

**INTEGRATED WEED MANAGEMENT
LICENSE ARTICLE 410 AND USFS 4E CONDITION 18**



Submitted to:
**PUBLIC UTILITY DISTRICT NO. 1
OF PEND OREILLE COUNTY
Newport, Washington**



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Box Canyon Project Integrated Weed Management Plan

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Section 1

Introduction

This document presents the Integrated Weed Management plan (IWMP) to be implemented by the Public Utility District No.1 of Pend Oreille County (District) in compliance with its license¹ for the Box Canyon Hydroelectric Project (Project), FERC No. 2042. The goal of the IWMP is the minimization or eradication of noxious weed occurrences on District or USFS-managed lands affected by the Box Canyon Project and/or related to compliance activities under the Project license. This plan is meant to ensure that the District's activities with respect to noxious weeds are consistent with The Record of Decision for the Pacific Northwest Region Invasive Plant Program--Preventing and Managing Invasive Plants (USFS 2005). This document adds invasive plant management direction to all National Forest Land and Resource Management Plans in the Pacific Northwest Region (Region 6). The management direction includes invasive plant prevention and treatment/restoration standards intended to help achieve stated desired future conditions, goals and objectives on National Forest System (NFS) lands. This is expected to result in decreased rates of spread of invasive plants, while protecting human health and the environment from the adverse effects of invasive plant treatment

The IWMP defines District policy regarding noxious weed prevention and management. The geographic scope of the IWMP includes all District-owned lands and NFS lands affected by the Project, as well as all lands subject to District license compliance activities. Any measures undertaken with respect to noxious weeds will be coordinated by District staff with other resource protection efforts and will, in particular, take into account the need to prevent disturbance to any known cultural resources, and to take appropriate actions in the event of unanticipated discovery of cultural materials.

For the purposes of the IWMP, noxious weeds are defined as all non-aquatic species listed under WAC 16-750 and included on the annual Pend Oreille County Noxious Weed Control Board (POCNWCB) Noxious Weed List. Management of aquatic plants in the Project area, including Eurasian watermilfoil (*Myriophyllum spicatum*), is addressed under a separate Aquatic Vegetation Management Plan.

The IWMP includes four components: noxious weed prevention, surveys and monitoring, management, and reporting. Tasks and activities in support of each component are described below.

¹ 112 FERC 61,055 issued July 11, 2005, Article 410 and USDA Forest Service (USFS) 4(e) Condition No. 18, included in Appendix B.

Section 2

Noxious Weed Prevention

2.1 Education

The District will initiate efforts to educate its employees as to the need for prevention, early detection, and control of noxious weed infestations. District employees will receive annual employee awareness training, addressing at minimum the following topics:

- District noxious weed policy, especially as relating to vehicle use.
- Environmental and economic impacts of noxious weeds.
- Recognition of key noxious weeds (common species and new invaders).
- Noxious weed reporting procedures, and name of responsible District staff.

During relicensing efforts, the District provided to the POCNWCB 500 copies of a field guide describing noxious weeds of Pend Oreille County for use in its educational efforts. The District will continue to support educational efforts regarding noxious weeds, including at minimum the following:

- Annual distribution of POCNWCB-prepared noxious weed brochures in customer billings.
- Funding for and maintenance of noxious weed educational signs at all Project Area USFS campgrounds.
- Funding for up to 1000 additional field guides to the noxious weeds of Pend Oreille County.

2.2 Equipment and Vehicles

Vehicles are a common vector of noxious weed dispersal, and simple vehicle cleaning methods have been found to slow dispersal for many noxious weed species. District policy will be for operators (whether District personnel or contractors) of vehicles and equipment to wash their vehicle after any off-highway use. This policy will be included as a written obligation when hiring contractors. In addition, all District vehicles will be supplied with a field guide to noxious weeds, for reference in weed identification.

2.3 Fill and Spoils

Fill used as part of Project operations or license compliance activities will either be from material available on site, or off-site fill certified to be free of noxious weed propagules. If created, spoils will be disposed of on-site, graded to match surrounding contours, and reseeded with a seed mix that is certified as prohibited and restricted noxious weed free for the State of Washington. Larger quantities of spoils will be land-filled according to local, county, and state regulations.

2.4 Ground-Disturbing Activities

The District will continue to engage in construction and maintenance activities as needed for normal Project operations, including vegetation management and erosion control work. However, all ground disturbing activities conducted as part of Project operations or license compliance activities will be planned and conducted in a manner as to prevent noxious weed infestations, including compliance with USFS noxious weed prevention guidelines where activities are conducted on NFS lands (USFS 1999).

All project plans will emphasize minimization of ground disturbance, and require that any disturbed areas be revegetated with a mix of shrubs and grasses approved in advance by the Colville National Forest (Appendix A) and POCNWCB. Revegetation efforts will be conducted during an appropriate season (usually spring), and monitored at least annually. Objectives and minimum requirements for revegetation will be those defined by the Colville National Forest. Failed revegetation efforts will be refined and repeated; definitions of failure will be project-specific and determined by the Box Canyon Habitat Subcommittee (BCHS) and the USFS for NFS lands. Appropriate erosion control measures (e.g., geotextiles or wattles) will be installed in disturbed areas until revegetation is complete.

Section 3

Noxious Weed Surveys and Monitoring

The IWMP will rely on field surveys to ascertain the extent, distribution, and species composition of noxious weed infestations. Initially, all lands addressed by the IWMP will be surveyed annually for noxious weeds. Survey frequency of some properties or infestations may be reduced at a future date as agreed to by the District and the Technical Committee. Surveyors will record noxious weed species composition, location, and relative abundance on each property, including GPS coordinates documenting the boundaries of infestations of high-priority weeds, if present. Methods for field surveys on National Forest System lands will meet USFS protocols. Surveys will collect all data required to meet FS standards described in the Invasive Plants Field Form (USFS 2006).

Species newly located during surveys will be managed within the broad guidelines described below (see Section 4.1), as well as under site-specific direction that will be modified annually as conditions change (see Section 4.2). Infestations located during previous surveys will be revisited over time as part of monitoring protocols.

For known noxious weed occurrences, monitoring efforts will consist of the annual noxious weed survey, which provides general information on noxious weed distributions and the efficacy of management. More intensive monitoring will be implemented for eradication efforts or other management of high-priority weeds. Monitoring intensity and methods for individual management efforts or properties will be determined at the annual IWMP meeting, within the following guidelines:

- Monitoring will follow standard scientific methods (e.g., Elzinga et al. 1998).

- Monitoring data will include (at minimum) a GPS-determined infestation boundary and relative abundance measures.
- Descriptive statistics will be preferred in evaluating management efforts.

Section 4

Noxious Weed Management

4.1 Guidelines

Under the IWMP, noxious weeds will be managed according to the degree and kind of threat they pose. High-priority species (typically listed noxious weeds under a mandatory control policy by the POCNWCB) will be designated for active management efforts and aimed at eradication or control. Low priority species (typically listed noxious weeds under a non-mandatory control policy by the POCNWCB, or unlisted exotic nuisance species) will be addressed through Project-wide prevention and education efforts and/or less intensive management. In general, emphasis will be placed on implementation of POCNWCB control policy and the feasibility of successful control of a given species. All management will be consistent with state and federal law, which will take precedence in the event any conflicts occur. The following guidelines will be used to broadly define approaches to noxious weed management under the IWMP:

Table 1. Guidelines for noxious weed management under the IWMP.

Current Weed Status	POCNWCB Class and Policy	IWMP Priority	Guideline Management Method and Examples
Not present, unlikely to invade	N/A	Low	No action
Not present, likely to invade	A; mandatory control	High	Prevention: education, annual surveys
Present, localized	All classes; mandatory control	High	Eradication: intensive herbicide treatment, mapping, detailed monitoring
Present, widespread	B and C; non-mandatory control	Moderate	Containment: herbicide treatment, eradication of outliers, biocontrol, or no action

Site-specific circumstances may dictate deviations from these guidelines. In particular, on lands with other resource concerns (e.g., rare plant occurrences) District noxious weed management will emphasize the protection of those resources.

4.2 Site-specific Management Direction

This section presents survey results and initial management direction for certain properties addressed by the IWMP, based on reconnaissance-level surveys of District properties conducted

in 2000 and 2001 as well as USFS and POCNWCB records. Management direction for other properties will be determined by the BCHS.

4.2.1 Box Canyon Dam

Box Canyon Dam is a 115-acre property situated on the west bank of Box Canyon Reservoir, including Box Canyon Dam and Campbell Park. Much of the property is steeply banked and forested; the developed portions are mostly mowed grass or paved. Noxious weed infestations are generally limited to mowing-tolerant weeds; undeveloped lands are dominated by natives and support few noxious weeds.

Table 2. Summary of known noxious weed infestations at Box Canyon Property.

Common Name	Scientific Name	POCNWCB Rating	Description of Infestation	Management Direction
Meadow hawkweed	<i>Hieracium caespitosum</i>	B	Occasional throughout nonforested habitat	To be determined by BCHS
Spotted knapweed	<i>Centaurea stoebe</i>	B	Occasional along edge of forested/mowed boundary	To be determined by BCHS

4.2.2 Finch Property

The Finch property is an approximately 54 acre parcel situated on the Box Canyon Reservoir shoreline opposite the Kalispel reservation. The area is undeveloped, with a history of grazing, and is dominated by wetland species tolerant of flooding. Reed canarygrass (*Phalaris arundinacea*) is a dominant species on parts of this property, although few other noxious weeds were observed during reconnaissance surveys. During relicensing studies, a patch of Japanese knotweed occurring on this property was observed being used by Canada geese for nesting.

Table 3. Summary of known noxious weed infestations at Finch Property.

Common Name	Scientific Name	POCNWCB Rating	Description of Infestation	Management Direction
Canada thistle	<i>Cirsium arvense</i>	C	Patchy on upper shoreline	To be determined by BCHS
Reed canarygrass	<i>Phalaris arundinacea</i>	C	Dense to patchy along shoreline; dense stand on island	To be determined by BCHS
Japanese knotweed	<i>Polygonum cuspidatum</i>	B-designate	Single patch on island	To be determined by BCHS

4.2.3 Usk Property

The Usk Property is an approximately 86-acre parcel situated on the west side of the Box Canyon Reservoir shoreline near the town of Usk. The property is bisected by the Usk bridge,

but is otherwise undeveloped. The property is dominated by wetland species tolerant of flooding, including dense stands of reed canarygrass as well as native species. During relicensing studies, an occurrence of prairie cordgrass (*Spartina pectinata*), a state sensitive species, was documented on the shoreline south of the bridge. Purple loosestrife (*Lythrum salicaria*) was reported to occur in a nearby garden as recently as 2000.

Table 4. Summary of known noxious weed infestations at Usk Property.

Common Name	Scientific Name	POCNWCB Rating	Description of Infestation	Management Direction
Canada thistle	<i>Cirsium arvense</i>	C	Occasional patches on upper flats	To be determined by BCHS
Reed canarygrass	<i>Phalaris arundinacea</i>	C	Dense stands on upper flats	To be determined by BCHS

4.2.4 Tacoma Creek and Everett Island Wildlife Management Areas

Surveys of the Tacoma Creek and Everett Island Wildlife Management Areas (WMAs) in 2001 documented noxious weed infestations typical of Pend Oreille County with regard to species, extent, and distribution. On the Tacoma Creek WMA, compacted soils along the access road south of Tacoma Creek supported the most substantial infestations in 2001. On Everett Island WMA, the causeway providing access to the island was the area of highest concern. Both WMAs also supported occasional infestations of common weeds scattered throughout (Table 5). Everett Island is also known to support an occurrence of *Spartina pectinata*, a sensitive plant species.

Table 5. Summary of known noxious weed infestations at Tacoma Creek and Everett Island Wildlife Management Areas.

Common Name	Scientific Name	POCNWCB Rating	Tacoma Creek WMA	Everett Island WMA
Canada thistle	<i>Cirsium arvense</i>	C	x	x
Common St. Johnswort	<i>Hypericum perforatum</i>	C	x	x
Common tansy	<i>Tanacetum vulgare</i>	C	x	x
Dalmatian toadflax	<i>Linaria dalmatica</i>	B	x	
Meadow hawkweed	<i>Hieracium caespitosum</i>	B	x	x
Orange hawkweed	<i>Hieracium aurantiacum</i>	B		x
Oxeye daisy	<i>Leucanthemum vulgare</i>	B	x	x
Reed canarygrass	<i>Phalaris arundinacea</i>	C	x	x
Queen-devil hawkweed	<i>Hieracium glomeratum</i>	B	x	x
Spotted knapweed	<i>Centaurea stoebe</i>	B	x	x

Common Name	Scientific Name	POCNWCB Rating	Tacoma Creek WMA	Everett Island WMA
Sulfur cinquefoil	<i>Potentilla recta</i>	B	x	x
Yellow toadflax	<i>Linaria vulgaris</i>	C	x	x
Yellow-flag	<i>Iris pseudacorus</i>	C		x

Weed management efforts began on the Tacoma and Everett Island WMAs in 2002 and continue as part of the annual management regime. On both WMAs, management consists of spot-treating small infestations of upland weeds scattered throughout the WMA as they recur. A typical herbicide application consists of a spray mix of Sylgard (1 pint/100 gallons volume) and Transline (10 oz/acre) or Hi-Dep (32 oz/acre), or a combination of both for more difficult infestations. No treatments are conducted in the vicinity of the *Spartina pectinata* occurrence. In addition, three years of fall fertilizer application were conducted on the Tacoma Creek WMA (approximately 6 acres treated) and Everett Island (approximately 2.5 acres on the mainland) WMAs (personal communication, John Marti, weed contractor, March 15, 2006). Other areas of particular note and individualized treatment include:

- All hawkweed (*Hieracium* sp.) occurrences. On the Tacoma WMA, the area next to the highway and south of the dike access road has been heavily infested at times. On the Everett Island WMA, the causeway bed also supports hawkweed infestations. Targeted spraying in both these areas has substantially reduced these infestations.
- Planned cottonwood enhancement and wetland creation sites. These will be aggressively planted with native species and may be spot-treated with herbicide during their establishment.

4.2.5 Holiday Shores Water System

The Holiday Shores Water System is a <0.1 acre property situated in a housing development north of the town of Ruby. The property is mostly cleared and kept mowed, and includes a small pump house.

Table 6. Summary of known noxious weed infestations at Holiday Shores Water System.

Common Name	Scientific Name	POCNWCB Rating	Description of Infestation	Management Direction
Common tansy	<i>Tanacetum vulgare</i>	C	Occasional throughout property	Mechanical control (regular mowing) to forest line
Meadow hawkweed	<i>Hieracium caespitosum</i>	B	Occasional throughout property	Cultivation followed by spring grass seeding
Orange hawkweed	<i>Hieracium aurantiacum</i>	B	Occasional throughout property	Cultivation followed by spring grass seeding
Spotted knapweed	<i>Centaurea stoebe</i>	B	Occasional throughout property	Mechanical control (regular mowing) to forest line
St. Johnswort	<i>Hypericum perforatum</i>	C	Occasional throughout property	Mechanical control (regular mowing) to forest line

4.3 National Forest System Lands

NFS lands affected by the Project include three campgrounds (Edgewater, Pioneer Park and Panhandle) as well as other, mostly undeveloped lands (Appendix B). Noxious weed occurrences known from Forest Service campgrounds are presented below. In addition, there are infestations of rush skeletonweed (*Chondrilla juncea*), a POCNWCB B-designate/TWMP high-priority weed, within 0.5 mile of Panhandle Campground and within 0.2 mile of Pioneer Campground (personal communication, Sharon Sorby, POCNWCB, May 2 2006).

Other NFS lands affected by the Project are believed to support occurrences of meadow knapweed (*Centaurea nigra x jacea*), spotted knapweed, Dalmation toadflax, common tansy, houndstongue, various hawkweeds, oxeye daisy, St. John's wort, sulfur cinquefoil, and reed canarygrass. They are also known to support occurrences of prairie cordgrass (*Spartina pectinata*) and purple meadow-rue (*Thalictrum dasycarpum*), both state-listed sensitive plants. Management direction for each of these properties will be determined by the BCHS and Forest Service.

Table 7: Summary of known noxious weed infestations at Edgewater, Panhandle and Pioneer Campgrounds.

Common Name	Scientific Name	POCNWCB Rating	Edgewater	Panhandle	Pioneer
Absinth wormwood	<i>Artemisia absinthium</i>	C		x	
Common tansy	<i>Tanacetum vulgare</i>	C	x	x	
Houndstongue	<i>Cynoglossum officinale</i>	C			x
Meadow hawkweed	<i>Hieracium caespitosum</i>	B	x	x	
Meadow knapweed	<i>Centaurea nigra x jacea</i>	B-designate	x		
Orange hawkweed	<i>Hieracium aurantiacum</i>	B	x	x	
Reed canarygrass	<i>Phalaris arundinacea</i>	C	x	x	
Smooth hawkweed	<i>Hieracium glomeratum</i>	B	x	x	
Spotted knapweed	<i>Centaurea stoebe</i>	B	x	x	x
St. John's wort	<i>Hypericum perforatum</i>	C	x	x	x
Sulfur cinquefoil	<i>Potentilla recta</i>	B		x	

4.4 Off-Site Weed Management Efforts

The District recognizes that the degree of threat and potential for invasion posed by certain high-priority noxious weeds warrants cooperative management unconstrained by property boundaries. To this end, the District will support the POCNWCB's efforts to eradicate high-priority noxious weeds in Pend Oreille County by contributing \$5,000 annually to these efforts for a period of at least three years. Unused funds will be carried over and made available in subsequent years. These management efforts will remain under the direction of the POCNWCB, which will maintain or increase its own commitment to noxious weed management during this time. After three years, the District's role in assisting these efforts will be re-evaluated at the annual IWMP cooperators meeting. New infestations of high-priority noxious weeds located on lands addressed by the IWMP will be managed under a strategy of eradication.

Section 5

Schedule, Reporting and Coordination

All IWMP provisions will be formally adopted and implemented by the District upon FERC approval of the IWMP. All IWMP activities in a given year will be documented in an annual report distributed to state and federal agencies, the Kalispel Tribe, and FERC. In addition, the District will host an annual IWMP meeting to coordinate all project plans with the IWMP, review noxious weed management goals and techniques, evaluate management results and monitoring data, and modify the IWMP as required to adapt to changing technology and conditions in the Project area.

Section 6

References

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring and monitoring plant populations. US Department of the Interior Bureau of Land Management, Denver CO.

US Department of Agriculture Forest Service (USFS). 1999. Colville National Forest Weed Prevention Guidelines. Colville National Forest, Colville, WA.

US Department of Agriculture Forest Service (USFS). 2005. Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement Record of Decision. Portland, OR.

US Department of Agriculture Forest Service (USFS). 2006. Invasive Plants Field Form. Colville National Forest, Colville, WA

Appendix A

Colville National Forest Revegetation Guidelines

A GUIDE TO SEEDING AND PLANTING VEGETATION

For the

COLVILLE NATIONAL FOREST

INTRODUCTION

Vegetation seeding and planting are two of several vegetation management tools available to land managers. It may be the most effective, least costly, and/or the most environmentally acceptable means of managing the kind, abundance, and structure of vegetation that develops on disturbed sites. Vegetation includes grasses, forbs, shrubs, and trees. Species mixtures, seeding and planting rates (plant densities), and application procedures can be formulated for specific ecological site conditions and vegetation management objectives.

This guide primarily deals with the seeding of grasses and legumes on roads, skid trails, landings and for fire rehabilitation activities. Recommendations for shrub and tree planting are included in Table 5, Revegetation With Native Species on the Colville National Forest.

INITIAL PROJECT PLANNING CONSIDERATIONS

The following selection of the seeding species mixes and rates should be based on the following explanation of vegetation management objectives, plant associations, and other site conditions in the area.

In general, the dryer the site the fewer plants that can be supported, thus seeding rates are reduced, and this is reflected in the Colville Forest Basic Seed Mix on page 14. Also seeding rates shown are for broadcast seeding. If aerial applications are used rates should be increased and conversely if using a drill, seeding rates should be decreased. Large seeded species have better seedling vigor than small seeded species and thus require fewer seeds per square foot.

VEGETATION MANAGEMENT OBJECTIVES

1. Prompt establishment of plant cover to minimize erosion on disturbed sites including fire disturbed areas, especially those that are steep, have erosive soils, or have other special conditions , which will reduce water runoff and sedimentation and improve water quality.
2. Prevent or reduce establishment of noxious weeds, especially where adjacent to existing (established) stands of noxious weeds.

SITE CONDITIONS AND PLANT ASSOCIATIONS

Sites are described by plant associations as found in Forested Plant Associations of the Colville National Forest by Clint Williams and Terry Lillybridge. Table 1 is a schematic table of the plant associations found on the Colville National Forest grouped based on an evaluation of moisture. Those associations which experience soil drought to the extent that moisture competition between tree seedlings and grass limits tree seedling survival during "average" moisture years are termed "dry" associations. Plant associations where moisture is rarely or never limiting are termed "moist" associations. Parameters of 'warm' and 'cold' have also been used. Table 2. contains a description of the species codes used.

TABLE 1. Dry and moist associations.

Cold/dry ←-----→ Cold/wet		
MODERATE TO MOIST SITES		
ABLA2/XETE *	ABLA2/RHAL-XETE *	ABLA2/RHAL *
ABLA2/VAME	ABLA2/CLUN	ABLA2/TRCA3 *
ABLA2/VASC *	ABLA2/COCA	
ABLA2/VACA	ABLA2/LIBOL	
ABLA2/CARU		
PICO/SHCA		PIEN/EQUIS
TSHE/XETE	TSHE/RUPE	TSHE/MEFE *
	TSHE/GYDR	
	TSHE/ARNU3	
	TSHE/CLUN	
THPL/VAME	THPL/ARNU3	THPL/OPHO *
	THPL/CLUN	
LOW MOISTURE SITES		
ABGR/VACA	ABGR/CLUN	
ABGR/PHMA		
PSME/VAME		
PSME/CARU	PSME/VACA	
PSME/PHMA	PSME/PHMA-LIBOL	
PSMA/SYAL		
PSME/SYOR		
PIPO-PSME/AGIN		
Warm/dry ←-----→ Warm/wet		

* indicates unsuitable for grass seeding based on elevation or moisture.

TABLE 2. Plant association species codes.

Code	Species	Common Name
ABLA2	<i>Abies lasiocarpa</i>	Subalpine fir
ABGR	<i>Abies grandis</i>	Grand fir
AGIN	<i>Agropyron inerme</i>	Beardless bluebunch wheatgrass
ARNU3	<i>Aralia nudicaulis</i>	Wild sarsparilla
CARU	<i>Clamagrostis rubescens</i>	Pine grass
CLUN	<i>Clintonia uniflora</i>	Queencup beadily
COCA	<i>Carex concinnoides</i>	Northwestern sedge
EQUIS	<i>Equisetum species</i>	Horsetail
GYDR	<i>Gymnocarpium dryopteris</i>	Oak fern
LAOC	<i>Larex occidentalis</i>	Western larch
LIBOL	<i>Linnaea borealis</i> var. <i>longiflora</i>	Twinflower
MEFE	<i>Menziesia ferruginea</i>	Rustyleaf menziesia
OPHO	<i>Oplopanax horridum</i>	American devilsclub
PICO	<i>Pinus contorta latifolia</i>	Lodgepole pine
PIEN	<i>Picea engelmannii</i>	Engelmann spruce
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine
PHMA	<i>Physocarpu malvaceus</i>	Ninebark
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir
RHAL	<i>Rhododendron albiflorum</i>	Cascade azalea
RUPE	<i>Rubus procerus</i>	Himalaya blackberry
SHCA	<i>Shepherdia Canadensis</i>	Russet buffaloberry
SYAL	<i>Symphoricarpos albus</i>	Common snowberry
SYOR	<i>Symphoricarpos oreophilus</i>	Mountain snowberry
THPL	<i>Thuja plicata</i>	Western redcedar
TRCA3	<i>Trautvetteria caoroliniensis</i>	False bugbane
TSHE	<i>Tsuga heterophylla</i>	Western hemlock
VACA	<i>Vaccinium caespitosum</i>	Dwarf huckleberry
VAME	<i>Vaccinium membranaceum</i>	Thinleaf huckleberry
VASC	<i>Vaccinium scoparium</i>	Grouse huckleberry
XETE	<i>Xerophyllum tenax</i>	Beargrass

In general, especially when doing roadside seeding, "Dry" refers to drier lower elevations and south facing mid-elevation slopes dominated by ponderosa pine Douglas fir and grand fir. "Moist" refers to sites the other sites and generally have Sitka alder as an indicator.

VEGETATIVE COMPETITION

According to current literature, the following generalities about the compatibility of grass seeding and tree regeneration appear valid in most instances:

1. Grass seeding on moist sites, at any seeding rate, has no statistically proven effect on established tree seedling survival but may limit the total number of tree seedlings that become established.
2. Grass seeding at more than 50 seeds per square foot on moist sites reduces the size of tree seedlings (mainly from reduced height growth) for at least 5 years (the length of the study).
3. Grass seeding on droughty sites greatly reduces the survival and total number of trees.
4. Grass seeding at very high rates (i.e., over 200 seeds per square foot) is wasteful of seed and may result in a less dense grass stand than seedings at lower rates because of competition among the grass seedlings.
5. Grass must be seeded as soon as possible after disturbance and before soils crust. Trees should be planted so they become established at the same time as the grass; i.e., plant trees and grass in the fall or grass in the fall and trees the following spring, never later.
6. Seeding with species such as orchardgrass (Dactylis glomerata), timothy (Phleum pratense), or bromes may lead to potential problems with rodents. These large grasses provide an attractive, abundant, and nutritious food supply. Grasses like timothy and orchardgrass have enlarged stem bases (where a large amount of carbohydrates are stored) that make them especially desirable to gophers.
7. Popular, commercially available species for seeding have been selected for vigor and their ability to become established. They can be highly competitive with themselves and with other plants.

TABLE 4. Number of pure live seed

Common name	pure live seeds	seeds/ft ² at 1 pound/acre
<u>Grasses</u>		
Bluegrass, big	917,000	21
Bluegrass, Canada	2,500,000	57
Bluegrass, Sandberg	912,000	21
Brome, mountain	90,000	2
Brome, smooth	125,000	3
Fescue, creeping red	615,000	14
Fescue, hard	565,000	13
Fescue, sheep	680,000	15.5
Wheatgrass, bluebunch	140,000	3
Wheatgrass, intermediate	100,000	2
Wheatgrass, western	118,000	3
Wheatgrass, pubescent	91,000	2
Wheatgrass, streambank	170,000	4
Wildrye, Dahurian	80,000	2
Wildrye, blue	150,000	2
<u>Legumes</u>		
Clover, Alsike	682,000	15.5
Clover, white Dutch	800,000	18.5
Milk vetch, cicer	145,000	3.5

COMPUTING APPLICATION RATES

The method of issuing a standard seeding rate of lbs/acre without considering germination, purity, or seed size is not very reliable. Germination rates and purity vary from species as well as seed lot to seed lot. Pure live seed (PLS) rates need to be calculated on a case-by-case basis. All certified seed will come with a label with this information by species. This allows for a real indicator of seed quality.

Small seeded grasses may provide up to three or four times as many seeds per square foot (hence rooted plants) as do some large seeded species when both are seeded at the same pounds per acre rate. If we base our rates on pure live seeds per square foot or per pound, we can control the number of rooted plants desired.

To determine the amount of seed to apply, do the following steps:

1. Determine percent pure live seed (% PLS).

$$\frac{\% \text{ purity} \times \% \text{ germination}}{100} = \% \text{ PLS}$$

2. Determine amount of pure live seed (PLS).

$$\begin{aligned} \text{Number of seeds/lb} \times \% \text{ PLS} &= \text{PLS/lb} \\ \text{Number of seeds/square ft} \times \% \text{ PLS} &= \text{PLS/square ft} \end{aligned}$$

3. Determine amount of seed (lb/square ft), based on a given PLS/square ft.

$$\frac{\text{PLS/square ft desired}}{\text{PLS/lb}} = \text{lb/square ft}$$

4. Convert to lb/acre.

$$\text{Lb/square ft} \times 43,560 \text{ square ft/acre} = \text{lbs/acre}$$

If you have a seeding rate based on actual pounds per acres (not based on PLS per acre), this can be converted to a PLS basis. This may occur in old texts and guides, especially if no mention of PLS is made. To determine the amount of seed needed to get the desired amount of pure live seed, use this formula.

$$\frac{\text{Old lbs/acre} \times 100}{\% \text{ PLS}} = \text{new lbs/acre}$$

Example 1. Here is an example based on a certified seed mix. The desired end seeding rate is 50 PLS/square ft of intermediate wheatgrass. Intermediate wheatgrass has approximately 88,000 seeds/lb.

Example mix label:

Intermediate wheatgrass	
% purity	98.20
% other crop	0.00
% inert	1.70
% weeds	0.10
% germination	85.00

Test date: 9/87	
Noxious weeds found: none	
Other weeds found: Cheatgrass 113 seeds/lb	
Henbit	65 seeds/lb

Determine % PLS:

$$(98.2\% \times 85\%)/100 = 83.47\% \text{ PLS}$$

Determine PLS/lb:

$$88,000 \text{ seeds/lb} \times 83.47\% \text{ PLS} = 73,453 \text{ PLS/lb}$$

Determine lb/acre to seed:

$$(50 \text{ PLS/square ft})/(73,453 \text{ PLS/lb}) = .00068 \text{ lb/square ft}$$

$$.00068 \text{ lb/square ft} \times 43,560 \text{ square ft/acre} = 29.6 \text{ lb/acre}$$

This indicates that 29.6 lb/acre of the particular seed purchased will need to be seeded to get the PLS stand desired.

Example 2. Here is an example of an old mix rate based on total seed, not PLS. The old recommendation was to seed 25 lb/acre. It has been determined that the mix you have purchased is only 85% PLS.

Determine needed seeding rate:

$$(25 \text{ lb/acre}/85\% \text{ PLS}) \times 100 = 29.4 \text{ lb/acre}$$

This indicates that particular mix, with its particular purity and germination, would have to be seeded at 29.4 lb/acre to get the desired 25 lb/acre.

Table 5. Species Adaptability

Ranges of effective environmental adaptability for plants seeded for soil conservation efforts in Oregon's forested regions. (Seeding to control erosion along forest roads, OSU Extension Service, Extension Circular 885, 1976)

Species	Average Annual Precipitation							
	<9"	9"-12"	12"-15"	15"-18"	18"-25"	25"-40"	40"-60"	>60"
Big bluegrass								
Sheep fescue								
Streambank wheatgrass								
Pubescent wheatgrass								
Hard fescue								
Smooth brome								
Intermediate wheatgrass								
Creeping red fescue								
Canada bluegrass								
Mountain brome								

SPECIES SELECTION

Below are discussions of species frequently considered in seeding mixes. Additional information can be obtained from various seed catalogs, vegetation or seeding guides, and range improvement texts.

I. Grasses

INTERMEDIATE WHEATGRASS

Agropyron intermedium (AGIN2) introduced 2' to 4' tall grass adapted to wide range of conditions. Fairly easily established, rapid developing, large seeded, long-lived, highly nutritious, mildly rhizomatous sod-forming grass. Maintains high levels of nutrition through growing season. Highly productive but does not withstand overgrazing. One of least competitive domestic species with trees. Does best in 14" or more precip; does well up to 10,000'. Fair tolerance to high water tables and flooding, salt, drought. Suitable to moist, finer textured, sandy loam to clay loam soils. Better winter, spring, or fall cover than smooth brome because more resistant to frost. Used for pasture, wildlife plantings, soil stabilization. Varieties: "Greenar" (late maturing, release from Washington), "Oahe" (high seed yield)

Seed 5 to 15 lbs PLS/ac depending on moisture and stand requirements. Allow 20 to 25 lbs PLS/ac for broadcasting. Seed in late fall or early spring.

STREAMBANK WHEATGRASS

Agropyron riparium (AGRI) native grass adapted to fine and medium textured soils. Quick germinating, rapid developing, long-lived, strongly rhizomatous grass with excellent seedling vigor. At elevations below 3,500', at least 12" of precip needed. Above 3,500', minimum precip is 9". Low-growing with narrow, smooth leaves. Although unpalatable to livestock, reduced forage production and long green period provide little fire hazard. If mowed, leave over 5" of stubble to maintain plant vigor. Misleading name because extremely drought tolerant; need not be on streambanks. Competes well with weeds except on too wet sites where it may be crowded out. Used in erosion control along roadsides (cuts, fills, borrow pits), streambanks, lakeshores. Also used for erosion control and ground cover on irrigated and dryland soils. Variety: "Sodar"

Seed 6 to 8 lbs PLS/ac. Double rate for broadcasting. Seed in late fall where precip is under 12"; early spring in higher precip areas with crusting soils. Broadcast seeding has unreliable success. Fertilize when mature with nitrogen at 20 to 30 lbs/ac.

BLUEBUNCH WHEATGRASS

Agropyron spicatum (AGSP) or Pseudoroegneria spicata is drought tolerant, 1-4' tall, native bunchgrass suited to shallow, gravelly, sandy, medium to clay soils. Does best in full or semi-shade. Precipitation range is 8-25", but best at 10-20" precipitation. Elevation ranges from 500' to 10,000'. Has fair tolerance to fire. Used for cattle, sheep, elk, deer feed. Variety: "Secar" (8-14" precip)

Seed 5 to 10 lbs PLS/ac. Allow 50 to 100% more for broadcasting, south-facing slopes, highly erosive areas, harsh sites. Seed in early spring or late fall. Prechill seed. Protect from grazing for two years or until roots are firmly established and seedheads are formed or by not grazing after may.

PUBSCENT WHEATGRASS

Agropyron trichophorum (AGTR2) 3' to 4' tall, introduced grass similar to intermediate wheatgrass. Adapted to very wide variety of conditions. Rapid developing, large seeded, long-lived, persistent, rhizomatous grass. Forms dense, persistent sod. Highly competitive with other species. Remains green fairly late in the summer so nutrient level remains relatively high but does not withstand overgrazing. Moderately palatable. Slightly more drought tolerant and winter hardy than intermediate wheatgrass, requiring only about 12" to 15" of precipitation. Does best on fine textured, medium to high fertility soils above 3,500'. Used for pasture and range, conservation on disturbed sites, erosion control, bank stabilization, wildlife nesting cover. Varieties: "Topar" (released from Pacific Northwest), "Greenleaf", "Luna" (dryland pasture)

Seed 5 to 15 lbs PLS/ac depending on moisture and desired stand. Allow 20 to 25 lbs PLS/ac for broadcasting. Seed in early spring or late fall. Mixes well with other cool season grasses, legumes, forbs, shrubs. Fertilize only if soil tests indicate deficiencies. Do not graze until plant roots firmly established.

SMOOTH BROME

Bromus inermis (BRIN) 2' to 4' tall, introduced grass adapted to wide variety of conditions. Rapid developing, leafy, large seeded, long-lived, creeping-rhizomatous sod grass. Both nutritious and palatable. Needs 16" or more of precipitation, yet fairly drought tolerant. Quite variable in characteristics and sensitive to frost. Strong root systems and coarse dense sod resist tramping. Growing season is early spring and early fall so usage should be controlled to avoid overgrazing. Grows best on relatively fertile, deep silty soils. Elevation range is 4,000' to 9,000'. Used for pasture, erosion control, wildlife plantings, reclamation. Variety: "Manchar" (north of recommended range)

Seed 5 to 7 lbs PLS/ac, increase for broadcasting. Seed in spring or late fall. Mulching results in better stands. Use rotational grazing and fertilizing for maintenance and better production.

SHEEP FESCUE

Festuca ovina (FEOV), closely related species to hard fescue, is reported to compete well with diffuse knapweed (Centarea diffusa, CEDI) in some field trials. Shorter leaved, more drought tolerant than hard fescue, and very persistent. At least 9" precipitation needed. Preferred where no forage is desired. Does best on sandy, gravelly, or rocky soils. Used for erosion control, turfgrass. Variety: "Covar"

HARD FESCUE

Festuca ovina var. duriuscula (FEOVD) or F. longifolia (FELD?) adapted to very wide variety of conditions. Slow developing, relatively small seeded, long-lived, bunchgrass with dense, extensive root system. Considered to be drought tolerant, winter hardy. Best where there is at least 15" precipitation. Low growing, very competitive, persistent. Though bunchgrass, it often forms near sod condition because of number of bunches. Usually dominates areas where it was part of mix though it was inconspicuous first year or two after seeding. These properties help it be very competitive with invading weeds. Only moderately useful for forage because of relatively low growth habit. It is adapted to well drained soils, that can be infertile. Used for erosion control, soil improvement. Excellent for roadsides, recreation areas. Variety: "Durar"

RED FESCUE, CREEPING RED FESCUE

Festuca rubra (FERU), F. rubra stolonifera (FERUS) shade tolerant, Sod forming grass which does best on medium to clay soils. Needs 18" or better precipitation. Used for erosion control. Varieties: many available

BIG BLUEGRASS

Poa ampla (POAM) a tall (up to 6') winter active, summer dormant native grass adapted to wide variety of sites. Long-lived, small seeded, very early maturing, drought tolerant, slow to establish bunchgrass. Grows during fall, winter, spring before high temperatures occur. Needs over 9" of precipitation. Competes well with winter active, annual species such as cheatgrass (Bromus tectorum, BRTE) and greens up very early in spring (up to 4 weeks earlier than crested wheatgrass). Some reports indicate it competes well with diffuse knapweed. Produces high quality forage in late fall and early spring but may be quite competitive with trees. Used for grazing, fire rehabilitation, year-round wildlife cover and upland bird nesting, erosion control on favorable sites. Variety: "Sherman"

Seed in fall on moist seedbed or very early in the spring. May be seeded alone or with alfalfa or other grasses. Aerial seeding has shown excellent results in pine zones. Seedlings should be protected from grazing for two years because it is easily pulled up; avoid grazing during seed head stages.

MOUNTAIN BROME

Bromus marginatus (BRMA) 1-4' tall, intermountain native bunchgrass with deep, well branched roots. Short-lived, with production dropping off rapidly after two years. Provides quick cover that doesn't compete with regeneration. Lives up to 8,000'. Used for erosion control (especially erodible slopes), fire rehabilitation. Excellent livestock, wildlife forage in early stages of development. Variety: "Bromar" (We appear out of its range)

Seed 8 to 12 lbs PLS/ac. Frequently used in mixes with sweet clover. Defer grazing until established.

CANADA BLUEGRASS

Poa compressa (POCO) naturalized, 'weedy', low growing, summer active, short leaved, short rhizomed, palatable grass. Low production. Needs over 15" precipitation. Suitable for low fertility soils. Used for cover and erosion control on roadsides, cuts and fills, borrow pits, recreation sites.

WESTERN WHEATGRASS

Agropyron smithii (Rydb.) is perhaps one of the best known and most commonly used native grasses. It is a long-lived, cool season species that has coarse blue-green leaves with prominent veins. It is a sod former with very strong, spreading rhizomes. Stems arise singly or in clusters of a few and reach heights of 1 to 3 feet. It is an excellent erosion control plant because of its spreading rhizomes. Although it is able to grow on a wide variety of soils it prefers the heavier but well drained soils. It requires moderate to high soil moisture content and is most common in the 10 to 14 in annual precipitation zones. It is grazing resistant and can survive fires if in the dormant stage. Recovery from fire is slow.

DAHURIAN WILDRYE

Elymus dahuricus is a short-lived perennial. It is quick to establish. It is used with other slow establishers. It is a palatable species.

BIG BLUEGRASS

Poa ampla (POAM) is a winter active, summer dormant species adapted to a wide variety of sites. It is native to the western United States. It is a long-lived, palatable, small seeded, very early maturing, drought tolerant, slow to establish, bunchgrass. It grows during the fall, winter and spring before high temperatures occur. It competes well with winter active, annual species such as cheatgrass and greens up very early in the spring. Some reports indicate it competes well with diffuse knapweed. It should be protected from grazing for at least two years because it is easily pulled up. It produces high quality forage in late fall and early spring but may be quite competitive with trees. This long lived perennial reaches 2-4 feet in height. It has a strong fibrous root system but will occasionally develop short rhizomes. It is the most persistent of all the cool season grasses.

SANDBERG BLUEGRASS

Poa sandbergii Perennial range grass. Survives well in dry areas. Grazes early; palatable throughout the season. Minimum precipitation is 8 inches.

BLUE WILDRYE

Elymus glaucus It is generally associated with moist woodland sites, but is remarkable in its drought tolerance and is able to persist on rather severe sites. Abundant seed production, good seed production, good germination, and relatively rapid seedling growth result in rapid stand establishment. Stands begin to decline dramatically after 3 to 4 years. It can not withstand heavy grazing.

II. Legumes

CICER MILKVETCH

Astragalus cicer Very persistent, high yielding perennial. Poor seedling vigor: slow to establish. Produces a high nutrient hay. Minimum precipitation 12 – 18 inches. Height 12 to 24 inches.

ALSIKE CLOVER

Trifolium hybridum (TRHY) is adapted to a fairly wide range of conditions. It is a nitrogen-fixing, short-lived, palatable, nutritious and moderately productive legume suited to areas with 18" or more precipitation. It is well adapted to poorly drained, acid soils and cool temperatures. It prefers silty clay loams, and does not tolerate droughty sits. It has smooth stems and leaves, reaching a height of 2-4 feet. It can be toxic to horses under some conditions. It is always seeded with grass. It should always be inoculated due to infrequent use of the species.

DUTCH WHITE CLOVER

Trifolium repens (TRRE) is normally used to provide a source of nitrogen for a sown companion grass. It is adapted to sites with over 18" precipitation. It is a long lived perennial, legume with various different varieties. It is highly palatable, nutritious forage for all classes of livestock. Grass seedlings benefit from the nitrogen produced by white clover. Solid stands of whit clover form a good erosion controlling cover on moist fertile soils, but stands may be sparse or spotty on dry sites. It thrives best in cool, moist climate in soils with ample lime, phosphate, and potash. Inoculate seeds before seeding.

Colville National Forest Basic Seeding Mix
Broad Cast Seeding Rates

Low Moisture Harsh Sites

	Seed/#	Seed/sq ft	#/ac
Sheep Fescue	662,500	58	4
Streambank Wheatgrass	142,000	14	4
Pubescent Wheatgrass	90,000	<u>12</u>	<u>6</u>
Totals		84	14

Substitutions:

Western Wheatgrass	118,000	11	4
Dahurian Wildrye	80,000	12	6
Bluebunch Wheatgrass	117,000	20	8
Big Blue Grass	900,000	42	2
Sandberg Blue grass	912,000	42	2

Higher moisture Moderate to Moist Sites

Hard Fescue	573,000	100	7
Streambank Wheatgrass	142,000	13	4
Intermediate Wheatgrass	90,000	<u>13</u>	<u>7</u>
Totals		126	18

Substitutions:

Mountain Brome	70,000	13	7
Creeping Red Fescue	547,000	51	4
Canada Bluegrass	2,400,000	100	2
Western Wheatgrass	118,000	11	4
Blue Wildrye	150,000	13	4
Smooth Brome	150,000	13	4

Substitution Legumes to consider:

Alsike Clover	682,000	15	1
Cicer milk vetch	145,000	7	2
White dutch clover	800,000	18	1

All seed must be "Prohibited & Restricted Noxious Weed Free For the State of Washington"

OTHER CONSIDERATIONS

LEGUMES

Legumes are advantageous in that they are nitrogen fixers. In many cases they are very attractive to grazing animals and this may not be desirable along travel ways. Since the majority species of noxious weeds are broadleaf varieties, the legumes will likely be removed from the site when treating for noxious weeds.

For best results, legumes should be properly inoculated before planting. Lack of inoculation may be a significant factor in the relatively poor rate of success in many legume seedings. It is very difficult to successfully inoculate seeds in broadcast seeding because of the exposure to sun and drying. However, encapsulated seed (with fertilizer and inoculant) may be an improvement.

FERTILIZER

Available literature is often confusing and contradictory. But some general conclusions are indicated:

1. Nitrogen fertilization inhibits tree and legume survival while stimulating grasses. Phosphorous or sulfur fertilization tends to stimulate legumes.
2. Nitrogen fertilizer without grass seeding may be more limiting to tree establishment (especially lodgepole pine) than is grass seeding without fertilizer.
3. Grass growth is helped more by fertilizer after the first year than at time of establishment. Some studies show that fertilization at the time of seeding may stimulate weeds.

If fertilizer is desired, approximately 50 pounds of available N per acre is recommended.

Fertilizers are expressed in a ratio that indicates the percent of nutrients available. This percentage ratio is expressed N:P:K:S, or total nitrogen (N):available phosphorous (P) or phosphoric acid (P_2O_5):soluble potassium (K) or potash (K_2O):sulfur (S).

Fertilizer recommendations are generally given either in pounds/acre of a specific ratio (100 lbs/acre of 16-20-0-0) or in pounds/acre of the required available nutrient (100 lbs/acre of available N). At first these two appear to be the same recommendation, but upon further examination, they are not.

When given pounds/acre of a specific fertilizer ratio, you can determine the amount of an available nutrient by multiplying the pounds/acre of the fertilizer by the nutrient percentage.

$$\begin{array}{r} \text{(lbs/acre of fertilizer)} \\ \times \text{(\% available nutrient)} \\ \hline \text{(lbs/acre of available nutrient)} \end{array}$$

When given pounds/acre of a required available nutrient, you can determine the pounds/acre of a specific fertilizer ratio by dividing the pounds/acre of the fertilizer by the nutrient percentage.

$$\frac{(\text{lbs/acre of available nutrient})}{(\% \text{ available nutrient})} = \text{lbs/acre of fertilizer}$$

In the above examples, the 100 lbs/acre of the 16-20-0-0 fertilizer actually only provides 16 lbs/acre of available N (100 lbs x .16 = 16 lbs). To provide 100 lbs/acre of available N, we would need 625 lbs/acre of the 16-20-0-0 fertilizer (100 lbs/.16 = 625 lbs).

Another key item to watch with fertilizer ratios is high concentrates vs. low concentrates. For example, the following two fertilizers supply the same ratio (1:2:2) of nutrients:

5-10-10*

15-30-30*

If you needed 100 lbs/acre of available N, which would you buy? First figure out the amount of pounds/acre you would need. At 5-10-10, you would need 2000 lbs/acre of the fertilizer (2000 lbs/acre x 5% = 100 lbs/acre). At 15-30-30, you would need 667 lbs/acre of the fertilizer (667 lbs/acre x 15% = 100 lbs/acre). If the cost per pound of the fertilizer is equal, the 15-30-30 represents a savings in actual cost as well as labor. The possible draw back would be if the high concentrate fertilizer poses an injury threat (burn) to seedlings.

- These ratios are examples and may not represent actual, available commercial fertilizers.

MONITORING

Once the seeding mix has been applied, monitor to check for correct application rates, seeding mix ratios, and seed species. A good text on grasses, such as The Manual of the Grasses of the United States has enlarged drawings of the grass seeds and florets to help determine grass species.

There is a simple method for monitoring seeding rates. Because seeds come in a variety of sizes and weights, there is no standard number of seeds per square foot. By using the CNF Basic Seed Mix application rates and a 13 ½" sq. ft. diameter hoop, an approximation of the application rate can be determined.

1. Determine type and quantity of seed applied according to the prescribed seed mix.
2. Find the seeded species in the Basic Seed Mix. Note the number of seeds/ft² of each species at an application rate of 1 pound/acre. Multiply the number of seeds for each species by the number of pounds that was to be applied for that species. This is how many pure live seeds (PLS) there should be per square foot for each species. Adjust this amount up according to purity and germination rates for the seed mix (may be as much as 10 to 15 percent).

3. Randomly toss a 13 ½" diameter hoop. Count the seeds within the hoop and compare to the numbers determined in step 2.

This monitoring should be done as soon as possible after seeding, as wind, small seed eating animals, rain, etc. can influence the amount of seed remaining (hopefully not too much).

Example 1. Here is an example based on a prescribed seed mix.

1. The prescribed seed mix and application rate is given as:

Intermediate wheatgrass	7 lbs /acre
Hard fescue	7 lbs /acre
Streambank Wheatgrass	4 lbs/acre

2. According to the CNF Basic Seeding Mix the number of seeds per square foot at the prescribed rate is as follows:

Intermediate wheatgrass	13 seeds/ft ²
Hard fescue	100 seeds/ft ²
Streambank Wheatgrass	<u>13 seeds/ft²</u>
Totals	126 seeds/sq.ft

3. Randomly toss the hoop in several locations. Count the number of each species found and average over the entire area. Compare this to the amounts figured in step 2. The very small seeded species like the clovers will be nearly impossible to see, so it may be necessary to count the large species and assume the small numbers are there.
4. Check the seed mix label and if it indicates that the percent germination is down, like 90% or less then the seeding rates may have to be increased appropriately to compensate for this.

Table 5

SUITABILITY TABLE FOR REVEGETATION WITH NATIVE SPECIES ON THE COLVILLE NATIONAL FOREST

<i>Species Name</i> Common Name	Suitability on the Colville National Forest	Forage Value	Average Number Clean Seed/lb.	Easiest to Propagate From....
<i>Achillia millefolium</i> Western yarrow	Generally Occurs: On a wide variety of sites including dry to mesic meadows and forest. Advantages: A good pioneer on poor soil. Drought resistant. Seed can be direct broadcast on site.		2,770,000	seed
<i>Alnus incana</i> Mountain alder	Generally Occurs: Low to moderate elevation riparian areas & wetlands. Does occur in upland areas except on spring and seepage areas. Advantages: Well developed root systems for protecting streambanks. Fast growing, fixes nitrogen, tolerates infertile soils. Seeds are easy to collect and propagate or can be sown directly on the site	Seed is eaten by birds and small mammals. Browse value low to moderate for livestock and big game.		Seed Seedlings transplants
<i>Acer glabrum</i> Rocky Mountain maple	Generally Occurs: Moist forest, moist draws, riparian areas. Advantages: Easy to establish by direct sowing of seed or container seedlings. Seed (samaras) are easy to collect.	Fruit eaten by birds and small mammals. Moderate browse value for large ungulates.	13,000 to 14,000	Seed seedlings
<i>Alnus sitchensis</i> Sitka alder	Generally Occurs: Along streambanks and by lakes at moderate to high elevation. Seral on upland following fire or other disturbance. Advantages: Great for erosion control; well developed root system, fast growing, tolerates infertile soil, fixes nitrogen, seeds are easy to collect and propagate or can be sown directly on site.	Moderate value for deer and elk. Seeds eaten by small rodents and birds.	1,100,00 to 2,000,000	Seed Seedlings transplants
<i>Amalanchier alnifolia</i> Saskatoo serviceberry	Generally Occurs: Open woods, canyons, and hillsides, from low to moderately high elevations. Advantages: Disadvantages: Usually need to collect a large amount of fruit as the seeds are often infertile or insect infested.	Moderate value for deer and elk, may be severely overuse on winter range. Birds, small mammals and bear eat the fleshy fruit.	83,000	Seedlings cuttings
<i>Anaphalis margaritacea</i> Pearly everlasting	Generally Occurs: On open sunny sites, often dry or very well drained. Advantages: Can pioneer bare ground and difficult, drought sites such as road shoulders and cutbanks. Seeds can be sown directly on site. Disadvantages: Seed purity can be a problem.		8,000,000 to 11,000,000	seed

<i>Arctostaphylos uva-ursi</i> Kinnickinick, bearberry	Generally Occurs: Meadows, rock outcrops, and dry woods; usually on thin, rocky or very well-developed soils. Advantages: Excellent groundcover, effective erosion control on sunny exposed sites such as roadcuts. Disadvantages: Germination from seed is difficult. Initial establishment from cuttings is usually slow but, in the long run, may be worth the wait.	The fruits are eaten by bears, small birds, and small mammals.	26,000 to 58,000	Cuttings
<i>Aster species</i> Aster	Generally Occurs: Moderate to high elevations. Mesic forest, riparian and wetland areas. Advantages: Disadvantages: Seedheads are often heavily infested with insects. Seeds must be treated with sulfuric acid and stratified.		900,000	Seed Seedlings
<i>Astragalus species</i> Milkvetch	Generally Occurs: Advantages: Nitrogen fixer.			
<i>Berberis repens</i> Oregon grape	Generally Occurs: On south aspects or lower elevation north aspects, dry to mesic sites that are well drained or rocky. Advantages: Attractive, low maintenance ground cover, good for erosion control. Disadvantages: Seed must be cold stratified.	Highly valued browse for wild ungulates, the fruits are eaten by birds.	58,000	Seed Cuttings
<i>Carex rossii</i> Ross sedge	Generally Occurs: Wide variety of forest and meadows sites. Advantages: Easy to propagate from plant divisions.			Plant division
<i>Ceanothus velutinus</i> Snowbrush ceanothus	Generally Occurs: On to mesic mountain slopes, usually south to west-facing. Dense stands develop from soil seed bank following hot burns. Advantages: Seeds are easy to collect and propagate by dirt sowing or growing container seedlings in the nursery.	Not very palatable to large ungulates.	91,000	Seed? Seedlings
<i>Ceanothus sanguineus</i> Redstem ceanothus	Generally Occurs: In more mesic woods compared to snowbrush Ceanothus. Advantages: Seeds are easily to collect and propagate by direct sowing or growing container seedlings in the nursery.	Higher in palatability to large ungulates.	132,000	Seed? seedlings
<i>Cornus stolonifera</i> (<i>Cornus sericea</i>) red-osier dogwood	Generally Occurs: along riparian areas and next to lakes, partial to full sunlight. Advantages: Excellent soil-binding characteristics. Propagates easily and fast growing from cuttings or seed.	Excellent for wildlife cover and browse for deer, elk and moose. Stabilizes streambanks. Fruit is eaten by small mammals, birds, and bears.	18,500	Cuttings seed

<i>Elymus glaucous</i> Blue wildrye	Generally Occurs: On open, moist mountain meadows and moist woods. Advantages: Can be sown directly and/or is easy to propagate. Establishes good cover for erosion control or land reclamation	Eaten by elk	124,000 to 155,000	Seed
<i>Epilobium angustifolium</i> Fireweed	Generally Occurs: In open, sunny places, especially after fire or disturbance, on cool, mesic sites. Advantages: Quick growing pioneer on disturbed soils. Seed is easy to collect and can be directly sown on site.	Eaten by deer and elk. Valued by beekeepers.	8,000,000 to 9,000,000	Seed
<i>Fragaria vesca & virginiana</i> Strawberry	Generally Occurs: In a wide variety of sites from moist, open mountain meadows to dry and mesic forests. Advantages: Attractive ground cover that can tolerate loose, ravelly soils. Good for stabilization of road cuts.	Berries sought by all varieties of wildlife. Foliage eaten by deer and elk.		Cuttings Transplants
<i>Hieracium albiflorum</i> Hawkweed	Generally Occurs: Open, moderately dry meadows and woods, with full to partial sunlight. Advantages: Can tolerate disturbed roadcuts with poor soils. Disadvantages: Can be easily confused with yellow hawkweed.	Eaten by deer.	Over 1,000,000	Seed
<i>Holodiscus discolor</i> Oceanspray	Generally Occurs: Warm, dry to mesic sites, often with rocky or stony soils. Advantages: It is a recommended species for land recommendations as it can tolerate highly disturbed areas. Disadvantages: Only 25% of seed is sound, so collect more than planned.	Low value forage for deer and elk.	5,340,000	
<i>Juniperus communis</i> Common juniper	Generally Occurs: Dry forests with rocky soils, rock outcrops. Advantages: Disadvantages: Slow growing.		36,000	Seed Cuttings
<i>Linnaea borealis</i> Twinflower	Generally Occurs: Mesic to moist forest with moderately well drained soils. Advantages: Attractive, low-growing ground cover.			Cuttings
<i>Pinus contorta</i> Lodgepole pine	Generally Occurs: Wide variety of forest sites on moist to moderately wet soils. Advantages: A good pioneer species on highly disturbed or burned soils.	Seeds eaten by birds and rodents.		Seeds Seedlings
<i>Lonicera utahensis</i> Utah honeysuckle	Generally Occurs: Mesic forests. Advantages: Easy to grow from seed, transplants or cuttings.		113,000	Seed Transplants Cuttings

<i>Lupinus species</i> Lupine	Generally Occurs: Between all species, this generally occurs on a wide variety of sites from dry meadows to forests and alpine. Advantages: Nitrogen fixer that can generally tolerate poor soils. Grows quickly and seeds are easy to collect.	Many species of lupine provide forage for wildlife.	35,000	Seed
<i>Pachistima myrsinites</i> Myrtle pachistima	Generally Occurs: In a wide variety of relatively dry to mesic forests, often with ravelly or stony soils. Advantages: Can tolerate exposed, dry sites. Disadvantages: Slow growing.			Cuttings
<i>Philadelphus lewisii</i> Mockorange	Generally Occurs: In riparian zones, draws, dry woods, cliffs, talus slopes, and rocky hillsides from sagebrush desert to the Douglas-fir zone. Advantages:		5,440,000	Seed? Seedlings
<i>Physocarpus albus</i> Ninebark	Generally Occurs: Relatively dry to mesic woods, especially in Douglas-fir and grand fir forests. Relatively stony, well drained soils. Advantages:		750,000	Seed Cuttings Seedlings
<i>Populus trichocarpa</i> Black cottonwood	Generally Occurs: Deep, moist soils and alluvial soils in floodplains. Will also establish on moist, disturbed soils in uplands	Eaten by a deer, elk and moose. Seeds eaten by birds.		Seed Cuttings
<i>Pteridium aquilinum</i> Bracken fern	Generally Occurs: Open forests with mesic soils Advantages: May tolerate disturbed and eroded soils.			Rhizomes
<i>Rosa species</i> Rose	Generally Occurs: Generally mesic forests, riparian zones. Advantages: Seed easy to collect.	Fruit eaten by birds and small mammals. Low to moderate brose for large ungulates.	25,000 to 50,00	Seed
<i>Rubus parviflorus</i> Thimbleberry	Generally Occurs: In partly sunny to partly shaded forest. Usually on rich, mesic to moist soils. Advantages: Can compete in some disturbed areas with compacted soils such as road shoulders. Easy to grow from seed.	Birds eat the fruit. Deer and elk may eat it.	204,000	Seed Seedlings
<i>Salix scouleriana</i> Scouler's willow	Generally Occurs: On mesic to moderately moist upland sites where it is a pioneer after fire or clearing. Advantages: Easy to propagate, grow rapidly, and have good soil binding properties. Disadvantages: Avoid use where site distance is a concern. Cuttings root only at the cut and must be forced at a nursery.	Moderate value browse for upland game birds, small and large mammals.	6,500?	Seed Rooted cuttings
<i>Sambucus racemosa</i> Black elderberry	Generally Occurs: In a wide variety of habitats but most often in riparian areas and moist woods. Advantages: Can grow fast on moist disturbed sites.	Shrubs provide food and nesting sites for a wide variety of birds. Deer and elk brose.	212,000	Cuttings

<i>Sorbus sitchensis</i> Mountain ash	Generally Occurs: Cool, mesic forest, especially in the subalpine fir zone. Grows well in disturbed areas after fire. Advantages: Important for wildlife, attractive, especially in the fall.	The fruits are an important food for birds and rodents. The twigs are browsed by big game.	140,00	Seed
<i>Spiraea betulifolia</i> Shiny-leaf spiraea	Generally Occurs: Advantages:			
<i>Symphoricarpos albus</i> Common snowberry	Generally Occurs: In moist woods and riparian areas with deep, fine-textured soils. Advantages:	The fruit is eaten by birds and rodents. Moderate browse value for big game.	76,000	Seed Cuttings
<i>Vaccinium membranacium</i> Big huckleberry (and other huckleberries)	Generally Occurs: In cool, mesic forest, generally at moderate to moderately high elevation. Advantages: Important for wildlife and berry pickers. Disadvantages: Relatively slow growing and labor intensive to propagate.	Berries eaten by birds, rodents, bears, and big game.		Seed Cuttings
<i>Xerophyllum tenz</i> Beargrass	Generally Occurs: Moderately high elevation in the subalpine fir and western hemlock zones. Advantages: Seed is easy to collect.	Seeds eaten by birds and small mammals. Low browse value for large ungulates.		Seedlings Seed?
<i>Vicia</i> species vetch	Generally Occurs: Advantages: Nitrogen fixer.			

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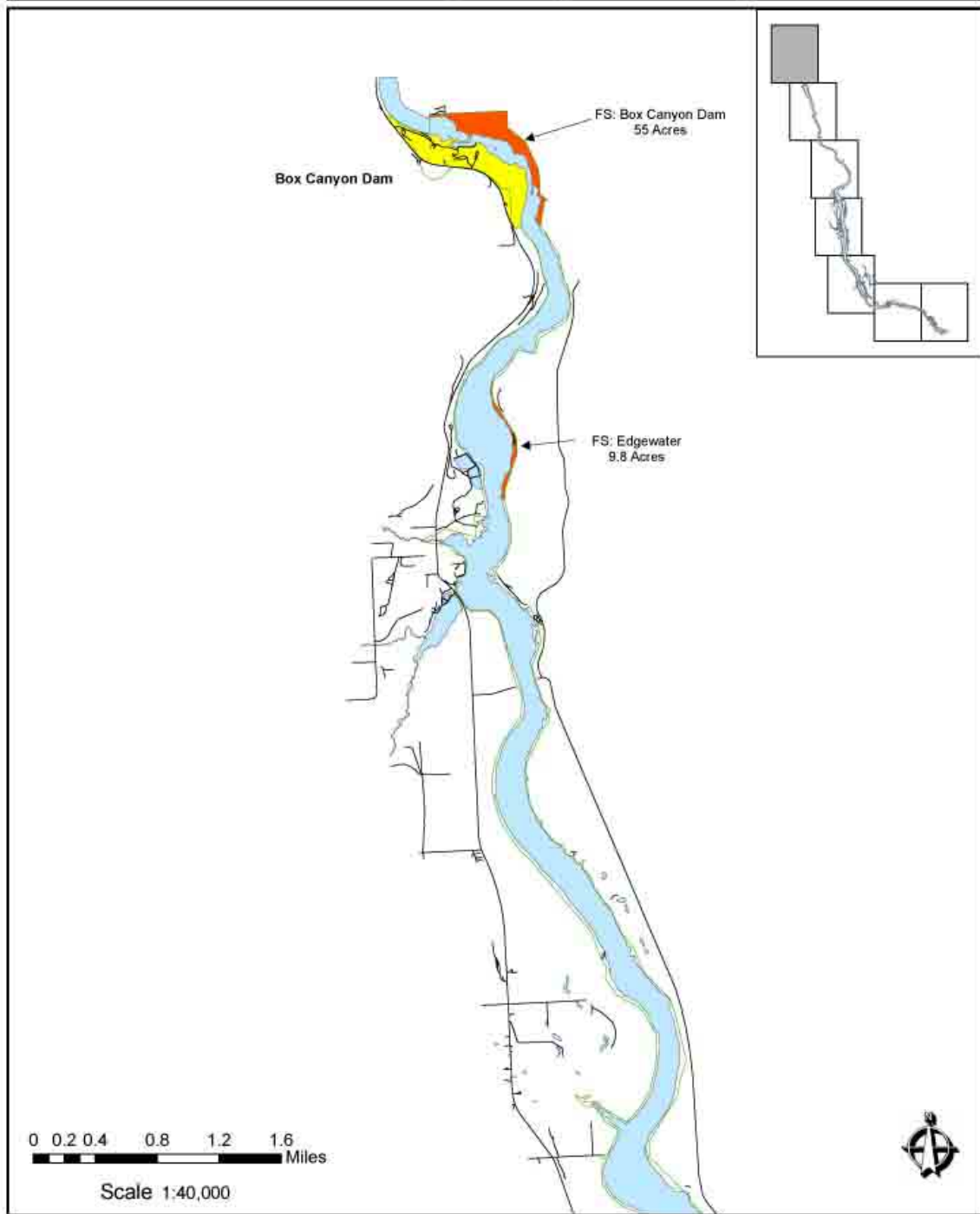
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Appendix B

**District Properties and National Forest System
Lands within the Box Canyon Project Boundary**

Pend Oreille PUD Ownership and National Forest System Lands within Box Canyon Project Boundary



Acreages reflect National Forest System
Lands within the
Box Canyon Project Boundary



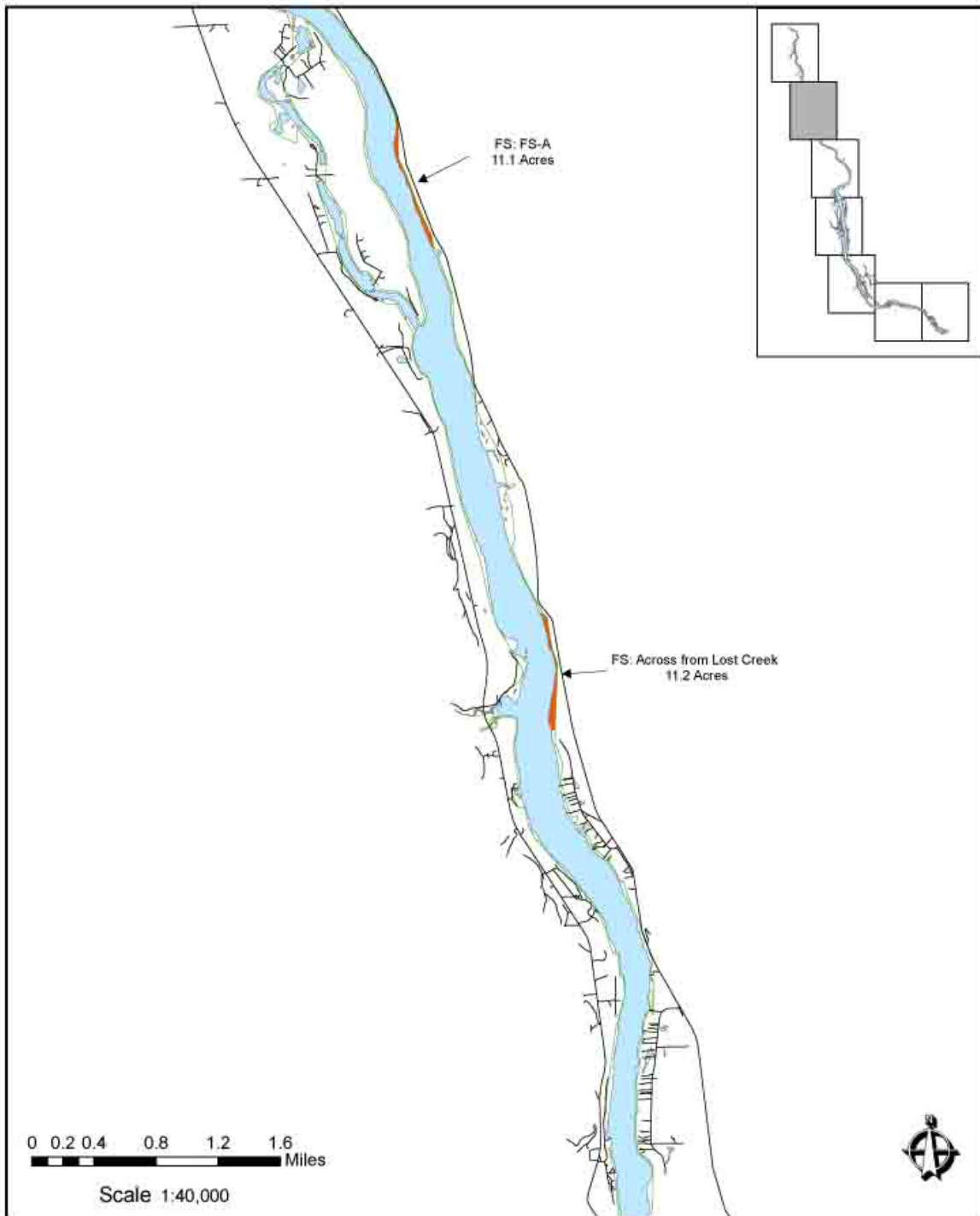
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Consulting Engineers, Architects, & Planners, Inc.

Legend

- Box Canyon Roads
- Project Boundary 2006
- National Forest System Lands
- PUD Properties
- Shoreline Boundary



Pend Oreille PUD Ownership and National Forest System Lands within Box Canyon Project Boundary



Acreages reflect National Forest System Lands within the Box Canyon Project Boundary



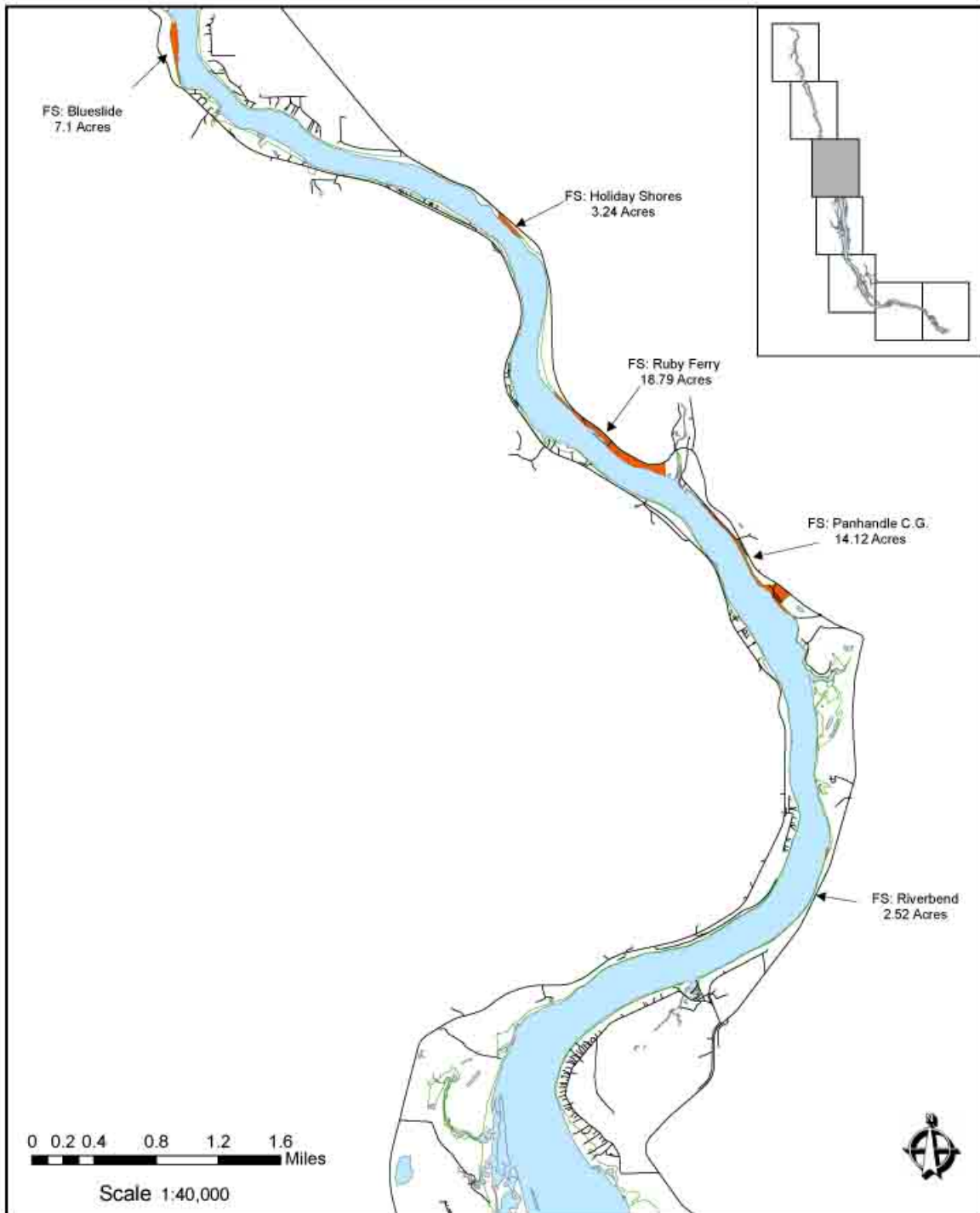
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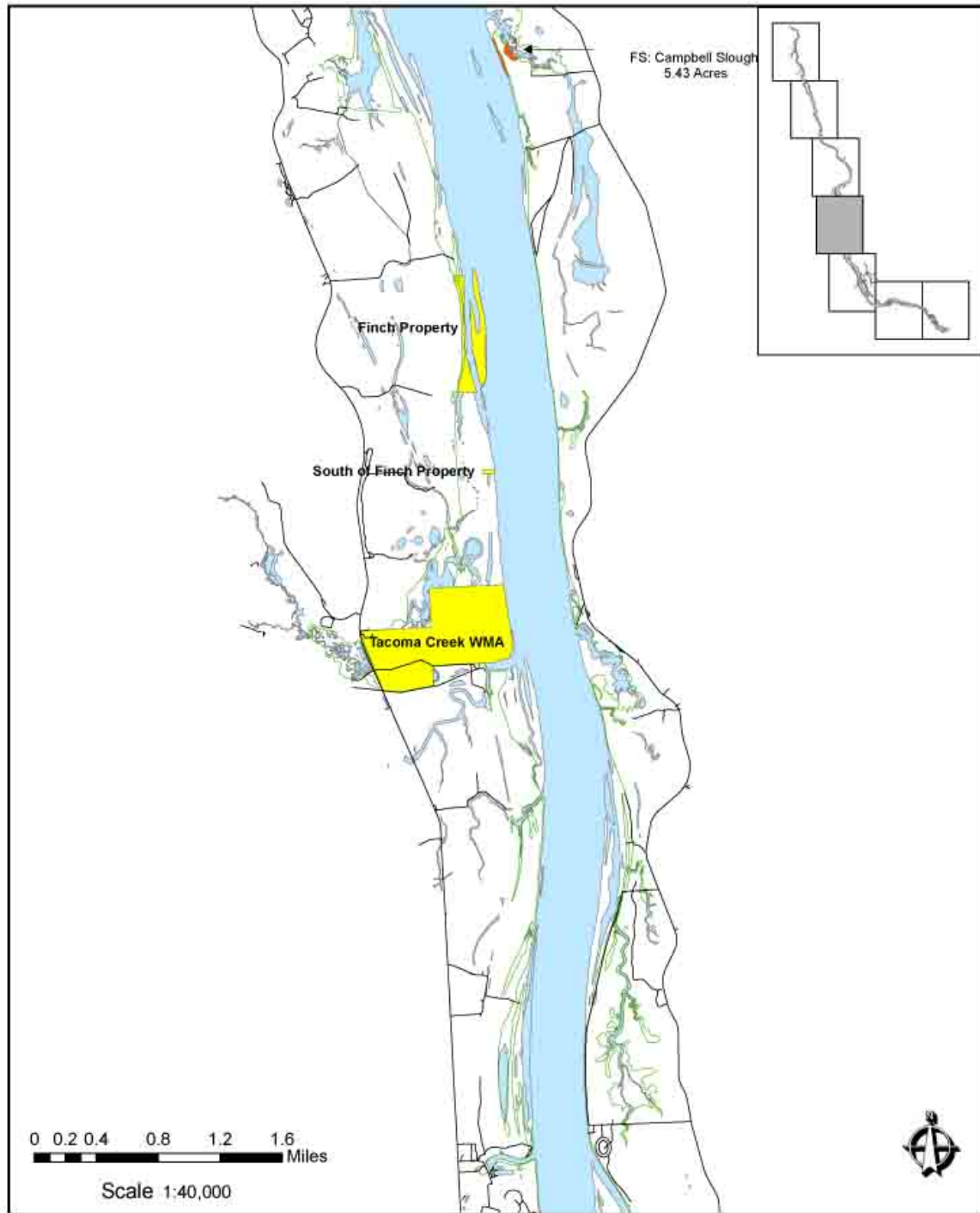


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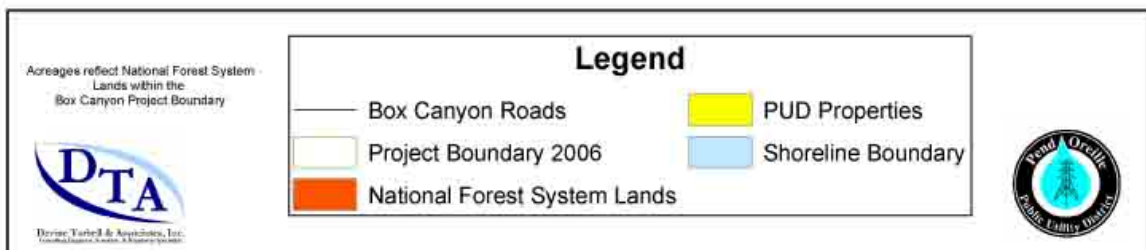
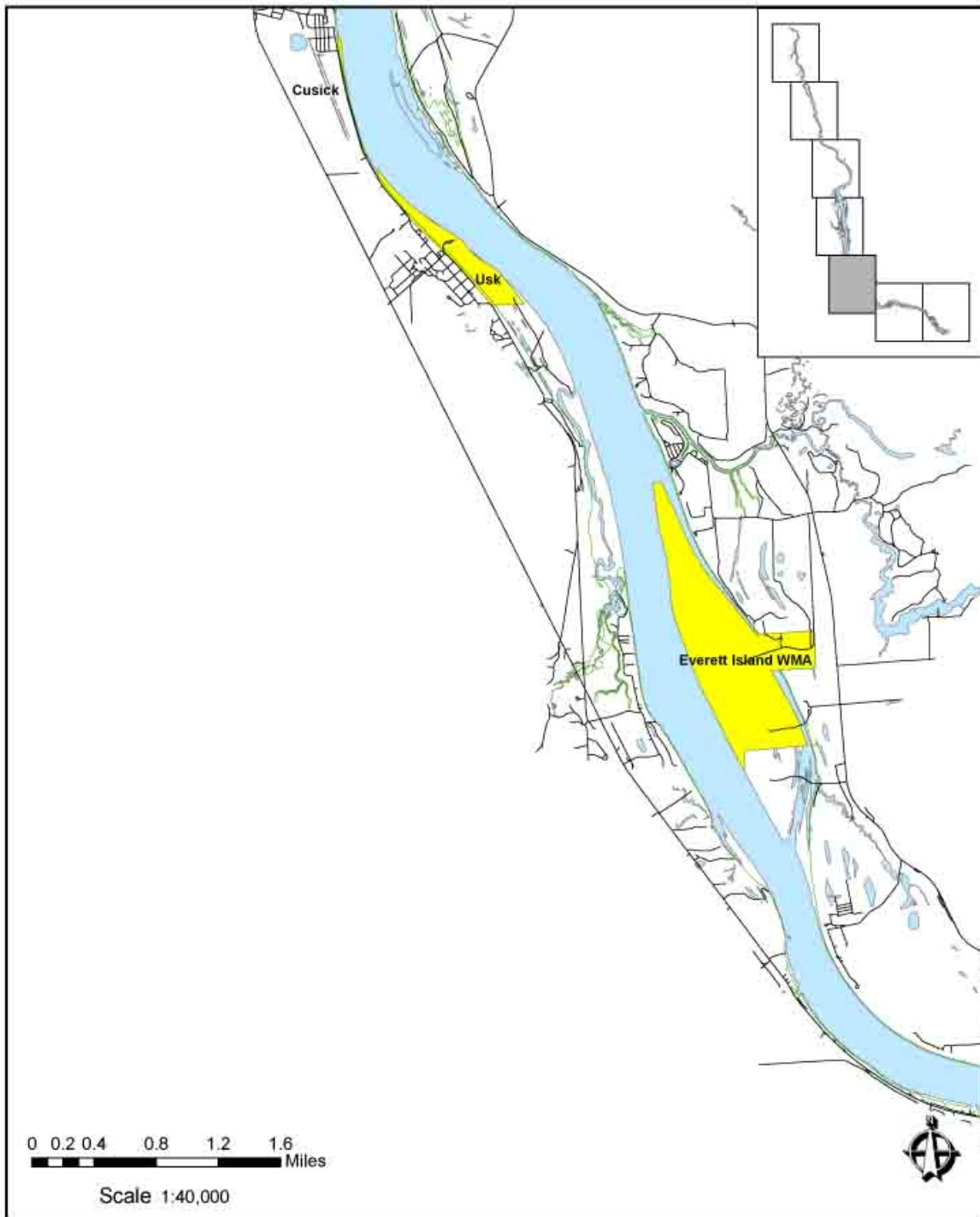
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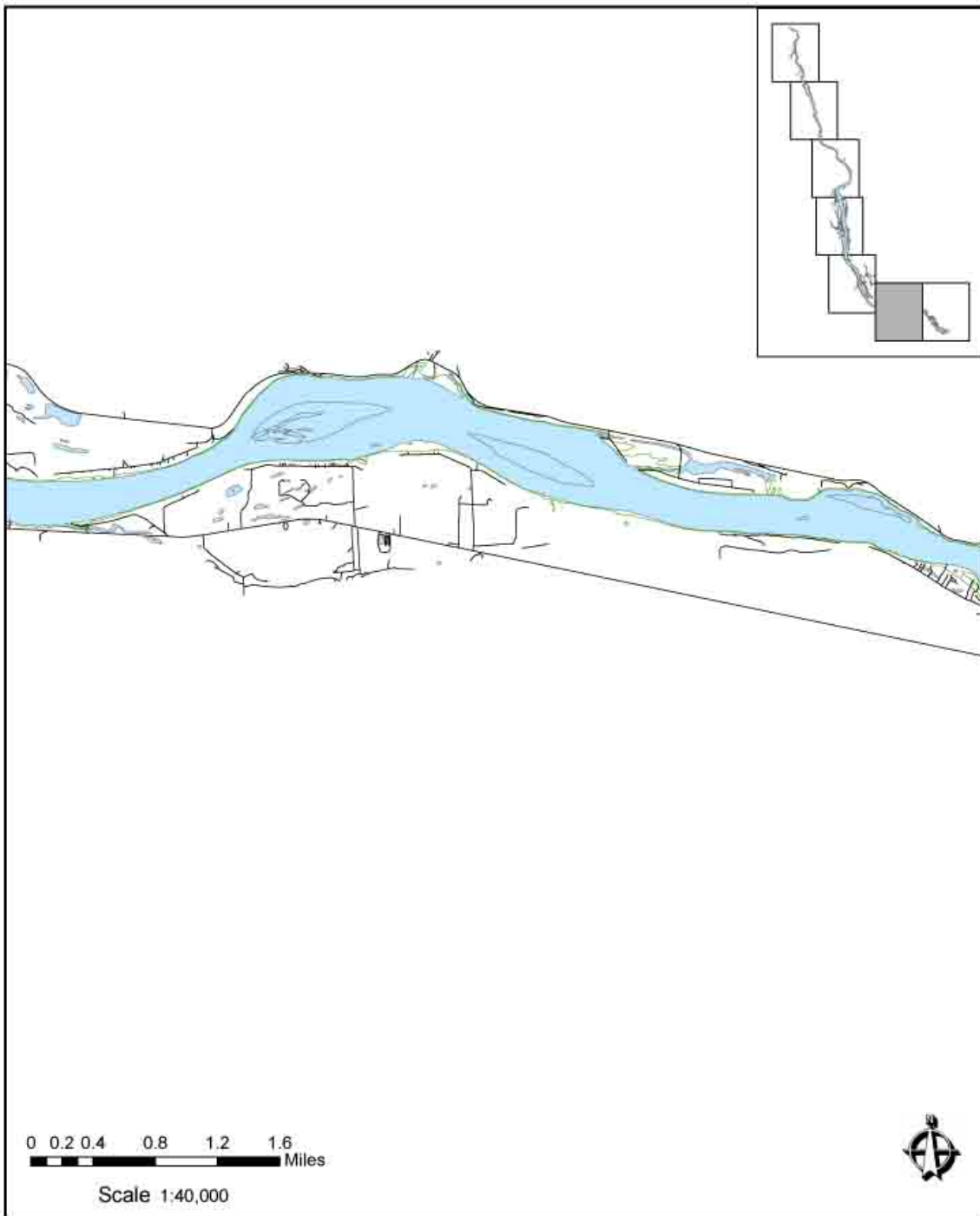
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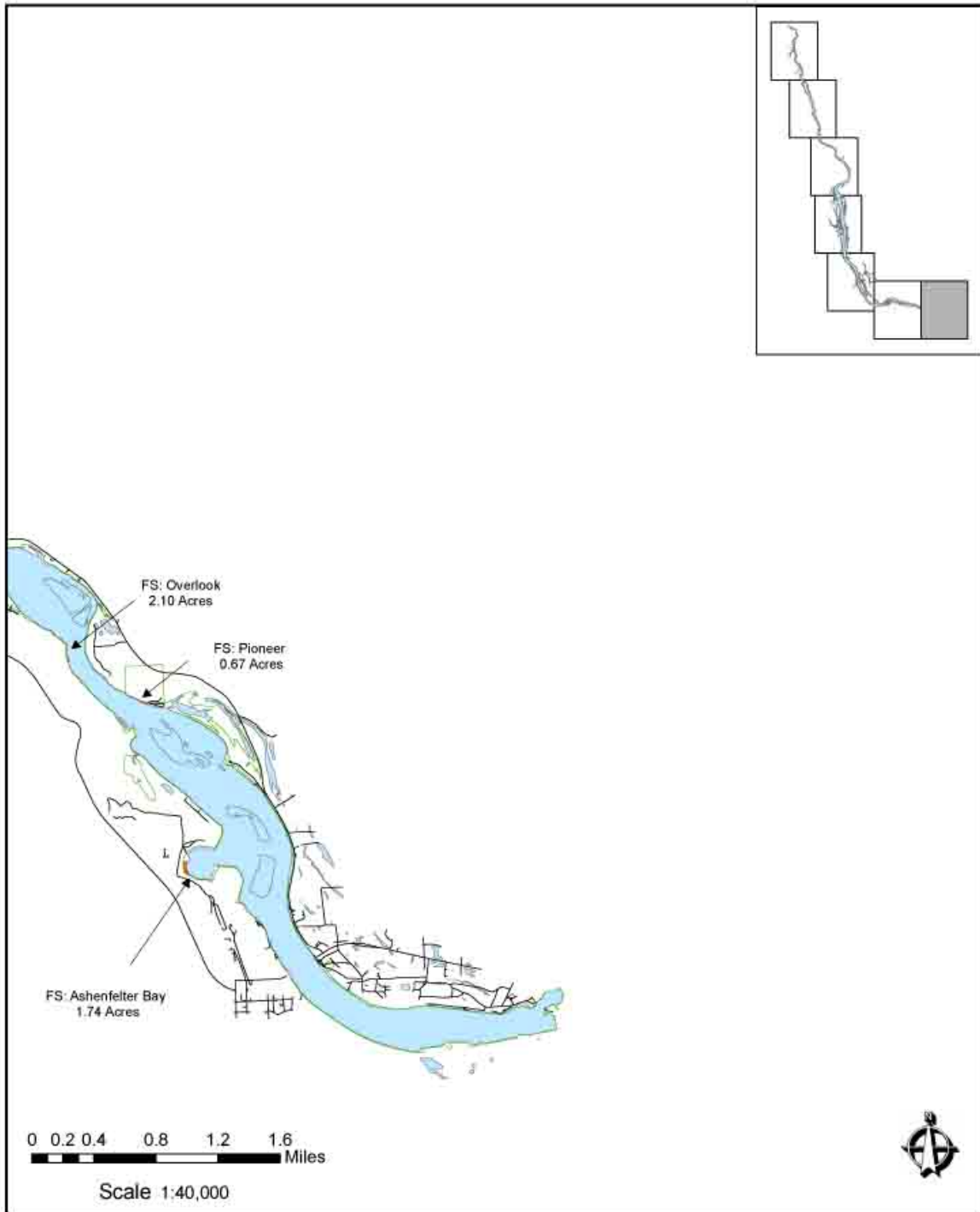


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