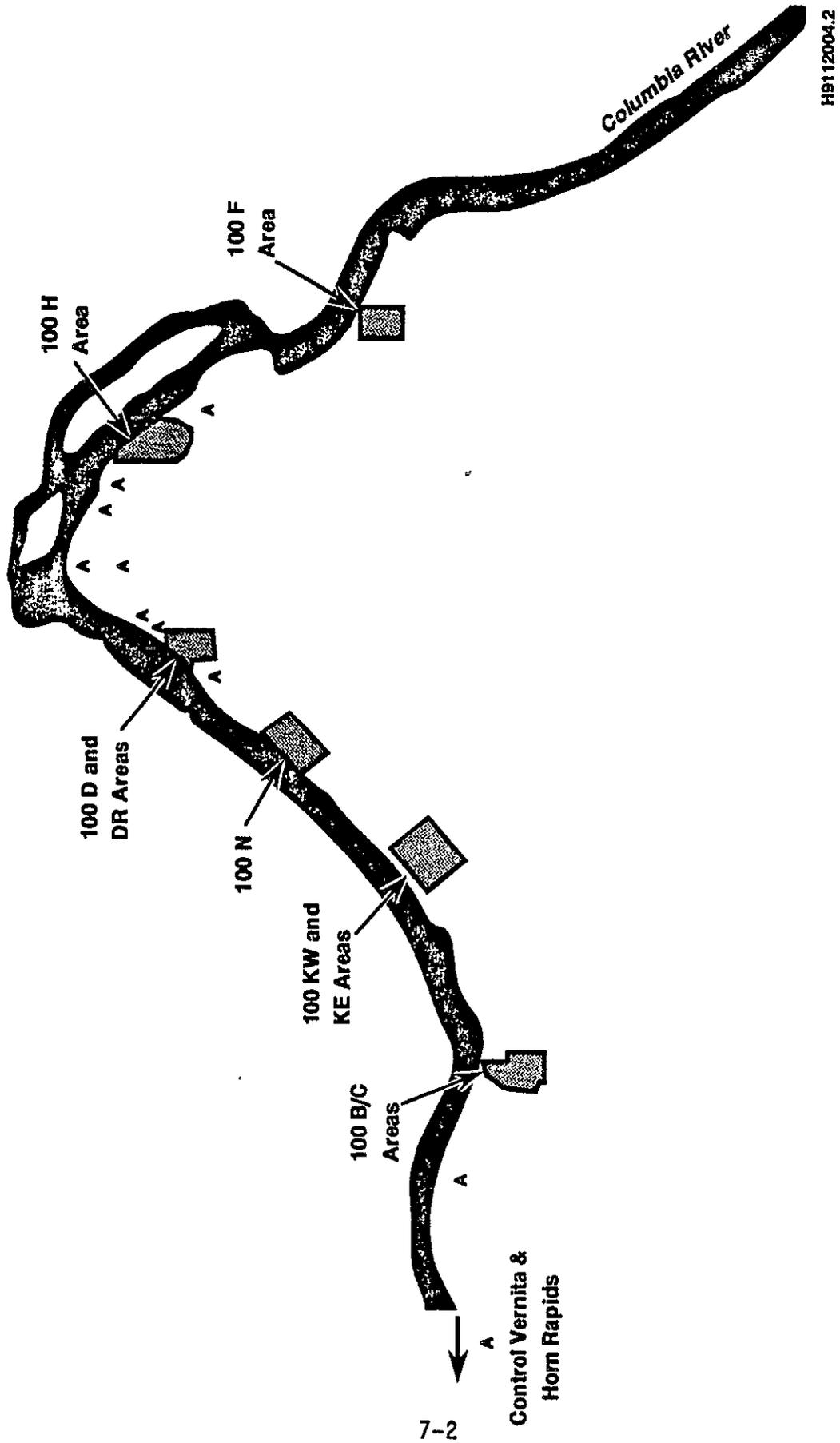
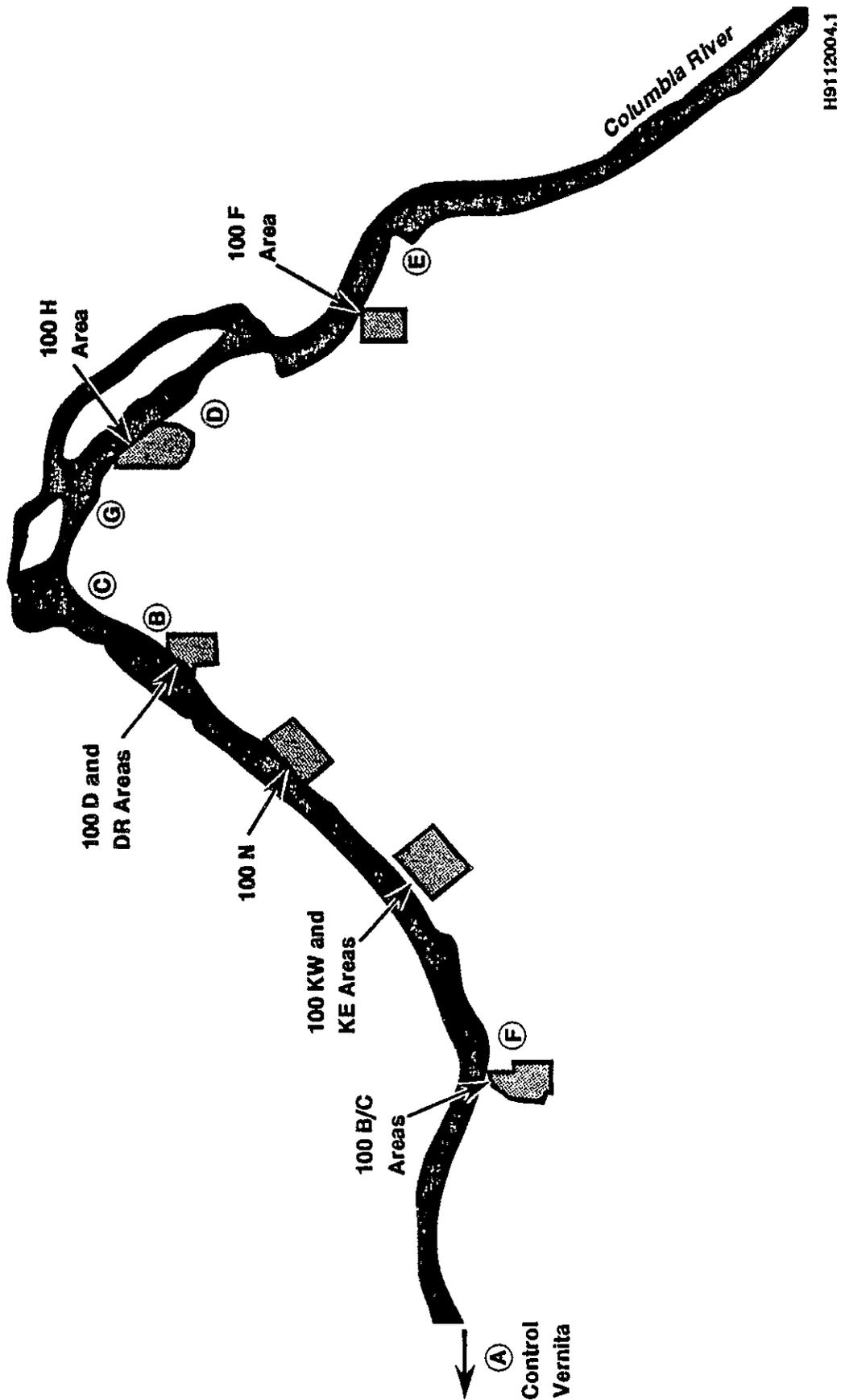


Figure 7-2. Sample Locations for Tree Leaf and Grass Samples.



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