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CARDD

MEPA ROUTING MEMO

To: Mark Bostrom

Through: Demi Blythe

From: Jorri Dyer on behalf of Heidi Anderson-Folnagy

Re: Adoption Decision for Salish Kootenai College

Project Sponsor: Salish Kootenai College

Name of Project: Flathead Lake Flowering Rush Controls Project

Agreement No: RITA-19-8875

Memo:

DNRC can issue an Adoption Decisions for the Bureau of Indian Affairs' Finding of No Significant Impact Environmental Assessment for the Salish Kootenai College Flathead Lake Flowering Rush Controls Project (attached). **SIGNATURE REQUIRED**

___/s/DEB___ MEPA/NEPA Coordinator Review

MNB

_____ Bureau Chief Review

_____ Division Administrator Signature

_____ Post for _30_ Days on DNRC's Environmental Docs page.

_____ File

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NATURAL RESOURCES
AND CONSERVATION

GREG GIANFORTE, GOVERNOR
1539 ELEVENTH AVENUE

STATE OF MONTANA

DIRECTOR'S OFFICE: (406) 444-2074
FAX: (406) 444-2684
PO BOX 201601
HELENA, MONTANA 59620-1601

DECISION NOTICE
ADOPTION OF EXISTING ENVIRONMENTAL REVIEW

Flathead Lake Flowering Rush Controls Project
April 2022
Salish Kootenai College
Flathead Reservation
Lake and Flathead Counties, Montana

Type and Purpose of Action

The purpose of the project is to assist the Confederated Salish and Kootenai Tribes (CSKT) and Salish Kootenai College Extension Program (SKCE) in meeting their primary need for managing the aquatic invasive species flowering rush.

The adopted EA addresses planned herbicide applications to control flowering rush (Butomus umbellatus) over a ten-year period from 2022 to 2032. It addresses CSKT and area landowner concerns regarding specific Flathead Lake treatment locations and provides specific mitigation to implement treatments.

Flowering rush was first reported in 1964 in Pleasant Bay on the west shore of Flathead Lake and has since become well established ten miles up the upper Flathead River and around the north shore, west shore, and south bay of Flathead Lake. Fewer spots exist along the east shore of the lake. Flowering rush is now well established in the Lower Flathead and Clark Fork rivers to Noxon Reservoir. There are several hundred acres in Lake Pend Oreille. In the upper and middle Columbia it is becoming established as small individual groups of plants, as well as in tributaries to the Columbia. The projects objectives are to reduce top growth to create open water habitat, reduce rhizome mass, and reduce small spot infestations.

Flowering rush alters previously open water habitat to closed water habitat that tends to favor invasive fish like northern pike, bass, and yellow perch. It is well documented that northern pike prey heavily on threatened bull trout and westslope cutthroat trout, a species of special concern, in Flathead Lake (Muhlfield 2007). There is considerable concern from middle Columbia River managers that flowering rush will convert Columbia River habitat that favors northern pike that prey on migrating salmon and native trout. Flowering rush interferes with recreational activities. Dense vegetation associated with heavy infestations of flowering rush make shoreline and lakefront waters non navigable and swimmable becomes restricted due to the presence of the parasite swimmer's itch that is much more prevalent in rush infested waters. Flowering rush may eventually affect property values as it continues to expand and reduce the aesthetics of lake front property.

If implementation of the proposed project successfully develops an ongoing management structure and ongoing funding can be secured, it is expected that many Flathead Lake landowners affected with flowering rush will join the project.

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Explanation of the decision(s) that must be made regarding the proposed action (i.e. approve grant or loan and provide funding):

DNRC will approve the grant to provide funding for the Flathead Lake Flowering Rush Controls Project.

Criteria for Adopting Existing Environmental Review

☒The existing environmental review covers an action paralleling or closely related to the proposed action.
☒The information in the existing environmental review is accurate and clearly presented.
☒The information in the existing environmental review is applicable to the action being considered.
☒All appropriate Agencies were consulted during preparation of the existing environmental review.
☒Alternatives to the proposed action evaluated as part of the existing environmental review effort.
☒The impacts of the proposed action been accurately identified as part of the existing environmental review.
☒The existing environmental review identifies any significant impacts as a result of the proposed action and those identified will they be mitigated below the level of significance.

Adopt

The existing environmental review can be considered sufficient to satisfy DNRC's MEPA review responsibilities. No further analysis needed.

Existing Analysis Prepared By:	**Name: Jorri Dyer** **Title: Program Specialist** **Email: jorri.dyer2@mt.gov**	**Date: 10/14/21**

Approved By:	Name: Mark Bostrom **Title:** CARD Division Adminstrator		
Signature:	DocuSigned by: Mark W Bostrom BF7A1C50B2AF4DE...	**Date:**	10/15/2021 | 11:31:05 AM MDT

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DEPARTMENT OF THE INTERIOR

Bureau of Indian Affairs

Final Environmental Assessment for the proposed Flathead Lake Flowering Rush Controls Project on the Flathead Reservation, Lake and Flathead Counties, Montana

AGENCY: Bureau of Indian Affairs

ACTION: Notice of Availability

SUMMARY: This notice is to advise interested parties that the Bureau of Indian Affairs (BIA) as lead federal agency, with the Confederated Salish and Kootenai Tribes (CSKT) of the Flathead Reservation, has prepared a final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the proposed Flathead Lake Flowering Rush Control Project on the Flathead Reservation, Lake and Flathead Counties, Montana. This notice also announces the EA and FONSI are now available in hard copy at the address below.

ADDRESSES: You may request a hard copy of the EA and FONSI by writing the BIA Flathead Agency, PO Box 40, Pablo, Montana 59855, and the Confederated Salish and Kootenai Tribes, PO Box 278, Pablo, Montana 59855.

FOR FURTHER INFORMATION CONTACT: Shana Radford, BIA Flathead Agency Superintendent, at (406) 675-2700, Jim Westerman, CSKT Shoreline Protection, at (406) 675-2700 extension 7212, and Virgil Dupuis, Extension Director, Salish Kootenai College, at (406) 275-4899.

SUPPLEMENTAL INFORMATION: CSKT, through contractual obligations to the BIA, has proposed the Flathead Lake Flowering Rush Control Project for a proposal to conduct herbicide applications and associated management to control flowering rush from 2022 to 2032 in Flathead Lake on the Flathead Reservation, Lake and Flathead Counties, Montana. The activities will occur under guidelines in the CSKT Integrated Noxious Weed Management Plan and amendments (1992/1993) and associated EA.

AUTHORITY: This notice is published pursuant to 43 CFR 46.305 of the Department of Interior Regulations (43 CFR 46 et seq.), the procedural requirements of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4371 et seq.), and in accordance with the exercise of authority delegated to the Assistant Secretary – Indian Affairs by 209 DM 8.

5-19-21

Agency Superintendent
Flathead Agency
Bureau of Indian Affairs
U.S. Department of the Interior

Date

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Finding of No Significant Impact

Flathead Lake Flowering Rush Control Project
Flathead Reservation, Lake and Flathead Counties, Montana

Based on the attached final Environmental Assessment (EA) for the Flathead Lake Flowering Rush Control Project for a proposal to conduct herbicide applications and associated management to control flowering rush from 2022 to 2032 in Flathead Lake on the Flathead Reservation, Lake and Flathead Counties, Montana, I have determined that by implementation of the agency proposed action with associated activities, and environmental mitigation measures as specified in the EA, the proposed Flathead Lake Flowering Rush Control Project will have no significant impact on the quality of the human environment. In accordance with section 102(2)(c) of the National Environmental Policy Act of 1969, as amended, an Environmental Impact Statement will not be required.

This determination is supported by the following findings:

1. Agency and Tribal Interdisciplinary Team involvement was conducted and environmental issues related to development of the Flathead Lake Flowering Rush Control Project were identified. Alternative course of action and mitigation measures were developed in response to environmental concerns and issues. Tribal community outreach was conducted (EA section 1.9).

2. The EA discloses the environmental consequences of the "proposed action" and "no action" alternatives.

3. Protective measures will be levied to protect air (Clean Air Act, as amended, 42 U.S.C. 7401 et seq.), noise, and water quality (Clean Water Act, as amended, 33 U.S.C. 1251 et seq.), as outlined in the mitigation measures (EA section 2.0 Mitigation, and sections 4.5 and 4.6).

4. The proposed action will not jeopardize threatened or endangered species (Endangered Species Act, as amended, 16 U.S.C. 1531 et seq.) (EA section 2.0 Mitigation and section 4.8).

5. There are no adverse effects on historic properties for the purpose of 36 CFR 800.9(b) by preserving archeological value through conduct of appropriate research in accordance with applicable standards and guideline (National Historic Preservation Act, as amended, 16 U.S.C. 470). Should undiscovered archeological remains be encountered during ground-disturbing activities, work will stop in the area of discovery and the stipulations of 36 CFR 800.11 will be followed (EA section 2.0 Mitigation and section 4.9).

6. Impacts to public health and safety are mitigated through implementation of safety measures (EA section 2.0 Mitigation).

7. The proposed action will not cause a significant effect to energy resources (Energy Policy Act of 2005), water resources, wetlands (E.O. 11990), or flood plains (E.O. 11988). The Flathead Lake Flowering Rush Control Project will not result in discharge of pollutants into waters of the U.S. or in surface water quality issues (Clean Water Act, as amended, 33 U.S.C. 1251 et seq.) (EA section 2.0 Mitigation, and sections 4.5 and 4.6).

8. The cumulative effects of the environment are mitigated to avoid or minimize effects of implementation of the proposed project.

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9. The proposed action would improve the economic and social conditions of the affected Indian community.

10. The Flathead Lake Flowering Rush Control Project will not have significant impacts on: natural and unique geographic features such as historic or cultural resources; park, recreation, or refuge lands; wilderness areas; wild and scenic rivers; national natural landmarks; sole or prime drinking water aquifers; prime and unique farmlands, wetlands, floodplains; national monuments; eagles and migratory birds, and other ecologically significant areas.

11. The proposed action will not produce highly controversial effects on the quality of the human environment, and will not have unresolved conflicts concerning alternate uses of available resources.

12. The proposed action will not have highly uncertain effects on the human environment or involve unique or unknown risks.

13. The proposed action will not establish a precedent for future actions with significant effects or represent a decision in principle about a consideration.

14. The Flathead Lake Flowering Rush Control Project is not related to other actions with individual insignificant but cumulatively significant environmental effects.

15. There will be no disproportionately high and adverse human health or environmental effects on minority or low-income communities (Environmental Justice E.O. 12898; Title VI of the Civil Rights Act of 1964).

16. The proposed action will not affect American Indian Religious Freedom (42 U.S.C. 1996). The action will not limit access to, and ceremonial use of, Indian sacred sites on federal lands, by Indian religious practitioners, and/or adversely affect the physical integrity of such sites (Native American Graves Protection and Repatriation Act, 25 U.S.C. 32).

17. The action will not contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area, or may promote the introduction, growth, or expansion of the range of such species.

18. The proposed action will not contribute to the disposal of solid or hazardous waste (Resource Conservation and Recovery Act of 1976; 43 U.S.C. 6901, et seq.).

19. The proposed action will not threaten a violation of federal, state, local, or tribal law or requirements imposed for the protection of the environment.

5-19-21

Agency Superintendent
Flathead Agency
Bureau of Indian Affairs
U.S. Department of the Interior

Date

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Flathead Lake
Flowering Rush Controls

Environmental Assessment
May 2021

Prepared by:
Salish Kootenai College
PO Box 70
Pablo, Montana 59855

Landowner:
Confederated Salish & Kootenai Tribes
of the Flathead Reservation
PO Box 278, Pablo
Montana, 59855

Authorization:
Bureau of Indian Affairs
Flathead Agency
PO Box 40
Pablo, Montana

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I. PROJECT PURPOSE AND NEED

1.1 **Purpose:** The federal action (40 CFR 1508.18) is the BIA approval of the Flathead Lake Flowering Rush Controls Project, which triggers BIA compliance with the National Environmental Policy Act (NEPA; 42 USC § 4321-4375) and associated regulations (40 CFR 1500-1508, 43 CFR 46). This Environmental Assessment (EA) is prepared to meet the BIA's NEPA responsibilities. The purpose of the action is to be able to implement the activities under the federal action to assist the Confederated Salish and Kootenai Tribes (CSKT) and Salish Kootenai College Extension Program (SKCE) in meeting their primary need for managing the aquatic invasive species flowering rush.

This EA addresses planned herbicide applications to control flowering rush (*Butomus umbellatus*) over a ten-year period from 2022 to 2032. It addresses CSKT and area landowner concerns regarding specific Flathead Lake treatment locations and provides specific mitigation to implement treatments.

If implementation of the proposed project successfully develops an ongoing management structure and ongoing funding can be secured, it is expected that many Flathead Lake landowners affected with flowering rush will join the project.

1.2 **Proponent**:

- Salish Kootenai College Extension (SKCE), contact Virgil Dupuis, SKCE Director
  - Project manager
- Peter Rice, Research Ecologist
  - Technical support
- Area Landowners
  - Shoreline Permits
- Confederated Salish and Kootenai Tribes (CSKT):
  - Shoreline Protection Office (SP0)
  - Environmental Protection Office
  - Tribal Historic Preservation Office
  - Tribal Fisheries Program
  - Tribal Wildlife Program
  - Tribal Council
- U.S. Army Corps of Engineers
- The State of Montana Department of Natural Resources and Conservation

1.3 Name of Project: <u>Flathead Lake Flowering Rush Controls</u>

1.4 **Type of Action:** The proposed action is to implement sequential annual herbicide treatments to flowering rush infestations during spring lake drawdown to reduce top and rhizome growth, and reduce the spread of flowering rush around Flathead Lake and down the Flathead, Clark Fork, and Columbia River system.

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1.5 **Proposed Implementation Dates**: Chemical applications would be done in April, 2022 - 2032.

Location: Littoral zone locations on the South half of Flathead Lake, Flathead Indian Reservation.

County: Portions of Lake County located within the exterior boundaries of the Flathead Indian Reservation.

Need for the Action: Flowering rush was first reported in 1964 in Pleasant Bay on the west shore of Flathead Lake and has since become well established ten miles up the upper Flathead River and around the north shore, west shore, and south bay of Flathead Lake. Fewer spots exist along the east shore of the lake. Flowering rush is now well established in the Lower Flathead and Clark Fork rivers to Noxon Reservoir. There are several hundred acres in Lake Pend Oreille. In the upper and middle Columbia it is becoming established as small individual groups of plants, as well as in tributaries to the Columbia.

Flowering rush alters previously open water habitat to closed water habitat that tends to favor invasive fish like northern pike, bass, and yellow perch. It is well documented that northern pike prey heavily on threatened bull trout and westslope cutthroat trout, a species of special concern, in Flathead Lake (Muhlfield 2007). There is considerable concern from middle Columbia River managers that flowering rush will convert Columbia River habitat that favors northern pike that prey on migrating salmon and native trout. Flowering rush interferes with recreational activities. Dense vegetation associated with heavy infestations of flowering rush make shoreline and lakefront waters non navigable and swimmable becomes restricted due to the presence of the parasite swimmer's itch that is much more prevalent in rush infested waters. Flowering rush may eventually affect property values as it continues to expand and reduce the aesthetics of lake front property.

Background documents:
Flowering Rush White Paper. Rice & Dupuis. 2019 update. Appendix E.
Flowering Rush Extension Bulletin. Mangold. 2010. Appendix F.

1.6 **Objectives**: The objectives of the proposed research are:

- To reduce top growth to create open water habitat, which will:
  - Reduce habitat favorable to invasive fish reducing competition with native fish
  - Restore boating and swimming usage of infested areas
  - Protect property values
- To reduce rhizome mass which will:
  - Reduce propagule pressure around the lake and downstream
- To reduce small spot infestations beneath boat lifts, behind breakwaters, and along shorelines to prevent them from expanding and connecting over the decades

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- To develop and maintain a data base of infestations, affected landowners, and treatment results
- To reduce habitat favorable to invasive fish
- To form a Flathead Lake Flowering Rush Controls Association that will:
    - Create a sustaining management plan for future applications, secure funding, and educate landowners
    - Engage landowners, CSKT, and State and federal agencies in the management of flowering rush in Flathead Lake
    - Encourage management in the north end of Flathead Lake and Upper Flathead River

Management Direction is Provided by the Following Documents:

- CSKT - Comprehensive Resources Plan, Volume 2, pages 2-5, Goals—Quality of Environment: "Maintain and enhance water quality by ... protecting Flathead Lake and its shoreline, protecting streams, riparian zones, and wetlands, and using environmentally safe methods to control insects and noxious weeds."
- CSKT - Integrated Noxious Weed Management Plan (INWP), 1992 and EA, 1993. INWMP, page 16, Management Areas— Critical Surface and Ground Water Areas, Management Objectives: "Protect riparian areas and wetlands from encroachment by noxious weeds while maintaining uncontaminated water supplies for humans, wildlife, livestock, fish, and other aquatic life."
- Integrated Noxious Weed Management Plan and Amendments, (CSKT 1993 b) and Environmental Assessment (CSKT 1993)
- Lower Flathead River Goals and Objectives (CSKT 1993)
- Flathead Lake Co-Management Plan (2001-2010)
- Montana Noxious Weed Management Plan (2017)
- Columbia Basin Flowering Rush Management Plan (2019)
- US Army Corps of Engineers Draft Environmental Assessment (2019)
- CSKT - Wetlands Conservation Plan for the Flathead Indian Reservation, 1999. See Page 38, Issue: Non-native species:
    - "Non-native aquatic species threaten the diversity and abundance of native aquatic species and the ecological stability of aquatic ecosystems." Species of concern and management programs are listed.
- Flathead Lake Tribal-State Co-Management Plan (2001-2010)
- SKC Extension Office 2018-2022

  Mission: *The Salish Kootenai College Extension mission is to improve the quality of life of our Tribal community with culturally appropriate, scientifically based education, demonstration, and research that sustains environmental resources and promotes healthy lifestyles for the Séliš, Ksanka and Qlispé people.*

  Goal 2. Reduce the impact of invasive species on the reservation and surrounding regional landscapes restoring productivity.

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Objective 1.1 Control and contain new invasive plants through building cooperative weed management areas.
Activities: A Montana flowering rush response developed as part of a four state, Upper Columbia Basin Conservation Area flowering rush initiative. CSKT and Flathead lakeshore owners control flowering rush.

Research

- Spatial Model of Flowering Rush in Flathead Lake (USDA-NIFA, SKCE & UM, 2009)
- Invasional Meltdown (USDA-NIFA, SKCE & UM 2011)
- Flathead and Clark Fork River Flowering Rush Inventory (MTDNRC, SKCE, 2013)
- Flathead Lake Flowering Rush Inventory (USDA-NIFA, SKCE ongoing)
- Flowering Rush Bio-Controls Program (Ongoing partnership of Washington State University, University of Montana, Salish Kootenai College, including numerous state and federal partners from Oregon, Washington, Idaho, and Montana)
- Flowering Rush Sequential Treatments (MTDNRC, SKCE & UM, 2015-2021)
- Developing an Integrated Management Strategy for Flowering Rush *Butomus umbellatus* (USFS, SKCE & UM)

Previous Environmental Assessments

- Proposal to Evaluate Flowering Rush Treatments—Various Herbicide Types and Concentrations, and Mechanical Removal, Checklist Environmental Assessment. Rose Leach signed 14 May 2008, at http://www.cskt. org/tr/nrd.htm
- Proposed Sequential Herbicide Treatments to Flowering Rush. Categorical Exclusion Checklist. Rose Leach signed July 23, 2010.
  Proposed Flowering Rush Treatments-Polson MT. Flathead Indian Reservation. Checklist Environmental Assessment. Signed April 14, 2011.

Regional Flowering Rush Plans and Environmental Compliance

- US Army Corp of Engineers Draft Environmental Assessment Flowering Rush Control in Washington, Idaho, Oregon, and Montana. 2019. Appendix G.
- Columbia Basin Flowering Rush Management Plan. 2019. Appendix H.
- US Army Corps of Engineers Biological Opinion. 2019. Appendix G

Funding Sources

- US Army Corp of Engineers, Aquatic Invasive Species Control Program, Controls
- MTDNRC, Aquatic Invasive Species Grant funds, Controls
- USDA-NIFA, Tribal College Research and Extension Programs, Planning and Education

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1.7 Related laws, regulations, and other agencies involved:

- CSKT Shoreline Protection Office (SPO)
- CSKT Tribal Historic Preservation Office (THPO)
- CSKT Natural Resources Department (NRD)
- The US Army Corps of Engineers (ACE) completed a Draft Regional Programmatic Flowering Rush Controls Environmental Assessment and endangered species consultation with the US Fish and Wildlife Service (FWS) for compliance with the Endangered Species Act (ESA, Appendix G).
- The US Environmental Protection Agency issues a Pesticide General Permit (PGP) in Indian Country in the State of Montana. The project proponent will file an electronic Notice of Intent (eNOI). The applicant and contractor will follow applicable conditions found in the Integrated Noxious Weed Management Plan and Amendments (Plan, CSKT 1993) and the Herbicide Handling Plan for Flathead Lake Flowering Rush Control Projects (see Appendix A).
- Section 7 of the Endangered Species Act (ESA; 16 U.S.C. 1531 et seq.) of 1973 as amended, and its implementing regulations found at 50 CFR 402, require federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat. SKCE would consult with The Tribal wildlife and fisheries management programs to assess effects to threatened and endangered wildlife and fish species, and to determine if consultation with the US Fish and Wildlife Service, as required by the Endangered Species Act, would be needed.

1.8 **Determination to be made:** This proposal has been presented to the CSKT Tribal Council for concurrence to proceed with NEPA analysis of the proposed flowering rush controls. The BIA, Flathead Agency, Superintendent must decide if more analysis is needed, or if the action can go forward with this level of analysis.

1.9 **SUMMARIZE SCOPING, EXPLAIN RELEVANT ISSUES:**

- The Tribal Council of the Confederated Salish and Kootenai Tribes were briefed on the Flathead Lake Flowering Rush Project on December 3, 2019. A public scoping meeting was held on December 10, 2019. Tribal resource specialists were scoped for issues in three separate meetings. These included a Department Head Coordination meeting on October 23, 2019 and two scoping meetings at the Natural Resources Department on December 11, 2019 and January 7, 2020. During these meetings questions were raised about the toxicity of herbicides (including the north end of the lake and lower Flathead River), and what process would be involved in forming a Flowering Rush Weed Management Area. Our responses to these and other concerns are summarized in Appendix I. Additional mitigation specific to wildlife are included in Section 2.0, Mitigation Measures. No other issues were identified that are not resolved by the standard features or mitigation measures listed in Section 2.0. All written comments and

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input from resource specialists are contained in the NEPA file for this project and available upon request.

- Priority for treatments were identified as;
  1. Lower Flathead River above the dam to lessen propagules entering the irrigation system through the Pablo Pumping Plant and flushing over the dam,
  2. High boat traffic and recreation areas to reduce spread by boats and lessen impacts to recreation,
  3. Leading edge of large infestations and spot infestations that are likely to grow together into large patches,
  4. Large patches in East, Elmo, and Dayton Bays.
- The Draft EA was forwarded for comments to the BIA - Northwest Regional Office on December 30, 2019. A copy of their comments and our responses are contained in Appendix I. The EA has been updated based on these recommendations and input from the Tribal Natural Resources Department.
- A local newspaper ad was published in the CharKoosta, Valley Journal, Missoulian, and Daily Interlake on December 4, 2019 to scope the public for issues and request input on the proposed research activities and Draft Environmental Assessment. Additionally, a newspaper notice announcing the availability of the Draft Environmental Assessment for public review and comment was published in the CharKoosta, Missoulian, and Daily Interlake on January 16, 2020. We received no public comments on the Draft EA.

1.10 LIST OF PERMITS NEEDED

- **The participant landowner must apply to the Tribal Shoreline Office for a Tribal Shoreline** permit (Ordinance # 64A). The applicant and contractor would implement measures listed on any permits received.

401 Certification from CSKT Water Quality Program, **EPA Pesticide General Permit (PGP).**

- SKCE would file a Notice of Intent for control and research projects and obtain a PGP, if required, prior to implementing the project. The proposal will comply with both the general conditions of the PGP and the CSKT special conditions found in Section 9 of the PGP. See Appendix A Herbicide Handling Plan for CSKT Section 9 Special PGP Provisions and Standard Practices to be followed when Flathead Lake Flowering Rush Controls are implemented. SKCE must submit any requested material to the Tribal NRD, including a copy of the completed contract 30 days prior to the application start date.

- **Cultural and Historic Site Review.** Section 106 of the National Historic Preservation Act (NHPA) as amended, and its implementing regulations found at 36 CFR Part 800, require federal agencies to identify cultural resources for a federal action. Project proponents will submit an annual work plan to the Tribal Historic Preservation Office who will review and provide guidance on proposed actions to avoid and minimize potential impacts to historic properties. In the rare circumstance where an impact may occur, the proponent will cease all work until resolution of the effect through the development of appropriate mitigation measures or appropriate changes to avoid impacts where possible.

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- **II. THE ALTERNATIVES**

2.0 Description of the Alternatives:
Alternative A, No Action.

- The No Action Alternative includes the BIA not approving the proposed flowering rush controls project and SKCE and landowners would not conduct treatments to help control flowering rush on the Flathead Reservation portion of Flathead Lake at this time.
- This alternative doesn't meet the Purpose and Need of the proposal.
- Grant funding that has already been secured would go unused.
- This would not preclude proposing this or other actions at some future time.

Alternative B Proposed Action (Preferred Alternative). Features of the proposed action include:

- The Preferred Alternative includes the BIA approving the proposed Flathead Lake Flowering Rush Controls Project. It also includes the BIA and SKCE implementing the activities under this proposal. This Alternative does meet the Purpose and Need of the project.
- The aquatic herbicides Imazapyr or Imazamox would be applied with methylated seed oil surfactants approved for aquatic application (Current research indicates that annual treatments reduce top growth for one growing season up to 95%, and after six years of sequential treatment rhizome mass has reduced by approximately 80%. See Appendix E).
- Individual contractors would be hired through a competitive bid process to perform herbicide applications.
- Herbicides would be used to treat approximately 40 to 200 plus acres per year of flowering rush patches that occur in large to small infestations in the Flathead Lake littoral zone (see Storymap at https://arcg.is/1Tzyzb).
- Site-specific maps, available as GIS layers usable on I-Pad and ArcGIS , are attached as Appendix C. Herbicides would be applied by:
    - Handgun fed with tanks attached to ATVs on the shore.
    - Handgun fed with tanks attached to an air boat stationed on the shore.
    - Boom sprayer attached to track-equipped ATV's.
    - Backpack sprayer.
- The provisions from the Herbicide Management Plan for Flowering Rush Controls (Appendix A) would be used for mixing, loading, handling, transporting, and applying herbicides and managing herbicide spills. This plan contains alternative provisions from the CSKT Noxious Weed Management Plan that will allow hauling and mixing of aquatic herbicides on boats and mixing of aquatic herbicides for ground applications within 500 feet of water. CSKT special provisions to the US EPA Pesticide General Permit would apply that permits mixing and loading within this 500 feet with mitigations that are included in Appendix A.
- Nurse Trucks would haul water and products to application sites.

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- Contractors would have equipment inspected by the CSKT Office of Pesticides and inform them of application schedules.
- Contractors would maintain herbicide application records and GPS data for application sites and make them available to the CSKT Office of Pesticides and SKCE.
- Landowners would notify the CSKT Shoreline Protection Office for use of hand tools on the bed of the lake to drain ponded water prior to applications.
- Treatments would be paid for by funds from the State of Montana Department of Natural Resources and the Army Corps of Engineers. Depending on the number of landowners signing up for the program and the amount of treatment funds, landowners may be asked to contribute an equitable portion in order to treat more area.
- From mapped infestations shown in Figure 1, actual treatment sites would be determined in scoping meetings with CSKT and area landowners including the State of Montana, municipalities, private landowners, and tribal members holding leases or trust land.
- Participating landowners would obtain shoreline protection permits as needed.

Mitigation Measures

Operational

Project operations would comply with the following conservation measures contained In the U.S Army Corp of Engineers, Draft Programmatic Environmental Assessment, June 2019, as they provide comprehensive mitigation for flowering rush herbicide applications.

- **General Practices**:
  a. Licensing/Certification: All applicators shall be state licensed or certified, or under the direct visual supervision of a state licensed or certified applicator.
  b. All applicators shall comply with all applicable federal, state, and herbicide manufacturer's directions, and requirements for handling pesticides, including storage, transportation, application, container disposal, and spill cleanup.
  c. Herbicide application shall be according to the chemical manufacturer's label recommendations for best results. Applicators shall use caution to minimize the application of herbicides to non-target species and structures within the application areas.
  d. Clean and inspect all mechanical equipment after using in a waterbody. Post proper signage and notices in treatment and adjacent areas warning of potential chemical exposure through contact, ingestion, or inhalation during activities such as walking, boating, fishing, or swimming according to product labels.

- **Calibration/Maintenance**:
  a. All application equipment (e.g. booms, back packs, etc.) shall be properly calibrated according to the chemical manufacturer's suggested application rates printed on the

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chemical label prior to use. Equipment and settings shall be properly maintained for the duration of the contract performance period.
b. Dyes shall be used to reduce the potential for over-application.
c. Appropriately sized nozzles shall be used to minimize the potential for drift.
d. Application equipment would be maintained to ensure proper application rates, minimize leakage, reduce drift, and ensure applicator safety. Equipment would be maintained, and visually inspected prior to each application.

- **Spill Management**:
  a. All applicators shall carry a Spill Prevention and Control Plan. The Plan shall provide detailed descriptions on how to prevent a spill or ensure effective and timely containment of any chemical spill. The Spill Prevention and Control Plan shall include spill control, containment, clean up, and reporting procedures.
  b. A spill kit must be available to all applicators and shall be within 150 feet of the application site.
  c. Equipment refueling will not occur within 100 feet of open water. This includes ATVs, trucks, and tractors.
  d. All concentrated or mixed solution pesticides shall be placed in locked storage in closed containers with watertight lids and placed in secondary containment vessels of 100% plus freeboard (worst annual rain event, which for this area is one inch over a square yard, which equals 2.385 gallons). A good rule of thumb is 110% of capacity.
  e. All mixing for spray bottles, and backpack sprayers shall be done within secondary containment of 110% capacity of the liquid.

- **Disposal:**
  a. Disposal of waste materials shall occur in accordance with the label and in accordance with all applicable Federal, state, and county laws regulations, as well as label restrictions and instructions.

- **Water Quality:**
  a. Only aquatic approved herbicides and surfactants would be used near “live” waters areas with shallow water tables. Herbicides would not be applied directly to water.
  b. Contractors would apply the herbicide products to dormant and emerging flowering rush plants while the lakebed is de-watered during early spring between March 1 and May 10 depending on winter and spring conditions.
  c. Anti-siphon equipment would be used to pump lake water into chemical tanks for mixing.
  d. The contractor would not apply herbicides to ponded or flowing water and would maintain a one-foot no-spray buffer around streams entering the lake and crossing the treatment zones.

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- Herbicide applications will be conducted only by persons licensed in the proper use of aquatic herbicides.

Nontarget Vegetation and plant species of special concern.

- To minimize impact on non-target vegetation and locations, herbicide will not be applied during temperature inversions, when wind speed exceeds 10 mph, and when air temperature exceeds 85 degrees Fahrenheit.
- Herbicide will not be applied to outside of flowering rush infestations. Flowering rush does grow at times intermixed with native vegetation. The native vegetation will be killed when treating flowering rush intermixed with native vegetation.
- Bulrush patches are being invaded by flowering rush. Herbicide applications will only be applied up to the edge of bulrush patches.
- No herbicide will be applied within 10 ft. of a plant species of special concern. From 10 to 100 ft. herbicides will be applied by a hand gun only.
- Applicators and field personnel will be informed of and trained to identify known plant species of special concern.

Recreation

- Signs would be posted at public access locations to notify the users of herbicide applications in the immediate area.

Water

- Applications of imazapyr would not occur within ½ mile of active potable drinking water sources. The participant application form asks whether potable drinking water is taken from the lake.
- Herbicide applications would comply with herbicide label requirements and direction from herbicide professionals to meet requirements (see Appendix A for specific direction on treatments near irrigation intakes).
- Observable water intake locations in the vicinity of treatment areas are mapped and will be provided to contractors, landowners, and CSKT.
- Concentrations of imazamox and imazapyr would be within label specifications, so no further mitigation would be needed related to potable water.

Fish, Wildlife, Amphibians

- All equipment used on-site would be pressure-washed to remove or reduce the potential for noxious plant seed dispersal and to prevent **Whirling Disease** dispersal.
- Boats and aquatic ATV's will be pressure washed and inspected for Aquatic Invasive Species prior to use.
- For the **grizzly bear**:
    a. All operations would be confined to daylight hours.
    b. Grizzly bear sightings and any bear-human conflicts as well as mountain lion conflicts would be reported to the CSKT Wildlife Program within 24 hours. Food items would be stored in closed vehicles.

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- Contractor's would comply with the following provisions when operating near active bald eagle nest site:
    a. If using a boat, move slowly and maintain no wake speeds.
    b. For all applications, work would begin farthest away from nesting sites and then gradually move toward the nest.
    c. Activities would not occur within 1/4 mile of an active bald eagle or swan nesting site. Evaluation of such conflict sites would be conducted annually to determine the active status of nesting bald eagle and swan sites.
- The CSKT Wildlife Program would be notified immediately if lethargic or dead **amphibians** are found following herbicide applications.
- Consultation with the CSKT Wildlife Program would be maintained throughout the project to identify and follow measures to avoid potential conflicts with bald eagle and swan nesting sites.

2.1 Other Alternatives Considered:

- There are limited control alternatives. The University of Montana (UM) has screened all aquatic herbicides available in greenhouse bucket trials and did not identify better control options than the two selected for this project. UM and SKCE with partner Lake Restoration tested three herbicide water column injection treatments in Flathead Lake with limited single year control results and no multiyear controls.
- An Aquatic Vegetation Rake (AVR) has been developed that excavates the rhizomes effectively to approximately the depth of six inches. This is an appropriate use for irrigation ditches and man-made structures but is not a likely candidate for use in natural water bodies. Hand removals are effective; however, they are labor-intensive, require multiple attempts, and highly dependent on skilled persons conducting the removal.
- Bottom barriers of weed block that allow gas exchange have been tested. These mats suppress flowering rush where they are placed only. Flowering rush beneath the mats remains viable and grows from under the mat edges. They require considerable management and monitoring by landowners which is burdensome. There are several non-permitted black plastic barriers in Flathead Lake. These barriers block gas exchange, cannot be removed, and are not permitted by CSKT Shoreline Protection Office.
- Burning is not valid as the top growth in spring is very wet and will not carry fire, and the reproductive rhizome would not be affected. Steam injection has been suggested, but not tested. The steam treatments would have to be intense enough to destroy the rhizome, and all other life to a depth of at least six inches in the lakebed.
- A biological control development project is underway and has identified potential biological vectors that are undergoing several years of evaluation and, if efficacious, several more years for release approval.

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III. AFFECTED ENVIRONMENT

- Descriptions of pertinent Affected Environments follow. Flathead Lake environments have also been described in the CSKT Comprehensive Resources Plan.
- (updated August 2015), the Flathead Lake and River Co-Management Plan (2001 - 2010), Lower Flathead System Fisheries Study, Final Report (June 1988). Readers are encouraged to reference these documents for information on other lake environments and values.

Vegetation: The ten-foot drawdown littoral zone of the south half of Flathead Lake has been invaded by flowering rush forming dense monocultures in East Bay, Elmo Bay, and mouth of Dayton Creek. Several marinas have developed dense flowering rush beds as well. The invasion in these situations create dense, monotypic stands in areas that were formerly open water, or a mix of open water and native aquatic macrophytes. These aquatic macrophytes tend to occupy deeper waters than the flowering rush, but they also grow in common.

Flowering rush is now well-distributed around the south end and west shore of Flathead Lake, occurring in small spot infestations of 4 sq. ft. up to 400 sq. ft., often occurring under boat launches, lifts, and behind breakwaters and marinas. Linear infestations occur along the shoreline. Other infestations are polygons ranging from less than .1 of an acre (4,000 sq. ft.) up to several acres, that occur in shallow bays. Large monocultures at East Bay, Elmo Bay, and mouth of Dayton Creek are estimated to be from 300 to 1,000 acres. We would expect the invasion on the west shore to continue to expand with patches becoming connected due to the substrate being more muck, sands, and cobbles, whereas the substrate on east shore is mostly gravels over sand in the littoral zone. The east shore has flowering rush in marinas. However, flowering rush has been found growing through 10 inches of gravel as individual plants on the east shore. Flowering rush has been detected in 20 feet of water along the west shore.

Approximately 250 acres of flowering rush have been mapped in small spots and patches (Appendix C). As of January 2021 landowners have signed up to treat approximately 150 acres, not including large patches in East Bay, Elmo Bay, or Dayton as additional field information and interdisciplinary team review is needed to assess those patches.

Native Vegetation: Native aquatic vegetation was termed “limited” or 5.4% vegetative cover in South Bay of Flathead Lake in the 1985 Lower Flathead System Fisheries Study. The Lower Flathead System Goose Study in 1985 sampled vegetation conditions at several locations in South Bay, East Bay, Elmo Bay, and the Lower Flathead River where flowering rush had a frequency of occurrence of .09% to .1%. Flowering rush has since significantly increased. Submersed and emergent native vegetation in Flathead Lake consists largely of:

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Sago pondweed	*Potamogeten pectinatus*
Common Elodea	*Elodea canadensis*
Coontail	*Ceratophyllum demersum*
Northern Watermilfoil	*Myriophyllum sibiricum*
Richardson's Pondweed	*Potamogeton richardsonii*
Hardstem Bulrush	*Schoenoplectus acutus*
Cattail	*Typha spp*
Mare's tail	*Hippuris vulgaris*
Bladder wort	*Utricularia spp*
Flowering rush	*Butomus umbellatus*

Cultural Resources. The project area contains archaeological, historic and cultural resources of significance to the Tribe. Potential impacts to these will be identified during the annual work plan development and avoidance measures identified in consultation with the Confederated Tribes of the Salish and Kootenai Tribal Historic Preservation Office.

Wildlife. The Flathead Lake shoreline has an abundance of wetland, riparian, and mixed forest and grassland environments that provide habitat for numerous species of mammals, birds, and reptiles.

Mammals such as moose, bears, muskrats, otters and beavers rely on associated wetlands, riparian areas, and streams for feed, hiding cover, and drinking. Bats forage on insects above water and mixed grass and forest lands along the shoreline provide habitat for deer, lions, cats, racoons, and several other wildlife species.

Riparian and wetlands provide essential habitat for waterfowl and migrating birds. These and other shoreline locations provide food and resting and nesting sites for many species of hawks, owls, heron, bittern, and swans. The bald eagle and osprey are raptors commonly seen along the shoreline where they nest, hunt, and feed.

Many reptiles (turtles, snakes and some lizards) also use riparian and wetland areas for food and cover.

In addition to threatened and endangered species discussed below, Tribal wildlife biologists are concerned about the potential effects of project activities on trumpeter swans and bald eagles.

CSKT Wildlife comments, with site specific mitigations are included in Appendix I. Maps of bald eagle and swan nesting locations have been provided and treatments and activities will be restricted when in the vicinity of active nesting sites. These maps remain on file with the CSKT Wildlife Program.

Fish. Native fish of Special Concern in Flathead Lake consist of the threatened bull trout and westslope cutthroat trout, a species of special concern. Other natives include the

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northern pike minnow, longnose and large scaly suckers, peamouth chub, and slimy sculpin. Additionally, there are three native minnow species.

Several species have been introduced since 1910. Among these, common game fish include largemouth bass, northern pike, yellow perch, pumpkinseed sunfish, rainbow trout, brook trout, and lake trout.

Flathead Lake and specific reaches of tributaries are designated as critical bull trout habitat (see map below). Bull trout will not be present near treatment sites during mid-April treatments during lake drawdown conditions. CSKT Fisheries comments are included in Appendix I.

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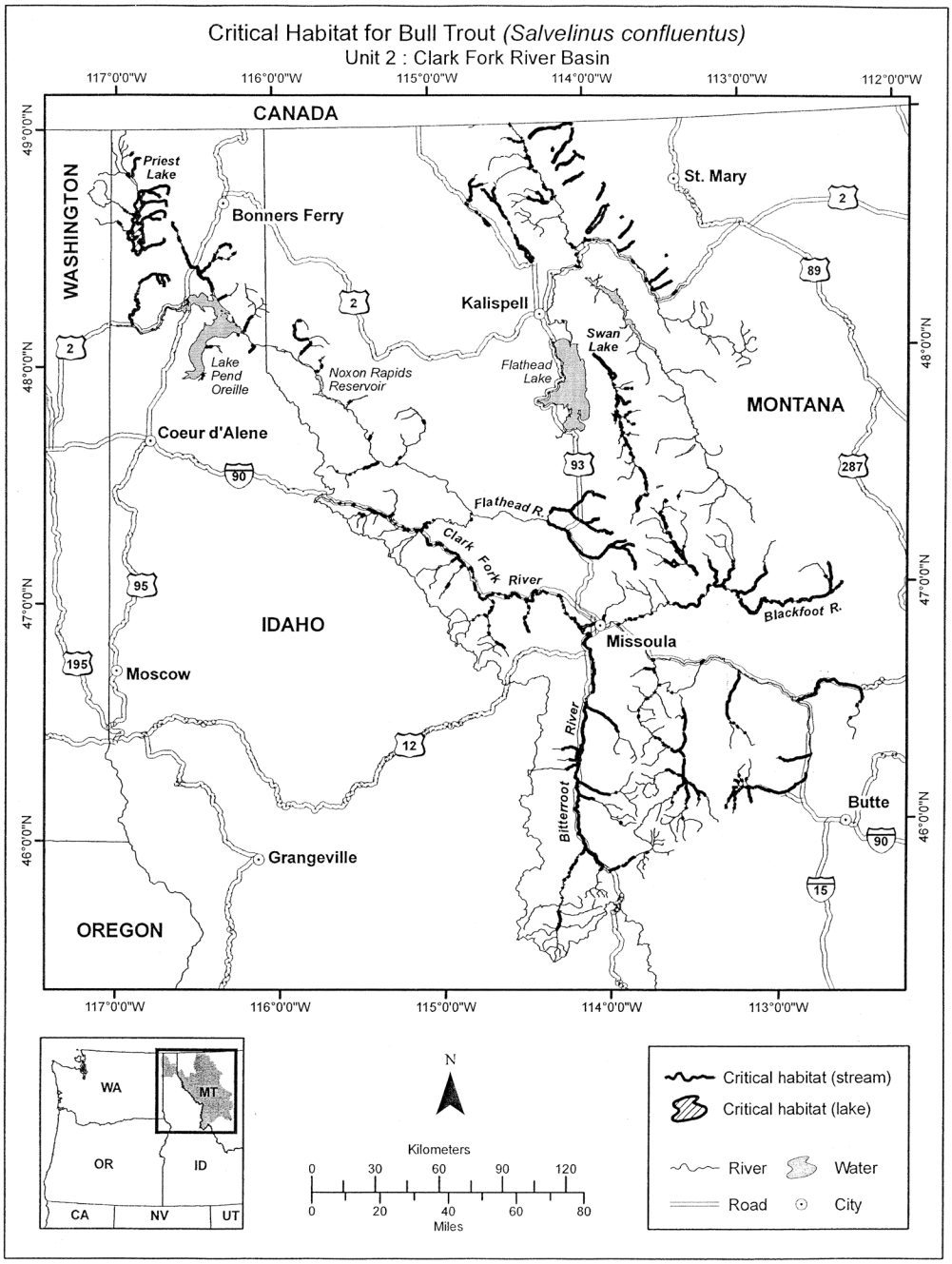

Recreation. Flathead Lake is the largest natural freshwater lake in the western U.S. and is the most used recreational resource on the Reservation. Millions of recreationalist boat, fish, camp, swim and sightsee on the lake. Community sponsored events include boat racing, fishing derbies and sail boating. Flowering rush degrades recreation creating habitat favorable for pond snails that are an alternate host for the swimmer's itch parasite that attacks swimmers. The lakeshore is heavily developed with full time and seasonal homes that are located on the lake for aesthetics and recreational values. There are no restrictions for recreational use of water bodies after treatments with imazapyr or imazamox (Appendix B).

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Threatened and Endangered Species and plant species of special concern. Section 7 of the Endangered Species Act (ESA; 16 U.S.C. 1531 et seq.) of 1973 as amended, and its implementing regulations found at 50 CFR 402, require federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat. SKCE consulted with the Tribal Wildlife Program to identify any threatened and endangered, as well as any candidate and proposed species.

Threatened or endangered species that occur within or near the project area include the:

- Bull trout
- Canada lynx
- North American wolverine
- Grizzly bear
- Yellow-Billed Cuckoo

Acorus americanus, American sweet flag, and *Carex comosa*, bristly sedge are listed as plant species of special concern by the Montana Heritage Program as occurring in some emergent zones of Flathead Lake. These plants may be present at or near proposed treatment sites. The Heritage Program list will be consulted during planning of annual treatments and during pre-treatment inspections to inform applicators to avoid such plants.

Water Quality. Researchers state that Flathead Lake remains one of the cleanest large lakes in the world's temperate regions. However, research also shows water quality has been steadily declining in the lake. Contributing causes include nutrients, siltation, suspended solids, flow alterations, organic enrichment, algae growth, PCBs, metals, and noxious aquatic plants such as flowering rush.

IV. EFFECTS ON THE PHYSICAL AND HUMAN ENVIRONMENTS

The purpose of preparing an EA is to determine whether or not the proposed action and associated activities will/may significantly affect the human environment. Analysis in this section includes all potentially significant effects/impacts (beneficial and adverse) on the components of the human environment. The analysis will concentrate on those components of the affected environment that will truly be affected.

4.1 Definitions:

The **Project Area** includes the immediate area(s) identified by inventory around the south end of Flathead Lake that may experience the treatments. Actual treatment sites will be determined with input from the public, Confederated Salish and Kootenai Tribes, and interested stakeholder landowners, and agencies.

- **Direct and Indirect Effects** (from CEQ regulations in Title 40 CFR 1508.8):
  - **Direct effects:** are caused by the action and occur at the same time and place.

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  - **Indirect effects:** are caused by the action and occur later in time or farther removed in distance but are still reasonably foreseeable.
  - Duration of effects (e.g., **short-term, long-term**) may or may not be discussed for a given issue. If mentioned, short- and long-term may be defined for clarity when they appear in the text.
- **Cumulative effects** (from CEQ regulations in Title 40 CF 1508.7) accrue in the Cumulative Effects Analysis Area (**analysis area** or **CEAA**).
  - **Cumulative effects:** result from the incremental effects from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency, group, or person undertakes them.
- The **Cumulative Effects Analysis Area (CEAA)** is defined by and appropriate to each relevant issue.
- The CEAA may be the same area for several issues, or it may differ.
- For this proposal, the CEAA was generally based on the surrounding vicinity of the project areas which are primarily private lakeside homes, parks, commercial marinas, and vacant lands.
- In the CEAA:
- Tribal lands in the vicinity of Flathead Lake would continue to be managed as Tribal homesite leases, commercial marinas (Blue Bay, Kwa Taq Nuk, Polson Marina, Big Arm Marina). State Parks and Fishing Access sites including Yellow Bay, Big Arm, Walstad, Finley Point State Parks, and Ducharme Fishing Access. City parks Sacajewea, Salish Point, and the Fairgrounds would continue to be managed for recreational use.

  Timber Management Areas in the Jette, Hellroaring, and Boulder areas would be used for timber production. Tribal lands managed for other natural resource values would include Tribal mitigation-managed lands managed for wetland and riparian habitat restoration, upland, wildlife habitat, and fisheries recovery, involving KERR, ARCO, BPA, and other Fisheries Program- and Wildlife Program-managed lands. Tribal lands along the lower Flathead River would be managed as grazing lands. Federal facilities on the lower Flathead River at the Pablo Pumping Plant (source of introduction to Pablo Wildlife Refuge that are Tribally owned, would be managed as are currently, or alternatives could be developed to reduce introduction of flowering rush into the irrigation system.

  Private lands (generally, fee status) would continue as lakeside homes, or vacant lands that could be developed.

  Long term management of flowering rush in Flathead Lake depends upon establishing a Management Area with funding for planning, data base management, expanding to the north end of Flathead Lake, and cost sharing.

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4.2 ALTERNATIVE A, No Action

POTENTIAL EFFECTS

ALL RESOURCES

Unless otherwise stated below, there would be continued direct, indirect, and cumulative negative effects to wetland and riparian habitats, because:

- The sites would continue to be infested with flowering rush that would spread until dense monocultures develop where open water and native plants previously existed.
- The environmental effects of flowering rush would continue to increase providing additional habitat for invasive fish, the swimmer's itch parasite, and decreased recreational use of Flathead Lake.
- The cooperators would not be able to use their secured grant funding.

Overall

- No treatments would occur.
- There would be no short-term change from the current condition.
- Over the long-term, the rush infestation would spread.
- Future removal of this undesired species would be more expensive, involve more lakeside cooperators, and take longer to decrease populations of flowering rush than if controls occurred without delay.

4.3 ALTERNATIVE B, Proposed Action

EFFECTS ON THE PHYSICAL ENVIRONMENT

LIST of RESOURCES

4.4. GEOLOGY AND SOIL QUALITY, STABILITY AND MOISTURE:

Are fragile, compactible or unstable soils present? Are there unusual geologic features? Are there special reclamation considerations?

- Soils vary through the treatment sites from sand, mud, high organic peat soils (East Bay), and lakebed sediments (lower Flathead River).

POTENTIAL EFFECTS

There would be minor short-term negative direct and indirect effects to lakebed soils from disturbance from:

- Using ATVs and air boat to implement hand spraying would minimally impact the lakebed or shoreline areas.
- Boom applications with track equipped ATVs can cause rutting of the lakebed under wetter conditions. Ongoing research trials in Ducharme Bay with a tracked machine leave minimally noticeable tracks in the lakebed.

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- Lakebed modifications using hand tools to assist drainage of surface water permitted through the Shoreline Protection Office if allowed.
- Use of design features and mitigation measures (Section 2) would reduce short-term negative effects.
- There would be no measurable short-term negative cumulative effects, due to the small areas treated and the large area the infestation covers. No change from current conditions.

There would be long-term direct, indirect, and cumulative benefits by decreasing the canopy cover and rhizome mass of rush through the treatments.

- There are peat soils located in the East Bay area that can be considered sensitive in that the potential for getting ATVs stuck is high. Contractors would be noticed of the potential for peat soils, and to exercise caution in those areas. Air boats would be better adapted for such areas.
- While the lakebed could be considered an unusual feature, the disturbance from the tracks of ATVs and air boat would be no more disruptive than those occurring naturally from lake water movements.

4.5 WATER QUALITY, QUANTITY AND DISTRIBUTION:

Are important surface or groundwater resources present? Is there potential for violation of ambient water quality standards, drinking water maximum contaminant levels, or degradation of water quality

Potential Effects

Flathead Lake is an important surface water resource in the project and analysis areas. With design features and mitigation measures in place, there would be no measurable negative direct, indirect, or cumulative effects to water quality as a result of the proposal.

- Use of design features and mitigation measures (Section 2), and the Herbicide Handling Plan (Appendix A) would reduce the potential for any negative effects.
- The lake is large compared to the dewatered areas that would experience treatment, so effects to water quality would be difficult to measure.
- The herbicides and methylated seed oil surfactants are approved for use in aquatic environments (See Appendix B for imazamox, imazapyr, and surfactant specimen labels and herbicide fact sheets).
- The herbicides would be sprayed on the leaves and stems of the plants, and lakebed sediments where the herbicide is held suppressing the development of flowering rush, even if it does not directly hit plants.
- No water sources will be directly treated with herbicides.
- There are no municipal potable water intakes in the treatment zone. For imazamox, we would be within label compliance related to herbicide use located within 1/4 mile of active potable water sources. For imazapyr, we would be within label compliance

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related to herbicide use located within 1/2 mile of active potable water sources. All treatments are to bare ground. No treatments will be made near active potable or irrigation water removal sites.

- The proponent has identified water intakes visible from the lake, and the participant landowners will state known locations of potable and irrigation water diversions in the vicinity of treated docks and marinas.
- The proponent's treatment protocol mitigates potential impact for pesticide chemistry impact to site waters by treating prior to site inundation as the lake comes to full-pool volume. Pesticide concentrations released into the localized water column through depuration or the temporary suspension of treated sediments into the water column are expected to be negligible. In water samples taken in July of 2020, 80 days after treatment, imazapyr and imazamox were not detected in the water column six inches above the treatment surface. In samples taken after the lake bed sediments were disturbed; imazapyr was detected at .161 ppb, and imazamox was detected at .0849. Label restrictions for irrigation water concentrations are imazapyr <1.0 ppb, and imazamox <50 ppb.
- The proponent has developed treatment site water column testing protocol as outlined in (Appendix A) to run standard analysis for pesticide concentration levels of concern in water samples drawn from selected treatment sites, post-inundation.
- The proponent would provide affected landowners bottled water if needed.

4.6 AIR QUALITY:

Will pollutants or particulate be produced? Is the project influenced by air quality regulations or zones (Class I airshed)?

Potential Effects

There would be negative direct and indirect effects to the target flowering rush, an aquatic invasive weed species, from implementing the proposal.

- The proposal was designed to remove the aquatic noxious plant, flowering rush.
- Use of design features and mitigation measures (Section 2) would reduce potential negative effects to non-target species.

There would be no measurable negative cumulative effect, due to the large area that would experience no change from current conditions.

There would be long-term direct, indirect, and cumulative benefits by removing flowering rush and thereby improving vegetative conditions on sites. As rush is removed, desirable open water conditions would be improved, particularly at docks and marinas.

- As rush is removed, native plant species could recolonize the wetland sites.
- Implementing the monitoring portions of the proposal would provide information on how rush infestations respond to treatments.

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- There are no known threatened or endangered plants or cover types in the project areas.
- Desired (native) vegetative communities would not be permanently altered.
- Desired (native) vegetative communities would be enhanced as flowering rush declines and native vegetation recovers.

4.7 TERRESTRIAL, AVIAN AND AQUATIC LIFE AND HABITATS:

Is there substantial use of the area by important wildlife, birds or fish?

Potential Effects

There would be negative direct and indirect effects to the non-native plant species portion of the selected aquatic habitats, from implementing the proposal.

The proposal was designed to remove the aquatic noxious plant, flowering rush.
In this sense, the negative effects of flowering rush removal is the desired result.

Use of design features and mitigation measures (Section 2) would reduce potential negative effects to non-target (native) species.

There would be no measurable negative cumulative effects, due to the large untreated areas that would experience no change from current conditions.

There would be long-term direct, indirect, and cumulative benefits by removing the flowering rush and thereby improving vegetative conditions on the sites.

There are important birds, fish, and other native species in the project and analysis area (See Section 3 above).

Herbicide fact sheets (Appendix B) indicate imazamox and imazapyr when applied as labeled are practically nontoxic (the EPA's lowest toxicity rating) to fish, invertebrates, birds, and mammals. These herbicides do not bio accumulate in fish, birds, or mammals, and will therefore pose minimal threat to prey animals. Any toxic effect would most likely occur at or near treatment locations that encompass a small percentage of the Fathead Lake littoral zone environment.

Conditions for these species should be improved by:

- Decreasing the cover of flowering rush favored by invasive fish thereby benefiting native fish.
- Native plant loses at flowering rush treatment locations is a negative effect. With continuing flowering rush herbicide treatments, there is an opportunity for restoring native aquatic vegetation.
- Improving our knowledge of how to treat other sites dominated by flowering rush.

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Conditions for birds may be decreased by:

- Decreasing grazing opportunities on flowering rush by ducks and geese at treatment locations, however there will be ample quantities of flowering rush not treated.

4.8 UNIQUE, ENDANGERED, FRAGILE OR LIMITED ENVIRONMENTAL RESOURCES:

Are any federally listed threatened or endangered species or identified habitat present?

Potential Effects

There are five federally listed threatened and endangered species (e.g., game and non-game wildlife and fish, etc.) in the project and analysis areas. Figure 1 Summarizes project effects on these species.

Figure 1. Threatened and endangered species summary of effects.

Species	Species Determination	Critical Habitat Determination
Canada Lynx	No Effect	No Effect
Grizzly Bear	No Effect	No Effect
North American Wolverine	No Effect	No Effect
Bull Trout	No Effect	No Effect
Yellow-Billed Cuckoo	No Effect	No Effect

There would be no negative effects to bull trout or bald eagles, as a result of the proposal (see Section 4.7 above).

- Use of design features and mitigation measures (Section 2) would reduce the potential for negative effects.
- The area affected is small, compared to the areas used by federally listed fish and wildlife species.

There would be long-term direct, indirect, and cumulative benefits to lake and wetland habitats—and species that might use them—by improving vegetative conditions on the sites. Benefits would be localized, because the areas affected would be small compared to the areas used by federally listed fish and wildlife species, and Tribal species of concern.

The proposal was designed to improve conditions on these sites by:

- Removing flowering rush to reduce rhizome mass reducing propagule pressure causing continued spread, returning open water conditions from increasingly closed water systems, and restoring recreational use on portions of Flathead Lake shoreline.

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- Increasing our understanding of how to best manage flowering rush in the future and on other sites.

The BIA and Tribal Fish Biologist and Wildlife Biologist determined that the proposed actions would have 'No Effect' to ESA-listed species. See Appendix I.

4.9 HISTORICAL AND ARCHAEOLOGICAL SITES:

There are archaeological, historic and cultural resources associated with the project location.

Potential Effects

There would be no substantial direct, indirect, or cumulative effects to historical sites by the proposal.

Project proponent will develop an annual work plan to be submitted to the CSKT THPO for review and comment. Avoidance measures will be developed in consultation with the Tribal Historic Preservation Office, and all efforts made to minimize or avoid impacts. In the rare circumstance that an adverse effect would occur the resolution of mitigation measures will take place prior to implementation of the proposed actions.

4.10 AESTHETICS:

Is the project on a prominent topographic feature? Will it be visible from populated or scenic areas? Will there be excessive noise or light?

Potential Effects

There would be no negative direct, indirect, or cumulative effects to aesthetics as a result of the proposal.

There would be long-term direct, indirect, and cumulative benefits by removing flowering rush and thereby improving vegetative and open water conditions at the sites.

Aesthetics would be improved by:

- Decreasing or eliminating the coverage of a non-native plant species and the potential re-establishment of the sites with desired (native) plant species.
- Re-establishment of native species would depend on the potential seed or propagule sources in the vicinity.

The sites are generally highly visible.

There would not be excessive noise or light during or after the proposal.

4.11 OTHER ENVIRONMENTAL DOCUMENTS PERTINENT TO THE AREA:

Are there other studies, plans or projects on this tract?

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There are other environmental assessments, permits, and reports on past and current research, environmental impacts, management plans, and inventory within and outside the analysis areas.

Related documents and management plans are listed in **Section 1.3** above. The current proposal is consistent with these documents.

4.12 HUMAN HEALTH AND SAFETY:

Will this project add to health and safety risks in the area?

Potential Effects

There would be potential short-term negative direct and indirect effects to safety, by implementing the proposal.

- Use of design features and mitigation measures (Section 2) would reduce the potential for negative effects.
- The SKC Extension Program staff, Lake County staff, CSKT staff, and the research staff have been trained on proper techniques, equipment, and materials to spray or manipulate vegetation in upland and aquatic habitats.
- Contractors and staff would follow herbicide labels, current guidelines, and any other pertinent specifications for these activities.

There would be no measurable cumulative effects to health and safety, due to the large area that would experience no change from current conditions.

There would be long-term direct, indirect, and cumulative benefits to health and safety, by removing the non-native plant species from the sites and opening up dock access.

4.13 INDUSTRIAL, COMMERCIAL AND AGRICULTURAL ACTIVITIES AND PRODUCTION:

Will the project add to or alter these activities?

Potential Effects

There would be no effects to agricultural or industrial uses, because:

- The sites occur in a large lake. (The Reservation portion is approximately 65,000 acres.) The largest agricultural diversion, the Pablo Pumping Plant, is near treatment sites on the Lower Flathead River. Treatments will not be made directly to irrigation waters during irrigation season. Treatments are in low water conditions in early April. There are other known agricultural uses for cropland and orchards that treatments will not affect.

It is possible that future commercial uses related to marina development could be promoted because of this proposal?

Several private and commercial marinas, private have been identified with flowering rush. Continued unabated spread of flowering rush will affect the operation of those marinas.

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That is, there could be direct, indirect, and cumulative effects to commercial development with the proposal.

Development of marinas on Flathead Lake have been followed with flowering rush invasion. Marinas that still the water and congregate boats are prime areas for establishment of flowering rush.

These proposed methods of controlling flowering rush have been favorably accepted by several marinas on the Lake that have been implementing annual treatments with enthusiasm. The costs are not low; however the benefits have been well worth it for several participants.

4.14 QUANTITY AND DISTRIBUTION OF EMPLOYMENT:

Will the project create, move, or eliminate jobs? If so estimated number.

Potential Effects

This project presents economic opportunity for those interested in contracting aquatic herbicide application work.

The proposal in the first year will provide approximately $34,000 in gross income to herbicide applicator contractors treating an estimated 60 to 100 acres during early spring when limited opportunity exists. The proposal will provide approximately $ 53,000 in staff and student support for planning, inventory, environmental compliance, monitoring, and administrative costs during the first year of the project.

Longer term gross income increases to approximately $150,000 per year for herbicide applicators (300 treated acres @ $500/acre) as participation increases, and $45,000 for administration, planning, environmental compliance, implementation, and monitoring wages.

*Treatment costs are based on a limited number treatments made by an aquatic applicator done in 2017-2020.

Benefits would occur during the time of active implementation.

Long term success of this depends upon establishing a Flathead Lake Flowering Rush Management Area with the funding base for management, implementation, oversite, and landowner participation. This would create several part-time jobs with contractor opportunities.

4.15 LOCAL AND STATE TAX BASE AND TAX REVENUES:

Will the project create or eliminate tax revenue?

No taxes would be created or eliminated.

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4.16 DEMAND FOR GOVERNMENT SERVICES:

Will substantial traffic be added to existing roads? Will other services (fire protection, police, schools, etc.) be needed?

There would be no effects to traffic or to the demand for government services.

4.17 LOCALLY ADOPTED ENVIRONMENTAL PLANS AND GOALS:

Are there State, County, City, USFS, BLM, Tribal, etc., zoning or management plans that would affect the proposal?

Other than the documents listed in Section 1.3, the proposal would not be affected by any locally adopted plans from other agencies.

4.18 ACCESS TO AND QUALITY OF RECREATIONAL AND WILDERNESS ACTIVITIES:

Are wilderness or recreational areas nearby or accessed through this tract? Is there recreational potential within the tract?

There would be no effects to recreation access in the sense of where boats may be lawfully allowed to launch.

There would be no effects to wilderness access from the proposal.

There would be direct, indirect, and cumulative benefits to recreation access potential, by removing the flowering rush from the treated sites.

Boating would be improved in that boats could more easily be launched and move through water without encountering and potentially spreading the flowering rush.

Downstream recreational use should improve with less flowering rush propagule pressure, fewer new and expanding invasions, and lessening habitat degradation for invasive fish.

4.19 DENSITY AND DISTRIBUTION OF POPULATION AND HOUSING:

Will the project add to the population and require additional housing?

There would be no effects to housing needs or population density

4.20 SOCIAL STRUCTURES AND MORES:

Is some disruption of native or traditional lifestyles or communities possible?

There would be no effects to social structures.

There would be slight and long-term direct, indirect, and cumulative benefits to native communities and the ability to practice native lifestyles, by improving vegetative conditions at the sites.

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4.21 CULTURAL UNIQUENESS AND DIVERSITY:

Will the action cause a shift in some unique quality of the area?

There would be no negative effects to cultural uniqueness or diversity.

There would be long-term direct, indirect, and cumulative benefits to cultural uniqueness by improving native vegetative conditions at the sites.

4.22 OTHER APPROPRIATE SOCIAL AND ECONOMIC CIRCUMSTANCES:

Is there a potential for other future uses for the area other than for the proposed type of management? Is future use hypothetical?

There would be no measurable direct, indirect, or cumulative effects to potential future uses from this proposal.

- The area of treatment is small compared to the entire lake and shoreline area, so that effects of removing the rush would not be measurable.
- Removing flowering rush from existing marinas and from shoreline properties, enhances the long-term economic value of those properties and will become an ongoing maintenance requirement.

V. OTHER EFFECTS

5.1. RELATIONSHIP OF SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Implementation of the proposal would have unavoidable adverse effects during the time of active spraying including ground disturbance. Increased noise and introduction of herbicides to the sites.

Anticipated adverse effects have been mitigated to the greatest extent practicable by design features and mitigation measures (Section 2).

Long-term benefits would outweigh short-term inconveniences.

Short-term uses—such as local access and perhaps use of some potable water intake lines—would experience slight disturbances during implementation of the proposal.

- Long-term productivity including benefits to vegetation and increased knowledge of how to treat flowering rush would outweigh short-term inconveniences and negative effects.

Negative effects to short-term uses have been mitigated to the extent practicable by design features and mitigation measures (Section 2).

5.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible losses (those that *cannot be undone*) would include the:

Use of fuel and materials used in herbicides.

- Loss of vegetation that would be killed or removed in the trials.

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- In this case, it is the goal of the project to decrease the coverage of an undesirable and non-native plant species, flowering rush.

Irretrievable losses (those that would be lost for a period of time) would include:

- Relative peace and quiet during implementation.
- Applications would be planned to allow use of potable water sources. The likelihood of not being able to use a lake potable water source for several days following treatment is low.
- Short-term losses of vegetation as a result of the herbicide treatment.

These losses would be reversed as treated sites return to open water environments and revegetate with desired native species.

5.3 ANY OTHER DISCLOSURES

No

5.4 LIST of PREPARERS, AGENCIES, and OTHER PERSONS CONSULTED:

Agencies, Companies, and Other Persons Consulted:

Army Corps of Engineers

US Environmental Protection Agency, SWPPP-NOI, Washington, D.C.

Individuals:

Virgil Dupuis, SKC, Extension Program, BS in Agriculture, 40 years experience

Doug Dupuis, Range Management Contractor, BS in Agriculture, 39 years management experience

Alvin Mitchell, SKC, Weed Technician, 10 years.

Andrew Skibo, PhD, Aquatic Herbicide Specialist, Amaruq Environmental Services, Missoula, MT

Dale Becker, CSKT-NRD, Wildlife Management Program, MS Fish and Wildlife Management, 35 years experience.

Barry Hanson, CSKT-NRD, Fisheries Program, MS Fisheries, 35 years experience.

Dan Lipscomb, CSKT-NRD, Shoreline Protection Program Manager, BS Wildlife Biology with a 30 minor in zoology and botany, 30 years.

Shannon Clairmont, CSKT-NRD, Wildlife Management Program, BS Wildlife Biology, 20 years experience.

Evan Smith, CSKT-NRD, Wetland Plan Conservation Plan Coordinator, 5 years.

Chauncey Means, CSKT-NRD, Water Quality Program Manager, 5 years.

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Casey Ryan, CSKT-NRD, Hydrologist, 5 years.

Ryan Evans, CSKT-NRD, Pesticide Specialist I, 5 years.

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Kathryn McDonald
Tribal Historic Preservation Officer
Tribal Historic Preservation Department
Confederated Salish Kootenai Tribes
kathryn.mcdonald@cskt.org

April 28, 2021

Bryan Mercier
Regional Director
Northwestern Region
Bureau of Indian Affairs

Title: Flathead Lake Flowering Rush Controls Project

In this letter of concurrence, Confederated Salish Kootenai Tribes Tribal Historic Preservation Officer, Kathryn McDonald, has read and agrees to the terms of the following documents; Flowering Rush Final Draft EA, Flowering Rush FONSI, Flowering Rush NOA, DECRM Concurrence THPO.

The documents are clear in stating Tribal Historic Preservation Department (THPD) will have an opportunity to review the annual work plan to ensure appropriate research and recommendations have been offered to the Flathead Lake Flowering Rush Controls Project. THPD is confident that the professional recommendations given will insure the safety, confidentiality, and integrity of each archaeological site. THPD is confident that this process can work with the overall objective of the project.

Thank you for considering THPD for cultural resource management recommendations while working on the Flathead Indian Reservation.

Sincerely,

Kathryn McDonald

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Appendix A. Flathead Lake Pesticide Handling Plan

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December 2020
Flathead Lake Flowering Rush Controls
Herbicide Handling Plan

Where Does the Flathead Lake Flowering Rush Controls: Herbicide Handling Plan Apply?

Handling herbicides in connection with applications of aquatic herbicides to the bed of Flathead Lake require adherence to this plan.

Why:

Logistics of treating these sites requires safe delivery, mixing, transporting and applying these products to prevent spills, and to rapidly contain and remove any accidentally discharge of herbicides onto the roadways, shoreline or open water in support of the Flathead Lake Flowering Rush Controls Project. The Confederated Salish and Kootenai Tribes (CSKT) Noxious Weed Management Plan and Environmental Assessment of 1992, Amendended in 1993) , did not contemplate the use of herbicides in aquatic environments. Use of pesticides on the Flathead Indian Reservation is regulated by US Environmental Protection Agency through a Pesticide General Use Permit (PGP).

CSKT contract specific provisions are to be attached to the PGP and contracts for herbicide applications. This Herbicide Handling Plan provides standard practice designs to fit application logistics, equipment, and distributions and size of treatment sites for delivery, mixing, disposal of herbicides and materials. This Plan provides basic response processes and emergency management equipment, and best practices for the use of aquatic herbicides during lake drawdown.

CSKT Pesticide General Permit Special Provisions:

1. Operators must follow conditions found in the Integrated Noxious Weed Management Plan and Amendments (Plan, CSKT 1993 b). the 2000 Forest Management Plan, the Flathead Lake Flowering Rush Controls Environmental Assessment (FLFRCEA) and other recent NEPA documents for conducting herbicide applications (see FLFRCEA). The conditions listed below must be included in the contract specific provisions or by a standard design practice.

A. Pesticides would be used to the water's edge only when the product's label allows such use.

Standard Practice: The herbicides proposed for use are labeled aquatic herbicides intended for use in aquatic environments. Label requirements for applications, rates, and mitigations will be followed including: no applications to flowing, ponded, or standing water.

B. When runoff potential is high, applicator would stay at least 10 feet from the edge of a natural break (ridge top) that leads into a wetland or riparian areas.

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C. **Applications within 50 feet of sensitive surface water would occur when wind speed is <10 mph.**

D. **Drift reducing additives would be used when working within 50 feet of open-water and wetland riparian areas.**

Standard Practice: Methylated seed oil surfactant is required for all applications that will reduce drift and runoff.

E. **Pesticide mixing and loading would take place at least 500 feet from sensitive surface and ground-water areas unless spill containment devises (absorbent mats) are used and an anti back-siphoning device is used when drafting water.**

Standard Practice: Aquatic herbicides may be loaded and mixed according to the special provisions below.

General Provisions:

- Limit delivering herbicides to the application site to the smallest amount possible, only bring enough for the day of work, leave stockpile in another safe location. Herbicides will be in original factory containers when transported to the application sites. Delivery trucks to application sites will have spill containment kits available for immediate use.
- Assure landowners permission exists for access to application site, and keep landowners informed.
- An approved spill kit must available immediately on site during transport, mixing, and application to mitigate minor and major spills (see Spill Management Plan for best practices and types of absorbents needed on site).

Special Provisions:

- Irrigation Water

F. The US Environmental Protection Agency (US EPA) and the State of Montana Department of Agriculture's Pesticide Registration Division have both determined that the approved and registered pesticides as outlined in (Appendix A) pose a negligible risk to human health, safety, and the environment when used according to label. Precautions concerning the use of pesticides around active irrigation sites will be followed at the time of pesticide application. To further mitigate any potential for offsite injury, all pesticide applications are to be timed such that the treatment sites will be exposed and treated according to the pesticide application plan prior to being re-inundated as the lake is filled to full-pool. Localized pesticide depuration is expected to be minimal. Further, the dilution ratio of lake water to the total potential amount of pesticide active ingredient applied on-site would preclude the accumulation of levels of concern in the water column within the treatment areas during post-inundation irrigation season.

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- Herbicide depuration POST-treatment

G. Water samples will be drawn from sites (TBD) within the project area post-treatment and post-inundation and sent overnight to a commercially-accredited third party laboratory for standard analysis for imazapyr detection and concentrations. Concentrations are expected to be below levels of concern (≤1.0 ppb) immediately upon site inundation; However, to ensure local irrigation safety, water samples will be drawn from the treatment areas for 60 days post treatment starting on or around June 15 (start of irrigation season) and analyzed for imazapyr and imazamox concentrations as outlined herein.

Hand gun applications fed with tanks attached to ATVs on the shore.
Special provisions:

- ATVs may be loaded with water for mixing, prior to adding herbicide, with lake water taken from the lake with a pump system equipped with anti-siphon equipment to prevent siphoning into the lake.
- ATVs will be loaded with herbicides when parked on a plastic tarp on level ground.

Boom sprayer applications attached to track equipped ATVS
Special provisions:

- ATVs may be loaded with water for mixing, prior to adding herbicide, with lake water taken from the lake with a pump system equipped with anti-siphon equipment to prevent siphoning into the lake.
- ATVs will be loaded with herbicides when parked on a plastic tarp on level ground.

Hand gun applications fed with tanks attached to an air boat stationed on the shore
Special provisions:

- Herbicides may be transported within the hull of the air boat.
- The hull of the air boat serves as an initial containment basin.
- An approved spill kit must be immediately available for on the air boat.

Backpack sprayer
Special provisions:

- For small spot infestations, backpacks may be mixed on site with similar provisions as filling ATVs utilizing a non-permeable drop tarp with appropriate spill containment provisions.

Inspections
Special provisions:

- Contractor equipment, spill containment plan, storage, delivery, mixing, and applications may be inspected by the CSKT Office of Pesticides.
- Contractor will keep the Office of Pesticides informed of application schedules

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H. Work would conform to the CSKT Best Management practices (CSKT 2000), from The Forest Management plan).

I. Only pesticides labeled for aquatic use would be applied near water bodies.

J. Tordon would not be applied in riparian zones.

K. All spray equipment would be calibrated in advance to help avoid contamination of surface and ground water sources.

2. The Operator must submit to the Tribal NRD a copy of the completed contract 30 days prior to the application start date.

3. All required material shall be sent to:

The Confederated Salish and Kootenai Tribes of the Flathead Nation
PO Box 278; Attn Evan Smith Water Quality Regulatory Specialist
Pablo, MT 59855

Reporting Pesticide Spill

If you have knowledge of sick or dead fish and aquatic life that you suspect may have been poisoned by pesticides, contact the CSKT Fisheries and Wildlife Departments, CSKT Conservation Wardens, or the United States Fish and Wildlife Service immediately. Notify an official as soon as possible after sickened or dead wildlife are discovered. Information about possible pesticide-related incidents includes the following:

1. Type of pesticide product
2. Use rates
3. Weather conditions
4. Aquatic species involved
5. Extent of the problem (number of fish killed)
6. Location
7. Size of pond or lake affected

1. Emergency contact phone numbers and people to notify in event of a spill

Notification guidance.
Report if there is <u>any</u> potential for harm to human health or the environment from the spill, or if the spill occurs in an area frequented by the public. The spill is not reportable

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when it does not result in pesticide lost to the environment, and there is no threat to air, soil, or water, such as when it occurs on a concrete floor, or in an enclosed area, and is removed by proper spill clean-up procedures.

From: **https://pesticidestewardship.org/spills/prevention/to respond appropriately to an accident**.

1. CSKT Water Quality Regulatory Specialist, Evan Smith, 406-883-2888
2. CSKT Disaster Emergency Coordinator, Dale 406-883-2888
3. Fire department, Sheriff's Office 911
4. Emergency medical help 911
5. Non-emergency spills, National Pesticide Information Center (800) 858-7378
6. Poison control center 800-222-1222
7. Region 8 EPA 800-424-8802
8. CHEMTREC 800-424-9300

Reporting Pesticide Spills

If you have knowledge of sick or dead fish and aquatic life that you suspect may have been poisoned by pesticides, contact the CSKT Fisheries and Wildlife Departments, CSKT Conservation Wardens, or the United States Fish and Wildlife Service immediately. Notify an official as soon as possible after sickened or dead wildlife are discovered. Information about possible pesticide-related incidents includes the following:

8. Type of pesticide product
9. Use rates
10. Weather conditions
11. Aquatic species involved
12. Extent of the problem (number of fish killed)
13. Location
14. Size of pond or lake affected

Spill Management Procedures

When a spill occurs focus on individuals' safety, spill containment and cleanup, and who to call for assistance. Train everyone working with pesticides (transport, storage, mixing/loading, application) in the emergency procedures to be followed. Know whether you plan to apply the spilled material or handle it as a hazardous waste for disposal. The pesticide, and what you use to absorb a liquid spill, determines whether it can be applied legally to an application site on the label, or if it requires disposal at a hazardous waste facility.

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Safety and First Aid.

1. The first concern is for the health and well-being of persons in and around the spill area.
    1. All persons should be trained in basic first aid and evacuation procedures.
    2. First aid kits and personal protective equipment (PPE) must be available and maintained.
    3. Telephone numbers of medical assistance and poison control center must be posted.
    4. Minimize exposure of personnel.
    5. Put on PPE before entering the spill area.
    6. Assess personnel exposures.
    7. Turn off possible sources of ignition (gas engines, electric motors, pilot lights) to prevent fire or explosions.
    8. Move injured or exposed personnel to a safe location.
    9. Contaminated clothing should be removed from the victim. Then wash skin that has been exposed to the spill with soap and water. Give additional first aid as required, such as flushing eyes that were contacted by the spill with clean water for 15 minutes.
    10. Get medical help for the injured persons. Always have someone stay with anyone who is injured until help arrives.
2. **Secure the site.**

    1. Prevent unauthorized people from entering the spill area.
    2. Post signs, and use barrier tape or rope around the area.
    3. Get help from police or others to set a safe perimeter around the spill site.
    4. Eliminate all sources of ignition in order to prevent fire or explosion from vapors.

3. **Protect yourself and others.** Wear appropriate personal protective equipment (PPE).
    1. Proper worker protection equipment for working with herbicides PPE.
    2. Notify others about the spill, and have backup close by.
4. **Control the spill.**
    1. Stop further leakage (shut valves, reposition leaking container etc.)
    2. If the leak is being directed into another container, ensure that it does not overflow.
5. **Contain the spill.** The spillage must be contained at the original site. Prevent the pesticide from entering ditches, storm drains, wells and waterways. A spill pooled on a paved road, or other impermeable surface can be easily removed. But if it reaches surface water, recovery will be very difficult or impossible. Block any entrance to storm drains or waterways.
    1. Block the spill from spreading by encircling it using a:
        1. Dike of sand or soil
        2. Absorbent materials including dry granular, pads, and booms for small to large spills, spills on open water, and shoreline conditions

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        3. Trench
        4. Rags
6. **Cover the spilled** pesticide to stop it from spreading.
    1. a) Liquid spills should be covered with an absorbent.
7. **Carefully handle leaking containers**.
    1. Segregate clean undamaged containers from the leaking ones for cleanup at a later time.
    2. Repackage leaking containers.
        1. Over-pack leaking containers that are going to disposal.
        2. Transfer pesticide to a new container, same type as original.
        3. Properly label new container
    3. Triple rinse the damaged or dirty empty container, and collect rinseate for later disposal or use as a diluent.
8. **Clean contaminated** area after finishing repacking.
9. **Disposal of spill materials.** All of the contaminated materials, including absorbent, clothes, soil, wood, etc. must be removed and packaged for disposal. Containers must be properly labeled and transported according to Department of Transportation (DOT) regulations by EPA permitted hazardous waste haulers to a permitted hazardous waste disposal facility. If spilled material cannot be used according to label instructions, it most likely is classified as a hazardous waste.

Compiled by *Ron Gardner, Cornell University Cooperative Extension*

https://pesticidestewardship.org/spills/introduction-to-spill-management/

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Appemdix B. Herbicide Labels, Herbicide Fact Sheets, Safety Sheets

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Wisconsin Department of Natural Resources

January 2012

Imazapyr Chemical Fact Sheet

Formulations

Imazapyr was registered with the EPA for aquatic use in 2003. The active ingredient is isopropylamine salt of imazapyr, (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid). Formulations that can be used on aquatic vegetation in Wisconsin include Habitat™, Ecomazapyr 2sl™, Imazapyr 2sl™, and Polaris AC. Imazapyr is used for control of emergent and floating-leaf vegetation. It is not recommended for control of submersed vegetation.

Aquatic Use and Considerations

Imazapyr is a systemic herbicide that moves throughout the plant tissue and prevents plants from producing a necessary enzyme, acetolactate synthase (ALS), which is not found in animals. Susceptible plants will stop growing soon after treatment and become reddish at the tips of the plant. Plant death and decomposition will occur gradually over several weeks to months. Imazapyr should be applied to plants that are actively growing. If applied to mature plants, a higher concentration of herbicide and a longer contact time will be required.

In Wisconsin, imazapyr is used to control the invasive plants common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*) and Japanese knotweed (*Polygonum cuspidatum*). Native species that are also controlled include cattails (*Typha* spp.), water lilies (*Nymphaea* sp.), pickerelweed (*Pontederia cordata*), duckweeds (*Lemna* spp.) and arrowhead (*Sagittaria* spp.).

It is important to note that repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants, even in aquatic plants. More resistant weeds have developed to the ALS inhibitor herbicides than to other herbicide types, and so this mechanism of action may be more susceptible to developing resistance. In order to prevent herbicide resistance, avoid using the same type of herbicides year after year, and when possible, use non-herbicide methods of control instead.

Post-Treatment Water Use Restrictions

There are no restrictions on recreational use of treated water, including swimming and eating fish from treated water bodies. If application occurs within a ½ mile of a drinking water intake, then the intake must be shut off for 48 hours following treatment. There is a 120-day irrigation restriction for treated water, but irrigation can begin sooner if the concentration falls below one part per billion (ppb).

Herbicide Degradation, Persistence and Trace Contaminants

Imazapyr is broken down in the water by light and has a half-life (the time it takes for half of the active ingredient to degrade) ranging from three to five days.

Three degradation products are created as imazapyr breaks down. These are pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid (quinolinic acid), and nicotinic acid. These degradates persist in water for approximately the same amount of time as imazapyr (half-lives of three to eight days).

In soils imazapyr is broken down by microbes, and persists with a half-life of one to five months. It doesn't bind to sediments, so leaching through soil into groundwater is likely.

Impacts on Fish and Other Aquatic Organisms

Imazapyr is practically non-toxic (the EPA's lowest toxicity category) to fish, invertebrates, birds and mammals. Toxicity tests were not conducted on amphibians or reptiles. It does not bioaccumulate in animal tissues.

*The Wisconsin Department of Natural Resources provides equal opportunity in its employment, programs, services, and functions under an Affirmative Action Plan. If you have any questions, please write to Equal Opportunity Office, Department of Interior, Washington, D.C. 20240. This publication is available in alternative format (*large print, Braille, audio tape. etc.*) upon request. Please call (608) 267-7694 for more information.*

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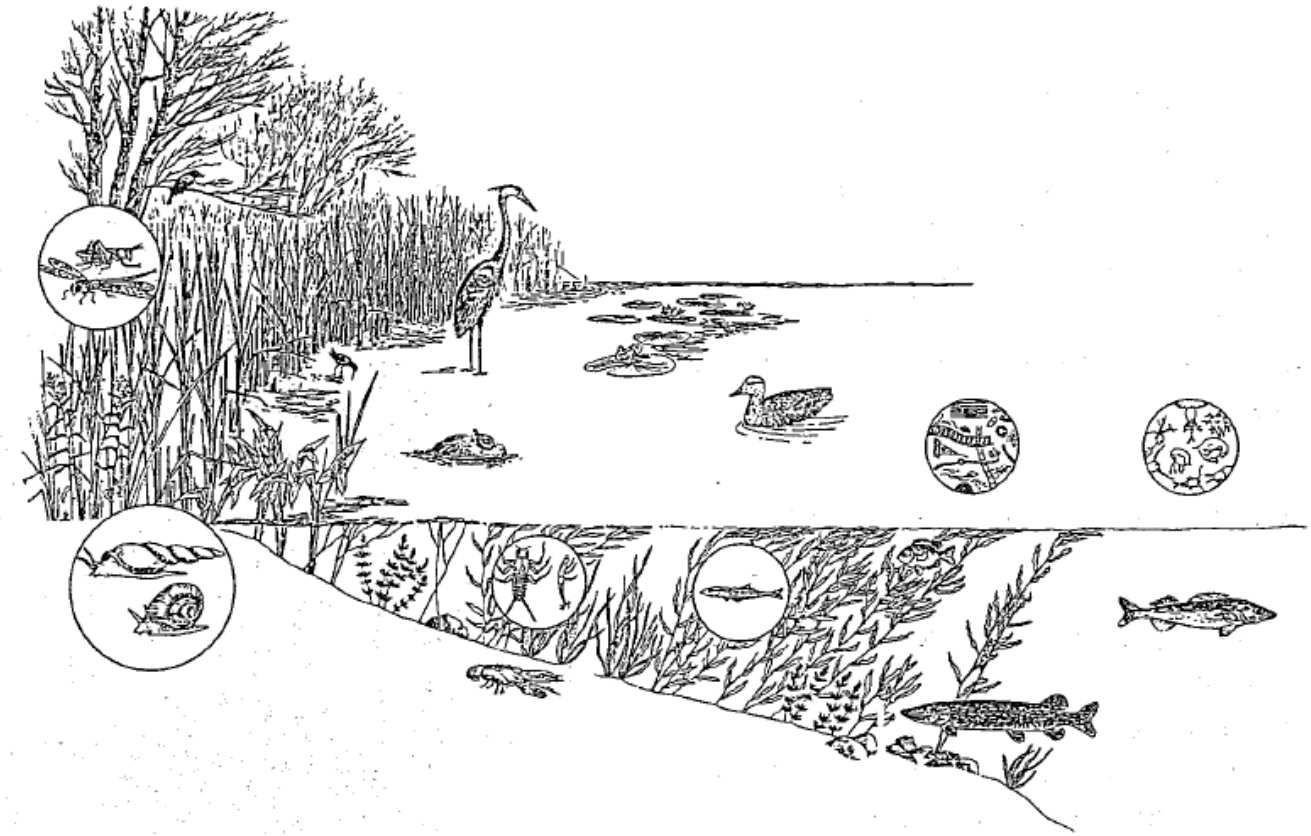

Human Health

Concentrated imazapyr has low acute toxicity on the skin or if ingested, but is harmful if inhaled and may cause irreversible damage if it gets in the eyes. Applicators should wear chemical-resistant gloves while handling, and persons not involved in application should avoid the treatment area during treatment.

Chronic toxicity tests for imazapyr indicate that it is not carcinogenic, mutagenic, or neurotoxic. It also does not cause reproductive or developmental toxicity, and is not a suspected endocrine disrupter.

Imazapyr degradates are no more toxic than imazapyr itself, and are excreted faster than imazapyr when ingested.

For Additional Information

Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides

Wisconsin Department of Agriculture, Trade, and Consumer Protection
http://datcp.wi.gov/Plants/Pesticides/

Wisconsin Department of Natural Resources
608-266-2621
http://dnr.wi.gov/lakes/plants/

Wisconsin Department of Health Services
http://www.dhs.wisconsin.gov/

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu/

Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707-7921

DNR PUB-WT-975 2012

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Wisconsin Department of Natural Resources

January 2012

Imazamox Chemical Fact Sheet

Formulations

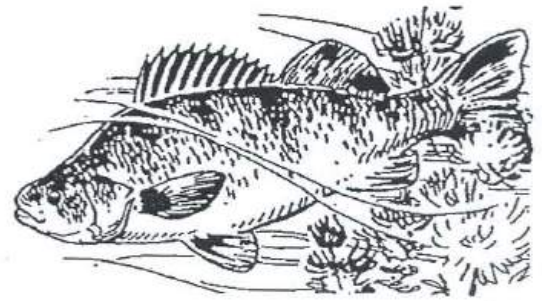
Imazamox is the common name of the active ingredient ammonium salt of imazamox (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-(methoxymethl)-3-pyridinecarboxylic acid. It was registered with EPA in 2008, and is currently marketed for aquatic use as Clearcast™. It is a liquid formulation that is applied to submerged vegetation by broadcast spray or underwater hose application and to emergent or floating leaf vegetation by broadcast spray or foliar application. There is also a granular version (Clearcast 2.7G™).

Aquatic Use and Considerations

Imazamox is a systemic herbicide that moves throughout the plant tissue and prevents plants from producing a necessary enzyme, acetolactate synthase (ALS), which is not found in animals. Susceptible plants will stop growing soon after treatment, but plant death and decomposition will occur over several weeks.

In Wisconsin, imazamox is used for treating emergent vegetation such as common reed (*Phragmites australis*) and flowering rush (*Butomus umbellatus*). Imazamox may also be used to treat the invasive curly-leaf pondweed (*Potamogeton crispus*). Imazamox is a relatively new herbicide that has not been extensively field tested, so there is some uncertainty regarding the sensitivity of non-target species. Desirable native species that may be affected could include other pondweeds (*P. nodosus, P. zosteriformis, P. foliosus, P. illinoensis, P. pusillus, P. gramineus, P. diversifolius, P. perfoliatus, P. amplifolius*), water shield (*Brasenia schreberi*) and some bladderworts (*Utricularia* spp.). Higher rates of imazamox will control Eurasian watermilfoil (*Myriophyllum spicatum*), but would also have a greater impact on native plants.

If used as a post-emergence herbicide, imazamox should be applied to plants that are



actively growing. It can also be used during a drawdown to prevent plant regrowth and on the emergent vegetation.

Repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants. Herbicide resistance has now been found in at least one aquatic nuisance plant species. In particular, ALS inhibitor-resistant weeds have appeared at a higher rate than other herbicide types in terrestrial uses. In order to prevent herbicide resistance, avoid using the same type of herbicides year after year, and when possible, use non-herbicide methods of control instead.

Post-Treatment Water Use Restrictions

Treated water may be used immediately following application for fishing, swimming, cooking, bathing, and watering livestock. If water is to be used as potable water or for irrigation, the tolerance is 50 parts per billion (ppb), and a 24-hour irrigation restriction may apply depending on the water body.

Herbicide Degradation, Persistence and Trace Contaminants

Dissipation studies in lakes indicate a half-life ranging from 4 to 49 days with an average of 17 days. Herbicide breakdown doesn't occur in deep, poorly-oxygenated water where there is no light. In this part of a lake, imazamox will tend to bind to sediment rather than breaking down, with a half-life of approximately 2 years.

*The Wisconsin Department of Natural Resources provides equal opportunity in its employment, programs, services, and functions under an Affirmative Action Plan. If you have any questions, please write to Equal Opportunity Office, Department of Interior, Washington, D.C. 20240. This publication is available in alternative format (*large print, Braille, audio tape. etc.*) upon request. Please call (608) 267-7694 for more information.*

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Once in soil, leaching to groundwater is believed to be very limited.

The breakdown products of imazamox are nicotinic acid and di- and tricarboxylic acids. None of the breakdown products are herbicidal nor suggest concerns for aquatic organisms or human health.

Impacts on Fish and Other Aquatic Organisms

Laboratory tests using rainbow trout, bluegill, and water fleas (*Daphnia magna*) indicate that imazamox is not toxic to these species at label application rates. Imazamox is rated practically non-toxic to fish and aquatic invertebrates. Imazamox does not bioaccumulate in fish.

Additional studies on birds indicate toxicity only at dosages that exceed approved application rates. However, honeybees are affected at application rates so drift during application should be minimized.

Human Health

Most concerns about adverse effects on human health involve applicator exposure. Concentrated imazamox can cause eye and skin irritation and is harmful if inhaled. Applicators should minimize exposure by wearing long-sleeved shirt and pants, rubber gloves, and shoes and socks.

In chronic tests, imazamox was not shown to cause tumors, birth defects or reproductive toxicity in test animals. Most studies show no evidence of mutagenicity. Imazamox is not metabolized and was excreted by mammals tested. Based on its low acute toxicity to mammals, and its rapid disappearance from the water column due to light and microbial degradation and binding to soil, imazamox is not considered to pose a risk to recreational water users.

For Additional Information

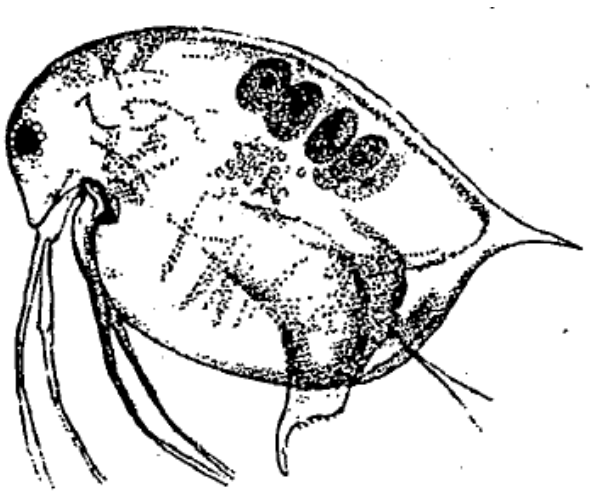
Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides

Wisconsin Department of Agriculture, Trade, and Consumer Protection
http://datcp.wi.gov/Plants/Pesticides/

Wisconsin Department of Natural Resources
608-266-2621
http://dnr.wi.gov/lakes/plants/

Wisconsin Department of Health Services
http://www.dhs.wisconsin.gov/

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu/



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ALLIGARE

IMAZAPYR 4 SL

SPECIMEN LABEL

For the control of undesirable vegetation in forestry sites, aquatic sites, grass pasture, rangeland, fence rows, maintenance of wildlife openings, and industrial noncropland areas including railroad, utility, pipeline rights-of-way, utility plant sites, petroleum tank farms, pumping installations, storage areas, building perimeters, irrigation and non-irrigation ditchbanks, roads, transmission lines, and industrial bare ground areas.

In the State of New York, aquatic uses are not allowed.

ACTIVE INGREDIENT:
Isopropylamine salt of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid)* 52.6%
OTHER INGREDIENTS 47.4%
TOTAL 100.0%
*Equivalent to 42.9% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid or 4 pounds acid per gallon.

EPA Reg. No. 81927-24 EPA Est. No. 37429-GA-001[BT]; 37429-GA-002[BO]; 81927-AL-001[PM]
Letter(s) in lot number correspond(s) to superscript in EPA Est. No.

KEEP OUT OF REACH OF CHILDREN
CAUTION!/PRECAUCION!

PRECAUCION AL USUARIO: Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand this label, find someone to explain it to you in detail.)

FIRST AID	
If swallowed:	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • **DO NOT** induce vomiting unless told to do so by the poison control center or doctor. • **DO NOT** give anything by mouth to an unconscious person.
If in eyes:	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If inhaled:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor or going for treatment. For medical emergencies involving this product, call 1-800-424-9300.	

Manufactured for: Alligare, LLC
13 N. 8th Street • Opelika, AL 36801

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION! Harmful if swallowed or absorbed through skin. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Remove and wash contaminated clothing and wash before reuse.

Personal Protective Equipment (PPE):
Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for Category A on an EPA chemical-resistant category selection chart.

Mixers, loaders, applicators, and other handlers must wear:
- Long-sleeve shirt and long pants
- Shoes plus socks
- Chemical-resistant gloves for all mixers and loaders, plus applicators using handheld equipment

Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them.

Pilots must use an enclosed cockpit that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(6)].

User Safety Recommendations:
- Users should wash hands with plenty of soap and water before eating, drinking, chewing gum, using tobacco or using the toilet.
- Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This product is toxic to plants. Drift and run-off may be hazardous to plants in water adjacent to treated areas. Do not apply to water except as specified on this label. Treatment of aquatic weeds may result in oxygen depletion or loss due to decomposition of dead plants. Do not treat more than one-half the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatments along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas. Do not contaminate water when disposing of equipment washwaters or rinsate. See Directions for Use for additional precautions and requirements.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of **Alligare Imazapyr 4 SL** should be mixed, stored and applied only in stainless steel, fiberglass, plastic, and plastic-lined steel containers.

DO NOT mix, store or apply **Alligare Imazapyr 4 SL** or spray solutions of **Alligare Imazapyr 4 SL** in unlined steel (except stainless steel) containers or spray tanks.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

DO NOT apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

Alligare Imazapyr 4 SL should be used only in accordance with directions on the booklet label. Keep containers closed to avoid spills and contamination.

Alligare Imazapyr 4 SL may be applied using helicopters, ground operated sprayers, low-volume hand-operated spray equipment such as back-pack and pump-up sprayers, and tree injection equipment.

Observe all cautions and limitations in the labels of products used in combination with **Alligare Imazapyr 4 SL**.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard. The requirements in this box apply to use on trees being grown for sale or other commercial use, or for commercial seed production, or for production of timber or wood products, or for research purposes.

DO NOT enter or allow worker entry into treated areas during the restricted entry interval (REI) of **48 hours.**

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:
- Coveralls
- Shoes plus socks
- Chemical-resistant gloves made of any waterproof material
- Protective eyewear

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Do not enter treated areas until sprays have dried.

IMPORTANT

DO NOT use on food or feed crops. **DO NOT** use on Christmas trees. **DO NOT** apply this product within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half mile of an active potable water intake in a standing body of water, such as a lake, pond or reservoir. **DO NOT** apply to water used for irrigation except as described in **APPLICATION TO WATERS USED FOR IRRIGATION** section of this label. Keep from contact with fertilizers, insecticides, fungicides, and seeds to prevent unintentional exposure of desirable vegetation to this product. **DO NOT** apply or drain or flush equipment on or near sensitive desirable plants, or on areas where their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots. **DO NOT** drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the treated soil may be washed or moved into contact with their roots. **DO NOT** apply to lawns. **DO NOT** side trim desirable vegetation with this product unless severe injury and plant death can be tolerated. Prevent drift of spray to desirable plants. Clean application equipment after using this product by thoroughly flushing with water.

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RESISTANCE

When herbicides with the same mode of action are used repeatedly over several years to control the same weed species in the same application site, naturally occurring resistant weed biotypes may survive a correctly applied herbicide treatment, propagate and become dominant in that site. These resistant weed biotypes may not be adequately controlled. Using herbicides with different modes of action within these sites can aid in delaying the proliferation and possible dominance of herbicide resistant weed biotypes. It is advisable that each user of this product check with the local extension service for a current list of resistant weed biotypes.

PRODUCT INFORMATION

Alligare Imazapyr 4 SL is an aqueous solution intended to be mixed in water and surfactants(s) and applied as a post-emergent spray for control of most annual and perennial grasses, broadleaf weeds, vines, brambles, hardwood brush, trees for forestry site preparation and release of conifers from woody and herbaceous competition. This product may be used for selective woody and herbaceous weed control in natural regeneration of certain conifers (see pine release). This product may also be mixed in water and used for stump and cut-stem treatment for control of unwanted woody vegetation. This product can be applied along forest roads to control undesirable vegetation. This product can be used for the control of undesirable vegetation along non-irrigation ditchbanks and for the establishment and maintenance of wildlife openings. See use directions for stump and cut stem treatments and herbaceous weed control and use directions for spot treatment of undesirable hardwood vegetation.

This product may be applied on forestry sites that contain areas of temporary surface water caused by the collection of water between planting beds, in equipment ruts, or in other depressions created by forest management activities, except in the states of California and New York. It is permissible to treat drainage ditches, intermittent drainage, intermittently flooded low lying sites, seasonally dry flood plains, and transitional areas between upland and lowland sites when no water is present, except in the states of California and New York. Only the edge of drainage ditches can be treated for drainage ditches that contain water. It is also permissible to treat marshes, swamps, and bogs after water has receded, as well as seasonally dry flood deltas, except in the states of California and New York.

When applied postemeregence to weeds, **Alligare Imazapyr 4 SL** will control most annual and perennial grasses and broadleaf weeds in addition to many brush and vine species. **Alligare Imazapyr 4 SL** will provide residual control of labeled weeds which germinate in the treated areas. Postemergence application with a surfactant is the method of choice in most situations, particularly for perennial weeds. For maximum affect, weeds should be growing vigorously at postemergence application and the spray solution should include a surfactant. **Alligare Imazapyr 4 SL** solutions may be broadcast by using ground or aerial equipment, or may be applied as a spot treatment by using low-volume techniques. In addition, **Alligare Imazapyr 4 SL** may be used for stump and cut stem treatments.

Alligare Imazapyr 4 SL controls vegetation by absorbtion through foliage and roots, from which it is translocated rapidly throughout the plant, where it accumulates in rapidly-growing meristematic tissue. Treated plants stop growing soon after spray treatment. Chlorosis (yellowing of plant tissue) first appears in the newest leaves and necrosis spreads from this point. In perennials, **Alligare Imazapyr 4 SL** is translocated into and kills the roots and underground storage tissues to prevent most regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species for several weeks after application and may take months for various woody plants, brush and trees.

PRECAUTIONS FOR AVOIDING INJURY TO NON-TARGET PLANTS

Untreated desirable plants can be affected by root uptake of this product from treated soil. Injury or loss of desirable plants may result if this product is applied on or near desirable plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots. When making applications along shorelines where desirable plants may be present, caution should be exercised to avoid spray contact with their foliage or spray application to the soil in which they are rooted. Shoreline plants that have roots that extend into the water in an area where this product has been applied generally will not be adversely affected by uptake of the herbicide from the water.

If treated vegetation is to be removed from the application site, **DO NOT** use the vegetative matter as mulch or compost on or around desirable species.

Untreated trees can occasionally be affected by root uptake of this product through movement into the top soil. Injury or loss of desirable trees or other plants may result if this product is applied on or near desirable trees or other plants, on areas where their roots extend or in locations where the treated soil may be washed or moved into contact with their roots.

SPRAY DRIFT MANAGEMENT

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

Spray drift from applying this product may damage sensitive plants adjacent to the treatment area. Only apply this product when the potential for drift to adjacent sensitive areas (e.g. residential areas, bodies of water, known habitat for threatened or endangered species, or non-target crops) is minimal. **DO NOT** apply when the following conditions exist that increase the likelihood of spray drift from intended targets: high or gusty winds, high temperatures, low humidity, temperature inversions.

The best drift management strategy and most effective way to reduce drift potential are to apply large droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see **WIND, TEMPERATURE AND HUMIDITY AND TEMPERATURE INVERSIONS**).

Controlling Droplet Size:

- Volume – Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- Pressure – **DO NOT** exceed the nozzle manufacturer's recommended pressures. For many nozzle types, lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- Number of Nozzles – use the minimum number of nozzles that provide uniform coverage.
- Nozzle Orientation – Orienting nozzles so that the spray is released parallel to the airstream produces larger droplets than other orientations and is recommended practice. Significant deflection from the horizontal will reduce droplet size and increase drift potential.
- Nozzle Type – Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift. **DO NOT** use nozzles producing a mist droplet spray.

Application Height: Making applications at the lowest possible height (aircraft, ground driven spray boom) that is safe and practical reduces exposure of droplets to evaporation and wind.

Swath Adjustment: When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the application equipment (e.g. aircraft, ground) upwind. Swath adjustment distance should increase with increasing drift potential (higher wind, smaller droplets, etc.).

Wind: Drift potential is lowest between wind speeds of 3-10 mph. However, many factors, including droplet size and equipment type, determine drift potential at any given speed. Application should be avoided below 3 mph due to variable wind direction and high inversion potential. NOTE: Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

Temperature and Humidity: When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions: Drift potential is high during a temperature inversion. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud, which can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Wind Erosion: Avoid treating powdery dry or light sandy soils when conditions are favorable for wind erosion. Under these conditions, the soil surface should first be settled by rainfall or irrigation.

Aerial Application Methods and Equipment: Use 2 or more gallons of water per acre. The actual minimum spray volume per acre is determined by the spray equipment used. Use adequate spray volume to provide accurate and uniform distribution of spray particles over the treated area and to avoid spray drift.

Aerial Applications:

1. Applicators are required to use a coarse or coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater for release heights below 10 feet; Applicators are required to use a very coarse or coarser droplet size or, if specifically using a spinning atomizer nozzle, applicators are required to use a VMD of 475 microns or greater for release heights above 10 feet; Applicators must consider the effects of nozzle orientation and flight speed when determining droplet size.
2. Applicators are required to use upwind swath displacement.
3. The boom length must not exceed 60% of the wingspan or 90% of the rotor blade diameter to reduce spray drift.
4. Applications with wind speed less than 3 mph and with wind speeds greater than 10 mph are prohibited.
5. Applications into temperature inversions are prohibited.

Ground Application (Broadcast): Use 5 or more gallons of water per acre. The actual minimum spray volume per acre is determined by the spray equipment used. Use adequate spray volume to provide accurate and uniform distribution of spray particles over the treated area and to avoid spray drift.

Ground Boom Applications:

1. Applicators are required to use a nozzle height below 4 feet above the ground or plant canopy and coarse or coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater.
2. Applications with wind speeds greater than 10 mph are prohibited.
3. Applications into temperature inversions are prohibited.

The use of treated waters on irrigated crops within 120 days is prohibited.

ADJUVANTS

Postemergence applications of this product may require the addition of a spray adjuvant for optimum herbicide performance. Only use spray adjuvants that are labeled for the specific use sites. When using for conifer release treatments, please refer to the conifer release section of this label. The addition of a Chemical Producers and Distributors Associations (CPDA) certified adjuvant may increase control. A CPDA certified drift control agent may also be used.

Nonionic Surfactants: Use a nonionic surfactant at the rate of 0.25% v/v or higher (see manufacturer's label) of the spray solution (0.25% v/v is equivalent to 1 quart in 100 gallons). For best results, select a nonionic surfactant with a HLB (hydrophilic to lipophilic balance) ratio between 12 and 17 with at least 90% surfactant in the formulated product (alcohols, fatty

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acids, oils, ethylene glycol or diethylene glycol should not be considered as surfactants to meet the above requirements).

Methylated Seed Soils or Vegetable Oil Concentrates: Instead of a surfactant, a methylated seed oil or vegetable-based seed oil concentrate may be used at the rate of 1.5 to 2 pints per acre. When using spray volumes greater than 30 gallons per acre, methylated seed oil or vegetable based seed oil concentrates should be mixed at a rate of 1% of the total spray volume, or alternatively use a nonionic surfactant as described above. Research indicates that these oils may aid in product deposition and uptake by plants under moisture or temperature stress.

Silicone Based Surfactants: See manufacturer's label for specific rates instructions. Silicone-based surfactants may reduce the surface tension of the spray droplet, allowing greater spreading on the leaf surface as compared to conventional nonionic surfactants. However, some silicone-based surfactants may dry too quickly, limiting herbicide uptake.

Invert emulsions: This product can be applied as an invert emulsion. Consult the invert chemical label for proper mixing directions.

Fertilizer/Surfactant Blends: Nitrogen based liquid fertilizers such as 28%N, 32%N, 10-34-0 or ammonium sulfate, may be added at the rate of 2 to 3 pints per acre in combination with the specified rate of nonionic surfactant, methylated seed oil or vegetable/seed oil concentrate. The use of fertilizers in a tank mix without a nonionic surfactant, methylated seed oil or vegetable/seed oil concentrate is not recommended.

Other: An antifoaming agent, spray pattern indicator or drift reducing agent may be applied at the product labeled rate if necessary or desired.

WEEDS CONTROLLED

Alligare Imazapyr 4 SL provides postemergence control and some residual control of the following target weed species. The degree of control is both species and rate dependent. Use **Alligare Imazapyr 4 SL** only in accordance with the directions on this label.

GRASSES:

The species of annual and perennial grasses controlled by **Alligare Imazapyr 4 SL** include the following:

Annual bluegrass *(Poa annua)*
Bahiagrass *(Paspalum notatum)*
Barnyardgrass *(Echinochloa crus-galli)*
Beardgrass *(Andropogon* spp.*)*
Bermudagrass *(Cynodon dactylon)*[1]
Big bluestem *(Andropogon gerardii)*
Broadleaf signalgrass *(Brachiaria platyphylla)*
Canada bluegrass *(Poa compressa)*
Cattail *(Typha* spp.*)*
Cheat *(Bromus secalinus)*
Cogongrass *(Imperata cylindrica)*[2]
Crabgrass *(Digitaria* spp.*)*
Crowfootgrass *(Dactyloctenium aegyptium)*
Dallisgrass *(Paspalum dilatatum)*
Downy brome *(Bromus tectorum)*
Fall panicum *(Panicum dichotomiflorum)*
Feathertop *(Pennisetum villosum)*
Fescue *(Festuca* spp.*)*
Foxtail *(Setaria* spp.*)*
Giant reed *(Arundo donax)*
Goosegrass *(Eleusine indica)*
Guineagrass *(Panicum maximum)*
Italian ryegrass *(Lolium multiflorum)*
Itchgrass *(Rottboellia exaltata)*
Johnsongrass *(Sorghum halepense)*[1]
Junglerice *(Echinochloa colonum)*
Kentucky bluegrass *(Poa pratensis)*
Lovegrass *(Eragrostis* spp.*)*[1]
Orchardgrass *(Dactylis glomerata)*
Panicum spp.
Paragrass *(Brachiaria mutica)*
Phragmites *(Phragmites australis)*
Prairie cordgrass *(Spartina pectinata)*
Prairie threeawn *(Aristida oligantha)*
Quackgrass *(Agropyron repens)*
Reed canarygrass *(Phalaris arundinacea)*
Saltgrass *(Distichlis stricta)*
Sand dropseed *(Sporobolus cryptandrus)*
Sandbur *(Cenchrus* spp.*)*
Smooth brome *(Bromus inermis)*
Sprangletop *(Leptochloa* spp.*)*
Timothy *(Phleum pratense)*
Torpedograss *(Panicum repens)*
Vaseygrass *(Paspalum urvillei)*
Wild barley *(Hordeum* spp.*)*
Wild oats *(Avena fatua)*
Wirestem muhly *(Muhlenbergia frondosa)*
Witchgrass *(Panicum capillare)*
Woolly cupgrass *(Eriochloa villosa)*

[1] Use higher labeled rates.
[2] Use minimum of 24 oz. per acre.

BROADLEAF WEEDS:

The species of annual and perennial broadleaf weeds controlled by **Alligare Imazapyr 4 SL** include the following:

Arrowwood *(Pluchea sericea)*
Broom snakeweed *(Gutierrezia sarothrae)*
Bull thistle *(Cirsium vulgare)*
Burclover *(Medicago* spp.*)*
Burdock *(Arctium* spp.*)*
Camphorweed *(Heterotheca subaxillaris)*
Canada thistle *(Cirsium arvense)*
Carolina geranium *(Geranium carolinianum)*
Carpetweed *(Mullugo verticillata)*
Chickweed, mouseear *(Cerastium vulgatum)*
Clover *(Trifolium* spp.*)*
Cocklebur *(Xanthium strumarium)*
Common chickweed *(Stellaria media)*
Common ragweed *(Ambrosia artemisiifolia)*
Cudweed *(Gnaphalium* spp.*)*
Dandelion *(Taraxacum officinale)*
Desert camelthorn *(Alhagi pseudalhagi)*
Diffuse knapweed *(Centaurea diffusa)*
Dock *(Rumex* spp.*)*
Dogfennel *(Eupatorium capillifolium)*
Fiddleneck *(Amsinckia intermedia)*
Filaree *(Erodium* spp.*)*
Fleabane *(Erigeron* spp.*)*
Giant ragweed *(Ambrosia trifida)*
Goldenrod *(Solidago* spp.*)*
Gray rabbitbrush *(Chrysothamnus nauseosus)*
Henbit *(Lamium aplexicaule)*
Hoary vervain *(Verbena stricta)*
Horseweed *(Conyza canadensis)*
Indian mustard *(Brassica juncea)*
Japanese bamboo/knotweed *(Polygonum cuspidatum)*
Knotweed, prostrate *(Polygonum aviculare)*
Kochia *(Kochia scoparia)*
Lambsquarters *(Chenopodium album)*
Little mallow *(Malva parviflora)*
Milkweed *(Asclepias* spp.*)*
Miners lettuce *(Montia perfoliata)*
Mullein *(Verbascum* spp.*)*
Nettleleaf goosefoot *(Chenopodium murale)*
Oxeye daisy *(Chrysanthemum leucanthemum)*
Pepperweed *(Lepidium* spp.*)*
Pigweed *(Amaranthus* spp.*)*
Plantain *(Plantago* spp.*)*
Pokeweed *(Phytolacca americana)*
Primrose *(Oenothera kunthiana)*
Puncturevine *(Tribulus terrestris)*
Purple loosestrife *(Lythrum salicaria)*
Purslane *(Portulaca* spp.*)*
Pusley, Florida *(Richardia scabra)*
Rocket, London *(Sisymbrium irio)*
Rush skeletonweed *(Chondrilla juncea)*
Russian knapweed *(Centaurea repens)*
Russian thistle *(Salsola kali)*
Saltbush *(Atriplex* spp.*)*
Shepherd's purse *(Capsella bursa-pastoris)*
Silverleaf nightshade *(Solanum elaeagnifolium)*
Smartweed *(Polygonum* spp.*)*
Sorrell *(Rumex* spp.*)*
Sowthistle *(Sonchus* spp.*)*
Spurge, annual *(Euphorbia* spp.*)*
Stinging nettle *(Urtica dioica)*
Sunflower *(Helianthus* spp.*)*
Sweet clover *(Melilotus* spp.*)*
Tansymustard *(Descurainia pinnata)*
Texas thistle *(Cirsium texanum)*
Velvetleaf *(Abutilon theophrasti)*
Western ragweed *(Ambrosia psilostachya)*
Wild carrot *(Daucus carota)*
Wild lettuce *(Lactuca* spp.*)*
Wild parsnip *(Pastinaca sativa)*
Wild turnip *(Brassica campestris)*
Woollyleaf bursage *(Ambrosia grayi)*
Yellow starthistle *(Centaurea solstitialis)*
Yellow woodsorrel *(Oxalis stricta)*

VINES AND BRAMBLES:

The species of vines and brambles controlled by **Alligare Imazapyr 4 SL** include the following:

Field bindweed *(Convolvulus arvensis)*
Hedge bindweed *(Calystegia sequium)*
Honeysuckle *(Lonicera* spp.*)*[1]
Morningglory *(Ipomoea* spp.*)*
Poison ivy *(Rhus radicans)*
Redvine *(Brunnichia cirrhosa)*
Trumpetcreeper *(Campsis radicans)*
Virginia creeper *(Parthenocissus quinquefolia)*
Wild buckwheat *(Polygonum convolvulus)*
Wild grape *(Vitis* spp.*)*
Wild rose *(Rosa* spp.*)*[1]
Including: Multiflora rose *(Rosa multiflora)*
Macartney rose *(Rosa bracteata)*

[1] Use higher labeled rates.

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WOODY BRUSH AND TREES:
The species of woody brush and trees controlled by **Alligare Imazapyr 4 SL** include the following:

Alder *(Alnus* spp.*)*
American beech *(Fagus grandifolia)*
Ash *(Fraxinus* spp.*)*[1]
Aspen *(Populus* spp.*)*
Autumn olive *(Elaeagnus umbellata)*
Bald cypress *(Taxodium distichum)*
Bigleaf Maple *(Acer macrophyllum)*
Birch *(Betula* spp.*)*[1]
Black oak *(Quercus kelloggii)*
Blackgum *(Nyssa sylvatica)*[2]
Boxelder *(Acer negundo)*
Brazilian peppertree *(Schinus terebinthifolius)*
Ceanothis *(Ceanothis* spp.*)*
Cherry *(Prunus* spp.*)*[1,2]
Chinaberry *(Melia azedarach)*
Chinese tallow-tree *(Sapium sebiferum)*
Chinquapin *(Castanopsis chrysophylla)*
Cottonwood *(Populus trichocarpa and Populus deltoides)*
Cypress *(Taxodium* spp.*)*
Dogwood *(Cornus* spp.*)*[1]
Eucalyptus *(Eucalyptus* spp.*)*
Hawthorn *(Crataegus* spp.*)*
Hickory *(Carya* spp.*)*[1]
Huckleberry *(Gaylussacia* spp.*)*
Lyonia spp.
Including: Fetterbush *(Lyonia lucida)*
Staggerbush *(Lyonia mariana)*
Madrone *(Arbutus menziesii)*
Maple *(Acer* spp.*)*
Melaleuca *(Melaleuca quinquenervia)*
Mulberry *(Morus* spp.*)*[1,3]
Oak *(Quercus* spp.*)*[4]
Persimmon *(Diospyros virginiana)*[2]
Poison oak *(Rhus diversiloba)*
Popcorn-tree *(Sapium sebiferum)*
Poplar *(Populus* spp.*)*
Privet *(Ligustrum vulgare)*
Red Alder *(Alnus rubra)*
Red Maple *(Acer rubrum)*
Saltcedar *(Tamarix pentandra)*
Sassafras *(Sassafras albidum)*
Sourwood *(Oxydendrum arboreum)*[2]
Sumac *(Rhus* spp.*)*
Sweetgum *(Liquidambar styraciflua)*
Sycamore *(Platanus occidentalis)*
Tanoak *(Lithocarpus densiflorus)*[1]
TiTi *(Cyrilla racemiflora)*[5]
Tree of heaven *(Ailanthus altissima)*
Vaccinium spp.
Including: Blueberry *(Vaccinium* spp.*)*
Sparkleberry *(Vaccinium arboretum)*
Willow *(Salix* spp.*)*
Yellow poplar *(Liriodendron tulipifera)*[1]

[1] Use higher labeled rates.
[2] Best control with applications prior to formation of fall leaf color.
[3] The degree of control may be species dependent.
[4] For Water oak *(Quercus nigra)*, Laurel oak *(Q. laurifloria)*, Willow oak *(Q. phellos)* and Live oak *(Q. virginiana)* use higher labeled rates.
[5] Suppression only.

MIXING AND APPLICATION INSTRUCTIONS

HELICOPTER EQUIPMENT:
Thoroughly mix the specified amount of **Alligare Imazapyr 4 SL** in 5 to 30 gallons of water per acre and apply uniformly with properly calibrated helicopter equipment. Use a nonionic surfactant to improve weed control. A drift control agent may be used at its specified label rate. An anti-foam agent may be added, if needed. Exercise all precautions to minimize or eliminate spray drift. Avoid applications during windy or gusty conditions. Use of a Microfoil™ boom, Thru-Valve™ boom, raindrop nozzles, controlled droplet booms and nozzle configurations is recommended. Maintain adequate buffer zones to minimize potential impacts to desirable vegetation.

IMPORTANT: **DO NOT** make applications by fixed wing aircraft.

Thoroughly clean mixing and application equipment by thoroughly flushing with water immediately after using this product. Prolonged exposure of uncoated/unpainted steel (except stainless steel) surfaces to this product may result in corrosion and failure of the exposed part. Maintaining painted surfaces may prevent corrosion.

GROUND EQUIPMENT:
Thoroughly mix and apply the specified amount of **Alligare Imazapyr 4 SL** in 5 to 100 gallons of water per acre. Use a nonionic surfactant to enhance weed control. A drift control agent and an anti-foam agent may also be added at the specified label rates, if needed. If desired, a spray pattern indicator may be used at the specified label rate. To minimize spray drift, select proper nozzles to avoid spraying a fine mist, use pressures less than 50 psi and **DO NOT** spray under gusty or windy conditions (also refer to **SPRAY DRIFT MANAGEMENT** section). Maintain adequate buffer zones to minimize potential impacts to desirable vegetation.

For best results, apply the spray solution to uniformly cover the foliage of the undesirable vegetation to be controlled.

Clean mixing and application equipment immediately after using this product by thoroughly flushing with water.

FOLIAR APPLICATIONS

Low Volume Foliar:
For low volume, select proper nozzles to avoid over-application. Moisten, but do not drench target vegetation causing spray solution to run off. Proper application is critical to ensure desirable results. Best results are achieved when the spray covers the crown and approximately 70 percent of the plant.

DIRECTED FOLIAR OR SPOT SPRAY EQUIPMENT:
For directed or spot spray applications with helicopter, ground equipment or low-volume hand-operated spray equipment, thoroughly mix 1.0 to 5.0% **Alligare Imazapyr 4 SL** by volume (v/v) in water with at least 1/4% nonionic surfactant by volume, according to the table below.

MIXING GUIDE FOR ALLIGARE IMAZAPYR 4 SL

SOLUTION VOLUME	Alligare Imazapyr 4 SL CONCENTRATION (%)			NONIONIC SURFACTANT
	1.0	2.5	5.0	
1 gallon	1-1/3 oz.	3-1/3 oz.	6-2/3 oz.	1/3 oz.
5 gallons	6-2/3 oz.	1 pint	2 pints	1-2/3 oz.
10 gallons	13-1/3 oz.	2 pints	4 pints	3-1/3 oz.
25 gallons	2 pints	5 pints	10 pints	8 oz.
100 gallons	1 gal.	2.5 gal.	5 gal.	2 pints

2 tablespoons = 1 fluid ounce

For optimum performance and efficacy, apply spray to uniformly cover the target vegetation foliage. Direct spray to avoid contacting desirable conifers. Avoid direct application to desired plant species as injury may occur.

IMPORTANT: **DO NOT** over apply to cause run-off from treated foliage. **DO NOT** exceed specified dosage rate per acre.

CUT STUBBLE:
This product can be applied within 2 weeks after mechanical mowing or cutting of brush. To suppress or control resprouting, uniformly apply a spray solution of this product at the rate of 1 to 2 pints per acre to the cut area. This product may be tank-mixed with picloram, or equivalent labeled product for this use to aid in control or suppression of brush. The addition of 5% (v/v) or more of a penetrating agent can aid in uptake through the bark or exposed roots.

Cut stubble applications are made to the soil and cut brush stumps. This type of application may increase ground cover injury. However, vegetation will recover. Making applications of this product directly to the soil can increase potential root uptake causing injury or death of desirable trees.

Efficacy can be increased and root uptake by desirable vegetation can be decreased if the brush is allowed to regrow and the foliage is treated. See the Brush Control section of this label.

STUMP AND CUT STEM TREATMENTS

Alligare Imazapyr 4 SL will control undesirable woody vegetation in forest management when applied as a water solution to the cambium area of freshly-cut stump surfaces or to cuts on the stem of the target woody vegetation. Applications can be made at any time of the year except during periods of heavy sap flow in the spring. Tree injection and cut stem treatments are most effective in late summer and early fall. **DO NOT** over-apply to cause run-off or puddling of spray solution.

MIXING:
Mix **Alligare Imazapyr 4 SL** as either a concentrate or dilute solution for stump and cut stem treatments. Apply dilute solutions to the surface of the stump or to cuts on the stem of the target woody vegetation. Apply concentrate solutions to cuts on the stem. Use of the concentrate solutions permits application to fewer cuts on the stem, especially for large diameter trees. Follow the application directions below to determine proper application techniques for each type of solution.

To prepare a dilute solution, mix 4 to 6 fluid ounces of **Alligare Imazapyr 4 SL** with one gallon of water. Except in the state of California, if temperatures are such that freezing of the spray mixture may occur, antifreeze (ethylene glycol) may be added according to manufacturer's label to prevent freezing. The use of a surfactant or penetrating agent may improve herbicide uptake through partially callused cambium tissue.

To prepare a concentrated solution, use undiluted **Alligare Imazapyr 4 SL** product or mix up to 75% water, by volume.

APPLICATION WITH DILUTE SOLUTIONS:
For cut stump treatments: Spray or brush the solution onto the cambium area of the freshly cut stump surface. Thoroughly wet the entire cambium area (the wood next to the bark of the stump).

For tree injection treatments: Using standard injection equipment, apply 1 milliliter of solution at each injection site around the tree with no more than one inch intervals between cut edges. Insure that the injector completely penetrates the bark at each injection site.

For frill or girdle treatments: Use a hatchet, machete or similar implement to make cuts through the bark around the tree at intervals no more than two inches between cut edges. Spray or brush **Alligare Imazapyr 4 SL** solution into each cut until thoroughly wet.

APPLICATION WITH CONCENTRATED SOLUTIONS:
For tree injection treatments: Using standard injection equipment, apply 1 milliliter of solu-

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tion at each injection site. Make at least one injection cut for every three inches of Diameter at Breast Height (DBH) on the target tree. For example, a three inch DBH tree will receive 1 injection cut while a six inch DBH tree will receive 2 injection cuts. On trees requiring more than one injection site, place the injection cuts at approximately equal intervals around the tree.

For hack and squirt treatments: Use a hatchet, machete or similar implement to make cuts at a downward angle completely through the bark and cambium at approximately equal intervals around the tree. Make at least one cut for every 3 inches of DBH on the target tree as described above, using a squirt bottle, syringe, or similar device apply about 1 milliliter of concentrate solution into each cut, ensuring that the solution does not run out of the cut.

NOTE: Injury may occur to desirable woody plants if the shoots extend from the same root system or their root systems are grafted to those of the treated tree.

SITE PREPARATION TREATMENTS

Alligare Imazapyr 4 SL will control labeled grass and broadleaf weeds, vines, brambles, woody brush and trees on forest sites when applied before replanting the following conifer crop species:

Crop Species	Rate (fl oz./A)
Loblolly Pine (*Pinus taeda*)	24 – 40
Loblolly X Pitch Hybrid	24 – 40
Longleaf Pine (*Pinus palustris*)	24 – 40
Shortleaf Pine (*Pinus echinata*)	24 – 40
Virginia Pine (*Pinus virginiana*)	24 – 40
Slash Pine (*Pinus elliottii*)	20 – 32
Douglas-Fir (*Pseudotsuga menziesii*)	12 – 24
Coastal Redwood (*Sequoia sempervirens*)	12 – 24
Western Hemlock (*Tsuga heterophylla*)	12 – 24
California Red Fir (*Abies magnifica*)	12 – 20
California White Fir (*Abies concolor*)	12 – 20
Jack Pine (*Pinus banksiana*)	12 – 16
Lodgepole Pine (*Pinus contorta*)	12 – 16
Pitch Pine (*Pinus rigida*)	12 – 16
Ponderosa Pine (*Pinus ponderosa*)	12 – 16
Sugar Pine (*Pinus lambertiana*)	12 – 16
White Pine (*Pinus strobus*)	12 – 16
Black Spruce (*Picea mariana*)	12 – 16
Red Spruce (*Picea rubens*)	12 – 16
White Spruce (*Picea glauca*)	12 – 16

Apply the specified rate of **Alligare Imazapyr 4 SL** per acre as a broadcast foliar spray for long-term control of labeled woody plants and residual control of herbaceous annual and perennial weeds. Within 4 to 6 weeks of treatment, herbaceous weeds will be controlled and may provide fuel to facilitate a site preparation burn for controlling conifers or other species tolerant to the herbicide.

For helicopter applications, apply the specified rate of **Alligare Imazapyr 4 SL** per acre in 5 to 30 gallons total spray solution. For mechanical ground sprays and backpack applications, apply the specified rate of **Alligare Imazapyr 4 SL** per acre in 5 to 100 gallons total spray solution. Use at least 1/2% percent by volume nonionic surfactant. Use the higher label rates of **Alligare Imazapyr 4 SL** and higher spray volumes to control especially dense, multi-layered canopies of hardwood stands or difficult to control species.

Tank mixes may be necessary to control conifers and other species that are tolerant to **Alligare Imazapyr 4 SL**. Observe all precautions and restrictions on the tank mix partner label. Always follow the most restrictive label. NOTE that some other products labeled for forest site preparation may kill plants such as legumes and blackberry that are desirable for wildlife habitat.

Where quick initial brown out (deadening of foliage) is desired for burning, apply a tank mixture of 16 to 32 fluid oz. **Alligare Imazapyr 4 SL** plus 16 to 64 fluid oz. Accord® or 16 to 48 fluid oz. Garlon 4™ per acre. To control seedling pines, apply 16 to 32 fluid oz. **Alligare Imazapyr 4 SL** plus 3 to 4 quarts Accord®. For site preparation, rates less than 24 oz. **Alligare Imazapyr 4 SL** will provide suppression of hardwood brush and trees; however, some resprouting may occur.

DO NOT plant seedlings of Black Spruce *(Picea mariana)* or White Spruce *(Picea glauca)* on sites that have been broadcast treated with **Alligare Imazapyr 4 SL** or into the treated zone of spot or banded applications for at least three months after treatment or injury may occur.

HERBACEOUS WEED CONTROL

Use **Alligare Imazapyr 4 SL** for selective weed control in the following conifers:

Crop Species	Rate (fl. oz./A)
Loblolly Pine *(Pinus taeda)*	6 - 10
Loblolly X Pitch Hybrid	6 - 10
Virginia Pine *(Pinus virginiana)*	6 - 10
Longleaf Pine *(Pinus palustris)*[1]	4 - 6
Shortleaf Pine (Pinus echinata)[1]	4 - 6
Slash Pine *(Pinus elliottii)*[1]	4 - 6
Douglas-Fir *(Pseudotsuga menziesii)*[1]	4 - 6

[1] Use of surfactant is not recommended.

Alligare Imazapyr 4 SL may be broadcast, banded over tree rows or directed for release of young conifers from herbaceous weeds. To diminish the possibility of conifer injury, **DO NOT** apply **Alligare Imazapyr 4 SL** when conifers are under stress from drought, diseases, animal or winter injury, planting shock or other stresses that may reduce conifer vigor. Broadcast applications may be made by helicopter, ground or backpack sprayer. For best results, apply **Alligare Imazapyr 4 SL** to newly emerged weeds. Use the higher labeled rates for hard-to-control weeds. Where herbaceous weeds have over-topped conifer seedlings, add a nonionic surfactant at up to 1/4% of the spray solution volume to improve weed control (except for Slash Pine, Longleaf Pine, and Douglas-fir). Conifers in the treated area may exhibit minor growth inhibition, especially when treatments are applied during periods of active conifer growth.

Alligare Imazapyr 4 SL may also be applied by backpack or hand-held sprayers to control herbaceous weeds around individual conifer seedlings. Mix 0.4 to 0.6 fluid oz. **Alligare Imazapyr 4 SL** and 0.2 fluid oz. nonionic surfactant per gallon of water. Direct the spray to the weeds and minimize spray contact with conifer seedlings to avoid seedling damage. **DO NOT** exceed the maximum labeled rates listed above.

Alligare Imazapyr 4 SL can also be tank mixed with a sulfometuron-methyl product to broaden the weed control spectrum. For loblolly pine only, apply 4 to 6 fluid oz. **Alligare Imazapyr 4 SL** plus a sulfometuron-methyl product at the specified label rate per acre. Application of **Alligare Imazapyr 4 SL** plus Oust® to other conifer species, however, may cause growth suppression.

CONIFER RELEASE TREATMENTS

Alligare Imazapyr 4 SL may be applied as a broadcast or directed spray to suppress the labeled brush, tree and herbaceous weed species. In conifer stands of all ages, use directed low-volume sprays onto unwanted vegetation and avoid direct contact to the conifers. **DO NOT** exceed the maximum labeled rates listed below.

Use broadcast applications of **Alligare Imazapyr 4 SL** for release of the following conifers from hardwood competition:

Crop Species	Rate (fl. oz./A)
Loblolly Pine *(Pinus taeda)*[3]	12 - 20
Loblolly X Pitch Hybrid[3]	12 - 20
Virginia Pine *(Pinus virginiana)*[3]	12 - 20
Longleaf Pine *(Pinus palustris)*	12 - 16
Pitch Pine *(Pinus rigida)*	12 - 16
Shortleaf Pine *(Pinus echinata)*	12 - 16
Slash Pine *(Pinus elliottii)*	12 - 16
White Pine *(Pinus strobus)*[1]	8 - 16
California Red Fir *(Abies magnifica)*	8 - 12
California White Fir *(Abies concolor)*	8 - 12
Lodgepole Pine *(Pinus contorta)*[2]	8 - 12
Douglas-Fir *(Pseudotsuga menziesii)*[2]	8 - 12
Jack Pine *(Pinus banksiana)*[2]	6 - 12
Black Spruce *(Picea mariana)*[2]	6 - 12
Red Spruce *(Picea rubens)*[2]	6 - 12
White Spruce *(Picea glauca)*[2]	6 - 12

[1] **DO NOT** make applications to white pine stands younger than three years old. To minimize potential injury to White Pine, release treatments should not be made prior to July 15.
[2] Applications should be made after formation of final conifer resting buds in the fall or height growth inhibition may occur.
[3] Mid-rotation release: For broadcast applications below the pine canopy in established stands of Loblolly Pine, Loblolly X pitch hybrid, and Virginia Pine use 16-32 oz. product per acre. For mid-rotation release of other species use rates listed above.

Apply the specified rate of **Alligare Imazapyr 4 SL** per acre when applying broadcast sprays by helicopter or ground spray equipment. Refer to mixing and application instructions for proper spray volumes. A nonionic surfactant may be added but at no more than 1/4% by volume of the finished spray. Use the higher label rates of **Alligare Imazapyr 4 SL** when controlling especially dense stands or hard to control species.

Conifers may exhibit some minor growth inhibition when release treatments are made during periods of active conifer growth. To minimize potential growth inhibition, **DO NOT** make broadcast applications to conifer stands, except loblolly pine, before the end of the second growing season and, then, not until late in the growing season. To reduce the possibility of conifer injury, **DO NOT** apply **Alligare Imazapyr 4 SL** when conifers are under stress from drought, diseases, animal or winter injury, or other stresses that reduce conifer vigor.

For release of loblolly pine seedlings during the first growing season following planting or for one-year-old natural loblolly pine regeneration: For one-year-old loblolly pine release, apply 12-20 fluid oz./A **Alligare Imazapyr 4 SL** after July 15. Use rates below 16 fluid oz./A for growth suppression of hardwoods; however, some hardwood resprouting should be expected.

For release of 2-to-5 year old slash pine and longleaf pine from undesirable woody plants: Broadcast release treatments over the top of pines after August 15 and only in stands 2 to 5 years old. **DO NOT** add surfactant to the spray solution and use the lower labeled rates on areas with sandy soils.

For release of slash pine over 5 years old by aerial application: Apply ONLY after September 15 after height growth has stopped and buds have set. Use 12 to 14 fluid oz **Alligare Imazapyr 4 SL** per acre but only 12 fluid oz on areas with sandy soils. **DO NOT** add surfactant to the spray solution. **DO NOT** over apply by overlapping the spray pattern or dressing up around the edges of a tract. Since this treatment may cause some inhibition in height growth or terminal dieback, it should not be used if such affects are unacceptable.

For use ONLY in Maine for release of Jack Pine, Black Spruce, Red Spruce and White Spruce: For hardwood growth suppression, apply **Alligare Imazapyr 4 SL** at rates less than 6 fluid oz. per acre when tank mixed with glyphosate. Use a nonionic surfactant at rates greater than 0.25% v/v. The use of **Alligare Imazapyr 4 SL** with more than 0.25% v/v non-

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ionic surfactant can result in conifer growth inhibition or mortality, and should not be used if this type of conifer injury is unacceptable.

The use of **Alligare Imazapyr 4 SL** rates below 6 oz./A are intended for hardwood brush growth suppression and hardwood brush resprouting should be expected.

USE FOR SPOT TREATMENT OF UNDESIRABLE BRUSH AND HARDWOOD VEGETATION

Apply Alligare Imazapyr 4 SL as a directed foliar or cut stem application in conifer stands of all ages for the conifer species listed above. Mix and apply as described above for directed foliar or cut stem applications. **DO NOT** exceed the maximum labeled rates listed above. Cut stem applications may be used for spot treatment of undesirable hardwoods in Ponderosa Pine stands using 12 oz. or less of product per acre.

Avoid direct spray contact to desired plant species as injury may occur. Injury may occur to non-target or desirable hardwoods or conifers if they extend from the same root system or their root systems are grafted to those of the treated tree or if their roots extend into the treated zone.

LATE ROTATION VEGETATION CONTROL IN WESTERN CONIFERS

In California, the Pacific Northwest and Inland Northwest, broadcast aerial applications of this product up to 24 fl. oz./A are permissible in conifer stands that are targeted for harvesting the year following treatment. Use minimum spray volume of 15 gallons per acre. Do not use this treatment if conifer injury or mortality cannot be tolerated.

BAG AND SPRAY APPLICATIONS FOR CONIFER RELEASE

In Douglas fir and Ponderosa pine stands, broadcast applications of this product up to 16 fl. oz./A are permissible when the trees are covered by bags prior to the application. The bags must prevent the spray mix from contacting the conifer foliage. On sites with coarse textured soils (e.g., decomposed granite, pumice, sandy or rocky sites) or low levels of soil organic matter (generally 5% or less) significant conifer growth inhibition and mortality is possible. Do not use this treatment on these types of sites if conifer growth inhibition and mortality cannot be tolerated.

AQUATIC USE SECTION

USE PRECAUTIONS AND RESTRICTIONS FOR AQUATICS

In the state of New York, Aquatic Uses are Not Allowed.

Applications may only be made for the control of undesirable emergent and floating aquatic vegetation in and around standing and flowing water, including estuarine and marine sites. Applications may be made to control undesirable wetland, riparian and terrestrial vegetation growing in or around surface water.

Aerial application is restricted to helicopter only.

Application of this product can only be made by federal or state agencies, such as Water Management District personnel, municipal officials and the U.S. Army Corps of Engineers, or those applicators who are licensed or certified as aquatic pest control applicators and are authorized by the state or local government.

Applications to private water: Applications may be made to private waters that are still, such as ponds, lakes and drainage ditches where there is minimal or no outflow to public waters.

Application to public waters: Applications may be made to public waters such as ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, streams, rivers, and other slow-moving or quiescent bodies of water for control of aquatic weeds or for control of riparian and wetland weed species.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

Recreational Use of Water in Treatment Area: There are no restrictions on the use of water in the treatment area for recreational purposes, including swimming and fishing.

Livestock Use of Water in/from Treatment Area: There are no restrictions on livestock consumption of water from the treatment area.

Precautions for Potable Water Intakes: Do not apply this product directly to water within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within one-half mile of active potable water intakes, the water intake must be turned off during application and for a minimum of 48 hours after the application. These aquatic applications may be made only in the cases where there are alternative water sources or holding ponds, which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. Note: Existing potable water intakes which are no longer in use, such as those replaced by connections to wells or a municipal water system, are not considered to be active potable water intakes. This restriction does not apply to intermittent, inadvertent over spray of water in terrestrial use sites.

APPLICATION TO WATERS USED FOR IRRIGATION

The use of treated waters on irrigated crops within 120 days of treatment is prohibited.

Seasonal Irrigation Water: This product may be applied during the off-season to surface waters that are used for irrigation on a seasonable basis, provided that there is a minimum of 120 days between product application and the first use of treated water for irrigation purposes or until product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Irrigation Canals/Ditches: Do not apply this product to irrigation canals/ditches unless the 120-day restriction on irrigation water usage can be observed or product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less. Do not apply this product to dry irrigation canals/ditches.

Quiescent or Slow Moving Waters: In lakes and reservoirs DO NOT apply this product within one (1) mile of an active irrigation water intake during the irrigation season. Applications less than one (1) mile from an active irrigation water intake may be made during the off-season, provided that the irrigation intake will remain active for a minimum 120 days after application or until product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Moving Water: Do not apply within one-half mile downstream of an active irrigation water intake. When making applications upstream from an active irrigation water intake, the intake must be turned off for a period of time sufficient to allow the upstream portion of treated water to completely flow past the irrigation intake before use can resume. Shut off time will be determined by the speed of water flow and the distance and length of water treated upstream from the intake. Consult local, state and/or federal authorities before making any applications upstream from an active irrigation water intake.

Use Sites: This product is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to control floating and emergent undesirable vegetation (see AQUATIC WEEDS CONTROLLED section and the ADDITIONAL WEEDS CONTROLLED section) in or near bodies of water which may be flowing, non-flowing, or transient. This product may be applied to specified aquatic sites that include lakes, rivers, streams, ponds, seeps, drainage ditches, canals, reservoirs, swamps, bogs, marshes, estuaries, bays, brackish water, transitional areas between terrestrial and aquatic sites and seasonal wet areas. See AQUATIC USE section of this label for precautions, restrictions, and instructions on aquatic uses.

Read and observe the following directions if aquatic sites are present in terrestrial non-crop areas and are part of the intended treatment area:

Herbicidal Activity: This product will control most annual and perennial grasses and broadleaf weeds in addition to many brush and vine species with some residual control of undesirable species that germinate above the waterline. This product is readily absorbed through emergent leaves and stems and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into, and kills, underground or submerged storage organs, which prevents regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until two or more weeks after application. Complete kill of plants may not occur for several weeks. Performance of this product may be reduced if rainfall occurs within 2 hours of application. **This product does not control plants which are completely submerged or have a majority of their foliage under water.**

Application Methods: This product must be applied to the emergent foliage of the target vegetation and has little to no activity on submerged aquatic vegetation. Product concentrations resulting from direct application to water are not expected to be of sufficient concentration or duration to provide control of target vegetation. Application should be made in such a way as to maximize spray interception by the target vegetation while minimizing the amount of over spray that enters the water. For maximum activity, weeds should be growing vigorously at the time of application and the spray solution should include a surfactant (See ADJUVANTS section for specific recommendations). This product may be selectively applied by using low-volume directed application techniques or may be broadcast-applied by using ground equipment, watercraft or by helicopter. In addition, this product may also be used for cut stump, cut stem and frill and girdle treatments within aquatic sites (see AERIAL APPLICATIONS and GROUND APPLICATIONS sections for additional details).

This product should be applied with surface or helicopter application equipment in a minimum of 5 gallons of water per acre. When applying by helicopter, follow directions under the AERIAL APPLICATIONS section of this label; otherwise refer to section on GROUND APPLICATIONS when using surface equipment.

Applications made to moving bodies of water should be made while travelling upstream to prevent concentration of this herbicide in water. Do not apply to bodies of water or portions of bodies of water where emergent and/or floating weeds do not exist.

When application is to be made to target vegetation that covers a large percentage of the surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in the suffocation of some sensitive aquatic organisms. Do not treat more than one half of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas.

Apply this product at 1 to 3 pints per acre depending on species present and weed density. Do not exceed the maximum label rate of 3 pints per acre (1.5 lb. ai/A) per year. Use the higher labeled rates for heavy weed pressure. Consult the AQUATIC WEEDS CONTROLLED section and the ADDITIONAL WEEDS CONTROLLED section of this label for specific rates.

This product may be applied as a draw down treatment in areas described above. Apply this product to weeds after water has been drained and allow 14 days before reintroduction of water.

AQUATIC SPECIES CONTROLLED

This product will control the following target species as specified in the INSTRUCTIONS section of the table. Rates are expressed in terms of product volume for broadcast applications and as a percent solution for directed applications including spot treatments. For percent solution applications, DO NOT apply more than the equivalent of 1.5 quarts of this product per acre.

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COMMON NAME	SCIENTIFIC NAME	INSTRUCTIONS
Floating Species		
*Duckweed	*Lemna minor*	1 – 1 ½ pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Duckweed, Giant	*Spirodela polyriza*	1 – 1 ½ pints/are (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Frogbit	*Limnobium spongia*	½ – 1 pint/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Spatterdock	*Nuphar luteum*	Apply a tank-mix of 1-2 pints/acre of this product + 4-6 pints/acre glyphosate (0.5% this product + 1.5% glyphosate) in 100 GPA water for best control. Ensure 100% coverage of actively growing, emergent foliage.
*Water Hyacinth	*Eichhornia crassipes*	½ – 1 pint/acre (0.5% solution) applied in 100 GPA water to actively growing foliage.
*Water Lettuce	*Pistia stratiotes*	½ – 1 pint/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
Emerged Species		
*Alligatorweed	*Alternanthera philoxeroides*	½ – 2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage. Tank-mix with glyphosate is NOT recommended, and may reduce alligatorweed control, requiring higher product rates.
*Arrowhead, Duck-potato	*Sagittaria* spp.	½ – 1 pint/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Bacopa, lemon	*Bacopa* spp.	½ – 1 pint/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Parrot feather	*Myriophyllum aquaticum*	Must be foliage above water for sufficient product uptake. Apply 1 – 2 pints to actively growing emergent foliage.
*Pennywort	*Hydrocotyle* spp.	½ – 1 pint/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Pickerelweed	*Pontederia cordata*	1 – 1½ pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Taro, wild; Dasheen; Elephant's Ear; Coco Yam	*Colocasia esculentum*	2 – 3 pints/acre (1.5% solution) applied in 100 GPA with a high quality 'sticker' adjuvant. Ensure good coverage of actively growing, emergent foliage.
*Water lily	*Nymphaea odorata*	1 – 1 ½ pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Water primrose	*Ludwigia uruguayensis*	2 – 3 pints/acre (1.5% solution), ensure 100% coverage of actively growing, emergent foliage. Tank-mix with glyphosate is NOT recommended and may reduce water primrose control.
Terrestrial/Marginal		
*Soda Apple, aquatic, Nightshade	*Solanum tampicense*	1 pint/acre applied to foliage
*Bamboo, Japanese	*Phyllostachys* spp.	1 ½ – 2 pints/acre applied to the foliage when plant is actively growing. Before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Brazilian Pepper; Christmasberry	*Schinus terebinthifolius*	1 – 2 pints/acre applied to foliage.
Cattail	*Typha* spp.	1 – 2 pints (1% solution) applied to actively growing, green foliage after full leaf elongation. Lower rates will control cattail in the north; higher rates are needed in the south.
Chinese Tallow Tree	*Sapium sebiferum*	8 – 12 ounces applied to foliage.
Cogongrass	*Imperata cylindrica*	Burn foliage, till area, that Fall spray 1 quart/acre this product + MSO applied to new growth.
Cordgrass, prairie	*Spartina* spp.	2 – 3 pints applied to actively growing foliage.
Cutgrass	*Zizaniopsis miliacea*	2 – 3 pints applied to actively growing foliage.
*Elephant Grass; Napier Grass	*Pennisetum purpureum*	1½ pints/acre applied to actively growing foliage.
*Flowering rush	*Butumu typla*	1 – 1½ pints applied to actively growing foliage.
Giant Reed, Wild Cane	*Arundo donax*	2 – 3 pints/acre applied in spring to actively growing foliage.

COMMON NAME	SCIENTIFIC NAME	INSTRUCTIONS
Terrestrial/Marginal		
*Golden Bamboo	*Phyllostachys aurea*	1½ – 2 pints/acre applied to the foliage when plant is actively growing before plants set seed heads. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Junglerice	*Echinochloa colonum*	1½ – 2 pints applied to actively growing foliage.
Knapweeds	*Centaurea species*	Russian Knapweed – 1 to 1½ pints + 1 quart/acre MSO fall applied after senescence begins
Knotweed, Japanese (see Fallopia japonica)	*Polygonum cuspidatum*	1½ – 2 pints/acre applied postemergence to actively growing foliage.
Melaleuca; Paperbark Tree	*Melaleuca quinquenervia*	For established stands, apply 2 pints/acre of this product + 6 pints/acre glyphosate + spray adjuvant. For best results, use 4 quarts/A methylated seed oil as an adjuvant. For ground foliar application, uniformly apply to ensure 100% coverage. For broadcast foliar control, apply aerially in a minimum of two passes at 10 gallons/acre applied cross treatment. For spot treatment, use a 25% solution of this product + 25% solution of glyphosate + 1.25% MSO in water applied as a frill or stump treatments.
*Nutgrass; Kili'p'opu	*Cyperus rotundus*	1 pint of this product + 1 quart/acre MSO applied early postemergence.
*Nutsedge	*Cyperus* spp.	1 – 1½ pints postemergence to foliage or pre-emergence incorporated, non-incorporated pre-emergence applications will not control.
Phragmites; Common Reed	*Phragmites australis*	1½ – 2 pints/acre applied to actively growing, green foliage after full leaf elongation, ensure 100% coverage. If stand has a substantial amount of old stem tissue, mow or burn, allow to regrow to approximately 5' tall before treatment. Lower rates will control phragmites in the north; higher rates are needed in the south.
*Poison Hemlock	*Conium maculatum*	1 pint of this product + 1 quart/acre MSO applied pre-emergence to early postemergence to rosette, prior to flowering.
Purple Loosestrife	*Lythrum salicaria*	½ pint/acre applied to actively growing foliage.
Reed canarygrass	*Phalaris arundinacea*	1½ – 2 pints/acre applied to actively growing foliage.
Rose, swamp	*Rosa palustris*	1 – 1½ pints/acre applied to actively growing foliage.
Russian-Olive	*Elaeagnus angustifolia*	1 – 2 pints/acre or a 1% solution, applied to foliage.
Saltcedar; Tamarisk	*Tamarix species*	Aerial apply 1 quart of this product + 0.25% v/v NIS applied to actively growing foliage during flowering. For spot spraying, use 1% solution of this product + 0.25% v/v NIS and spray to wet foliage. After application, wait at least two years before disturbing treated saltcedar. Earlier disturbance can reduce overall control.
Smartweed	*Polygonum* spp.	1 pint/acre applied early postemergence.
Sumac	*Rhus* spp.	1 – 1½ pints/acre applied to foliage.
Swamp Morning Glory; Water Spinach; Kangkong	*Ipomoea aquatic*	½ – 1 pint/acre of this product + 1 quart/ acre MSO applied early postemergence.
Torpedo Grass	*Panicum repens*	2 pints/acre (1 – 1.5% solution), ensure good coverage to actively growing foliage.
*White Top; Hoary Cress	*Cardaria draba*	½ – 1 pint/acre of this product applied to actively growing foliage, ensure good coverage.
Willow	*Salix* spp.	1 – 1 ½ pints/acre of this product applied to actively growing foliage, ensure good coverage.

*Not approved for use in California.

TANK MIXES

This product may be tank mixed with other aquatic use herbicides for the control of emergent and floating aquatic vegetation provided that the tank mix herbicide label does not prohibit such mixing. Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label instructions and restrictions when making an application involving tank mixes.

TANK MIXES FOR WEED AND BRUSH CONTROL

This product may be tank mixed with other registered herbicide products to provide control of species tolerant to this product.

Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label when making an application involving tank mixes. Tank mixing with 2,4-D or products which contain 2,4-D could result in reduced performance of this product when 2,4-D is used at high rates.

INVERT EMULSIONS:

This product can be applied as an invert emulsion. Consult the invert chemical label for proper mixing directions.

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FOR CONTROL OF UNDESIRABLE WEEDS UNDER PAVED SURFACES

This product can be used under asphalt, pond liners and other paved areas ONLY in industrial sites or where the pavement has a suitable barrier along the perimeter that prevents encroachment of roots of desirable plants.

This product should be used only where the area to be treated has been prepared according to good construction practices. If rhizomes, stolons, tubers or other vegetative plant parts are present in the site, they should be removed by scalping with a grader blade to a depth sufficient to ensure their complete removal.

IMPORTANT: Paving should follow applications of this product as soon as possible. DO NOT apply where the chemical may contact the root of desirable trees or other plants.

The product is not recommended for use under pavement on residential properties such as driveways or parking lots, nor is it recommended for use in recreational areas such as under bike or jogging paths, golf cart paths, or tennis courts, or where the landscape plantings could be anticipated.

Injury or death of desirable plants may result if this product is applied where roots are present or where they may extend into the treated area. Roots of trees and shrubs may extend a considerable distance beyond the branch extremities or so-called drip line.

APPLICATION DIRECTIONS FOR PAVED SURFACES:

Applications should be made to the soil surface only when final grade is established. Do not move soil following application of this product. Apply this product in sufficient water (at least 100 gals. per acre) to ensure thorough and uniform wetting of the soil surface, including the shoulder areas. Add this product at a rate of 3 pints per acre (1.1 fluid ounces per 1000 square feet) to clean water in the spray tank during the filling operation. Agitate before spraying.

If the soil is not moist prior to treatment, incorporation of this product is needed for herbicide activation. This product can be incorporated into the soil to a depth of 4 to 6 inches using a rototiller or disc. Rainfall or irrigation of 1 inch will also provide uniform incorporation. Do not allow treated soil to wash or move into untreated areas.

FOR CONTROL OF UNDESIRABLE WEEDS IN UNIMPROVED DORMANT BERMUDAGRASS AND BAHIAGRASS

This product may be used on unimproved dormant bermudagrass and bahiagrass turf on roadsides and utility rights-of-way. The application of this product on established common and coastal bermudagrass and bahiagrass provides control of labeled broadleaf and grass weeds. Competition from these weeds is eliminated, releasing the bermudagrass and bahiagrass. Treatment of bermudagrass with this product results in a compacted growth habit and seedhead inhibition.

Uniformly apply with properly calibrated ground equipment using at least 10 gallons of water per acre with a spray pressure 20 to 50 psi.

IMPORTANT: Temporary yellowing of grass may occur when treatment is made after growth commences. DO NOT add surfactant in excess of the specified rate (1 fluid ounce per 25 gallons of spray solution). DO NOT APPLY to grass during its first growing season. DO NOT APPLY to grass that is under stress from drought, disease, insects, or other causes.

DOSAGE RATES AND TIMING:

Bermudagrass – Apply this product at 3 to 6 fluid ounces per acre when the bermudagrass is dormant. Apply this product at 3 to 4 fluid ounces per acre after the bermudagrass has reached full green-up. Applications made during green-up will delay green-up. Include a surfactant in the spray solution (see IMPORTANT statement above).

For additional pre-emergence control of annual grasses and small seeded broadleaf weeds, add Endurance® or Pendulum® herbicide at the rate of 3.3 to 6.6 pounds per acre. Consult the Endurance® or Pendulum® label for weeds controlled and for other use directions and precautions.

For control of johnsongrass in bermudagrass turf, apply this product at 4 fluid ounces per acre plus a registered herbicide with addition of an approved surfactant. For additional control of broadleaves and vines, a registered herbicide may be added to the above mix at the rate of 1 to 2 pints per acre. Observe all precautions and restrictions of the labels.

Bahiagrass – Apply this product at 2 to 4 fluid ounces per acre when the bahiagrass is dormant or after the grass has initiated green-up but has not exceeded 25% green-up. Include in the spray solution a surfactant (See Adjuvant section for specific recommendations on surfactants).

WEEDS CONTROLLED

Bedstraw (*Galium* spp.)
Bishopweed (*Ptilimnium capillaceum*)
Buttercup (*Ranunculus parviflorus*)
Carolina geranium (*Geranium carolinianum*)
Fescue (*Festuca* spp.)
Foxtail (*Setaria* spp.)
Little barley (*Hordeum pusillum*)
Seedling Johnsongrass (*Sorghum halepense*)
Wild carrot (*Daucus carota*)
White clover (*Trifolium repens*)
Yellow woodsorrel (*Oxalis stricta*)

GRASS GROWTH AND SEEDHEAD SUPPRESSION

This product may be used to suppress growth and seedhead development of certain turfgrasses in unimproved areas. When applied to desirable turf, this product may result in temporary turf damage, death, and/or discoloration. Effects to the desirable turf may vary with environmental conditions. For optimum performance, application should be made prior to culm elongation. Applications may be made before or after mowing. If applied prior to mowing, allow at least three days of active growth before mowing. If following a mowing, allow sufficient time for the grasses to recover before applying this product or injury may be amplified.

DO NOT APPLY to turf under stress (drought, cold, insect damaged, etc) or severe injury or death may occur.

Bermudagrass – Apply this product at 3 to 4 fluid ounces per acre from early green-up to prior to seedhead initiation. DO NOT add a surfactant for this application.

Cool Season Unimproved Turf – Apply this product at 1 fluid ounce per acre plus 0.25% nonionic surfactant. For increased suppression, this product may be tank-mixed with other products suitable for this use.

Tank-mixes may increase injury to desired turf. Consult each product label for recommended turf species and other use directions and precautions. Tank mixes with 2,4-D or products containing 2,4-D at higher rates may decrease the effectiveness of this product.

TOTAL VEGETATION CONTROL WHERE BAREGROUND IS DESIRED

This product is an effective herbicide for preemergence or postemergence control of many annual and perennial broadleaf and grass weeds where bare ground is desired. This product is particularly effective on hard-to-control perennial grasses. This product at 0.75 to 3 pints per acre can be used alone or in tank mix with Diuron, Simazine, Vanquish®, or other registered herbicides labeled for this use. The degree and duration of control are dependent on the rate of this product used, tank-mix partner, the volume of carrier, soil texture, rainfall and other conditions.

Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label when making an application involving tank-mixes.

Applications of these products may be made anytime of the year. Use equipment calibrated to deliver desired gallons per acre spray volume and uniformly distribute the spray pattern over the treated area.

Postemergence Applications: Always use a spray adjuvant (See ADJUVANTS section of this label) when making a postemergence application. For optimum performance on tough to control annual grasses, apply 100 gallons per acre or less. For spot treatments, this product may be used as a follow-up treatment to control escapes or weed encroachment in a bare ground situation. To prepare the spray solution, thoroughly mix in each gallon of water 0.5 to 5% of this product plus an adjuvant.

FOR SPOT TREATMENT WEED CONTROL IN GRASS PASTURE AND RANGELAND

For the control of undesirable vegetation in grass pasture and rangeland this product may be applied as a spot treatment at a rate of 1 to 24 fluid ounces of product per treated acre using any of the described ground application methods. Spot applications to grass pasture and rangeland may not exceed more than one tenth of the area to be grazed or cut for hay. See appropriate sections of this label for specific use directions for the application method and vegetation control desired. DO NOT apply more than 48 fluid ounces per acre per year.

Grazing and haying restrictions: There are no grazing restrictions following application of this product. DO NOT cut forage grass for hay for seven days after application of this product.

GUIDELINES FOR RANGELAND USE

This product may be applied to rangeland for the control of undesirable vegetation in order to achieve one or more of the following vegetation management objectives:

1. The control of undesirable (non-native, invasive and noxious) plant species.
2. The control of undesirable vegetation in order to aid in the establishment of desirable rangeland plant species.
3. The control of undesirable vegetation in order to aid in the establishment of desirable rangeland vegetation following a fire.
4. The control of undesirable vegetation for purposes of wildlife fuel reduction.
5. The release of existing desirable rangeland plant communities from the competitive pressure of undesirable plant species.
6. The control of undesirable vegetation for purposes of wildlife habitat improvement.

To ensure the protection of threatened and endangered plants when applying this product to rangeland:

1. Federal agencies must follow NEPA regulations to ensure protection of threatened and endangered plants.
2. State agencies must work with the Fish and Wildlife Service or the Service's designated state conservation agency to ensure protection of threatened and endangered plants.
3. Other organizations or individuals must operate under a Habitat Conservation Plan if threatened or endangered plants are known to be present on the land to be treated.

ROTATIONAL CROP INSTRUCTIONS

Rotational crops may be planted twelve months after applying this product at the specified pasture and rangeland rate. Following twelve months after an application of this product, and before planting any crop, a successful field bioassay must be completed. The field bioassay consists of a test strip of the intended rotational crop planted in the previously treated area in the grass pasture/rangeland and grown to maturity. The test strip should include low areas and knolls, and include variations in soil type and pH within the treated area. If no crop injury is evident in the test strip, the intended rotational crop may be planted the following year.

Use of this product in accordance with label directions is expected to result in normal growth or rotational crops in most situations; however, various environmental and agronomic factors make it possible to eliminate all risks associated with the use of this product and, therefore, rotational crop injury is always possible.

ADDITIONAL WEEDS CONTROLLED

In terrestrial sites, this product will provide preemergence or postemergence control with residual control of the following target vegetation species at the rates listed. Residual control refers to control of newly germinating seedlings in both annuals and perennials. In general, annual weeds may be controlled by preemergence or postemergence applications of this product. For established biennials and perennials postemergence applications of this product are recommended.

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The rates shown below pertain to broadcast applications and indicate the relative sensitivity of these weeds. The relative sensitivity should be referenced when preparing low volume spray solutions (see Low Volume section of Ground Applications); low volume applications may provide control of the target species with less product per acre than is shown for the broadcast treatments. This product should be used only in accordance with the directions on this label.

The relative sensitivity of the species listed below can also be used to determine the relative risk of causing non-target plant injury if any of the below listed species are considered to be desirable within the area to be treated.

Resistant Biotypes: Naturally occurring biotypes (a plant within a given species that has a slightly different, but distinct, genetic makeup from other plants of the same species) of some weeds listed on this label may not be effectively controlled. If naturally occurring resistant biotypes are present in an area, this product should be tank-mixed or applied sequentially with an appropriate registered herbicide having a different mode of action to ensure control.

GRASSES

COMMON NAME	SPECIES	GROWTH HABIT[2]
	Apply 1.0 – 1.5 pints per acre[1]	
Annual bluegrass	*(Poa annua)*	A
Broadleaf signalgrass	*(Brachiaria platyphylla)*	A
Canada bluegrass	*(Poa compressa)*	P
Downy brome	*(Bromus tectorum)*	A
Fescue	*(Festuca* spp.*)*	A/P
Foxtail	*(Setaria* spp.*)*	A
Italian ryegrass	*(Lolium multiflorum)*	A
Johnsongrass	*(Sorghum halepense)*	P
Kentucky bluegrass	*(Poa pratensis)*	P
Lovegrass	*(Eragrostis* spp.*)*	A/P
*Napier grass	*(Pennisetum purpureum)*	P
Orchardgrass	*(Dactylis glomerata)*	P
Paragrass	*(Brachiaria mutica)*	P
Quackgrass	*(Agropyron repens)*	P
Sandbur	*(Cenchrus* spp.*)*	A
Sand dropseed	*(Sporobulus cryptandrus)*	P
Smooth brome	*(Bromus inermis)*	P
Vaseygrass	*(Paspalum urvillei)*	P
Wild oats	*(Avena fatua)*	A
Witchgrass	*(Panicum capillare)*	A
	Apply 1.5 – 2.0 pints per acre[1]	
Barnyardgrass	*(Echinochloa crus-gali)*	A
Beardgrass	*(Andropogon* spp.*)*	P
Bluegrass, Annual	*(Poa annua)*	A
*Bulrush	*(Scirpus validus)*	A
Cheat	*(Bromus secalinus)*	A
Crabgrass	*(Digitaria* spp.*)*	A
Crowfootgrass	*(Dactyloctenium aegyptium)*	A
Fall panicum	*(Panicum dichotomiflorum)*	A
Giant Reed	*(Arundo donax)*	A
Goosegrass	*(Eleusine indica)*	A
Itchgrass	*(Rottboellia exaltata)*	A
Junglerice	*(Echinochloa colonum)*	A
Lovegrass	*(Eragrostis* spp.*)*	A
*Maidencane	*(Panicum hemitomon)*	A
Panicum, Browntop	*(Panicum tasciculatum)*	A
Panicum, Texas	*(Panicum texanum)*	A
Prairie threeawn	*(Aristida oligantha)*	P
Reed canarygrass	*(Phalaris arundinacea)*	P
Sandbur, Field	*(Cenchrus incertus)*	A
Signalgrass	*(Brachiaria platyphylla)*	A
Torpedograss	*(Panicum repens)*	P
Wild barley	*(Hordeum* spp.*)*	A
Wooly Cupgrass	*(Eriochloa villosa)*	A
	Apply 2.0 – 3.0 pints per acre[1]	
Bahiagrass	*(Paspalum notatum)*	P
Bermudagrass[3]	*(Cynodon dactylon)*	P
Big bluestem	*(Andropogon gerardil)*	P
Cattail	*(Typha* spp.*)*	P
Cogongrass	*(Imperata cylindrical)*	P
Dallisgrass	*(Paspalum dilatatum)*	P
Feathertop	*(Pennisetum villosum)*	P
Guineagrass	*(Panicum maximum)*	P
Phragmites	*(Phragmites austalis)*	P
Prairie cordgrass	*(Spartina pectinata)*	P
Saltgrass[3]	*(Distichlis stricta)*	P
Sand dropseed	*(Sporobolus cryptandrus)*	P
Sprangletop	*(Leptochloa* spp.*)*	A
Timothy	*(Phleum pretense)*	P
Wirestem muhly	*(Muhlenbergia frondosa)*	P

BROADLEAF WEEDS

COMMON NAME	SPECIES	GROWTH HABIT[2]
	Apply 1.0 – 1.5 pints per acre[1]	
Alligatorweed	*(Alternanthera philoxeroides)*	A/P
Burdock	*(Arctium* spp.*)*	B
Goosegrass	*(Eleusine indica)*	A
Camphorweed	*(Heterotheca subaxillaris)*	P
Carolina geranium	*(Geranium carolinianum)*	A
Clover	*(Trifolium* spp.*)*	A/P
Common chickweed	*(Stellaria media)*	A
Common ragweed	*(Ambrosia artemisiifolia)*	A
Dandelion	*(Taraxacum officinale)*	P
Dog fennel	*(Eupatorium capillifolium)*	A
Filaree	*(Erodium* spp.*)*	A
Fleabane	*(Erigeron* spp.*)*	A
Hoary vervain	*(Verbena stricta)*	P
Horseweed	*(Conyza canadensis)*	A
Indian mustard	*(Brassica juncea)*	A
Kochia	*(Kochia scoparia)*	A
Lambsquarters	*(Chenopodium album)*	A
*Lespedeza	*(Lespedeza* spp.*)*	P
Miners lettuce	*(Montia perfoliata)*	A
Mullein	*(Verbascum* spp.*)*	B
Nettleleaf goosefoot	*(Chenopodium murale)*	A
Oxeye daisy	*(Chrysanthemum leucanthemum)*	P
Pepperweed	*(Lepidium* spp.*)*	A
Pigweed	*(Amaranthus* spp.*)*	A
Plantain	*(Plantago* spp.*)*	P
Puncturevine	*(Tribulus terrestris)*	A
Russian thistle	*(Salsola kali)*	A
Smartweed	*(Polygonum* spp.*)*	A/P
Sorrell	*(Rumax* spp.*)*	P
Sunflower	*(Helianthus* spp.*)*	A
Sweet clover	*(Melilotus* spp.*)*	A/B
Tansymustard	*(Descurainia pinnata)*	A
Western ragweed	*(Ambrosia psilostachya)*	P
Wild carrot	*(Daucus carota)*	B
Wild lettuce	*(Lactuca* spp.*)*	A/B
Wild parsnip	*(Pastinaca sativa)*	B
Wild turnip	*(Brassica campestris)*	B
Woollyleaf bursage	*(Franseria tomentosa)*	P
Yellow woodsorrel	*(Oxalis stricta)*	P
	Apply 1.5 – 2.0 pints per acre[1]	
Broom snakeweed[4]	*(Gutierrezia sarothrae)*	P
Bull thistle	*(Cirsium vulgare)*	B
Burclover	*(Medicago* spp.*)*	A
Chickweed, Mouseear	*(Cerastium vulgatum)*	A
Clover, Hop	*(Trifolium procumbens)*	A
Cocklebur	*(Xanthium strumarium)*	A
Cudweed	*(Gnaphalium* spp.*)*	A
Desert Camelthorn	*(Alhagi pseudalhagi)*	P
Diffuse knapweed	*(Centaurea diffusa)*	A
Dock	*(Rumex* spp.*)*	P
Fiddleneck	*(Amsinckia intermedia)*	A
Goldenrod	*(Solidago* spp.*)*	P
Henbit	*(Lamium aplexicaule)*	A
Knotweed, prostrate	*(Polygonum aviculare)*	A/P
Pokeweed	*(Phytolacca americana)*	P
Purple loosestrife	*(Lythrum salicaria)*	P
Purslane	*(Portulaca* spp.*)*	A
Pusley, Florida	*(Richardia scabra)*	A
Rocket, London	*(Sisymbrium irio)*	A
Rush skeletonweed[4]	*(Chondrilla juncea)*	B
Saltbrush	*(Atriplex* spp.*)*	A
Shepherd's-purse	*(Capsella bursa-pastoris)*	A
Spurge, Annual	*(Euphorbia* spp.*)*	A
Stinging nettle[4]	*(Urtica dioica)*	P
Velvetleaf	*(Abutilon theophrasti)*	A
Yellow starthistle	*(Centaurea solstitialis)*	A
	Apply 2.0 – 3.0 pints per acre[1]	
Arrowweed	*(Pluchea sericea)*	A
Canada thistle	*(Cirsium arvanse)*	P
Giant ragweed	*(Ambrosia trifida)*	A
Grey rabbitbrush	*(Chrysothamnus nauseosus)*	P
Little mallow	*(Malva parviflora)*	B
Milkweed	*(Asclepias* spp.*)*	P
Primrose	*(Oenothera kunthiana)*	P
Russian knapweed	*(Centaurea repens)*	P
Silverleaf nightshade	*(Solanum eleagnifolium)*	P
Sowthistle	*(Sonchus* spp.*)*	A
Texas thistle	*(Cirsium texanum)*	P

VINES AND BRAMBLES

COMMON NAME	SPECIES	GROWTH HABIT[2]
	Apply 0.5 pint per acre	
Field bindweed	*(Convolvulus arvensis)*	P
Hedge bindweed	*(Calystegia sequium*	A
	Apply 1.0 – 1.5 pints per acre[1]	
Wild buckwheat	*(Polygonum convolvulus)*	P

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IMAZAPYR 4 SL

Specimen Label

COMMON NAME	SPECIES	GROWTH HABIT[2]
	Apply 1.5 – 2.0 pints per acre[1]	
Greenbriar	*(Smilax* spp.*)*	P
Honeysuckle	*(Lonicera* spp.*)*	P
Morningglory	*(Ipomoea* spp.*)*	A/P
Poison ivy	*(Rhus radicans)*	P
Redvine	*(Brunnichis cirrhosa)*	P
Wild rose	*(Rosa* spp.*)*	
Including: Multiflora rose	*(Rosa multiflora)*	P
McCartney rose	*(Rosa bracteata)*	P
	Apply 2.0 – 3.0 pints per acre[1]	
Blackberry	*(Rubus* spp.*)*	P
Dewberry	*(Rubus* spp.*)*	P
*Kudzu[3]	*(Pueraria lobata)*	P
Trumpetcreeper	*(Campsis radicans)*	P
Virginia creeper	*(Parthenocissus quinquefolia)*	P
Wild grape	*(Vitis* spp.*)*	P

BRUSH SPECIES

COMMON NAME	SPECIES	GROWTH HABIT[2]
	Apply 2.0 – 3.0 pints per acre[1]	
American beech	*(Fagus grandifolia)*	P
Ash	*(Fraxinius* spp.*)*	P
Bald cypress	*(Taxodium distichum)*	P
Bigleaf maple	*(Acer macrophylum)*	P
Black locust[5]	*(Robinia pseudoacacia)*	P
Blackgum	*(Nyssa sylvatica)*	P
Boxelder	*(Acer negundo)*	P
Brazilian peppertree	*(Schinus terebinthifolius)*	P
Cherry	*(Prunus* spp.*)*	P
Chinaberry	*(Melia azadarach)*	P
Chinese tallowtree	*(Sapium sebiferum)*	P
Dogwood	*(Cornus* spp.*)*	P
Elm[6]	*(Ulmus* spp.*)*	P
Hawthorn	*(Cartaegus* spp.*)*	P
Hickory	*(Carya* spp.*)*	P
Honeylocust[5]	*(Gleditsia triacanthos)*	P
Maple	*(Acer* spp.*)*	P
Melaleuca	*(Melaleuca quiquenervia)*	P
Mulberry	*(Morus* spp.*)*	P
Oak	*(Quercus* spp.*)*	P
Persimmon	*(Diospyros virginiana)*	P
*Pine[5]	*(Pinus* spp.*)*	P
Poplar	*(Populus* spp.*)*	P
Privet	*(Ligustrum vulgare)*	P
Red Alder	*(Alnus rubra)*	P
Red Maple	*(Acre rubrum)*	P
Rubber rabbitbrush	*(Chrysothamnus nauseaosus)*	P
Russian Olive	*(Eleagnus angustifolia)*	P
Sassafras	*(Sassafras albidum)*	P
Saltcedar	*(Tamarix ramosissima)*	P
Sourwood	*(Oxydendrum arboretum)*	P
Sumac	*(Rhus* spp.*)*	P
Sweetgum	*(Liquidambar styraciflua)*	P
*Water willow	*(Justica americana)*	P
Willow	*(Salix* spp.*)*	P
Yellow poplar	*(Liriodendron tulipifera)*	P

*Not approved for use in California
[1]The higher rates should be used where heavy or well-established infestations occur.
[2]Growth Habit – A=Annual, B=Biennial, P=Perennial
[3]Use a minimum of 75 GPA – Control of established stands may require repeat applications
[4]For best results, early postemergence applications are required.
[5]Tank-mix with glyphosate or triclopyr.
[6]Tank-mix with glyphosate.

STORAGE AND DISPOSAL

DO NOT contaminate water, food or feed by storage or disposal.
PESTICIDE STORAGE: DO NOT store below 10°F.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying.
(Nonrefillable ≤ 5 gallons): Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
(Nonrefillable > 5 gallons): Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. Then offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

IMPORTANT: Read the entire **DIRECTIONS FOR USE** and the **CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY** before using this product. If terms are not acceptable, return the unopened product container at once.

CONDITION OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

To the extent consistent with applicable law, upon purchase or use of this product, purchaser and user agree to the following terms:

Warranty: Alligare, LLC (the Company) warrants that this product conforms to the chemical description on the label in all material respects and is reasonably fit for the purpose referred to in the directions for use, subject to the exceptions noted below, which are beyond the Company's control. To the extent consistent with applicable law, the Company makes no other representation or warranty, express or implied, concerning the product, including no implied warranty of merchantability or fitness for a particular purpose. No such warranty shall be implied by law, and no agent or representative is authorized to make any such warranty on the Company's behalf.

Terms of Sale: The Company's directions for use of this product must be followed carefully. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, and the manner of use or application (including failure to adhere to label directions), all of which are beyond the Company's control. To the extent consistent with applicable law, all such risks are assumed by the user.

Limitation of Liability: To the extent consistent with applicable law, the exclusive remedy against the Company for any cause of action relating to the handling or use of this product is a claim for damages, and in no event shall damages or any other recovery of any kind exceed the price of the product which caused the alleged loss, damage, injury or other claim. To the extent consistent with applicable law, under no circumstances shall the Company be liable for any special, indirect, incidental or consequential damages of any kind, including loss of profits or income, and any such claims are hereby waived. Some states do not allow the exclusion or limitation of incidental or consequential damages.

The Company and the seller offer this product, and the purchaser and user accept this product, subject to the foregoing warranty, terms of sale and limitation of liability, which may be varied or modified only by an agreement in writing signed on behalf of the Company by an authorized representative.

Microfoil is a trademark of Rhone Poulenc Ag. Company.
Thru-Valve is a trademark of Waldrum Specialties.
Accord is a registered trademark of Monsanto Company
Oust is a registered trademark of E.I. DuPont de Nemours and Company.
Garlon is a trademark of Dow AgroSciences Company.
Pendulum is a registered trademark of BASF.
Endurance and Vanquish are registered trademarks of Syngenta Group Company.

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SAFETY DATA SHEET

EMERGENCY CALL: 1-800-424-9300 (CHEMTREC)

1. IDENTIFICATION

PRODUCT NAME: Alligare Imazapyr 4 SL
DESCRIPTION: A liquid herbicide.
EPA Reg. No.: 81927-24

COMPANY IDENTIFICATION:
Alligare, LLC
13 N. 8th Street
Opelika, AL 36801

2. HAZARD IDENTIFICATION

WARNING

May be harmful if swallowed or in contact with skin (H303+H313)

Toxic to aquatic life (H401)

HAZARD CLASSIFICATION

Health Hazard	Category
Acute Toxicity, Oral	5
Acute Toxicity, Dermal	5

Physical Hazards	Category
None	-

Environmental Hazards	Category
Hazardous to the aquatic environment, short-term	2

HAZARDS NOT REQUIRING CLASSIFICATION

Spray solutions of Alligare Imazapyr 4 SL must be mixed, stored and applied only in stainless steel, fiberglass, plastic, and plastic-lined steel containers. DO NOT mix, store or apply Alligare Imazapyr 4 SL or spray solutions of Alligare Imazapyr 4 SL in unlined steel (except stainless steel) containers or spray tanks.

PRECAUTIONARY STATEMENTS

Avoid release to the environment not in accordance with the product label. (P273)

IF SWALLOWED: Call a Poison Control Center of doctor if you feel unwell. (P301+ P312)

IF ON SKIN: Call a Poison Control Center of doctor if you feel unwell. (P302+P312)

Dispose of contents / container in accordance with local regulations. Refer to the product label for specific disposal instructions. (P501)

3. COMPOSITION / INFORMATION ON INGREDIENTS

Common Name	Chemical Name	CAS #	Composition
Isopropylamine salt of Imazapyr	Isopropylamine salt of (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid)	81510-83-0	52.6%

4. FIRST AID MEASURES

Have the product container or label with you when calling a poison control center or doctor or going for treatment. For medical emergencies involving this product, call 1-800-424-9300.

IF SWALLOWED: Call a doctor or poison control center immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison center or doctor. Do not give anything by mouth to an unconscious person.

IF ON SKIN OR CLOTHING: Take off contaminated clothing and wash before reuse. Rinse skin immediately with plenty of water. If skin irritation or rash occurs: call a poison control center or doctor for treatment advice.

5. FIREFIGHTING MEASURES

Flash point: Not combustible.

Flammable Limits (LFL-UFL): N/A

Fire and Explosion Hazards: Data not available.

Means of Extinction: Foam, CO_2, dry chemical, or water spray.

Fire Fighting Instructions: Evacuate area of all unnecessary personnel and fight fire from a safe distance upwind. Contain contaminated water / firefighting water; do not allow to enter drains or waterways. Foam or dry chemical fire extinguishing systems are preferred to prevent environmental damage from excessive water runoff.

Firefighting Equipment: Firefighters should be equipped with self-contained positive pressure breathing apparatus and turnout gear.

Hazardous Combustion Products: When thermally decomposed, may release hazardous and / or toxic fumes.

NFPA Ratings: Health: 1 / Flammability: 1 / Instability: 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Isolate area and keep unnecessary and unprotected personnel from entering. Wear suitable personal protective clothing and equipment as described in Section 8 of this document. Extinguish sources of ignition nearby and downwind and ensure adequate ventilation.

Environmental Precautions: Do not discharge into soil / subsoil or into drains / surface water / groundwater. Contain contaminated water / firefighting water.

Spill Cleanup: Dike spillage. Pick up with suitable absorbent material. Place into suitable container for reuse or disposal in a licensed facility. Spilled substance/product should be recovered and applied according to label rates whenever possible. If application of spilled substance/product is not possible, then spills should be contained, solidified, and placed in suitable containers for disposal. After decontamination, spill area can be washed with water. Collect washwater for approved disposal.

7. HANDLING AND STORAGE

Handling: Wear appropriate personal protective clothing and equipment (see Section 8 below.) Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing

Storage: Keep out of reach of children and animals. Do not store below 10°F. Store product in original container only, away from other pesticides, fertilizer, food, or feed.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls: Workplace should be equipped with a shower and eye-wash station.

Protective Clothing: Handlers must wear long-sleeved shirt and long pants, chemical-resistant gloves made of any waterproof material (such as polyethylene or polyvinylchloride), and shoes plus socks.

General: Follow the manufacturer's instructions for cleaning and maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	transparent blue, slightly viscous liquid	**pH:**	5.0-5.5
		Kinematic viscosity:	not available
Odor:	not available	**Solubility:**	soluble
Melting/freezing point:	not available	**Partition coefficient:**	not available
Boiling point/Boiling range:	not available	**Vapor pressure:**	not available
Flammability:	not available	**Density:**	1.2 mg/L
Flammability limits (upper/lower):	not available	**Relative vapor density:**	not available
Flash point:	not available	**Particle characteristics:**	not available
Auto-ignition temperature:	not available		
Decomposition temperature:	not available		

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID: All sources of ignition (sparks, open flame and excessive heat). Prolonged exposure to extreme temperatures. Electrostatic discharge. Prolonged storage.

CHEMICAL STABILITY: Stable under normal use and storage conditions. May decompose if heated.

HAZARDOUS DECOMPOSITION PRODUCTS: When thermally decomposed, may release hazardous and / or toxic fumes.

INCOMPATIBILITY WITH OTHER MATERIALS: Strong alkalis, oxidizing agents.

HAZARDOUS REACTIONS: This product is chemically stable and no hazardous reactions should occur if stored and handled as prescribed / indicated.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION

ORAL TOXICITY (rat LD_{50}): > 2,000 mg/kg

DERMAL TOXICITY (rat LD_{50}): > 2,000 mg/kg

INHALATION TOXICITY (rat LC_{50}): > 4.72 mg/L (4-hour)

EYE IRRITATION: Minimally irritating

SKIN IRRITATION: Non-irritating

SKIN SENSITIZATION: Not a contact sensitizer

CARCINOGENICITY:

EPA:	Not Listed		
ACGIH:	Not Listed	**NTP:**	Not Listed
IARC:	Not Listed	**OSHA:**	Not Listed

MUTAGENIC TOXICITY: No evidence of mutagenic effects during *in vivo* and *in vitro* assays.

REPRODUCTIVE TOXICITY: No evidence in animal studies.

12. ECOLOGICAL INFORMATION

This product is toxic to plants. Drift and run-off may be hazardous to plants in water adjacent to treated areas. Do not apply to water except as specified on this label.

The following information is for the active ingredient, Imazapyr:

AQUATIC TOXICITY
Rainbow Trout (96-hr LC_{50}): > 100 mg/L
Bluegill (96-hr LC50): > 100 g/L
Diatoms (96-hr EC_{50}): 1.3 mg/L
Green Algae (7-day EC_{50}): 71 mg/L

AVIAN TOXICITY
Mallard Duck (Oral LD_{50}): > 2,150 mg/kg
Bobwhite Quail (Oral 8-day): > 2,150 mg/kg

13. DISPOSAL CONSIDERATIONS

PESTICIDE DISPOSAL: Do not contaminate water, food, or feed by storage or disposal. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Refer to the product label for specific container handling instructions.

14. TRANSPORT INFORMATION

UN Number:	Not regulated
Proper Shipping Name:	Not regulated
Transport Hazard Class:	Not applicable
Packing Group:	Not applicable
Hazard Zone:	Not applicable
Marine Pollutant:	No
Hazardous Substance RQ:	None
Labels / Placards:	US-DOT: Not regulated for domestic ground transport IMDG, IATA: Not regulated for transport under IMDG/IATA
Emergency Guide:	Not applicable

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

FIFRA –

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. The following is the hazard information as required on the pesticide label:

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed or absorbed through skin. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Remove and wash contaminated clothing and wash before reuse.

See inside label booklet for additional Precautionary Statements.

ENVIRONMENTAL HAZARDS

This product is toxic to plants. Drift and run-off may be hazardous to plants in water adjacent to treated areas. Do not apply to water except as specified on this label. Treatment of aquatic weeds may result in oxygen depletion or loss due to decomposition of dead plants. Do not treat more than one-half the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatments along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas. Do not contaminate water when disposing of equipment washwaters or rinsate. See Directions for Use for additional precautions and requirements.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of Alligare Imazapyr 4 SL should be mixed, stored and applied only in stainless steel, fiberglass, plastic, and plastic-lined steel containers.

DO NOT mix, store or apply Alligare Imazapyr 4 SL or spray solutions of Alligare Imazapyr 4 SL in unlined steel (except stainless steel) containers or spray tanks.

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15. REGULATORY INFORMATION (CONT.)

All pesticides are governed under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The regulatory information presented below is pertinent only when this product is handled outside of the normal use and application as a pesticide. This product is excluded from listing requirements under EPA/TSCA.

SARA Title III – Section 302 Extremely Hazardous Substances
Not listed

SARA Title III – Section 311/312 Hazard Categories
Immediate

SARA Title III – Section 312 Threshold Planning Quantity
N/A

SARA Title III – Section 313 Reportable Ingredients
None

CERCLA –
Not listed

CALIFORNIA PROP 65 STATUS –
This product does not contain any chemicals known to the state of California to cause cancer or reproductive toxicity.

CANADA –
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all of the information required by CPR.

16. OTHER INFORMATION

THIS INFORMATION IN THIS SDS IS BASED ON DATA AVAILABLE AS OF THE REVISION DATE GIVEN HEREIN, AND BELIEVED TO BE CORRECT. CONTACT ALLIGARE, LLC TO CONFIRM IF YOU HAVE THE MOST CURRENT MSDS. JUDGMENTS AS TO THE SUITABILITY OF THE INFORMATION HEREIN FOR THE INDIVIDUAL'S OWN USE OR PURPOSES IS NECESSARILY THE INDIVIDUAL'S OWN RESPONSIBILITY. ALTHOUGH REASONABLE CARE HAS BEEN TAKEN IN THE PREPARATION OF SUCH INFORMATION, ALLIGARE, LLC EXTENDS NO WARRANTIES, MAKES NO REPRESENTATIONS, AND ASSUMES NO RESPONSIBILITY AS TO THE ACCURACY OR SUITABILITY OF SUCH INFORMATION FOR APPLICATION TO THE INDIVIDUAL'S PURPOSES OR THE CONSEQUENCES OF ITS USE.

This Safety Data Sheet (SDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA APPROVED PRODUCT LABELING (attached to and accompanying the product container). This SDS provides important health, safety, and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course.

SDS Version: 3.0 Effective Date: 07/23/18

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ALLIGARE

IMAZAMOX GROUP 2 HERBICIDE

IMOX™ HERBICIDE Specimen Label

A herbicide for the selective management of undesirable vegetation in and around aquatic sites and terrestrial non-crop areas, industrial sites and rights-of-ways. The herbicide may be used on listed sites that are cut for hay or grazed.

ACTIVE INGREDIENT:
Ammonium salt of imazamox* 12.1%
OTHER INGREDIENTS: 87.9%
TOTAL: 100.0%
*Equivalent to 11.4% imazamox acid
Contains 1 pound of imazamox acid equivalent per gallon.

EPA Reg. No. 81927-66

KEEP OUT OF REACH OF CHILDREN
CAUTION/PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Manufactured for:
Alligare, LLC
13 N. 8th Street
Opelika, AL 36801

FIRST AID	
If on skin or clothing:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 to 20 minutes. • Call a poison control center or doctor for treatment advice.
If in eyes:	• Hold eyes open and rinse slowly and gently with water for 15 to 20 minutes. • Remove contact lenses, if present, after the first 5 minutes; then continue rinsing eyes. • Call a poison control center or doctor for treatment advice.
If inhaled:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance; then give artificial respiration, preferably mouth to mouth if possible. • Call a poison control center or doctor for further treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-424-9300 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION: Harmful if absorbed through skin or inhaled. Causes moderate eye irritation. Avoid breathing spray mist. Avoid contact with skin, eyes or clothing.

PERSONAL PROTECTIVE EQUIPMENT (PPE)
Applicators and other handlers must wear:
- Long-sleeved shirt and long pants
- Chemical-resistant gloves such as barrier laminate, butyl rubber ≥ 14 mils, nitrile rubber ≥ 14 mils, neoprene rubber ≥ 14 mils, natural rubber (includes natural rubber blends and laminates) ≥ 14 mils, polyethylene, polyvinyl chloride (PVC) ≥ 14 mils, or viton ≥ 14 mils
- Shoes plus socks

Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMEDATIONS
User should:
- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of the gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS
This pesticide may be hazardous to plants outside the treated area. Do not apply to water except as specified in this label. Do not contaminate water when disposing of equipment washwater and rinsate.

PHYSICAL OR CHEMICAL HAZARDS
Do not mix or allow coming in contact with oxidizing agents. Hazardous Chemical Reaction may occur.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. This labeling must be in the possession of the user at the time of pesticide application.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Read the entire label before using **Alligare IMOX™ Herbicide**. Consult your State Agricultural Experimental Station or Extension Service Specialist for additional information on application timing, rates and any additional requirements or restrictions.

Ensure spray drift to non-target susceptible species does not occur.

DO NOT apply **Alligare IMOX Herbicide** in any manner not specifically described in this label.

Endangered Plant Species
To prevent potential negative impacts to endangered plant species, **DO NOT** apply **Alligare IMOX Herbicide** in a way that adversely affects federally listed endangered and threatened species.

PRODUCT INFORMATION
Alligare IMOX Herbicide is a water miscible concentrate designed to mix with water to form a solution. It may be diluted with water or applied directly to aquatic sites for selective vegetation management of susceptible aquatic vegetation or diluted and applied as a broadcast or spot spray to control target floating and emergent terrestrial and riparian vegetation.

Aquatic sites include: arroyos, bayous, canals and irrigation canals, creeks, ditches, estuarine sites, marine sites, lakes, marshes, ponds, reservoirs, rivers, slow-moving or quiescent bodies of water, streams, swamps and wetlands. The sites listed above may be treated with **Alligare IMOX Herbicide** during drawdown conditions.

Alligare IMOX Herbicide may also be applied for terrestrial and riparian vegetation control in industrial noncropland sites, and railroad, utility, and highway rights-of-way. Industrial noncropland sites include utility plant sites, tank farms, pumping installations, storage areas, fence rows and ditch banks. **Alligare IMOX Herbicide** may also be used for the establishment and maintenance of wildlife openings. The sites listed above and treated with **Alligare IMOX Herbicide** may be grazed or cut for hay.

Alligare IMOX Herbicide is an imidazolinone class herbicide that works by inhibition of acetolactate synthase (ALS) enzyme. **Alligare IMOX Herbicide** is quick to act by absorption and translocation into the foliage and/or roots, thus inhibiting plant growth. Once target plant growth is inhibited, leaves and growing points begin to discolor, followed by plant death or severe growth inhibition.

Many factors such as application rate, weed species, weed pressure, conditions of weeds including size and climatic factors impact the degree of weed control. Applications made to actively growing weeds at the early stages of development will optimize performance.

Alligare IMOX Herbicide is effective for the control/suppression of common problematic submersed, emergent and floating broadleaf and monocot aquatic vegetation. The degree of control and selectivity can be managed by timing, use rates, and application technique.

Specific use directions will be found in the following sections below:
- Terrestrial Sites
  - Foliar Broadcast Application
  - Foliar Spot Treatment Application
  - Injection (Hack and Squirt), Frill and Girdle, and Cut Stump application
  - Basal Application
- Aquatic Sites
  - Water Application to Submersed, Emergent and Floating Vegetation.
  - Foliar Application to Emergent and/or Floating Vegetation.
  - Aerial Application
  - Drawdown Application

RESISTANCE MANAGEMENT RECOMMENDATIONS
For resistance management, **Alligare IMOX Herbicide** is a Group 2 herbicide. Any weed population may contain or develop plants naturally resistant to **Alligare IMOX Herbicide** and other Group 2 herbicides. Weed species with acquired resistance to Group 2 herbicides may eventually dominate the weed population if Group 2 herbicides are used repeatedly in the same field or in successive years as the primary method of control for targeted species. This may result in partial or total loss of control of those species by **Alligare IMOX Herbicide** or other Group 2 herbicides.

Suspected herbicide-resistant weeds may be identified by these indicators:
- Failure to control a weed species normally controlled by the herbicide at the dose applied, especially if control is achieved on adjacent weeds;
- A spreading patch of non-controlled plants of a particular weed species; and
- Surviving plants mixed with controlled individuals of the same species.

To delay herbicide resistance:
- Avoid the consecutive use of **Alligare IMOX Herbicide** or other target site of action Group 2 herbicides that might have a similar target site of action, on the same weed species.
- Use tank mixtures or premixes with herbicides from different target site of action Groups as long as the involved products are all registered for the same use, have different sites of action and are both effective at the tank mix or prepack rate on the weed(s) of concern.
- Base herbicide use on a comprehensive Integrated Pest Management (IPM) program.
- Scout fields prior to application to identify the weed species present and their growth state to determine if the intended application will be effective.
- Scout fields after application to verify that the treatment was effective.

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- Contact your local extension specialist, certified crop advisors and/or manufacturer for herbicide resistance management and/or integrated weed management recommendations for specific crops and resistant weed biotypes.

Report any incidence of non-performance of this product against a particular weed species to your Alligare LLC retailer, representative or call 888-252-4427. If resistance is suspected, treat weed escapes with an herbicide having a different mechanism of action and/or use non-chemicals means to remove escapes, as practical, with the goal of preventing further seed production.

ADJUVANTS

For applications of **Alligare IMOX Herbicide** to emergent, floating or shoreline species, use of a spray adjuvant is required. The spray adjuvant used needs to be appropriate for aquatic sites.

Nonionic Surfactants: Use a nonionic surfactant at 0.25% volume/volume (v/v) or higher (see manufacturer's label) of the spray solution (0.25% v/v is equivalent to 1 quart in 100 gallons). For best results, select a nonionic surfactant with an HLB (hydrophilic to lipophilic balance) ratio between 12 and 17 with at least 70% surfactant in the formulated product (alcohols, fatty acids, oils, ethylene glycol or diethylene glycol should not be considered as surfactants to meet the above requirements).

Methylated Seed Oils or Vegetable Oil Concentrates: Methylated seed oil (MSO) or vegetable oil concentrate (VOC) may be used in replacement of a surfactant at 1.5 to 2 pints per acre. When using spray volumes greater than 30 gallons per acre, mix methylated seed oil or vegetable oil concentrates at 1% v/v of the total spray. The data indicates MSO aids in the deposition and imazamox uptake by plants under stress.

Silicone-Based Surfactants: Silicone-based surfactants allow greater spreading of the spray droplet on the leaf surface, as compared to conventional nonionic surfactants. However, some silicone-based surfactants may dry too quickly and limit herbicide uptake or cause a target floating plant to sink quickly.

Refer to the surfactant manufacturer's label for specific rates.

Invert Emulsions: Alligare IMOX Herbicide may be applied as an invert emulsion spray. Prior to preparing an invert emulsion (water – oil) spray, conduct a jar test to check spray mixture compatibility. Invert emulsion sprays are designed to minimize spray drift and spray runoff, resulting in more herbicide on the target foliage. Use a single tank (batch mixing) or injected (in-line mixing) to prepare the invert emulsion spray. Refer to the emulsifier manufacture's label for specific rates and proper mixing directions for aquatic sites.

Other: An antifoaming agent, spray pattern indicator, sinking or drift control agent may be applied at the product labeled rate if necessary or desired.

Tank Mixing: It is the pesticide user's responsibility to ensure that all products are registered for the intended use. Read and follow the applicable restrictions and limitations and directions for use on all product labels involved in tank mixing. Users must follow the most restrictive directions for use and precautionary statements of each product in the tank mixture.

SPRAY DRIFT MANAGEMENT (Mandatory)

Aerial Applications

- Do not release spray at a height greater than 10 ft above the vegetative canopy, unless a greater application height is necessary for pilot safety.
- For all applications, applicators are required to use a Coarse or coarser droplet size (ASABE S572.1).
- The boom length must not exceed 65% of the wingspan for airplanes or 75% of the rotor blade diameter for helicopters.
- Applicators must use ½ swath displacement upwind at the downwind edge of the application site.
- Nozzles must be oriented so the spray is directed toward the back of the aircraft.
- Do not apply when wind speeds exceed 10 miles per hour at the application site.
- Do not apply during temperature inversions.

Ground Applications

- Apply with the nozzle height recommended by the manufacturer, but no more than 3 feet above existing terrestrial or aquatic vegetation.
- For all applications, applicators are required to use a Coarse or coarser droplet size (ASABE S572.1).
- Do not apply when wind speeds exceed 10 miles per hour at the application site.
- Do not apply during temperature inversions.

SPRAY DRIFT ADVISORIES

- THE APPLICATOR IS RESPONSIBLE FOR AVOIDING OFF-SITE SPRAY DRIFT.
- BE AWARE OF NEARBY NON-TARGET SITES AND ENVIRONMENTAL CONDITIONS.
- IMPORTANCE OF DROPLET SIZE
  An effective way to reduce spray drift is to apply large droplets. Use the largest droplets that provide target pest control. While applying larger droplets will reduce spray drift, the potential for drift will be greater if applications are made improperly or under unfavorable environmental conditions.
  Controlling Droplet Size - Ground Boom
  - Volume - Increasing the spray volume so that larger droplets are produced will reduce spray drift. Use the highest practical spray volume for the application. If a greater spray volume is needed, consider using a nozzle with a higher flow rate.
  - Pressure - Use the lowest spray pressure recommended for the nozzle to produce the target spray volume and droplet size.
  - Spray Nozzle - Use a spray nozzle that is designed for the intended application. Consider using nozzles designed to reduce drift.

  Controlling Droplet Size - Aircraft
  - Adjust Nozzles - Follow nozzle manufacturers recommendations for setting up nozzles. Generally, to reduce fine droplets, nozzles should be oriented parallel with the airflow in flight.
- BOOM HEIGHT - Ground Boom
  Use the lowest boom height that is compatible with the spray nozzles that will provide uniform coverage. For ground equipment, the boom should remain level with the application site and have minimal bounce.
- RELEASE HEIGHT - Aircraft
  Higher release heights increase the potential for spray drift. When applying aerially, do not release spray at a height greater than 10 ft above the canopy, unless a greater application height is necessary for pilot safety.
- SHIELDED SPRAYERS
  Shielding the boom or individual nozzles can reduce spray drift. Consider using shielded sprayers. Verify that the shields are not interfering with the uniform deposition of the spray on the target area.
- TEMPERATURE AND HUMIDITY
  When making applications in hot and dry conditions, use larger droplets to reduce effects of evaporation.
- TEMPERATURE INVERSIONS
  Drift potential is high during a temperature inversion. Temperature inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light to no wind. The presence of an inversion can be indicated by ground fog or by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing. Avoid applications during temperature inversions.
- WIND
  Drift potential generally increases with wind speed. AVOID APPLICATIONS DURING GUSTY WIND CONDITIONS.
  Applicators need to be familiar with local wind patterns and terrain that could affect spray drift.

TERRESTRIAL USE DIRECTIONS

Apply **Alligare IMOX Herbicide** with ground and aerial equipment including both fixed-wing aircraft and helicopter in sufficient water to obtain uniform distribution of spray to targeted foliage. Use foliar broadcast spray, foliar spot spray, injection (hack and squirt), frill and girdle, cut stump, or basal methods of applications.

Broadcast Spray Application
DO NOT apply more than 1 gallon of **Alligare IMOX Herbicide** per acre per year.

Foliar Spot Application
Apply as a solution containing up to 5% v/v **Alligare IMOX Herbicide** spray.

Injection (Hack and Squirt), Frill and Girdle, and Cut Stump Application
Treatments may be made using up to 100% v/v **Alligare IMOX Herbicide** solution.

Basal Application
Treatments can be made using up to 25% v/v **Alligare IMOX Herbicide** spray. Basal applications require the use of a good emulsion system to maintain **Alligare IMOX Herbicide** in a stable emulsion with a penetrating agent.

TERRESTRIAL RESTRICTIONS

DO NOT apply more than 1 pound of imazamox acid equivalent (1 gallon) per acre per year.

DO NOT exceed 2 applications of **Alligare IMOX Herbicide** per year.

Minimum Retreatment Interval: 14 days

Vegetation Controlled

Alligare IMOX Herbicide may be used for the control of the following plant species. **Alligare IMOX Herbicide** may be effective for the control or suppression of additional plant species not listed below. The use of **Alligare IMOX Herbicide** for the control or suppression of undesirable plants not listed below may be done at the discretion of the user.

To the extent consistent with applicable law, the user assumes responsibility for any lack of control or suppression associated with application to weeds not listed on this label.

Foliar Application- Species Controlled

Common Name	Scientific Name	Rate Foliar (fl . oz./A)	Note(s)
Alligator weed	*Alternanthera philoxeroides*	64 - 128	**A.**
Annual ryegrass	*Lolium multiflorum*	16 - 32	
Artichoke, Jerusalem	*Helianthus tuberosus*	64 - 128	
Bedstraw	*Galium aparine*	64 - 128	
Beet, wild	*Beta procumbens*	64 - 128	
Brazilian pepper* Christmasberry*	*Schinus terebinthifolius*	96 - 128	**B.**
Buckwheat, wild	*Polygonum convolvulus*	64 - 128	
Buttercup	*Ranunculus* spp.	64 - 128	
California bulrush*	*Schoenoplectus californicus*	64 - 128	
Camphor tree*	*Cinnamomum camphora*	2% - 5% v/v	
Canola, volunteer (non-Clearfield®)	*Brassica campestris* *Brassica napus*	64 - 128	
Cattail	*Typha* spp.	32 - 64	
Chickweed, common	*Stellaria media*	64 - 128	
Chinese tallowtree Popcorn tree	*Sapium sebiferum*	64 - 128	**C.**
Cocklebur, common	*Xanthium strumarium*	64 - 128	
Filaree, redstem Filaree, whitestem	*Erodium cicutarium* *Erodium moschatum*	64 - 128	

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Common Name	Scientific Name	Rate Foliar (fl . oz./A)	Note(s)
Flixweed	*Descurainia sophia*	64 - 128	
Giant ragweed**	*Ambrosia trifida*	32 - 64	
Henbit	*Lamium amplexicaule*	64 - 128	
Jamaican nightshade*	*Solanum jamaicense*	2% - 5% v/v	
Japanese stiltgrass	*Microstegium vimineum*	32 - 64	**D. & E.**
Jimsonweed	*Datura stramonium*	64 - 128	
Johnsongrass, rhizome Johnsongrass, seedling	*Sorghum halepense*	32 - 64 16 - 32	
Knotweed, prostrate	*Polygonum aviculare*	64 - 128	
Kochia	*Kochia scoparia*	64 - 128	
Lambsquarters, common	*Chenopodium album*	64 - 128	
Lettuce, miner's	*Mantia perfoliata*	64 - 128	
Mallow, common Mallow, Venice	*Malva neglecta* *Hibiscus trionum*	64 - 128	
Mustard spp.	*Brassica* spp.	64 - 128	
Nettle, burning	*Urtica urens*	64 - 128	
Nettleleaf goosefoot	*Chenopodium murale*	64 - 128	
Nightshade, black Nightshade, Eastern black Nightshade, hairy	*Solanum nigrum* *Solanum ptycanthum* *Solanum sarrachoides*	64 - 128	
Old World climbing fern*	*Lygodium microphyllum*	5% v/v	
Pennycress, field	*Thlaspi arvense*	64 - 128	
Phragmites*	*Phragmites australis*	64 - 128	**F., G. & H.**
Pigweed, prostrate Pigweed, redroot Pigweed, smooth Pigweed, spiny	*Amaranthus blitoides* *Amaranthus retroflexus* *Amaranthus hybridus* *Amaranthus spinosus*	64 - 128	
Puncturvine	*Tribulus terrestris*	64 - 128	
Purple loosestrife*	*Lythrum salicaria*	32 - 64	
Purslane, common	*Portulaca oleracea*	64 - 128	
Radish, wild	*Raphanus raphanistrum*	64 - 128	
Ragweed, common Ragweed, giant	*Ambrosia artemisiifolia* *Ambrosia trifida*	64 - 128	
Rocket, London Rocket, yellow	*Sisymbrium irio* *Barbarea vulgaris*	64 - 128	
Saltcedar*	*Tamarix* spp.	64 - 128	**B. & D.**
Sedge*, purple Sedge*, yellow	*Cyperus rotundus* *Cyperus esculentus*	32 - 64	**B.**
Shepherd's-purse	*Capsella bursa-pastoris*	64 - 128	
Smartweed, ladysthumb Smartweed, Pennsylvania Smartweed, swamp	*Polygonum persicaria, Persicaria maculosa* *Polygonum pensylvanicum, Persicaria pensylvanica* *Polygonum coccineum, Persicaria amphibia*	64 - 128	
Spike rush*	*Eleocharis* spp.	64 - 128	
Spurge, prostrate	*Euphorbia maculata*	64 - 128	
Sunflower, common	*Helianthus annuus*	64 - 128	
Swinecress	*Coronopus didymus*	64 - 128	
Tansymustard, green	*Descurainia pinnata*	64 - 128	
Taro	*Taro* spp.	64 - 128 5% v/v	
Thistle, Russian	*Salsola iberica*	64 - 128	
Tropical soda apple*	*Solanum viarum*	2% - 5% v/v	
Umbrella plant	*Cyperus involucratus*	64	**I. & J.**
Water primrose	*Ludwigia* spp.	32 - 64	**A.**
Wetland nightshade*	*Solanum tampicense*	2% - 5% v/v	
Whitetop* Hoary cress*	*Cardaria draba*	8 - 16	
Willoweed panicle	*Epilobium brachycarpum*	64 - 128	
Velvetleaf	*Abutilon theophrasti*	64 - 128	

* Not approved for this use in California.
** Suppression of larger, well-established plants

A. Use with an appropriate labeled glyphosate product will improve efficacy.
B. Also use a 2% - 5% v/v **Alligare IMOX Herbicide** spray
C. See Special Weed Control section.
D. Use MSO at 1% v/v by spray.
E. **Alligare IMOX Herbicide** will provide some residual control of subsequent seedling emergence.
F. Use 1 quart per acre of methylated seed oil (MSO); apply in late vegetative stage up to killing frost.
G. Also use a spot treatment with 1% - 2% v/v **Alligare IMOX Herbicide** spray.
H. Older stands of phramites and stands growing in water may require follow-up applications to control.
I. Apply with MSO or COC.
J. Also use as a spot treatment with 5%v/v **Alligare IMOX Herbicide** spray.

For optimum control with foliar applications, use methylated seed oil (MSO) at 1% v/v spray.

Specific Weed Control - Chinese Tallowtree
Apply **Alligare IMOX Herbicide** at 64 - 128 fluid ounces per acre or 0.5 - 2.0% v/v spray as a foliar application for selective control of Chinese tallowtree in and around tolerant tree species. Control Chinese tallowtree with foliar applications using aerial, handgun, or backpack application methods. Use an application method and spray volume that provides adequate coverage of targeted Chinese tallowtree plants. Add methylated seed oil at 1quart per acre for broadcast applications, or at 1% v/v for spot backpack and handgun applications. Tolerant hardwood species may exhibit varying degrees of leaf discoloration and temporary injury.

Areas that may be Grazed or Cut for Hay
Alligare IMOX Herbicide applied to listed aquatic and terrestrial non-crop sites may be grazed or cut for hay at a maximum use rate of 1 gallon per acre of **Alligare IMOX Herbicide** or 5% v/v spray for spot treatments. There are no grazing or haying restrictions.

AQUATIC USE DIRECTIONS

Apply **Alligare IMOX Herbicide** beneath the water surface or broadcast directly to the water surface for the control of target submersed aquatic plant species and for some emergent and floating species, or as a foliar broadcast application for emergent and floating species.

Apply **Alligare IMOX Herbicide** with ground and aerial equipment including both fixed-wing aircraft and helicopter in sufficient water to obtain uniform distribution of spray to water surface and/or targeted foliar applications.

Water Application to Submersed, Emergent and Floating Vegetation
Inject below the water surface or broadcast apply to the water surface with **Alligare IMOX Herbicide** to control submersed aquatic plant species and some emergent and floating species. Apply **Alligare IMOX Herbicide** as an undiluted product or diluted with water prior to application. When surface-matted conditions exist, inject **Alligare IMOX Herbicide** below the water surface to improve product distribution and efficacy.

Apply **Alligare IMOX Herbicide** to water to achieve a final concentration of the active ingredient of no more than 500 ppb. To maintain the desired vegetation response, multiple applications of **Alligare IMOX Herbicide** may be made during the annual growth cycle.

Alligare IMOX Herbicide Rates Per Treated Surface Acre

Average Water Depth of Treatment Site (feet)	Desired Active Ingredient Concentration (ppb)*			
	50	100	200	500
	Alligare IMOX Herbicide Rate per Treated Surface Acre (fl. oz.)			
1	17	35	69	173
2	35	69	138	346
3	52	104	207	518
4	70	138	277	691
5	87	173	346	864
6	104	207	415	1037
7	122	242	484	1210
8	139	277	553	1382
9	157	311	622	1555
10	174	346	691	1728

* **Alligare IMOX Herbicide** contains 1.0 pound of imazamox acid equivalent per gallon.
1 gallon = 128 fl. oz.

Foliar Application to Listed Emergent and/or Floating Vegetation
Broadcast apply or spot treat the water surface with **Alligare IMOX Herbicide** to control emergent and floating species. For broadcast applications, use a minimum of 10 gallons of water per surface acre in properly calibrated equipment for uniform coverage. Use higher spray volumes to ensure uniform spray coverage, when treating areas with large and/or dense vegetation. To minimize the drift potential, use an appropriate spray pressure depending upon spray equipment, conditions and application objectives. (See Spray Drift Ground Boom Application Requirements section.) As a spot treatment, use from 0.25 - 5% v/v **Alligare IMOX Herbicide** spray.

To enhance foliar applications on emergent and floating weeds, always use an adjuvant. If spray is washed off by wave action, control will be reduced.

In aquatic sites, application techniques described in the **Terrestrial Use Directions** section may be used to treat target emergent vegetation.

Aerial Application
Both fixed-wing aircraft and helicopter may be used to apply **Alligare IMOX Herbicide** by air. For direct applications to the water, there is no minimum spray volume. For broadcast applications targeting emergent and/or floating vegetation, use a minimum of 5 gallons of water per surface acre in properly calibrated equipment for uniform coverage. For aerial applications, best results are obtained by using a minimum of 20 gallons per acre. (See Spray Drift Aerial Application Requirements section.)

Drawdown Application
Alligare IMOX Herbicide may be used for preemergence and/or postemergence control/suppression of aquatic vegetation in drawdown situations. As a broadcast spray, apply **Alligare IMOX Herbicide** at rates up to 1 gallon per acre or as a spot treatment with up to 5% v/v **Alligare IMOX Herbicide** spray. After water has receded and exposed soil is moist to dry, make application. After foliar postemergence applications, delay at least two weeks before reintroducing water.

AQUATIC RESTRICTIONS

DO NOT exceed maximum use rate per application:

Water treatment - 500 parts per billion (ppb) (173 fluid ounces of **Alligare IMOX Herbicide** (1.35 pounds of imazamox acid equivalent) per acre foot)

Foliar broadcast application - 1 gallon **Alligare IMOX Herbicide** per acre
(1.0 pound of imazamox acid equivalent) per acre

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Foliar spot application - up to 5% v/v **Alligare IMOX Herbicide**

Minimum Retreatment Intervals:
Water treatment - 14 days; unless the retreatment is following an initial water column application that has failed to maintain the original targeted ppb concentration.

Foliar broadcast applications – 14 days

Foliar spot applications – Retreat as needed

Irrigation Restrictions
- **DO NOT** use treated water to irrigate greenhouses, nurseries, or hydroponics until the imazamox concentration has been determined by an acceptable method to be less than or equal to 1.0 ppb.
- **DO NOT** plant sugar beets, onions, potatoes or non-Clearfield® canola in soils that have been previously irrigated with **Alligare IMOX Herbicide** treated water until a soil bioassay successfully demonstrates acceptable levels of crop tolerance. The only exception to this restriction is if the water is from foliar applications to emergent and/or floating vegetation in flowing water sites where it has been applied at less than or equal to 1.5 quarts per acre to waters with an average depth of greater than or equal to 4 feet.
- **DO NOT** use **Alligare IMOX Herbicide** treated waters resulting in a concentration greater than 50 ppb for irrigation of established (emerged) plants until residue levels have been shown to be less than or equal to 50 ppb by an acceptable method.
- **DO NOT** make **Alligare IMOX Herbicide** applications in and around golf course irrigation, sod farm irrigation, and vineyard irrigation waterbodies without testing potential irrigation water prior to irrigation and confirming the imazamox concentration to be less than or equal to 1.0 ppb.
- In still or quiescent waters, **DO NOT** use **Alligare IMOX Herbicide** treated water resulting in a concentration greater than 10 ppb for irrigation of newly seeded or newly established plants until imazamox residue levels have been shown to be less than or equal to 10 ppb by an acceptable method.
- Wait 24 hours before irrigating from still or quiescent waters after making an **Alligare IMOX Herbicide** application for sub-merged vegetation less than 100 feet from an irrigation intake.
- Wait 24 hours before irrigating from still and quiescent waters after making an **Alligare IMOX Herbicide** application to emergent and/or floating vegetation if greater than 25% of the surface area of the water body has been treated or application was made less than 100 feet from an irrigation intake.
- Flowing waters may be used to irrigate allowable sites with no restrictions when **Alligare IMOX Herbicide** is applied at less than or equal to 2 quarts per acre to waters with an average depth of greater than or equal to 4 feet.
- After application of **Alligare IMOX Herbicide** to dry irrigation canals/ditches below the high-water mark, the initial flush of water during recharge must not be used for irrigation purposes unless the imazamox concentration has been determined by an acceptable method to be less than 25 ppb.

Alligare IMOX Herbicide applied at less than or equal to 2 quarts per acre in or on waters with a minimum average depth greater than or equal to 4 feet, will result in imazamox concentrations less than 25 ppb.

Other Water Use Restrictions
There are no restrictions on livestock watering, swimming, fishing, domestic use, or use of treated water for agricultural sprays. No recharge flush or water use restrictions are required for applications to dry areas above the high-water line of irrigation canals or channels.

Potable Water
Alligare IMOX Herbicide may be applied to potable water sources at concentrations up to 500 ppb to within a distance of 1/4 mile from an active potable water intake. Within 1/4 mile of an active potable water intake, **Alligare IMOX Herbicide** may be applied, but water concentrations resulting from injection and/or foliar applications may not exceed 50 ppb. If water concentrations greater than 50 ppb are required, the potable water intake must be shut and, if necessary, an alternate water supply be made available until the water concentration can be shown to be less than 50 ppb by an acceptable method.

Vegetation Controlled or Suppressed
The performance of **Alligare IMOX Herbicide** is dependent upon many factors including: dose, time of year, stage of plant growth, plant susceptibility, environmental conditions, method of application, and water movement. The rate selection is partially dependent on characteristics of the treatment area and whether growth regulation or control is desired. A repeat application to control or suppress regrowth may be required depending on environmental and growing conditions. To determine best management practices to control individual species and to meet specific aquatic plant management objectives consult with the local extension service.

Emergent, Floating, and Shoreline Species

Common Name	Scientific Name	Rate (fl . oz./A)	Note(s)
Alligatorweed	*Alternanthera philoxeroides*	64 - 128	**A.& B.**
American lotus	*Nelumbo lutea*	64 - 128	
Arrowhead	*Sagittaria* spp.	32 - 64	
Cattail	*Typha* spp.	32 - 64	**C.**
Chinese tallowtree	*Sapium sebiferum*	64 - 128	
Common reed	*Phragmites* spp.	96 - 128	**D. & E.**
Common salvinia	*Salvinia minima*	32 - 64	**F.**
Floating heart	*Nymphoides* spp.	64 - 128	**G.**
Floating pennywort	*Hydrocotyle ranunculoides*	32 - 64	**A.**
Flowering rush	*Butomus umbellatus*	64 - 128	
Four-leaf clover	*Marsilea* spp.	32 - 64	
Frog's bit, Sponge plant	*Lymnobium* spp.	16 - 32	
Giant cane	*Arundo donax*	64 - 128	
Japanese knotweed	*Polygonum cuspidatum*	64 - 128	
Mexican lily	*Nymphaea mexicana*	32 - 64	
Mosquito fern	*Azolla* spp.	-	**G.**
Parrotfeather	*Myriophyl/um aquaticum*	64 - 128	**H.**
Pickerelweed	*Pontederia cordata*	32 - 64	
Saltcedar	*Tamarix* spp.	64 - 128	**G.**
Smartweed, ladysthumb Smartweed, Pennsylvania Smartweed, swamp	*Polygonum persicaria, Persicaria maculosa* *Polygonum pensylvanicum, Persicaria pensylvanica* *Polygonum coccineum, Persicaria amphibia*	64 - 128	
Spatterdock	*Nuphar lutea*	64 - 128	
Umbrella plant	*Cyperus involucratus*	64	**I.& J.**
Variable-leaf milfoil	*Myriophyllum heterophyllum*	64 - 128	**K. & L.**
Water chestnut	*Trapa natans*	64 - 128	**M. & G.**
Water hyacinth	*Eichhornia crassipes*	16 - 32	
Water lettuce	*Pistia stratiotes*	48 - 96	
Water lily	*Nymphaea* spp.	32 - 64	
Water primrose	*Ludwigia* spp.	32 - 64	**B.**
Watershield	*Brasenia schreberi*	48 - 64	
Wild taro	*Colocasia esculenta*	96 - 128	

A. Repeat applications may be necessary.
B. Use with an appropriate labeled glyphosate product for faster brownout.
C. Apply after full greenup through killing frost.
D. Apply with MSO; apply in late vegetative stage up to killing frost.
E. Also apply as a spot treatment using 1% to 2% v/v **Alligare IMOX Herbicide** spray. Older stands of phragmites and stands growing in water may be more difficult to control and will require follow-up applications.
F. Apply with MSO or MSO plus silicone-based surfactant; retreatment will be necessary.
G. Also apply as a spot treatment using 2% to 5% v/v **Alligare IMOX Herbicide** plus 1% v/v MSO spray.
H. Apply only to emergent vegetation.
I. Apply with MSO or VOC.
J. Also apply as a spot treatment using 5% v/v **Alligare IMOX Herbicide** spray.
K. Apply with MSO (1 % v/v) as an emergent foliar treatment when plants have emerged on the surface.
L. Also apply as a spot treatment using 1% to 3%v/v **Alligare IMOX Herbicide** spray.
M. Apply with MSO to emergent part of plant.

Vascular Aquatic Plant Control Using Surface or Injected Herbicide Applications (50-500 ppb)
There are three herbicide susceptibility levels of control for vascular aquatic plants: susceptible (50-200 ppb), intermediately susceptible (100-300 ppb) and partially susceptible (200-500 ppb).

Some vascular aquatic plants that are easy to control from foliar applications of **Alligare IMOX Herbicide** may be hard to control from in-water applications. Higher use rates may be required to achieve desired control/suppression in sites with high water exchange rates or when treating more mature or less susceptible plants or when targeting more difficult-to-control aquatic species or when treating small areas in larger bodies of water (partial or spot treatments). Lower concentrations are normally used when conducting early season large-scale treatments; when greater selectivity is desired; and treating larger areas, more immature or susceptible plants, and areas with less potential for rapid water exchange.

Use of lower rates may increase selectivity on some species within the same category. Effects on susceptible plants can range from control to growth regulation depending on treatment site characteristics, exposure time, and application rate. Susceptible plant species may exhibit herbicide stress or reduced growth during active treatment phases. Whole lake applications with lower rates may provide plant growth regulation or greater selectivity while higher rates will normally provide broader activity.

Vascular Aquatic Plant Susceptibility Chart

Common Name	Scientific Name	Rate (ppb)
American pondweed	*Potamogeton nodosus*	100 – 300
Bladderwort	*Utricularia* spp.	100 – 300
Bulrush	*Schoenoplectus califomicus*	200 – 500
Cattail	*Typha* spp.	200 – 500
Coontail	*Ceratophyllum demersum*	200 – 500
Curlyleaf pondweed	*Potamogeton crispus*	50 – 200
Eelgrass, Japanese	*Zostera japonica*	200 – 500
Egeria	*Egeria densa*	200 – 500
Eurasian watermilfoil	*Myriophyllum spicatum*	50 – 200
Flowering rush	*Butomus umbeliatus*	200 – 500
Frog's bit	*Lymnobium spongia*	100 – 300
Hydrilla	*Hydrilla verticillata*	50- 200
Illinois pondweed	*Potamogeton illinoensis*	100 - 300
Pickerelweed	*Pontederia cordata*	100 - 300
Salvinia	*Salvinia* spp.	100 - 300
Sago pondweed	*Stuckenia pectinata*	50 – 200
Southern naiad	*Najas guadalupensis*	200 – 500

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Common Name	Scientific Name	Rate (ppb)
Spatterdock	*Nuphar lutea*	200 – 500
Spikerush	*Eleocharis baldwinii*	100 - 300
Variable-leaf milfoil	*Myriophyllum heterophyllum*	100 - 300
Water hyacinth	*Eichhomia crassipes*	50 – 200
Water lily	*Nymphaea odorata*	200 – 500
Watershield	*Brasenia schreberi*	200 – 500
Water stargrass	*Heteranthera dubia*	50 – 200
Wigeon grass	*Ruppia maritima*	100 – 300

Specific Weed Control Directions

For Eurasian Watermilfoil. Use **Alligare IMOX Herbicide** at 100 - 200 ppb range early in the growing season to actively growing plants. Repeat applications may be required on mature Eurasian watermilfoil where the vegetation has topped out.

For Hydrilla. Use **Alligare IMOX Herbicide** at 150 - 200 ppb range early in the growing season to actively growing plants. Repeat applications may be required if the application is made prior to topped-out hydrilla. To suppress and growth-regulate hydrilla for up to 10 - 12 weeks, use a single application of 50 to 75 ppb. To extend the period of growth suppression when normal hydrilla growth resume, apply a second application of 50 to 75 ppb.

For Japanese Eelgrass. Since Japanese eelgrass is found in tidal and intertidal areas and is a submersed aquatic plant, apply **Alligare IMOX Herbicide** either directly in the water or directly to the plant (e.g. at low tide).

- **Low-tide application -** When the Japanese eelgrass is exposed at low tide, apply **Alligare IMOX Herbicide** uniformly with properly calibrated broadcast or spot treatment equipment in 10 or more gallons of water per acre.
  - Use of an appropriate spray adjuvant approved for aquatic is optional.
  - For spot treatments apply up to 5% v/v **Alligare IMOX Herbicide** spray**.** When treating areas with large and/or dense vegetation, higher spray volumes may be required. Depending upon spray equipment, conditions, and application objectives, adjust spray pressure to minimize drift potential.
  - For broadcast application, apply 4 - 32 fluid ounces per acre of **Alligare IMOX Herbicide**. Use the lower rate for management of seedlings.

- **In-water application** – If Japanese eelgrass is submersed, apply **Alligare IMOX Herbicide** as broadcast spray to the water surface or injected below the water surface. **Alligare IMOX Herbicide** may be applied as undiluted product or diluted with water before application. Under surface-matted conditions, inject **Alligare IMOX Herbicide** below the water surface to improve product distribution. Apply **Alligare IMOX Herbicide** to water to achieve a final concentration of the active ingredient of no more than 500 ppb. Multiple applications of **Alligare IMOX Herbicide** may be made during the annual growth cycle to maintain the desired vegetation response.

For Sago Pondweed. In dry ditches (drainage and irrigation), sago pondweed may be controlled or growth-suppressed with soil-applied **Alligare IMOX Herbicide** at 64 - 128 fluid ounces per acre. In irrigation canals, apply **Alligare IMOX Herbicide** after drawdown and prior to water recharge.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.
PESTICIDE STORAGE: Store in original container only. Avoid freezing. Store above 32°F. If frozen, poor weed control may result. In case of leak or spill, use absorbent materials to contain liquids and dispose as waste.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
(For rigid containers 5 gallons or less)
CONTAINER HANDLING: Non-refillable container. Do not reuse or refill this container. Offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.
(For nonrefillable rigid containers larger than 5 gallons)
CONTAINER HANDLING: Non-refillable container. Do not reuse or refill this container. Offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

(For refillable rigid containers larger than 5 gallons)
CONTAINER HANDLING: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Offer for recycling, if available or recondition if appropriate or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. If practical, agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

Batch Code:

CONDITION OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

To the extent consistent with applicable law, upon purchase or use of this product, purchaser and user agree to the following terms:
Warranty: Alligare, LLC (the Company) warrants that this product conforms to the chemical description on the label in all material respects and is reasonably fit for the purpose referred to in the directions for use, subject to the exceptions noted below, which are beyond the Company's control. To the extent consistent with applicable law, the Company makes no other representation or warranty, express or implied, concerning the product, including no implied warranty of merchantability or fitness for a particular purpose. To the extent consistent with applicable law, no such warranty shall be implied by law, and no agent or representative is authorized to make any such warranty on the Company's behalf.
Terms of Sale: The Company's directions for use of this product must be followed carefully. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, and the manner of use or application (including failure to adhere to label directions), all of which are beyond the Company's control. To the extent consistent with applicable law, all such risks are assumed by the user.
Limitation of Liability: To the extent consistent with applicable law, the exclusive remedy against the Company for any cause of action relating to the handling or use of this product is a claim for damages, and in no event shall damages or any other recovery of any kind exceed the price of the product which caused the alleged loss, damage, injury or other claim. To the extent consistent with applicable law, under no circumstances shall the Company be liable for any special, indirect, incidental or consequential damages of any kind, including loss of profits or income. Some states do not allow the exclusion or limitation of incidental or consequential damages.
The Company and the seller offer this product, and the purchaser and user accept this product, subject to the foregoing warranty, terms of sale and limitation of liability, which may be varied or modified only by an agreement in writing signed on behalf of the Company by an authorized representative.

IMOX™ is a trademark of Alligare, LLC

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SAFETY DATA SHEET

SDS DATE: 2/9/15

ALLIGARE MSO 1

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: ALLIGARE MSO 1

DISTRIBUTOR: ALLIGARE, LLC
ADDRESS: 13 N 8th Street, Opelika, AL 36801

EMERGENCY CHEMTREC PHONE: US: 1-800-424-9300 International: 1-202-483-7616

CHEMICAL NAME: Proprietary mixture
CHEMICAL FAMILY: Methyl Ester of Soya Oil
CHEMICAL FORMULA: Mixture

PRODUCT USE: Adjuvant

SECTION 1 NOTES: None

SECTION 2: HAZARDOUS INGREDIENTS

GHS Ratings:

Toxicity Categories: This product is not hazardous according to OSHA Hazard Communication Standard 29 CFR 1910.1200 (2012)

Signal Word: NONE

HAZARDS
May be harmful if swallowed.
May cause an allergic skin reaction.
May be harmful if inhaled.

PRECAUTIONS
Keep out of reach of children.
Read label before use.
Keep container tightly closed.
Keep only in original container.
Avoid breathing dust/fume/gas/mist/vapors/spray.
Wash hands thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use personal protective equipment as required.
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
IF ON SKIN: Wash with plenty of soap and water.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes.
Remove contact lenses if present and easy to do then continue rinsing cautiously.

SECTION 3: HAZARDS IDENTIFICATION

INGREDIENT	CAS NO.	% WT
None		

NOTE: Product does NOT contain any pesticides or pest control agents

SECTION 3 NOTES: These specific chemical identity and /or exact percentage (concentration) of composition has been withheld as a trade secret.

CARCINOGENICITY

OSHA: No **ACGIH:** No **NTP:** No **IARC:** No **OTHER:** No

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SECTION 4: FIRST AID MEASURES

EYE CONTACT- *IF IN EYES:* Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do then continue rinsing. Have the product container with you when calling a poison control center or doctor, or going for treatment.

SKIN CONTACT - *IF ON SKIN OR CLOTHING:* Take off contaminated clothing and wash it before reuse. Wash with plenty of soap and water for several minutes. Call a poison center, doctor, chemical manufacturer, importer, or distributor to specify the appropriate source of emergency medical advice.

INGESTION - *IF SWALLOWED:* Unless advised otherwise by a poison control center or doctor, have person rinse mouth with water, if able. Do not give anything by mouth to an unconscious person. Call a poison center, doctor, chemical manufacturer, importer, or distributor to specify the appropriate source of emergency medical advice if you feel unwell.

INHALATION - *IF INHALED:* If breathing is difficult, remove person to fresh air and keep at rest in a position comfortable for breathing. If person is not breathing, call 911 or an ambulance, and then give artificial respiration, preferably mouth to mouth if possible.

NOTES TO PHYSICIANS OR FIRST AID PROVIDERS:

SECTION 4 NOTES: None

SECTION 5: FIRE FIGHTING MEASURES

NFPA HAZARD CLASSIFICATION

HEALTH:	1	**FLAMMABILITY:**	1	**REACTIVITY:**	0	**OTHER:**	-

IN CASE OF FIRE: Foam, Dry Chemical, CO2.

SPECIAL FIRE FIGHTING PROCEDURES: Use a positive-pressure, self-contained air supply. Avoid getting water from fire-fighting into domestic or irrigation water supplies.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

HAZARDOUS DECOMPOSITION PRODUCTS: During combustion, oxides of carbon.

SECTION 5 NOTES: None

SECTION 6: ACCIDENTAL RELEASE MEASURES

ACCIDENTAL RELEASE MEASURES: Surround and absorb all spills. Material should be collected and disposed in proper manner. Dike the area to prevent spill from spreading. Soak up spill with a suitable absorbent such as clay, sawdust or kitty litter. Flush spill area with water. Slippery when wet. Prevent liquid entering sewers. If slipperiness remains apply more dry-sweeping compound. Sweep up absorbed material and place in a chemical waste container for disposal. Wear suitable protective equipment.

SECTION 6 NOTES: Slippery when wet.

SECTION 7: HANDLING AND STORAGE

HANDLING Keep out of reach of children. Read label before use. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling. Use personal protective equipment as required.

STORAGE: Store in a cool well-ventilated place. To avoid product degradation and equipment corrosion, do not use iron, copper or aluminum containers or equipment. Material is hygroscopic and should not be exposed to moisture in order to maintain product integrity. Keep in original container tightly closed. Do not reuse empty container. Do not store with food, feed, or other material to be used or consumed by humans or animals. Do not contaminate water supplies. For optimal storage, store between 40° and 90° F.

SECTION 7 NOTES: None

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SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values

VENTILATION: Normal room ventilation (mechanical) or outdoor use should be satisfactory.

RESPIRATORY PROTECTION: Not necessary unless ventilation is inadequate. Then use OSHA or NIOSH approved respirator, as appropriate.

EYE PROTECTION: Chemical goggles and face shield

SKIN PROTECTION: Chemical gloves, long-sleeved shirts and pants.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Eye wash and safety shower should be easily accessible

WORK HYGIENIC PRACTICES: Wash thoroughly with soap and water after handling product and before eating, drinking, or using tobacco products. Clean affected clothing, shoes, and protective equipment before reuse.

EXPOSURE GUIDELINES: If exposed, see section 4 for acute exposure first aid.

SECTION 8 NOTES: None

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Clear, pale yellow

ODOR: Fatty odor.

ORDER THRESHOLD; Not known

PHYSICAL STATE: Solid

pH AS SUPPLIED: Not applicable

pH (Other):

INITIAL BOILING POINT: **F:** Unknown
C: Unknown

BOILING POINT RANGE: **F:** Unknown
C: Unknown

MELTING POINT: **F:** Unknown
C: Unknown

FREEZING POINT: **F:** Unknown
C: Unknown

FLASH POINT: **F**: >200
C: >93

METHOD USED: PMCC

FLAMMABILITY (solid, gas):

FLAMMABLE LIMITS IN AIR, UPPER: Unknown
(% BY VOLUME) **LOWER**: Unknown

VAPOR PRESSURE (mmHg): @
F: Unknown
C: Unknown

VAPOR DENSITY (AIR = 1): @
F: Unknown
C: Unknown

RELATIVE DENSITY: 0.870 to 0.884

EVAPORATION RATE: Unknown
BASIS (butyl acetate=1):

SOLUBILITY IN WATER: Dispersible

PARTITION COEFFICIENT: n-octanol/water): Unknown

AUTO-IGNITION TEMPERATURE: Unknown

DECOMPOSITION TEMPERATURE: Unknown

VISCOSITY: @ >20.5 mm^2/s
F: 104
C: 40

SECTION 9 NOTES: Values are not product specifications.
Note: These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.

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SECTION 10: STABILITY AND REACTIVITY

STABILITY: Stable ◉ Unstable ○

CONDITIONS TO AVOID (STABILITY): Prolonged excessive heat, strong oxidizing agents.

INCOMPATIBILITY (MATERIAL TO AVOID): Strong acids, gases, and oxidizers.

HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: CO_2, O_2.

HAZARDOUS POLYMERIZATION: Will not occur

CONDITIONS TO AVOID (POLYMERIZATION): None known

SECTION 10 NOTES: None

SECTION 11: TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION: None

MIXTURE TOXICITY Dermal Toxicity(estimated): 3,005.00mg/kg
Oral Toxicity(estimated): 3,075.00mg/kg

COMPONENT TOXICITY Not available

SECTION 11 NOTES: None

SECTION 12: ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: None

ECOTOXICITY: Not available

BIOACCUMULATIVE POTENTIAL: Not available

MOBILITY IN SOIL: Not available

OTHER ADVERSE EFFECTS: Not available

SECTION 12 NOTES: None

SECTION 13: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Do not contaminate water, food or feed by storage or disposal. Dispose of contents in container to an approved waste disposal facility in accordance with all local /regional/national/international regulations.

CONTAINER DISPOSAL: Triple rinse (or equivalent) adding rinse water to application tank. Offer container for recycling or dispose of in a sanitary landfill or by other procedures approved by local regulations.

RCRA HAZARD CLASS: None

SECTION 13 NOTES: None

SECTION 14: TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION

DOT Shipping Description: Not Regulated

U.S. Surface Freight Classification: ADHESIVES, ADJUVANTS, SPREADERS OR STICKERS (NMFC 4610; CLASS: 60)
Consult appropriate ICAO/IATA and IMDG regulations for shipment requirements in the Air and Maritime shipping modes.

OTHER AGENCIES: None

SECTION 14 NOTES: None

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SECTION 15: REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS

TSCA (TOXIC SUBSTANCE CONTROL ACT): Mixture not listed

CERCLA (COMPREHENSIVE RESPONSE COMPENSATION, AND LIABILITY ACT): Not Regulated

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT): Not Regulated

311/312 HAZARD CATEGORIES: None

313 REPORTABLE INGREDIENTS: None

INTERNATIONAL REGULATIONS: None

SECTION 15 NOTES: None

SECTION 16: OTHER INFORMATION

OTHER INFORMATION: None

DISCLAIMER:
The recommendation for safe handling and protection procedures is believed to be generally suitable for the standard uses of this compound. However, each user should identify his intended uses of this material and determine whether they are appropriate. All data included in this document is released as typical values and should not be utilized to determine the suitability of this material for a particular use or purpose. No warranty, either expressed or implied, is hereby made, nor do we give permission, inducement, or recommendations to practice any patented invention without a license. All data is offered for consideration, investigation and verification purposes only.

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ALLIGARE

ALLIGARE MSO 1

METHYLATED SEED OIL BLEND

PRINCIPAL FUNCTIONING AGENTS:
Methylated seed oil and other oils and emulsifiers.....100%
All ingredients are accepted for use under 40 CFR 180.

KEEP OUT OF REACH OF CHILDREN
CAUTION! / PRECAUCIÓN!

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements: May cause eye or skin irritation. Avoid contact with eyes, skin, or clothing. Do not take internally. Wear protective eyewear when handling. Avoid breathing vapors. When handling wear coveralls over short-sleeved shirt, short pants, socks, chemical resistant shoes and chemical resistant gloves.

READ AND FOLLOW ALL LABEL DIRECTIONS AND CAUTIONS ON ALL PRODUCTS USED.

FIRST AID

Call a poison control center or doctor immediately for treatment advice.
Have the product container or label with you when call or going for treatment.

IF SWALLOWED: Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes.

IF INHALED: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth to mouth if possible.

IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses if present, after the first 5 minutes, then continue rinsing eye. Have the product container with you when calling a poison control center or doctor, or going for treatment.

GENERAL INFORMATION

ALLIGARE MSO is an oil-based spray adjuvant, designed for use with pesticides that suggest or require the use of an oil adjuvant. **ALLIGARE MSO** has been shown to boost the performance of products such as 2,4-D esters, SU's and many other products where the use of an oil adjuvant is advised. **ALLIGARE MSO** can be especially helpful wherever weeds have become large, have thick, waxy coatings or are otherwise under stress. **ALLIGARE MSO** is used on agricultural crops, in forestry applications, in industrial and R.O.W. settings, in pasture and rangeland areas and in T&O or in any non-aquatic application.

NET CONTENTS:

- ☐ 2.5 U.S. Gallons (9.46 liters)
- ☐ 30 Gallon (113.55 liters)
- ☐ 270 Gallons (1022.061 liters)

APPLICATION RATES

ALLIGARE MSO may be used at rates of 3/4 pint to 6 quarts per acre depending on conditions and weeds. The lowest rates should be used on weeds with thin wax layers under ideal conditions. Higher doses will be required when stress occurs causing thicker wax layers, if there are large numbers of weeds or with weeds that have naturally thicker waxy cuticles.

AQUATIC USE RATES

Application	amount of ALLIGARE MSO per 100 gallons of spray solution
Aquatic-surface	16 to 32 ounces
Aquatic-submerged	20 to 40 ounces

NOTE: Always follow the recommendations on the label of the active formulation.

DIRECTIONS

Follow the mixing order on the label of the pesticide.

If no order is specified, add this product after other tank mix additives and pesticides, with good agitation. Do not put water into this product container unless all of the product has been poured out. Then triple rinse the container and pour the rinsate into the mix tank. Then continue adding water.

STORAGE AND DISPOSAL: Store in a cool, dry place. Do not introduce water to the container before use or during storage. Follow all local, state and local regulations for disposal of this and all other products and containers.

WARRANTY

Alligare, LLC warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. Alligare, LLC MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANT-ABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.
Inherent Risks of Use: It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperature, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Alligare, LLC or the seller. All such risks shall be assumed by buyer.
Limitation of Remedies: The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Alligare, LLC's election, one of the following:
1. Refund of purchase price paid by buyer or user for product bought, or 2. Replacement of amount of product used. Alligare, LLC shall not be liable for losses or damages resulting from handling or use of this product unless Alligare, LLC is promptly notified of such loss or damage in writing. In no case shall Alligare, LLC be liable for consequential or incidental damages or losses.
The terms of the "Warranty Disclaimer" above and this "Limitation of Remedies" cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Alligare, LLC or the seller is authorized to vary or exceed the terms of the "Warranty Disclaimer" or this "Limitation of Remedies" in any manner.

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BASF
The Chemical Company

Safety data sheet
CLEARMAX IMAZAMOX

1. Substance/preparation and company identification

Company
BASF CORPORATION
100 Campus Drive
Florham Park, NJ 07932

24 Hour Emergency Response Information
CHEMTREC: 1-800-424-9300
BASF HOTLINE: 1-800-832-HELP

Substance number:	000000136003
Molecular formula:	C15 H18 N3 O4 . N H(4)
Molecular weight:	322.4 g/mol
Chemical family:	imidazole derivative
Synonyms:	ammonium salt of imazamox (active ingredient)

2. Composition/information on ingredients

CAS Number	Content (W/W)	Chemical name
247057-22-3	12.1 %	ammonium salt of imazamox (active ingredient)
	87.9 %	Proprietary ingredients

3. Hazard identification

Emergency overview

CAUTION: HARMFUL IF ABSORBED THROUGH SKIN.
HARMFUL IF INHALED.
Avoid contact with the skin, eyes and clothing.
Avoid inhalation of mists/vapours.

Potential health effects

See Product Label for additional precautionary statements.

Primary routes of exposure
Routes of entry for solids and liquids include eye and skin contact, ingestion and inhalation. Routes of entry for gases include inhalation and eye contact. Skin contact may be a route of entry for liquified gases.

Acute toxicity:
Relatively nontoxic after single ingestion. Slightly toxic after short-term skin contact. Relatively nontoxic after short-term inhalation.

Irritation:
May cause slight irritation to the skin. May cause moderate but temporary irritation to the eyes.

Repeated dose toxicity:
No known chronic effects.

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Medical conditions aggravated by overexposure:
No data available.

Potential environmental effects

Aquatic toxicity:
There is a high probability that the product is not acutely harmful to aquatic organisms.

Terrestrial toxicity:
With high probability not acutely harmful to terrestrial organisms.

4. First-aid measures

General advice:
First aid providers should wear personal protective equipment to prevent exposure. Remove contaminated clothing. Move person to fresh air. If person is not breathing, call 911 or ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or physician for treatment advice. Have the product container or label with you when calling a poison control center or doctor or going for treatment.

If inhaled:
Remove the affected individual into fresh air and keep the person calm. Assist in breathing if necessary.

If on skin:
Rinse skin immediately with plenty of water for 15 - 20 minutes.

If in eyes:
Hold eyes open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after first 5 minutes, then continue rinsing.

If swallowed:
Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor. Never induce vomiting or give anything by mouth if the victim is unconscious or having convulsions.

Note to physician

Hazards:	Accidental or deliberate ingestion of this product/substance in excess of 2 fluid ounces in a child or 8 fluid ounces in an adult, may produce signs and symptoms of propylene glycol poisoning, including severe metabolic acidosis, oxaluria, hypocalcemia and renal failure due to crystalluria.
Antidote:	No known specific antidote.
Treatment:	Treat according to the symptoms under clinical conditions. Treatment with intravenous bicarbonate to combat acidosis and treatment with ethanol to inhibit the metabolism of the glycol to oxalat may be necessary.

5. Fire-fighting measures

Flash point: No data available.

Suitable extinguishing media:
foam, dry extinguishing media, carbon dioxide, water spray

Hazards during fire-fighting:
carbon monoxide, carbon dioxide, nitrogen oxide, nitrogen dioxide,
If product is heated above decomposition temperature, toxic vapours will be released. The substances/groups of substances mentioned can be released if the product is involved in a fire.

Protective equipment for fire-fighting:
Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

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Further information:
Evacuate area of all unnecessary personnel. Contain contaminated water/firefighting water. Do not allow to enter drains or waterways.

NFPA Hazard codes:
Health : 1 Fire: 1 Reactivity: 0 Special:

6. Accidental release measures

Personal precautions:
Take appropriate protective measures. Clear area. Shut off source of leak only under safe conditions. Extinguish sources of ignition nearby and downwind. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.

Environmental precautions:
Do not discharge into the subsoil/soil. Do not discharge into drains/surface waters/groundwater. Contain contaminated water/firefighting water.

Cleanup:
Dike spillage. Pick up with suitable absorbent material. Place into suitable containers for reuse or disposal in a licensed facility. Spilled substance/product should be recovered and applied according to label rates whenever possible. If application of spilled substance/product is not possible, then spills should be contained, solidified, and placed in suitable containers for disposal. After decontamination, spill area can be washed with water. Collect wash water for approved disposal.

7. Handling and storage

Handling

General advice:
RECOMMENDATIONS ARE FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS. PESTICIDE APPLICATORS & WORKERS must refer to the Product Label and Directions for Use attached to the product for Agricultural Use Requirements in accordance with the EPA Worker Protection Standard 40 CFR part 170. Ensure adequate ventilation. Provide good ventilation of working area (local exhaust ventilation if necessary). Keep away from sources of ignition - No smoking. Keep container tightly sealed. Protect contents from the effects of light. Protect against heat. Protect from air. Handle and open container with care. Do not open until ready to use. Once container is opened, content should be used as soon as possible. Avoid aerosol formation. Avoid dust formation. Provide means for controlling leaks and spills. Do not return residues to the storage containers. Follow label warnings even after container is emptied. The substance/ product may be handled only by appropriately trained personnel. Avoid all direct contact with the substance/product. Avoid contact with the skin, eyes and clothing. Avoid inhalation of dusts/mists/vapours. Wear suitable personal protective clothing and equipment.

Protection against fire and explosion:
No explosion proofing necessary.

Storage

General advice:
Keep only in the original container in a cool, dry, well-ventilated place away from ignition sources, heat or flame. Protect containers from physical damage. Protect against contamination. The authority permits and storage regulations must be observed.

Storage incompatibility:
General: Segregate from incompatible substances. Segregate from foods and animal feeds. Segregate from textiles and similar materials.

Storage stability:
If substance/product crystallizes, thaw at room temperature.

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Temperature tolerance
Protect from temperatures below: 32 °F

8. Exposure controls and personal protection

Users of a pesticidal product should refer to the product label for personal protective equipment requirements.

Advice on system design:
Whenever possible, engineering controls should be used to minimize the need for personal protective equipment.

Personal protective equipment

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

Respiratory protection:
Wear respiratory protection if ventilation is inadequate. Wear a NIOSH-certified (or equivalent) TC23C Chemical/Mechanical type filter system to remove a combination of particles, gas and vapours. For situations where the airborne concentrations may exceed the level for which an air purifying respirator is effective, or where the levels are unknown or Immediately Dangerous to Life or Health (IDLH), use NIOSH-certified full facepiece pressure demand self-contained breathing apparatus (SCBA) or a full facepiece pressure demand supplied-air respirator (SAR) with escape provisions.

Hand protection:
Chemical resistant protective gloves, Protective glove selection must be based on the user's assessment of the workplace hazards.

Eye protection:
Safety glasses with side-shields. Tightly fitting safety goggles (chemical goggles). Wear face shield if splashing hazard exists.

Body protection:
Body protection must be chosen depending on activity and possible exposure, e.g. head protection, apron, protective boots, chemical-protection suit.

General safety and hygiene measures:
Wear long sleeved work shirt and long work pants in addition to other stated personal protective equipment. Work place should be equipped with a shower and an eye wash. Handle in accordance with good industrial hygiene and safety practice. Personal protective equipment should be decontaminated prior to reuse. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks). Take off immediately all contaminated clothing. Store work clothing separately. Hands and/or face should be washed before breaks and at the end of the shift. No eating, drinking, smoking or tobacco use at the place of work. Keep away from food, drink and animal feeding stuffs.

9. Physical and chemical properties

Form:	liquid	
Odour:	acidic, mild	
pH value:	5.8 - 6.2	
Boiling point:	approx. 100 °C	(760 mmHg)
Density:	1.05 g/cm3	
Relative density:	1.05	

10. Stability and reactivity

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Conditions to avoid:
Avoid all sources of ignition: heat, sparks, open flame. Avoid extreme temperatures. Avoid prolonged exposure to extreme heat. Avoid contamination. Avoid electro-static discharge. Avoid prolonged storage.

Substances to avoid:
oxidizing agents

Hazardous reactions:
The product is chemically stable.
Hazardous polymerization will not occur. No hazardous reactions if stored and handled as prescribed/indicated.

Decomposition products:
Hazardous decomposition products: No hazardous decomposition products if stored and handled as prescribed/indicated., Prolonged thermal loading can result in products of degradation being given off.
Hazardous decomposition products:

Thermal decomposition:
Possible thermal decomposition products:
carbon monoxide, carbon dioxide, nitrogen oxide
Stable at ambient temperature. If product is heated above decomposition temperature toxic vapours may be released. If product is heated above decomposition temperature hazardous fumes may be released.

Corrosion to metals:
Corrosive effects to metal are not anticipated. Not corrosive to: mild steel

11. Toxicological information

Acute toxicity

Oral:
LD50/rat: > 5,000 mg/kg
Slightly toxic to practically nontoxic.

Inhalation:
LC50/rat: > 5 mg/l / 4 h
Moderately toxic.
LC50/rat: > 20 mg/l / 1 h

Dermal:
LD50/rat: > 4,000 mg/kg
Slightly toxic.

Skin irritation:
rabbit: non-irritant (FHSA Guideline)

Eye irritation :
rabbit: non-irritant

Sensitization:
modified Buehler test/guinea pig: Skin sensitizing effects were not observed in animal studies.

Genetic toxicity:
Information on: imazamox
No mutagenic effect was found in various tests with microorganisms and mammals.

Carcinogenicity:

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Information on: imazamox
In long-term studies in rats and mice in which the substance was given by feed, a carcinogenic effect was not observed.

Reproductive toxicity:
Information on: imazamox
The results of animal studies gave no indication of a fertility impairing effect.

Developmental toxicity/teratogenicity:
Information on: imazamox
No indications of a developmental toxic / teratogenic effect were seen in animal studies.
---

12. Ecological information

Information on: imazamox
Acute and prolonged toxicity to fish:
Rainbow trout/LC50 (96 h): = > 122 ppm

Information on: imazamox
Acute toxicity to aquatic invertebrates:
Daphnia magna/EC50: >122 ppm

Information on: imazamox
Toxicity to aquatic plants:
algae/EC50 (120 h): > 0.037 mg/l

Information on: imazamox
Other terrestrial non-mammals:
mallard duck/LC50: > 5,572 ppm
Honey bee/LD50: > 100 ug/bee
---

13. Disposal considerations

Waste disposal of substance:
Pesticide wastes are regulated.
Improper disposal of excess pesticide, spray mix or rinsate is a violation of federal law.
If pesticide wastes cannot be disposed of according to label instructions, contact the State Pesticide or Environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container disposal:
Rinse thoroughly at least three times (triple rinse) in accordance with EPA recommendations. Consult state or local disposal authorities for approved alternative procedures such as container recycling. Recommend crushing, puncturing or other means to prevent unauthorized use of used containers.

14. Transport information

Reference Bill of Lading

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15. Regulatory information

Federal Regulations

Registration status:
TSCA, US released / exempt

SARA hazard categories (EPCRA 311/312): Not hazardous

16. Other information

Refer to product label for EPA registration number.

Local contact information
Product Stewardship
919 547-2000

IMPORTANT: WHILE THE DESCRIPTIONS, DESIGNS, DATA AND INFORMATION CONTAINED HEREIN ARE PRESENTED IN GOOD FAITH AND BELIEVED TO BE ACCURATE , IT IS PROVIDED FOR YOUR GUIDANCE ONLY. BECAUSE MANY FACTORS MAY AFFECT PROCESSING OR APPLICATION/USE, WE RECOMMEND THAT YOU MAKE TESTS TO DETERMINE THE SUITABILITY OF A PRODUCT FOR YOUR PARTICULAR PURPOSE PRIOR TO USE. NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, DATA OR INFORMATION SET FORTH, OR THAT THE PRODUCTS, DESIGNS, DATA OR INFORMATION MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE. FURTHER, YOU EXPRESSLY UNDERSTAND AND AGREE THAT THE DESCRIPTIONS, DESIGNS, DATA, AND INFORMATION FURNISHED BY BASF HEREUNDER ARE GIVEN GRATIS AND BASF ASSUMES NO OBLIGATION OR LIABILITY FOR THE DESCRIPTION, DESIGNS, DATA AND INFORMATION GIVEN OR RESULTS OBTAINED, ALL SUCH BEING GIVEN AND ACCEPTED AT YOUR RISK.
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Appendix C. Site Specifgic Infestation Maps

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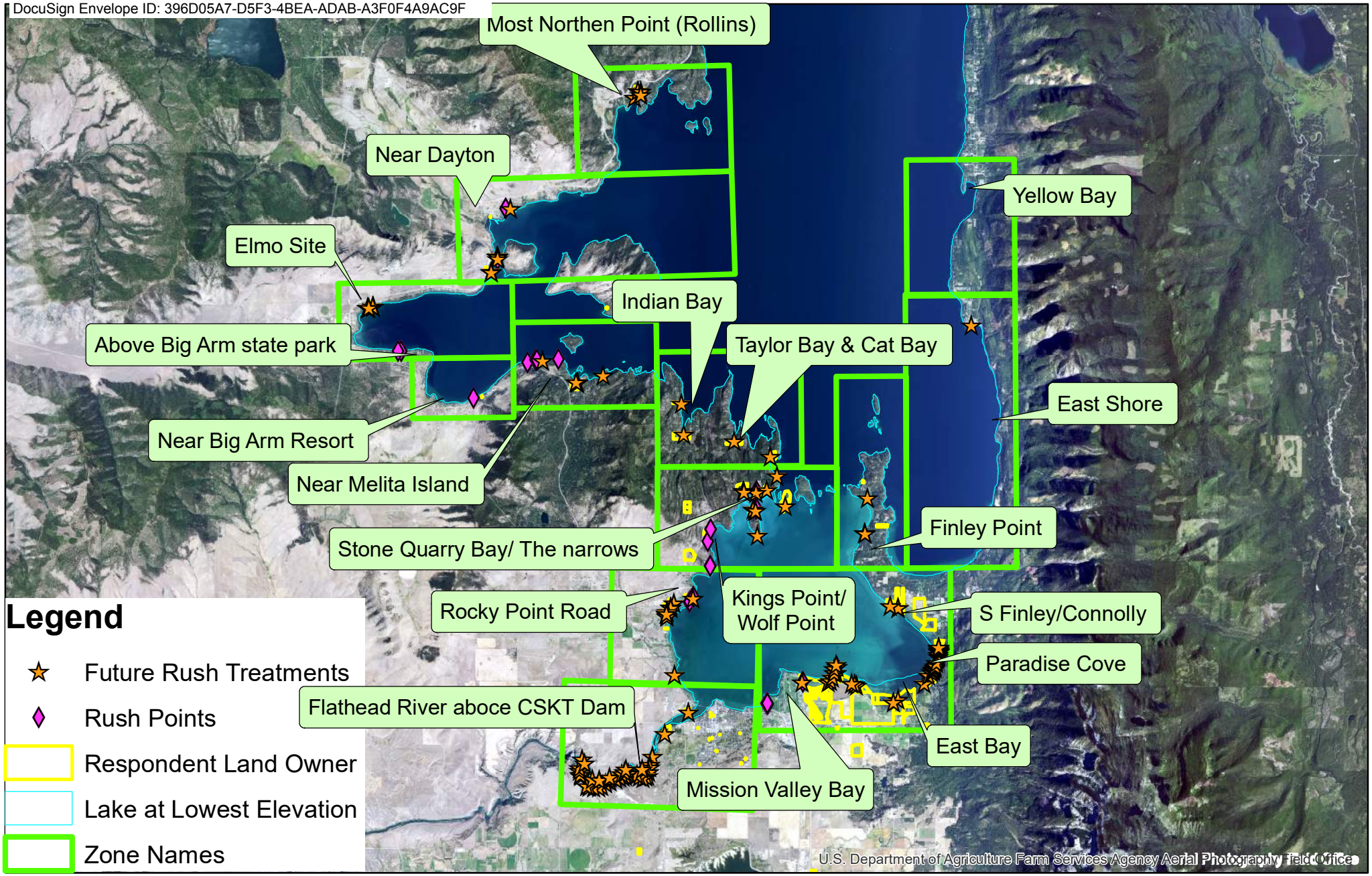

0 2.75 5.5 11 Miles

N W E S

1 inch = 24,116 feet

Rush Treatment Sites

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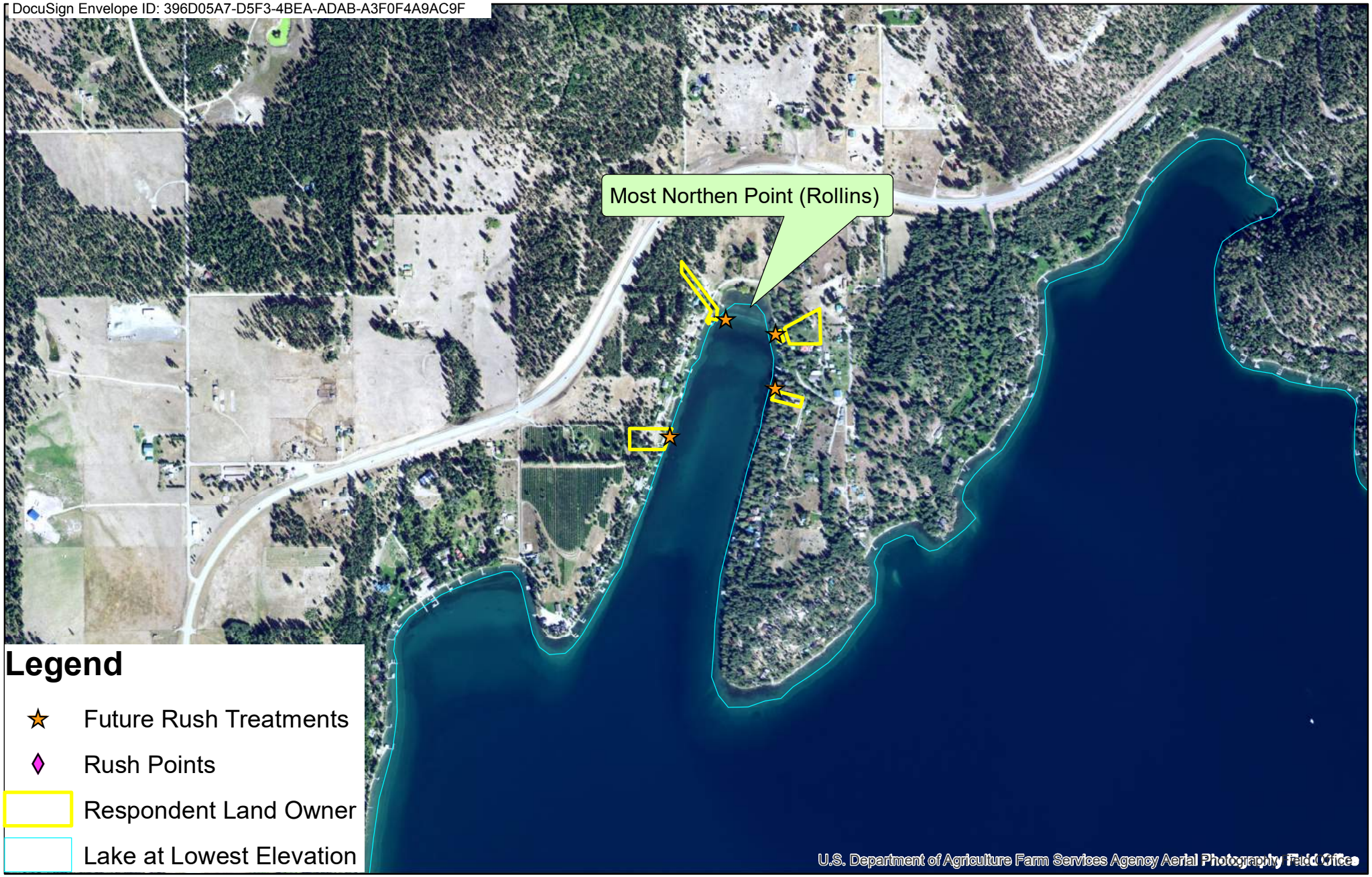

0 0.175 0.35 0.7 Miles

N W E S

1 inch = 1,523 feet

Most Northern Part (Rollins)

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0 0.05 0.1 0.2 Miles

N W E S

1 inch = 473 feet

Near Dayton (1)

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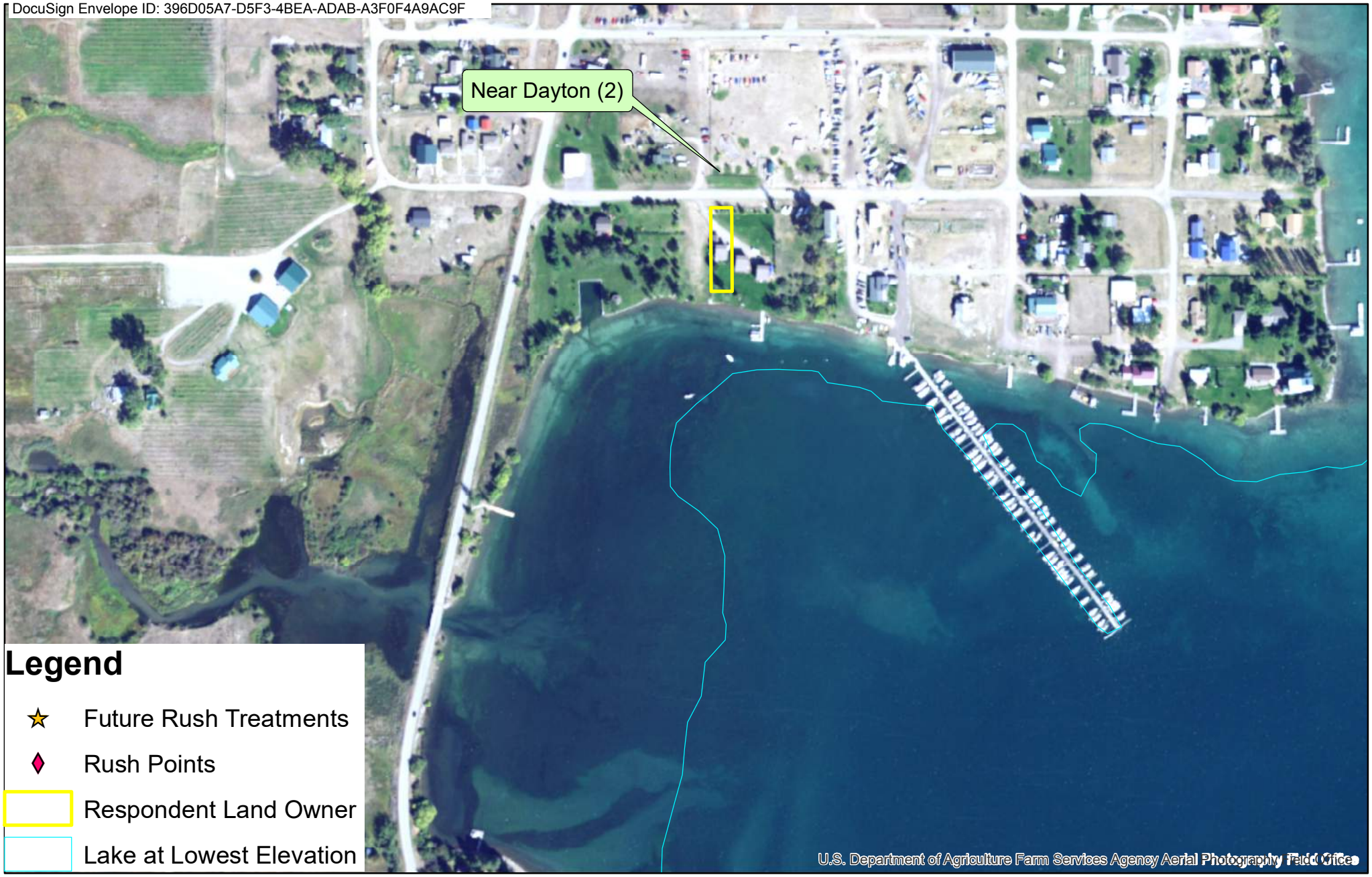

0 0.05 0.1 0.2 Miles

N W E S

1 inch = 459 feet

Near Dayton (2)

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0 0.075 0.15 0.3 Miles

N W E S

1 inch = 667 feet

Near Dayton (3) (By Collins Island)

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Elmo Site

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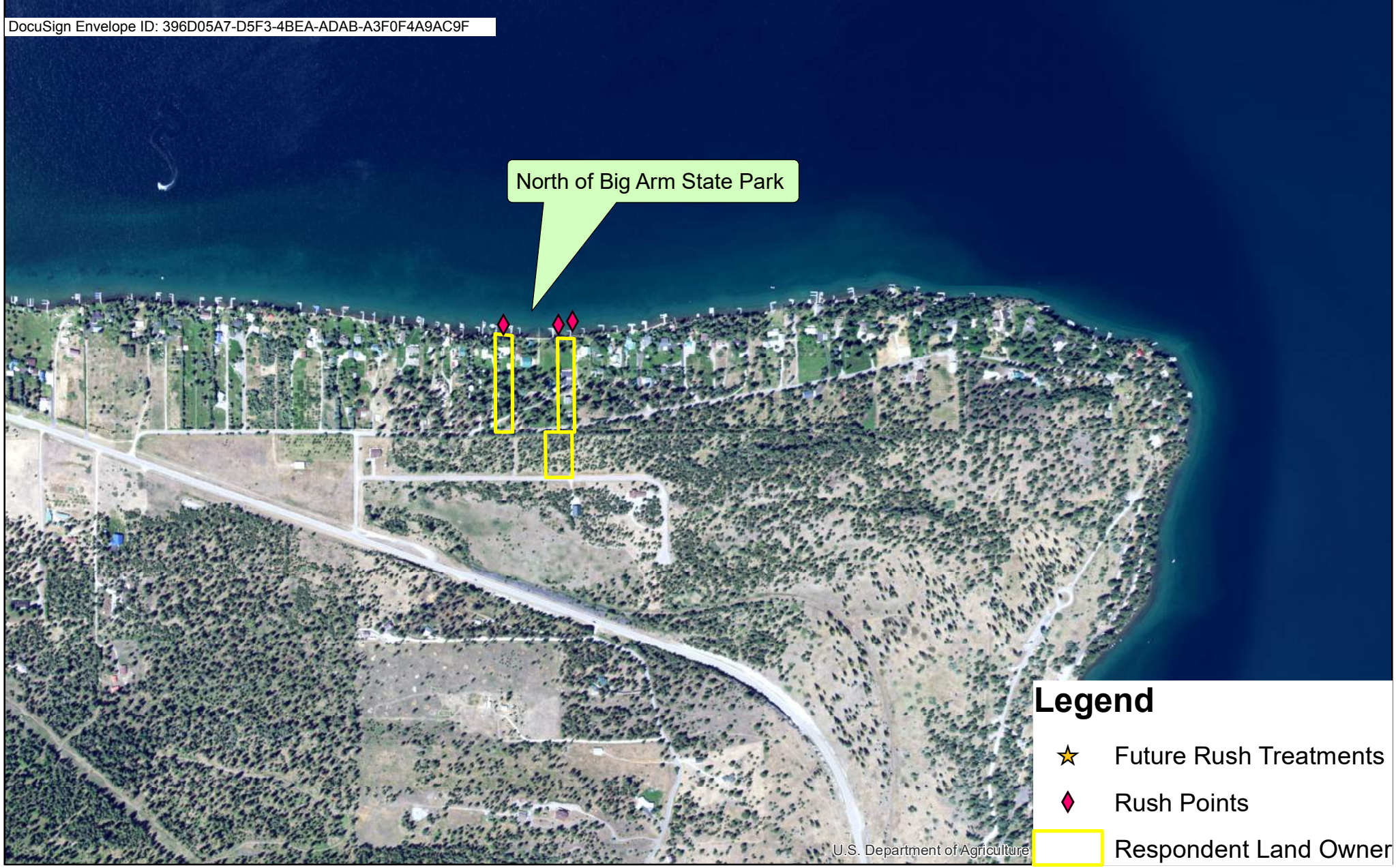

0 0.15 0.3 0.6 Miles

N W E S

1 inch = 1,250 feet

North Big Arm State Park

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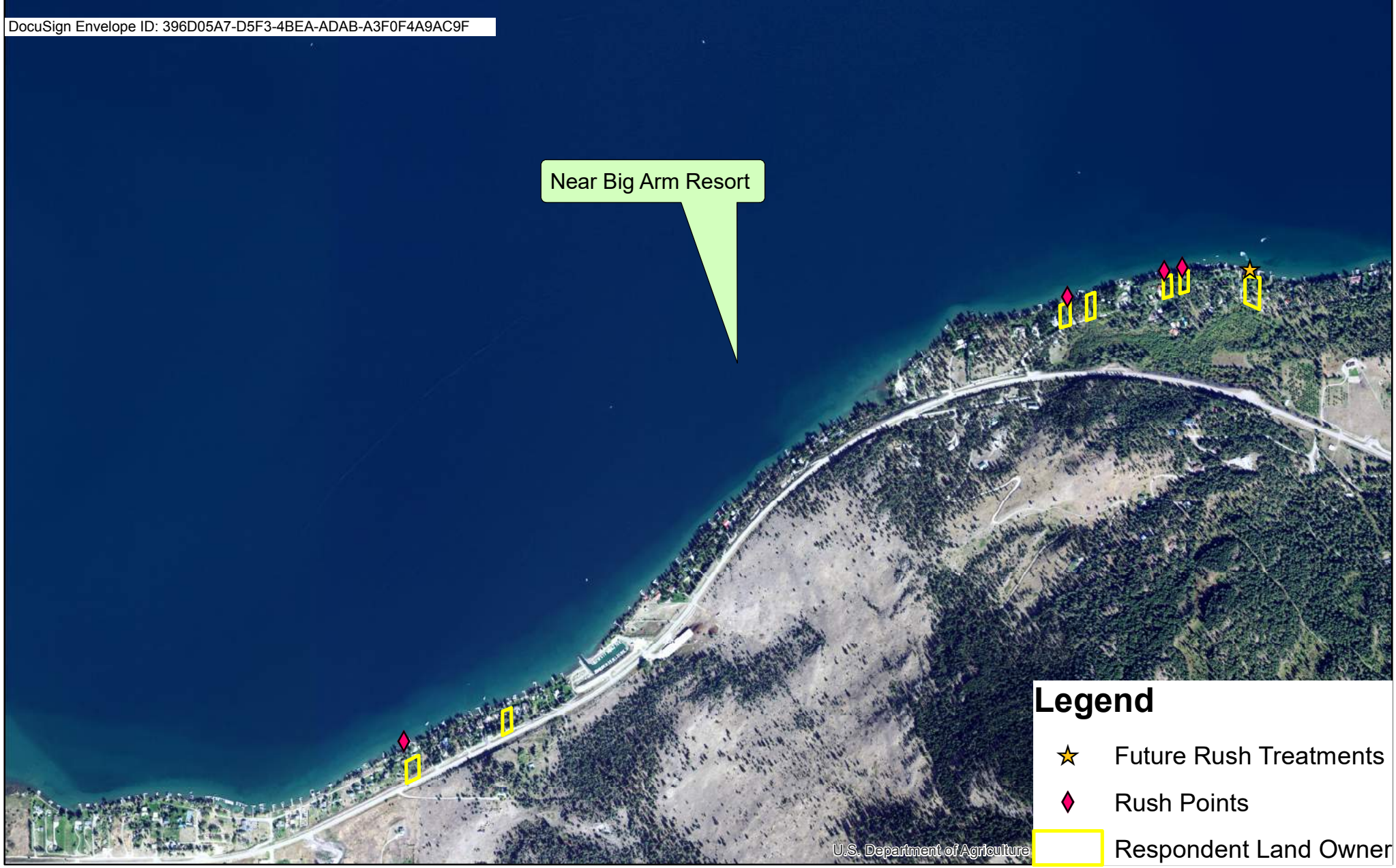

0 0.225 0.45 0.9 Miles

N W E S

1 inch = 2,000 feet

Near Big Arm Resort

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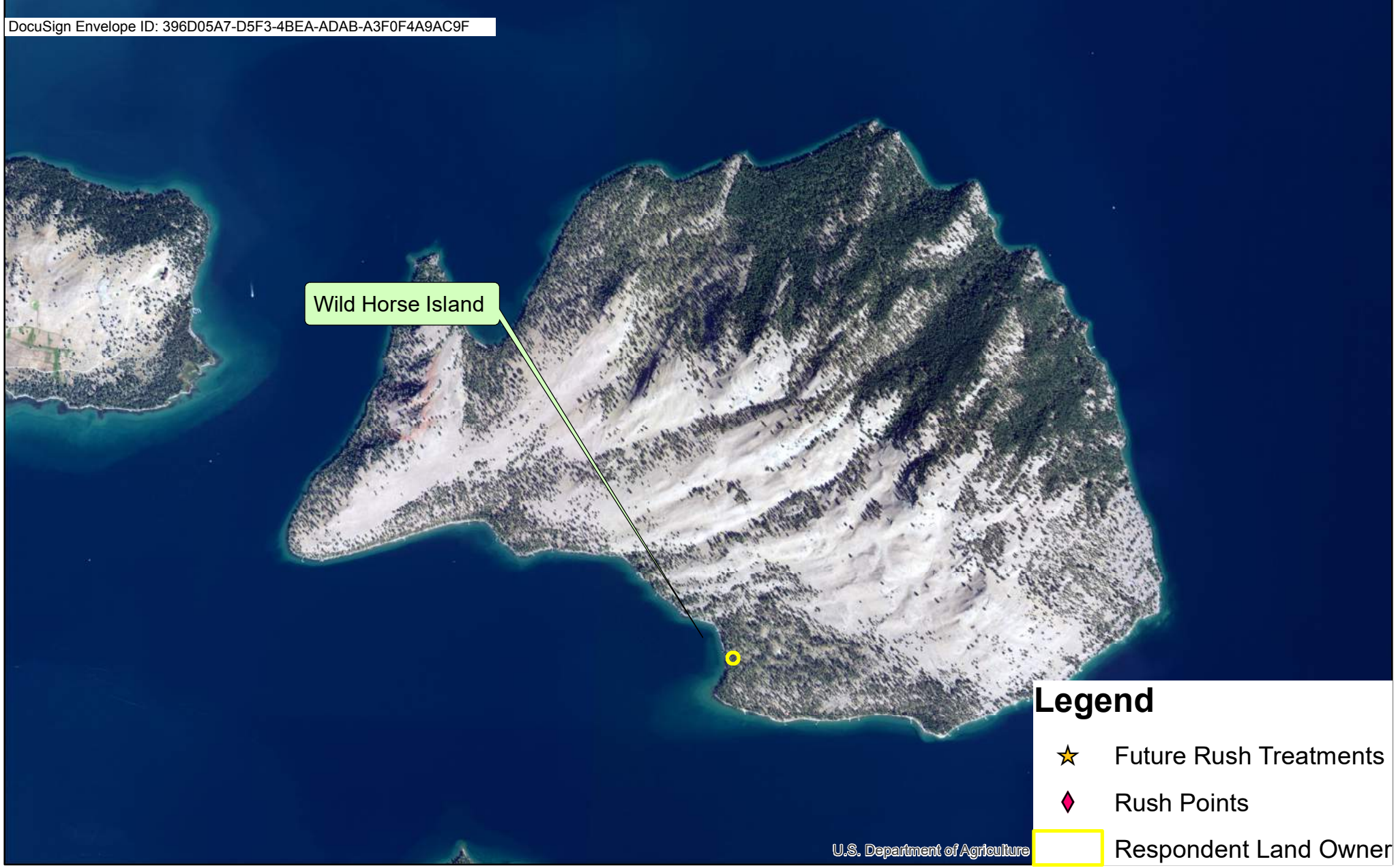

0 0.4 0.8 1.6 Miles

N W E S

1 inch = 3,333 feet

Wild Horse Island

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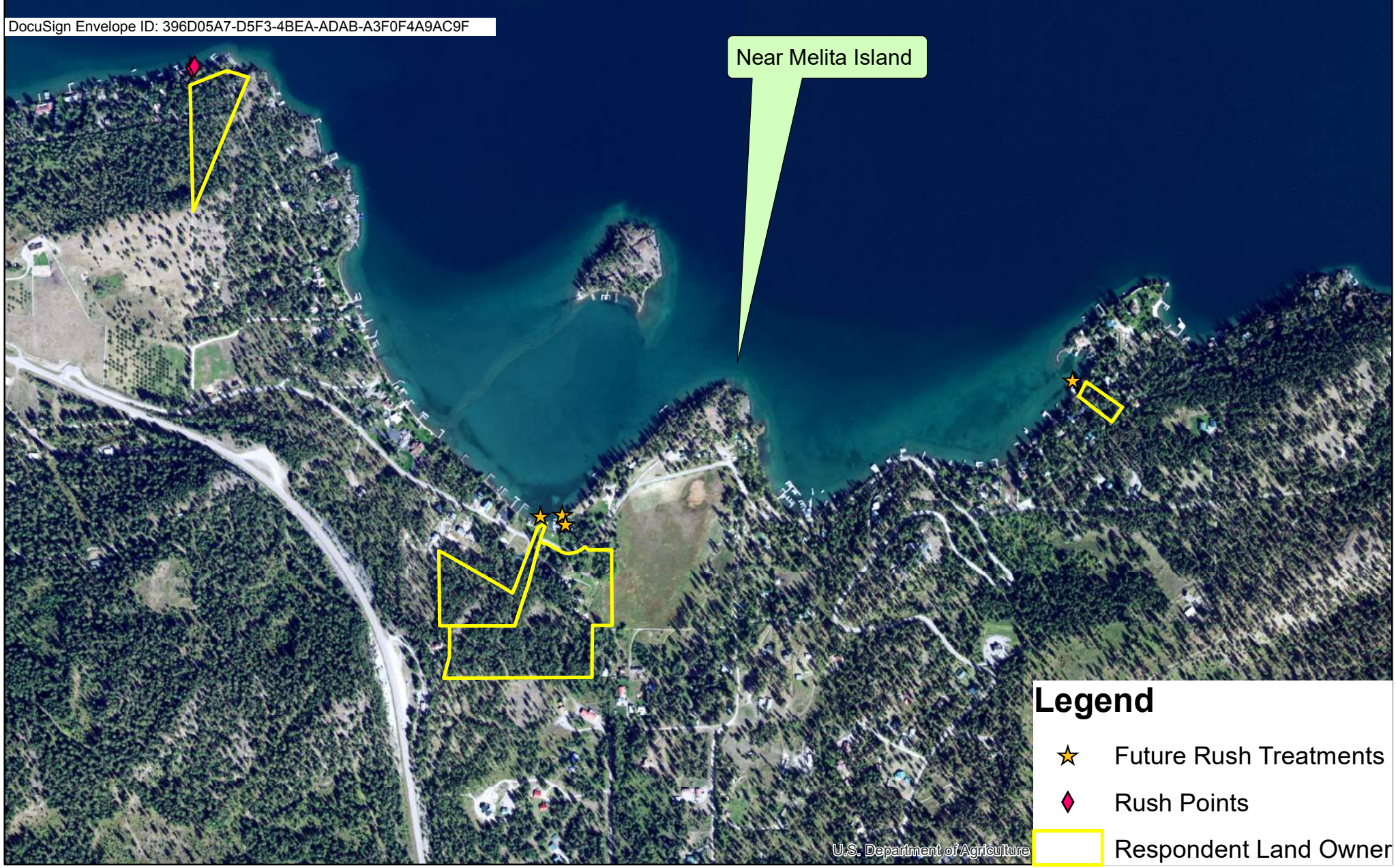

0 0.15 0.3 0.6 Miles

N W E S

1 inch = 1,242 feet

Near Melita Island

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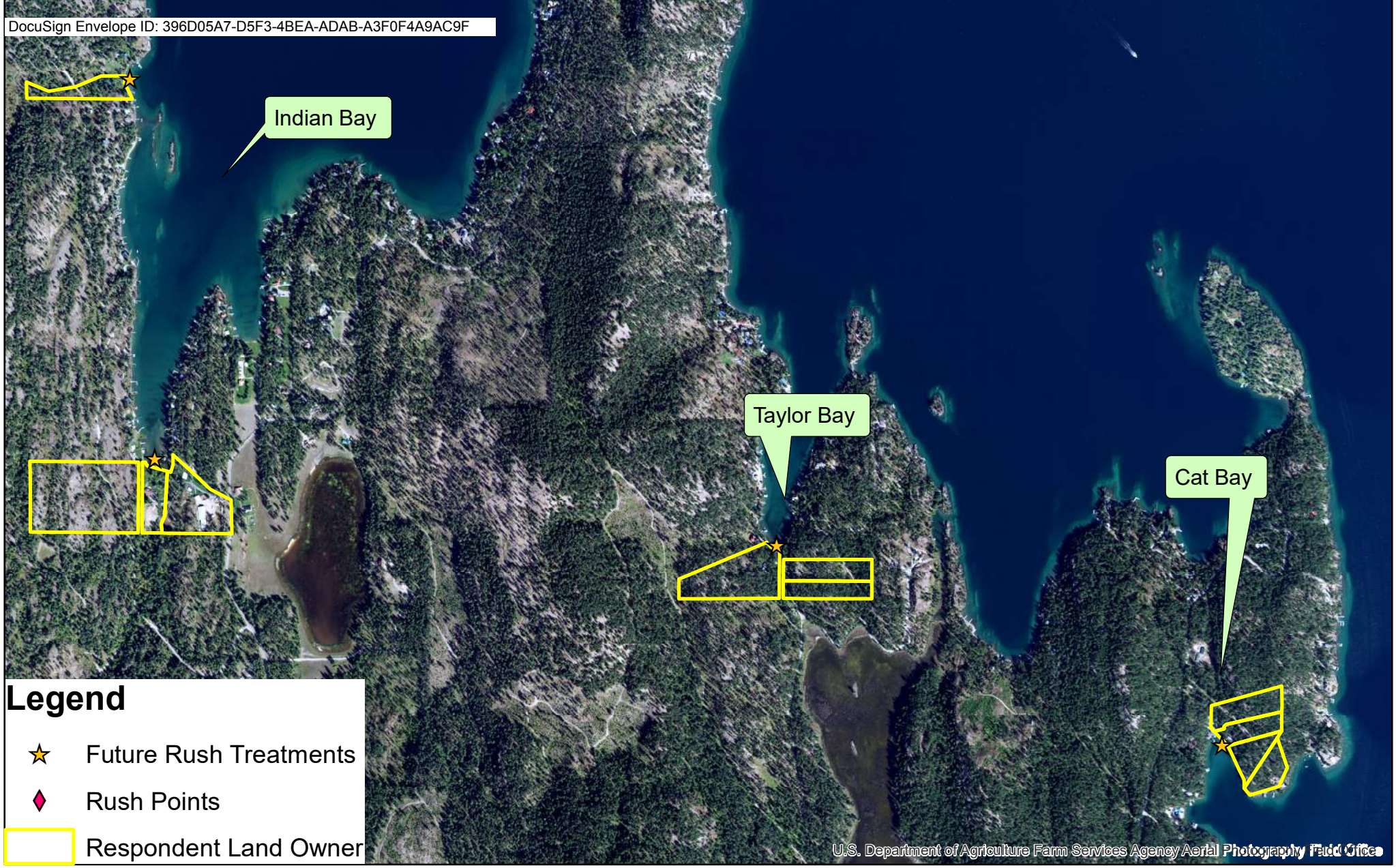

0 0.225 0.45 0.9 Miles

N W E S

1 inch = 2,000 feet

Indian, Taylor, and Cat Bay

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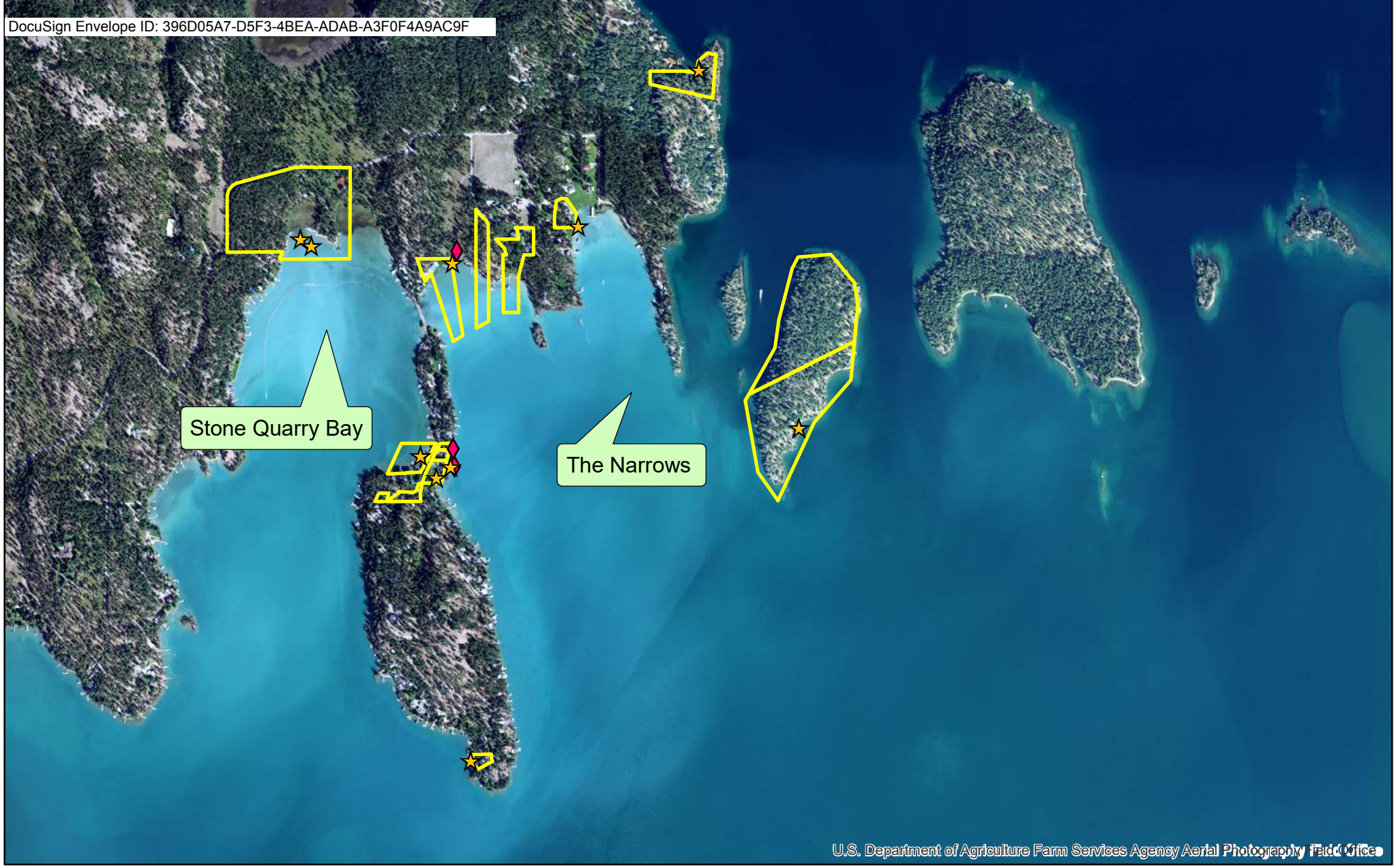

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Stone Quarry Bay and The Narrows

0 0.25 0.5 1 Miles

1 inch = 2,083 feet

N W E S

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Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Near Kings Point/ Wolfs Point

0 0.25 0.5 1 Miles

1 inch = 2,083 feet

N W E S

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Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Rocky Point

0 0.3 0.6 1.2 Miles

1 inch = 2,500 feet

N W E S

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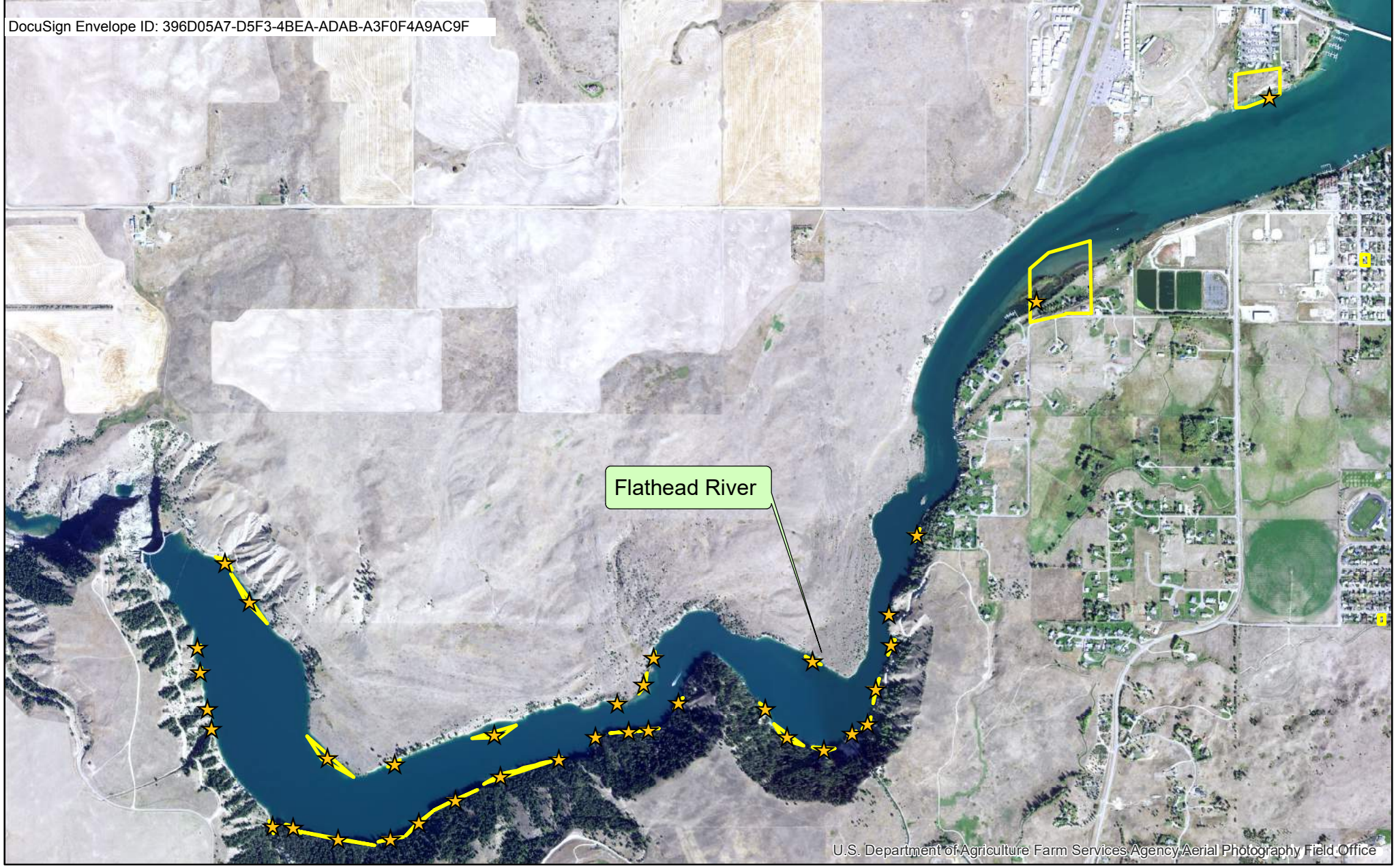

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Flathead River

0 0.3 0.6 1.2 Miles

1 inch = 2,500 feet

N W E S

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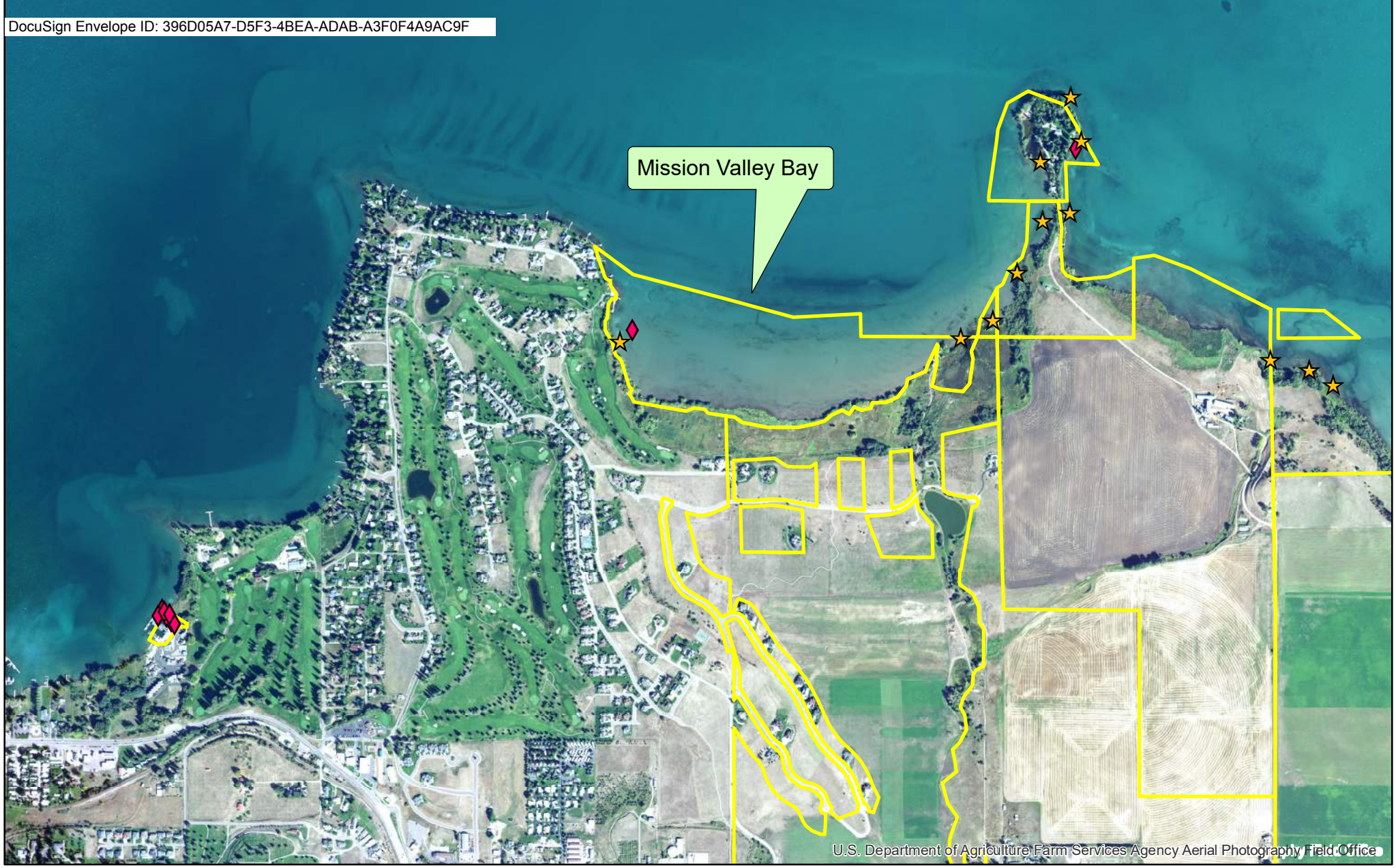

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

0 0.225 0.45 0.9 Miles

1 inch = 1,887 feet

N W E S

Mission Valley Bay

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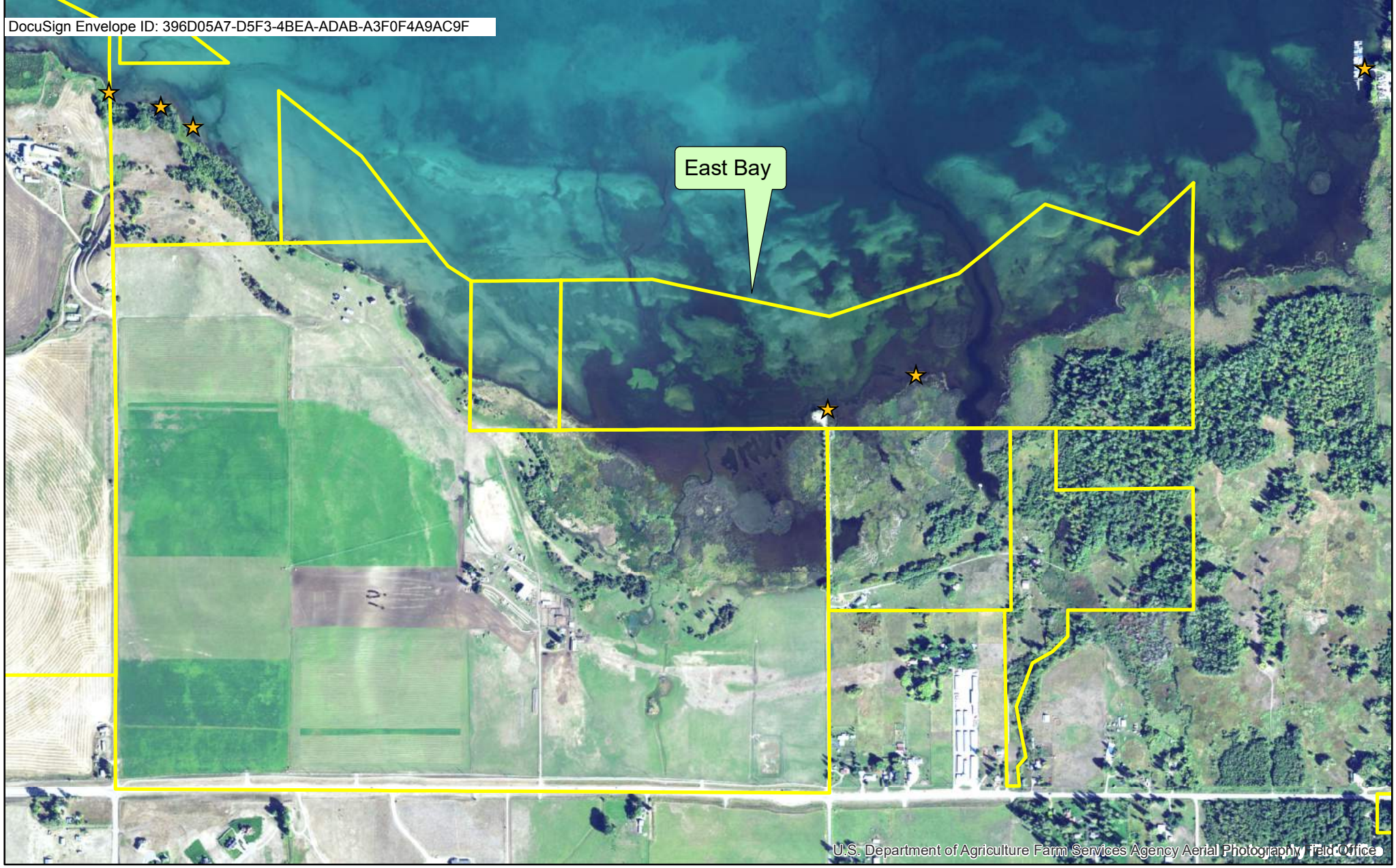

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Easy Bay

0 0.15 0.3 0.6 Miles

1 inch = 1,414 feet

N W E S

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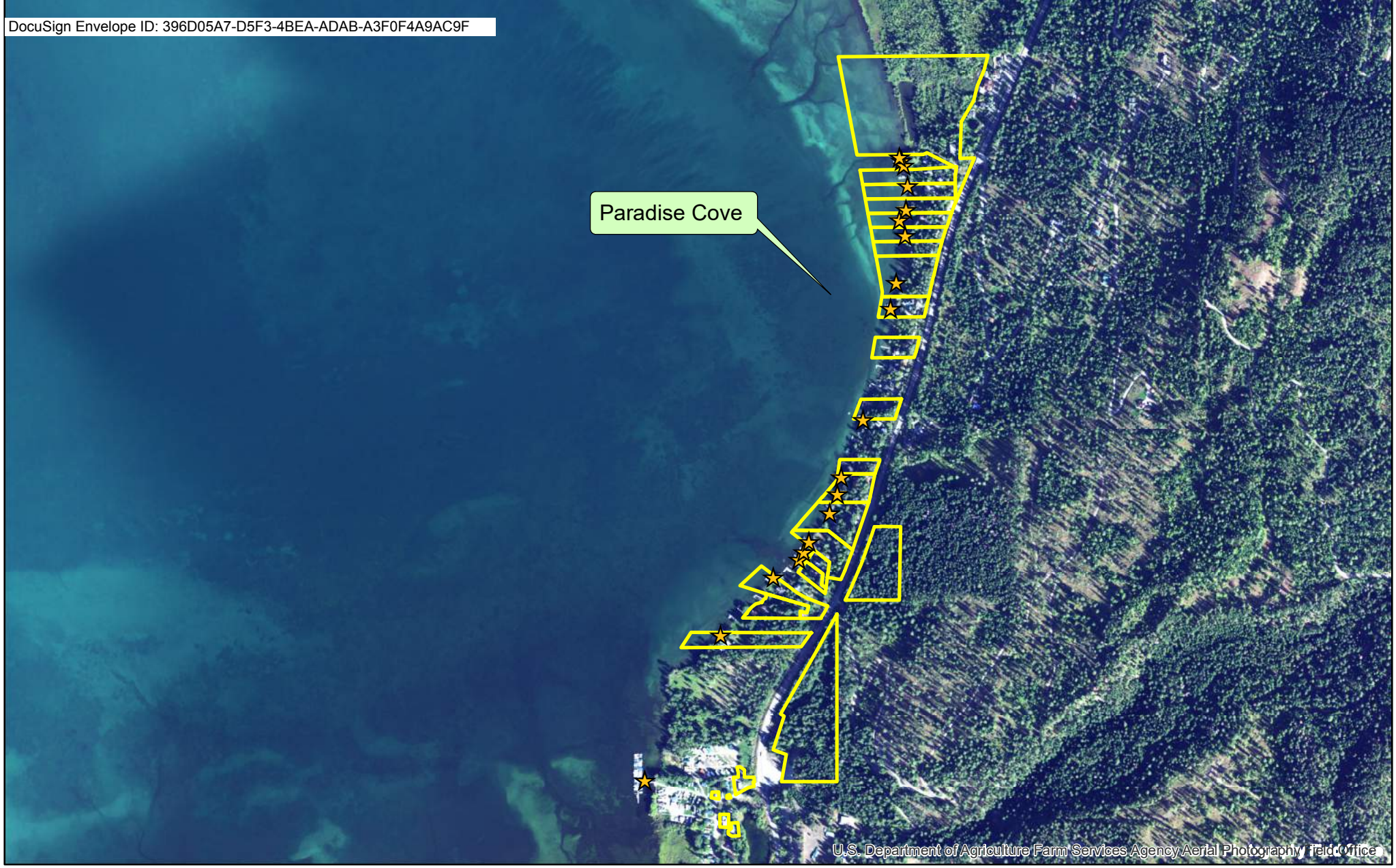

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Paradise Cove

0 0.15 0.3 0.6 Miles

1 inch = 1,414 feet

N W E S

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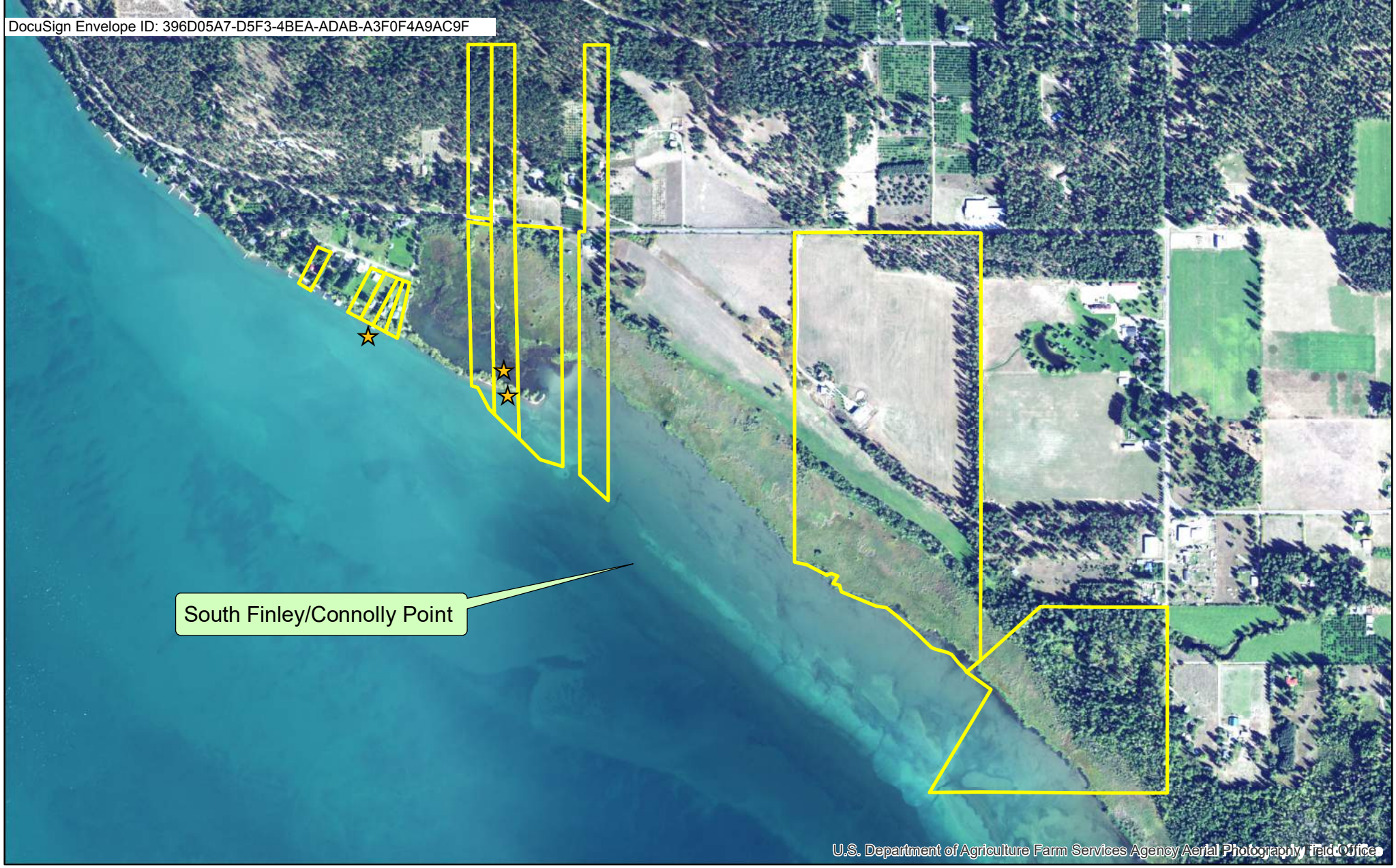

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

South Finley/ Connolly Point

0 0.15 0.3 0.6 Miles

1 inch = 1,377 feet

N W E S

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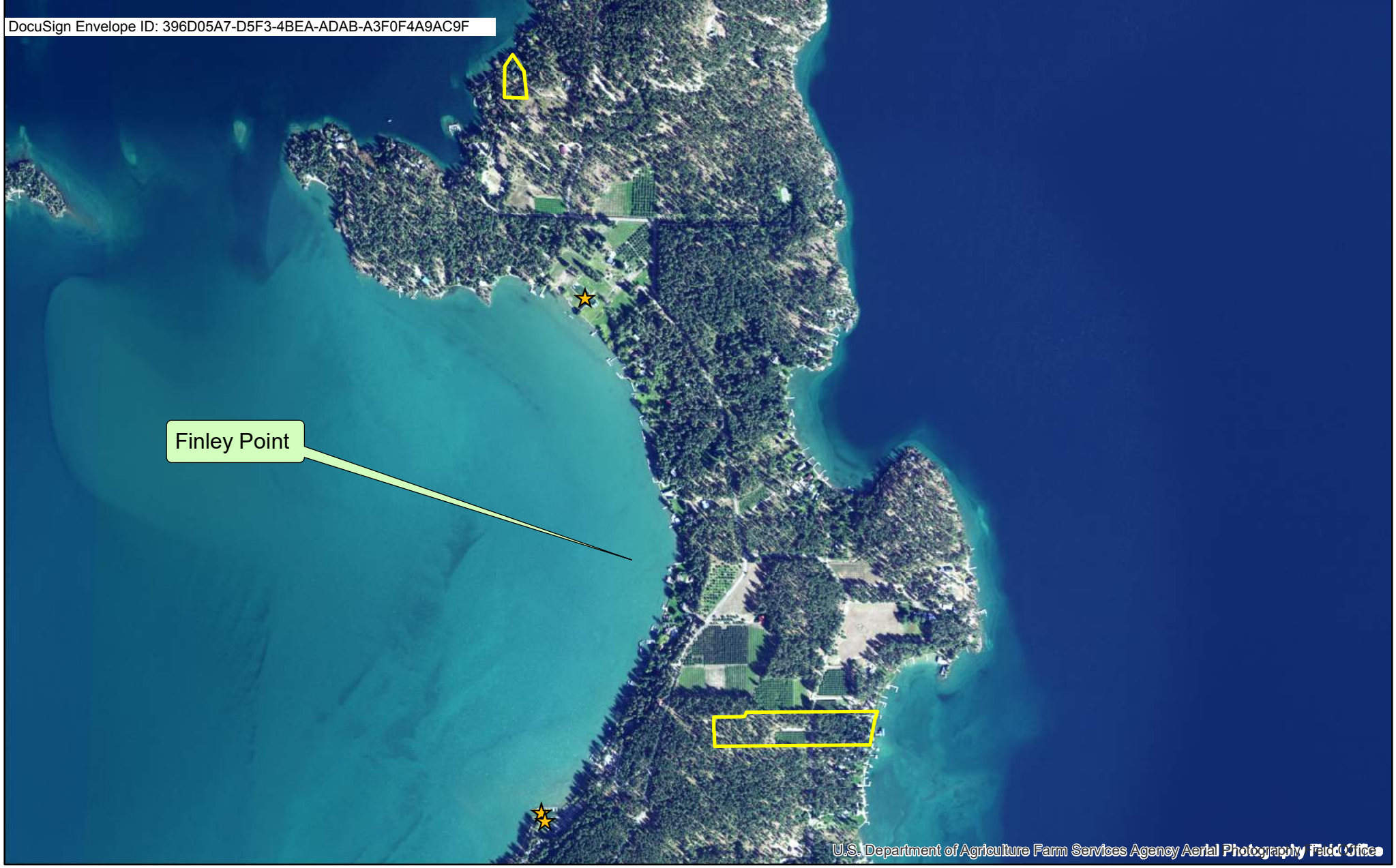

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

Finley Point

0 0.2 0.4 0.8 Miles

1 inch = 1,667 feet

N W E S

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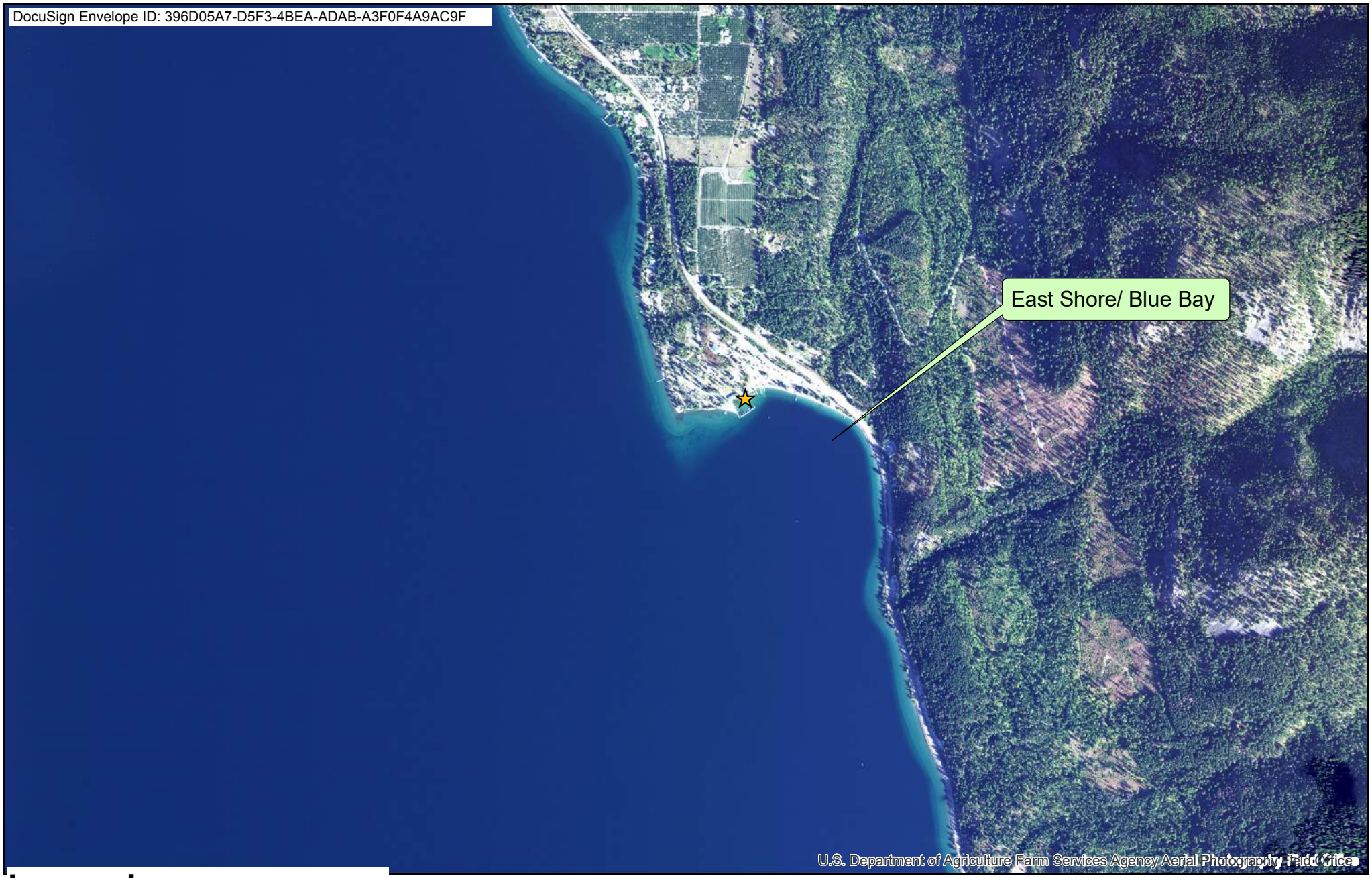

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

East Shore/ Blue Bay

0 0.25 0.5 1 Miles

1 inch = 2,083 feet

N W E S

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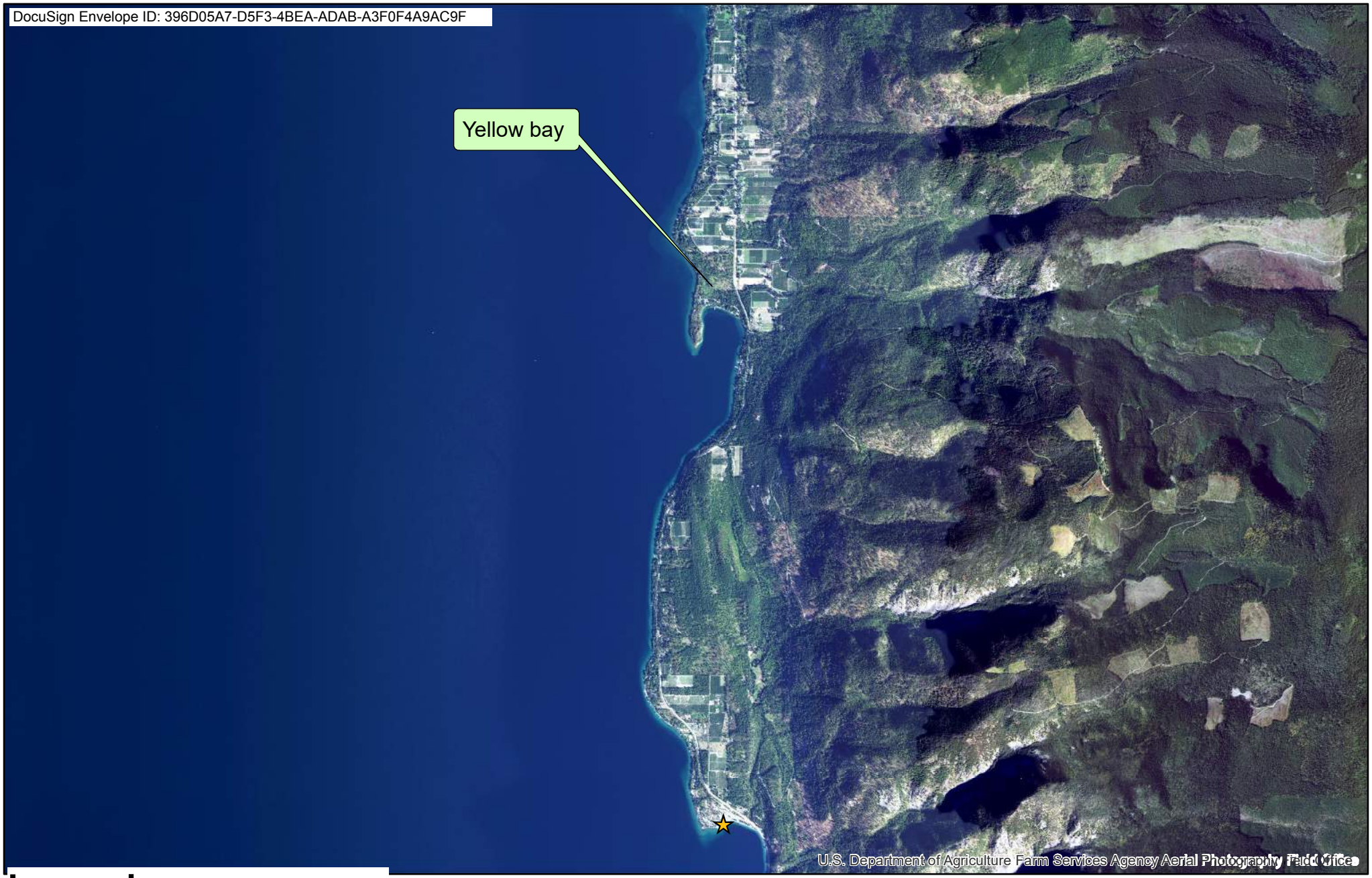

Legend

- Future Rush Treatments
- Rush Points
- Respondent Land Owner

0 0.75 1.5 3 Miles

N W E S

1 inch = 6,667 feet

Yellow Bay

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Appendix E. Flowering Rush White Paper

10/02/2019

FLOWERING RUSH:
AN INVASIVE AQUATIC MACROPHYTE
SPREADING FROM THE FLATHEAD SYSTEM
DOWN THE COLUMBIA RIVER SYSTEM

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Summary

Flowering rush (*Butomus umbellatus*) is an invasive Eurasian aquatic macrophyte with emerged and fully submerged forms that can dominate irrigation systems, wetlands, littoral zone of lakes, river edges and sloughs. It is now widely naturalized in wetlands, lakes, ditches, and slow-moving rivers in 21 states and 8 provinces surrounding the USA/Canada border, and is continuing to expand outward (Anonymous. 2019).

Mapping of Flathead Lake in Montana in 2008 had delineated ~ 2,000 infested acres. It had passed through Kerr Dam and colonized the Flathead and Clarks Fork Rivers 165 miles downriver into Lake Pend Oreille in north Idaho. In the following decade it has reached Lake Roosevelt which is formed by Grand Coulee Dam in Washington. The first known flowering rush location down river of Lake Roosevelt is in Lake Entiat, the impoundment behind Rocky Reach Dam (Anonymous 2019). Flowering rush has also been found in the Columbia River above the confluence with the Yakima River. There is also a large infestation near the headwaters of the southern reach of the Columbia Rivers System in an irrigation system that spills into American Falls Reservoir on the Snake River. These large infestations at the headwaters of the Columbia River will continue to spread downstream and infest much of the main stem of the system. The Flathead Lake hydroelectric facility is operated to reach low pool in early spring, whereas an unregulated natural lake would reach low pool in late summer. This unnatural late summer through winter high pool with spring drawdown creates conditions that are favorable for establishment of flowering rush infestations and disadvantages to native macrophytes evolved to a hydrologic cycle with a late summer low pool. It colonizes previously unvegetated portions of variable drawdown zones. These monotypic colonies in previously open water littoral zones are likely to induce cascading ecosystem and trophic effects on the Columbia River System. However higher order impact have not yet been studied. They are likely to include alteration of sediment transport and deposition,

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and formation of new habitat favorable to introduced fish and disadvantages to native trout and salmon.

Origin and Distribution

Flowering rush is native to temperate Europe and western Asia (Tutin and others 1980). It was first noted in North America between 1897 and 1905 along the St. Lawrence River in Quebec (Fletcher 1908; Stuckey 1968), then was reported to be spreading down river by 1918 (Knowlton 1923), and was well dispersed along the St. Lawrence by 1938 (Marie-Victorin 1938). It was first observed in the United States in 1929 around Lake Champlain in New York (Muenscher 1930). In 1949 it was observed on the banks of the Snake River at Idaho Falls (Anderson and others 1974). By 1967 it was widely distributed into at least western Lake Erie (Stuckey 1968). The first Flathead Lake Montana report dates to 1964 at Peaceful Bay in the northwest corner of the lake (Rice 2009). By 1974 it had become extensively naturalized in Canada and the northern parts of the United States (Anderson and others 1974). In 1997 it was found in Silver Lake in northwest Washington (Rice 2009). As of 1999 to ~ 2007 flowering rush is know to have spread westward throughout Canada and most of the northern tier states (Kartesz and Meacham 1999; PLANTS 2009). In 2008 an infestation was found in the Yakima River (Washington) above its confluence with the Columbia (Rice 2009)

Anderson et al. (1974) recognized three areas of infestation in North America and suggested that because of morphological and size differences the St. Lawrence River region, Great Lakes region, and western U.S.-Idaho Snake River populations possibly came as three separate introductions. The four sexually sterile triploid genotypes found in North America were closely related to native genotypes from the Netherlands and northern Germany (Kliber and Eckert 2005). Kliber and Eckert's (2005) genetic evidence further suggested that the introduction of these triploids to North America was facilitated by export as horticultural plants from the Netherlands to North America. Kliber and Eckert (2005) also detected two sexually fertile diploid genotypes in North America; but their investigation did not clearly match the two North American diploid genotypes to any of the genotypes they had sampled in the native Eurasian range.

Biology and Ecology

Flowering rush, a monocot, is phylogenetically unique in that it is the only species in the Butomaceae family. This aquatic macrophyte has emergent and fully submerged phenotypes. The emergent form with rigid vertical leaves is present in Flathead Lake at full pool depths to ten feet. A fully submerged form with lax leaves that wave in the current is present at full pool depths of 10 to 20 feet. The rigid leaves of the emergent phenotype are up to six feet long and the lax leaves of the submerge phenotype can reach ten feet in length and float up to the surface. The leaves are distinctively triangular in cross section. Flowering rush is a non-persistent emerged macrophyte. After the leaves senesce in the fall they collapse to the lake bed unlike cattail and bulrush which although senesced remain erect throughout the year. The inflorescence of flowering rush has an umbel-like form with usually 20 to 50 individual 3 petal plus 3 sepal pink flowers on 5 inch long pedicles arising from a round flowering stalk.

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The most relevant morphological feature of flowering rush is a monopodial rhizome approximately one foot long that can form branches from lateral rhizome buds. These are clonal infestations and individual plants are called ramets. The karyotype present in Flathead Lake is known to have a mean of 22 rhizome branches per ramet (Lui and others 2005). A study of a European population revealed that individual flowering rush ramets produced an average of 196 lateral rhizome buds over a six year duration (Hroudova 1989).

There are two karyotypes, a diploid (2n = 2x = 26) cytotype and a triploid (2n = 3x = 36) (Krahulcova and Jarolimova 1993). The diploid is self compatible and the triploid is self-sterile within clones. Depending on karyotype and genotype flowering rush can reproduce and be dispersed in four forms:

1. seeds
2. vegetative bulblets formed in the inflorescence
3. vegetative bulblets formed on the side of rhizomes
4. larger lateral rhizome fragments

The plant is sold globally to people doing water gardening. Seeds allow long distance dispersal from one water body to another. The rhizome bulblets (also called bulbils), inflorescence bulblets, and rhizome fragments facilitate spread within an infested water body.

Kliber and Eckert (2005) determined the ploidy of specimens collected from Flathead Lake and these Flathead Lake flowering rush were a triploid karyotype. Although about one in a thousand of the triploid ramets can produce a flowering stalk, these flowers are sterile (Eckert and others 2003) (Rice, Dupuis & Mitchell unpublished data). This Flathead Lake triploid genotype also does not produce any significant number of bulblets in the inflorescence or on the rhizome (Rice, Dupuis & Mitchell unpublished data), a local observation which is consistent with the reports for this triploid elsewhere in North America (Thompson and Eckert 2004; Lui and others 2005). Reproduction and subsequent dispersal by this Flathead Lake sterile triploid is entirely by rhizome fragmentation.

The rhizomes are extremely friable. Lateral rhizome buds develop a constriction between the bud and the main rhizome itself. This constriction allows spontaneous release of lateral rhizome structures by flowing water, waves, ice scour, passing boats, waterfowl, animals and any other disturbance of the littoral zone and the rhizome mat (Marie-Victorin 1938). The same disturbances, including waterfowl feeding on the rhizomes, break the rhizomes into pieces. These rhizome propagules are buoyant and this facilitates their dispersal (Marie-Victorin 1938). Propagule pressure is lower from the sterile triploid than the diploid which can also release bulblets and seeds, but the probability of establishment from rhizome fragments is probably much greater because of the high amount of stored carbohydrate available to facilitate expansion of the initial root system.

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Susceptible Habitat

Water level drawdowns above unvegetated sediments allows flowering rush establishment from previously floating rhizome fragments. Wave action also deposits rhizome fragments along the shoreline. Fine sediments (Rice, Dupuis, & Reddish unpublished data), particularly silty substrates, and current speeds less than 2 mph enable rhizome fragments to root and establish new plants. In addition, the warmer temperatures of drawdown exposed sediments or the water/sediment interface at shallow depths promotes root development, leaf sprouting and rapid growth of rhizome fragments. Warmer sediment and shallow water column temperatures also promote regrowth from established rhizomes and lead to stand thickening (Hroudova and others 1996; Delisle and others 2003). Any subsequent year drawdowns allow the flowering rush population to be renewed by vegetative reproduction (Hroudova and others 1996). The Kerr Dam hydroelectric facility on Flathead Lake is operated to reach low pool in early spring, whereas an unregulated natural lake would reach low pool in late summer. This unnatural late winter/spring drawdown creates seasonal conditions that are favorable for the establishment of flowering rush infestations in previously unvegetated littoral zones. In native vegetation populated littoral zones and wetlands flowering rush has a phenological and hydrologically derived competitive advantage over the native macrophytes which have evolved to a hydrologic cycle with a late summer low pool. Sloughs, backwaters, and other area with slow current speeds and fine sediments allow establishment of flowering rush in rivers.

Impacts

Other than a strong propensity to form monotypic or near monotypic stands, the higher order impacts of flowering rush have not received much scientific study. It is widely accepted that flowering rush has strong impacts on recreational, irrigation, and industrial use of shallow waters, and that its monotypic tendencies may be affecting desirable native littoral species (Boutwell 1990; Les and Mehrhoff 1999). Obvious impacts for Montana and southeast Idaho are resultant from the occlusion of open water and restrictions on flow.

Water delivery in irrigation ditches in the Flathead valley is starting to be reduced by flowering rush invasion. This flowering rush impact on irrigated agriculture is well recognized in southeast Idaho (Steve Howser Aberdeen-Springfield Canal Company personal communication). The Aberdeen-Springfield canal system provides water for sprinkler irrigation of potatoes and other cash crops. Approximately 150 miles of the 300 miles of the main delivery canals are infested with flowering rush and require some removal by chaining every second or third year.

Recreational use of Flathead Lake is being impaired by dense monotypic infestations adjacent to the shoreline and docks. This includes impediment of boat passage due to prop fouling, blockage for swimming, and loss of open water for near shore fishing. The flowering rush infestations provide ideal habitat for great pond snails (*Lymnaea stagnalis*), which are an intermediate host for the trematode parasite (*Trichobilharzia ocellata*) that causes swimmer's itch.

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The most critical environmental aspect of the flowering rush invasion is that it is forming dense stands in previously unvegetated littoral zones. As the extent of unchecked infestations increases there are likely to be trophic and ecosystem cascades. These would be the result of increased water temperature, nutrient transfers from the hydrosoil to the water column (Van Eeckhout and Quade 1994; James and others 2003), altered sediment transport, deposition, and accretion rates. Swimmers inch may be dismissed as a simple nuisance however it is indicative of other higher order biotic impacts that are reasonable hypotheses of long term consequences of this invasion. Aquatic food webs are likely to be changed. Of particular relevance for Montana and the Pacific Northwest are the potential negative impacts on the maintenance and restoration of native salmonids. The expanding stands of flowering rush provide habitat for structurally orientated introduced fish species that are obligate vegetation spawners and/or ambush predators of cutthroat trout, bull trout, and juvenile salmon. These vegetation adapted piscivorous species include small and large mouth bass, yellow perch, and northern pike (Tabor and others 1993; Fritts and Pearsons 2004; Bonar S. A. and others 2005; Schultz 2006; Cooper and others 2008). The negative impact of structurally orientated introduced fish on open water native salmonids throughout the Columbia River Basin is well documented (Sanderson and others 2009). Northern pike have been confirmed as having serious impacts on cutthroats and bull trout in the Flathead (Muhlfeld and others 2008). Some of the sloughs on the Upper Flathead River that are being utilized by radio tagged northern pike are heavily infested with flowering rush (Peter Rice, personal observation). Light trapping of larval and juvenile fish in one of these sloughs (Fennon) in 2013 indicated that juvenile northern pike were exclusively sheltering in flowering rush stands (Table 1) (Rice & Dupuis 2013) where the previous year collapsed leaves provide spawning habitat for adult northern pike. The flowering rush infestations also harbored larger numbers of other introduced fish,

Table 1. Percent of positive light trap detects for juvenile fish in Fennon Slough (2013).

Habitat Type	# of light traps	Largemouth Bass	Yellow Perch	Pumpkin-seed	Northern Pike
100% Flowering Rush	44	77.3	31.8	6.8	11.4
100% Native	36	55.6	2.8	0	0
Open Water	36	25.0	0	0	0

Macroinvertebrate capture data from the 2013 light trapping in Fennon Slough shows aquatic insect species composition segregation by habitat type (Figure 1). The macroinvertebrate community utilizing the flowering rush habitat is clearly different than that occupying the native vegetation. Ecological effects size differences are also statistically significant and ecologically important (Table 2) (Rice & Dupuis 2013.

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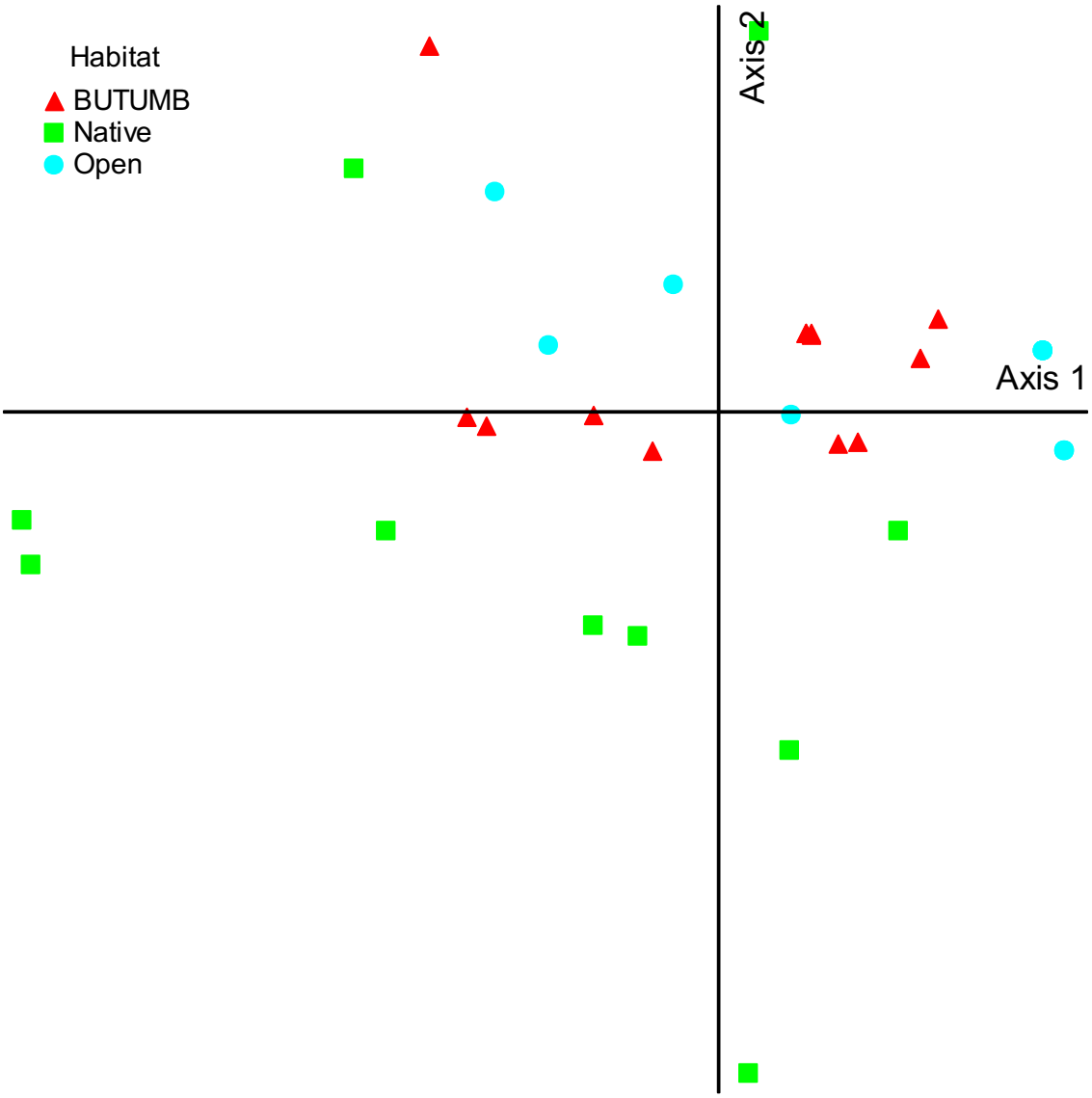

Figure 1. Aquatic plant community (all fish & macroinvertebrates) ordination for Fennon Slough 2013 light trap samples (BUTUMB = flowering rush) (2D NMS stress 16.3).

Table 2. Ecological Effect Size (A) for Fennon Slough 2013 light trap samples (Multi-Response Permutation Procedure **p≤0.01 ***p≤0.001).

	Flowering Rush	Native Veg
Native Veg	0.168***	
Open Water	0.092**	0.190***

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2009 Status Of Flowering Rush In Montana And Adjoining States/Provinces

Since the first colony was noticed in Peaceful Bay in 1964 flowering rush has spread around the circumference of Flathead Lake, with the possible exception of the northeast shore where heavy wave action may be retarding maintenance of permanent infestations along most of the shoreline. Based on remote sensing and spatial modeling the current minimum acreage estimate for the littoral zone for the 0 to 10 ft depth is 1,039 acres (Table 3). It must be noted that image classification generally identifies only areas of high density. There likely are many more acres of low-density or interspersed flowering rush that were not identified in this initial remote sensing classification. We do not currently have the capability to directly assess the extent of infestation by the fully submerged phenotype, but our best estimate is that at least a thousand acres of the10 to 20 ft deep littoral zone is infested. As a minimum to the 20 ft depth we estimate that 2,039 acres or 14% of the littoral zone is currently infested. There are also 1,536 acres of wetlands immediately adjacent to Flathead Lake. The current investigations of these adjacent wetlands have been limited to a 133 acre block along the North Shore (Lorang & Reddish unpublished data). Flowering rush was identified there in 8.6 acres or 6.5% of that wetland. Projected to all the adjacent wetlands this sample would yield a best estimate of 100 wetland acres currently infested at density high enough to be detected my remote image analysis.

Table 3. Flathead Lake acreage estimates of current flowering rush infestations and area susceptible to infestation based on a remote sensing spatial analysis (Rice, Reddish, Dupuis & Mitchell 2010).

Initial Results Spatial Modeling	Current		Susceptible	
Habitat	Habitat Size Acres	Infested* Acres	Maximum Acres	% of Lake
0-10' Littoral	5,823	>1,039	4,364	3.5
10-20' Littoral	8,375	?>1,000	6,546	5.3
	14,558	?>2,039	10,910	8.8
% Current & Susceptible of the Littoral Zone		>14	75	
Adjacent Wetlands	1,536	100	?1,536	

*dense infestations with high cover value

Spatial modeling, primarily based on remote sensing and spectral image analysis of lakebed substrate exposed at low pool, suggests that 10,910 acres of the 0 to 20 ft littoral zone are susceptible to infestation. Which is 75% of the littoral zone and equivalent to 8.8% of the Lake surface area (Rice, Reddish, Dupuis & Mitchell 2010). All of the 1,536 adjacent wetlands acres may ultimately be susceptible, but flowering rush displacement of the native macrophytes is occurring at a considerably slower rate than flowering rush establishment in previously unvegetated littoral zones.

Flowering rush rhizomes have been discharge through Kerr Dam into the lower Flathead River and continued down the Clark Fork River reaching the Clark Fork delta at

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the head of Lake Pend Oreille. Then the infestation extends as currently scattered small colonies along the northeast shoreline of Lake Pend Oreille to Sandpoint, reaching into the part of the Pend Oreille River impounded by Albeni Dam. Current acreage estimates for impoundments downriver of Kerr dam on Flathead Lake are Thompson Falls Reservoir 28 acres, Noxon Reservoir 46 acres, present at trace levels in Cabinet Gorge Reservoir (Madsen and Cheshier 2009); and 50 to 200 acres in Lake Pend Oreille (Madsen and Wersal 2008)(Kate Wilson & Tom Woolf personal communication). There is no current quantitative estimate for flowering rush in the Flathead and Clark Fork rivers, but it is not infrequent in sloughs, backwater eddies, and low flow areas proximal to boat launch sites.

In Idaho, in addition to Lake Pend Oreille, the Snake River from Idaho Falls to American Falls has a number of known infestations (Rice 2009). Below Idaho Falls, the Aberdeen-Springfield Canal system, which provides sprinkler irrigation water for potatoes and other crops in southeast Idaho, has significant infestations in ~150 miles of the 300 miles of its high delivery volume canals (Steve Howser, personal communication). The manager of the Aberdeen-Springfield Canal Irrigation System estimates that properly managing flowering rush in that system would increases the costs to farmer shareholders by 8% a year (Steven Howser, personal communication). There are reports of smaller infestations in other irrigation systems in that area of southeast Idaho. Flowering rush has been drawn up out of the Flathead River at the Pablo Reservoir lift station and is now being redistribution through the irrigation system on the floor of the Flathead Valley in Montana. Idaho has the most acreage irrigated from the Columbia River System with over 3 million acres under irrigation at any given time, while Oregon irrigates 1.9 million acres and Washington 1.8 million acres. All these irrigation systems are at risk to flowering rush infestation by rhizome fragments suspended in the water being withdrawn from the Columbia System below the Snake River and Flathead River infestations.

In Washington there are disjunct (relative to the main stem of the Columbia River System) infestations in Silver Lake (northeast WA) and the Yakima River above its confluence with the Columbia (Rice 2009). There are no reported infestations for Oregon. However North and South Dakota, Alberta, and British Columbia have reports of flowering rush but details have not been compiled (PLANTS 2009). Washington added flowering rush to its noxious weed list in January 2009, Oregon added it in February 2009, and Idaho is currently in the process of adding it to its state list.

Research in Montana

The University of Montana and Salish Kootenai College have been conducting applied research since 2007 that would provide scientific information and applied techniques for the management of flowering rush. Topics include phenology, rhizome dispersal, inventory, karyotyping, herbicides, digging trials for low density infestations, and a spatial model to estimate the current extent of infestation in Flathead Lake, identify susceptible habitats, and predict the maximum infestation in Flathead Lake. Foliar applied herbicides are being tested in replicated plots at Flathead Lake sprayed when the water is off the site due to late winter/early spring drawdown but the new leaves are

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emerging (May). And also foliar spraying at high pool when as much as 5 ½ feet of leaf is below the water line and only 6 to 18 inches of leaf is elevated above the water line (July). The goal of these foliar treatments, which began in 2008, is to kill the rhizomes, but it is too early to determine if multi-year suppression is being obtained. Eight water column injection herbicides were screened in greenhouse trials for efficacy on flowering rush as a treatment for submersed plants. A number of these aquatic herbicides exhibited high activity on flowering rush (Rice 2010), but the concentration exposure times (CETs) required for in-lake treatments are difficult to impossible to maintain (Rice et al. 2014). Some of the results of this applied research work have been incorporated in this document.

Management Options

Management options for flowering rush are not well developed. Montana has been taking a pioneering role in developing control strategies.

- Habitat at 2 to 3 quarts/acre and Clearcast at 2 quarts/acre and all with an MSO adjuvant can provide season long (May through September) suppression of top growth when applied as foliar spray to emerged leaves during the spring drawdown period (Figure 2).
- Water column injection herbicides would be necessary for suppression of the fully submerged phenotype and the emergent form when there is only a short length of leaf elevated above the water line. However in-lake trials to implement this technique were not effective (Rice et al. 2013; Clean Lakes, Inc. 2012).
- Mechanical harvesting has been used in Midwestern lakes and ponds but most of the shoreline owners groups that were harvesting have now concluded that the mechanical removal approach was only increasing rhizome dispersal, and at great cost.
- It may be possible to dig out the rhizomes for low density (~1 ramet per 100 ft^2) infestations at drawdown or in shallow water, but it would require great care to remove and retain all the friable rhizome fragments.
- Signage at boat access points and other public notification processes could reduce the probability of transport to other water bodies and reduce the disturbance/rhizome fragmentation within an infested waterway.

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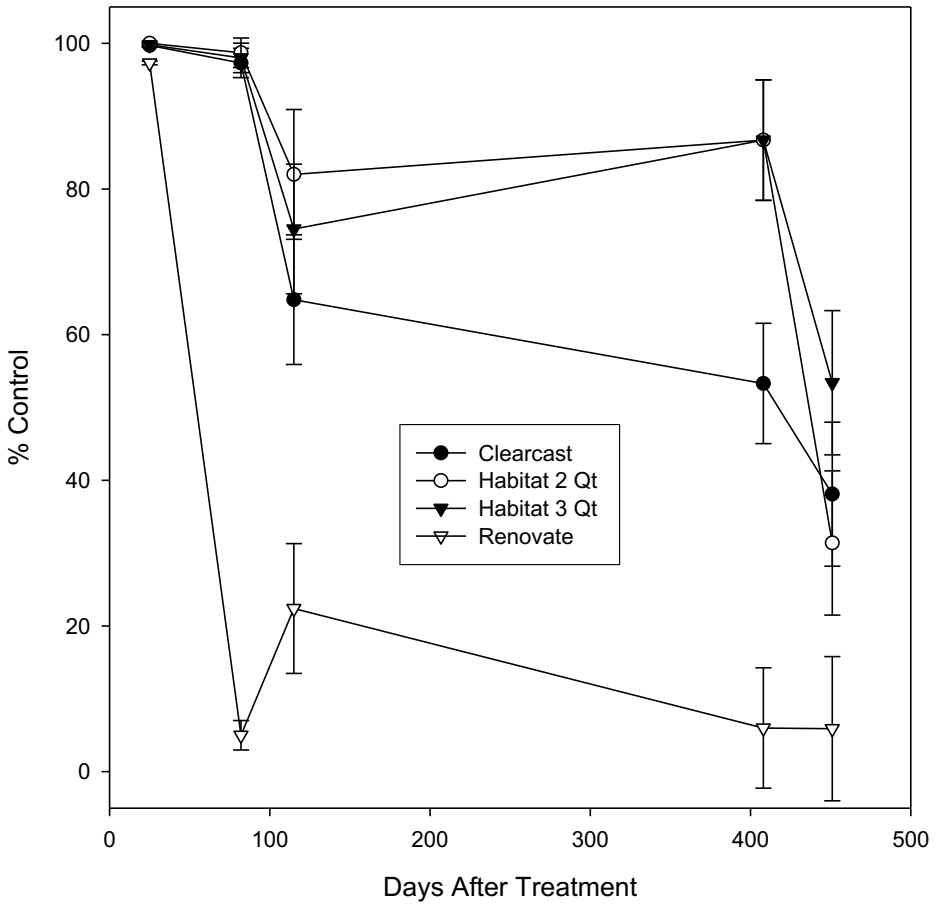

Figure 2. Percent control of flowering rush + or - one standard error after low pool (exposed sediments) foliar treatments on May 27, 2008.

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- Sustained sequential year spraying during draw down. From 2014 through 2018 two herbicide treatments, Clearcast (imazamox) & Habitat (imazapyr), both with 2 qt/ac Competitor MSO were applied as "dry ground" treatments during the spring (May) drawdown in East Bay of Flathead Lake (Tables 4 & 5, Figure 3) (Rice et al. 2019). As in the 2008 one time draw down treat Habitat was more efficacious than Clearcast. The percent canopy cover control obtained by Habitat in most years would be commercially acceptable for the summer season recreational uses. The percent control of spring emerging leaf tips after having sprayed the previous year range from 70% to 94% for Clearcast and 92% to 99% for Habitat.

Table 4. Summary of % control of flowering rush obtained over 5 years with Habitat and Clearcast herbicides applied during the spring drawdown (May) period.

Sampled		% Control	
Date	**DAFT***	**Clearcast**	**Habitat**
8/13/2014	**107**	62.0	96.0
10/8/2014	**163**	55.3	98.5
4/20/2015	**357**	94.3	98.6
7/13/2015	**441**	69.5	95.2
4/19/2016	**722**	65.9	91.1
8/1/2016	**826**	96.4	98.2
5/2/2017	**1100**	91.8	98.0
7/25/2017	**1166**	74.5	91.6
4/30/2018	**1462**	77.8	96.6
7/27/2018	**1533**	78.5	91.1

*Days After First Treatment

Table 5. Percent control of leaf tips emerging in late April-early May.

% Control	2015	2016	2017	2018
Clearcast	94	70	92	76
Habitat	99	92	98	97

However in spite of the high degree of top growth suppression there are still very large numbers of new leaf tips emerging in the following spring (Table 6). This persistent emergence of leaf tips from the rhizomes allows the new top growth to replenish the carbohydrate reserves of the rhizomes and maintain the perennating buds.

Table 6. Density (#/acre) of late April-early May emerging leaf tips.

Treatment	2015	2016	2017	2018
Control	6,616,610	3,302,235	3,334,610	3,136,314
Clearcast	382,428	975,292	270,128	757,774
Habitat	88,019	253,434	66,773	106,230

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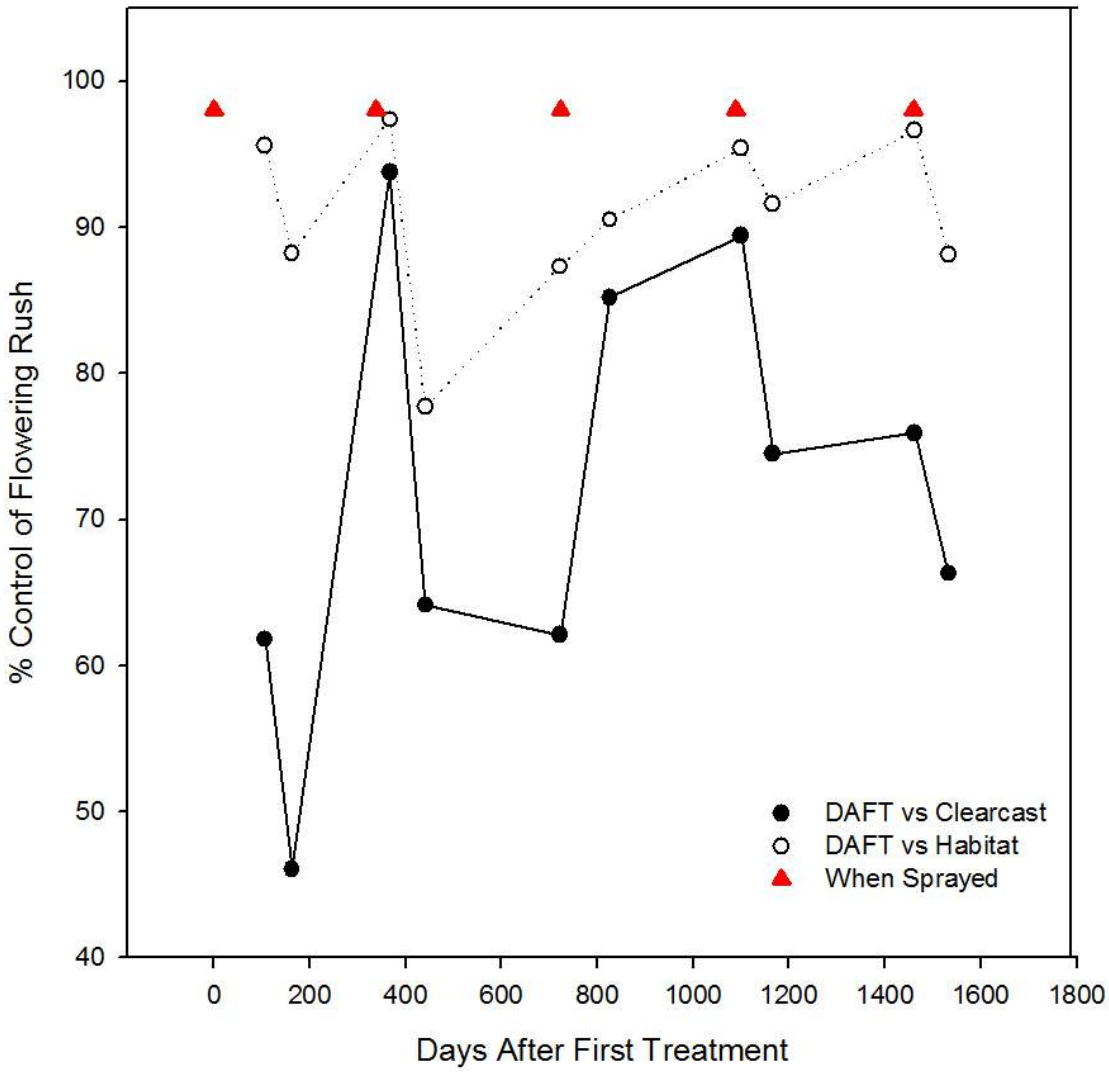

Figure 3. Graphic summary of flowering rush canopy cover suppression obtained by sequential spraying with Habitat and Clearcast herbicides from May 2014 through July 2018.

Rhizome samples in substrate cores taken from the sequentially sprayed spring test plots have been collected since 2016 to determine the number of meristematic buds that can sprout new leaves, rhizome weights, and fine root rates. As of 2018 we are seeing large reductions in the vegetative reproductive potential of the rhizome system (Table 7) (Rice et al. 2019).

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Table 7. Decline in leaf re-growth potential from flowering rush rhizomes after 4 years (2014-2017) of sequential herbicide spraying.

		Sprout Count	Sprout Count	Rhizome Weight (g)	Rhizome Weight (g)	Fine Root Weight (g)	Fine Root Weight (g)
	Mo.-Yr.	**Apr-18**	**Aug-18**	**Apr-18**	**Aug-18**	**Apr-18**	**Aug-18**
Clearcast	Mean	10.3	15.6	13.3	15.5	30.4	11.9
Habitat	Mean	4.4	4.1	7.8	5.8	19.8	5.3
No-Spray	Mean	39.5	94.5	73.6	94.5	51.4	43.3
Pairwise Clearcast vs. Habitat							
	Kruskal-Wallis p.	0.189	0.09	0.291	0.09	0.127	**0.028**
	Tamhane's T2 p.	0.338	**0.009**	0.417	**0.009**	0.191	**0.006**

- Although chemical and mechanical control methods continue to be explored and are applicable to incipient infestations and small areas with high value for recreation or conservation, they will not prove practical for flowering rush at the whole watershed scale, creating concerns that the flowering rush populations will continue to expand and spread in perpetuity without restriction. In looking for possible alternative control methods for large dynamic water bodies, the Flowering Rush Biocontrol Consortium (FRBC) was formed in 2012 and a biocontrol research and development program was initiated in 2013. Flowering rush is an excellent candidate for biocontrol because it is the sole genus and species within the family Butomaceae. This increases the probability of finding a host-specific biocontrol agents, and likely reduces the number of test plant species required for host-specificity testing. The FRBC consists of many federal, state and provincial partners that have pooled resources to fund CABI Europe-Switzerland to conduct field surveys, host-specificity tests, and impact studies of potential biocontrol agents. Among a host of insects associated with flowering rush three potential biocontrol agents have been identified and are being actively investigated, including a rhizome and leaf-mining weevil (*Bagous nodulosus*), a stem/leaf-mining fly (*Phytoliriomyza ornata*), and a white smut (*Doassansia niesslii*) (Häfliger, P. et al.). Host-specificity tests have thus far indicated that *B. nodulosus* has a very narrow host range and final testing will likely be completed in 2019 with the expectation that we can complete a TAG petition in 2020 to bring this weevil in to the United States by 2021. A fourth agent, the weevil *Bagous validus*, is being reevaluated.

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Conclusion

A suite of suppression methods applicable to flowering rush infestations at different site types with different management concerns would be an important element in implementing a strategic plan to suppress flowering rush in the Flathead headwaters of the Columbia River system. These control options need to be continued to be developed and implemented in a timely manner relative to the down river spread rate of this aquatic weed while it is still at an early stage of invasion of the overall Columbia River system, not just Flathead Lake and River. Demonstrating the possibility of effective suppression removes a barrier to motivating the numerous local, state, and regional natural resource jurisdictional entities from coalescing on the development and implementation of an aggressive early response to this invasion of a large and critical aquatic resource that provides a high level of ecosystem services. Significant progress has been made over the last decade in building awareness of this invasion among Federal, State, Provincial, and County agencies managing aquatic resources in the Columbia River Basin. This has led to the just completed Columbia Basin Flowering Rush Management Plan by the Columbia Basin Cooperative Weed Management Area.

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Appendix F. Flowering Rush Extension Publication

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Biology, Ecology and Management of

Flowering Rush

(Butomus umbellatus)

EB0201 December 2010

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- Cover photo of canal system near Polson, Montana by Alvin Mitchell
- Inset cover photo by Ben Legler

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Flowering rush is a non-native aquatic resembling a large sedge that grows along lake shores and slow moving water bodies. In Montana it was recorded in Flathead Lake in 1964 and has spread to Thompson Falls, Noxon Reservoir, Cabinet Gorge, portions of the Flathead River, and the Clark Fork River. Prolific growth in irrigation ditches reduces water availability, and dense stands in previously unvegetated areas inhibit boating, fishing and swimming. Minor disturbances cause the roots to fragment, providing long distance dispersal. At this time, control methods are limited. Hand digging has led to mixed results as rhizomes fragment easily, increasing dispersal. Studies on chemical control options are ongoing.

PLANT BIOLOGY

Identification

Flowering rush is an aquatic species resembling a large sedge (cover photo) that may grow as an emergent plant with upright foliage in shallower waters (shoreline to roughly 10 feet [or 3 m]), or a submerged plant with flexible leaves suspended in the water column in deeper waters (approximately 10-20 feet [3-6.1 m] depths). The roots are fleshy and **rhizomatous** (Figure 1). Leaves are triangular in cross section, narrow and twisted toward the leaf tip (Figure 2). Flowering rush belongs to its own family, Butomaceae.

Flowering rush is easy to identify when flowering; 20-50 flowers grow in a round cluster that resembles an umbrella, hence the species name *umbellatus* (cover). Individual flowers are ¾ to 1 inch (2-2.5 cm) wide, consisting of six light pink to rose-colored petals. The three outer petals, which are actually **sepals**, are smaller and may be slightly greenish. Flowers have nine **stamens** (Figure 3) arranged in an outer whorl of six and an inner whorl of three. There are six **carpels** (Figure 3), each of which can produce about 200 seeds.

FIGURE 1. Fleshy rhizomatous roots. The arrows point to the white knobby structures from which new leaves will emerge. (photo by Peter Rice)

FIGURE 2. Leaves are triangular in cross section. (photo by Gary Fewless)

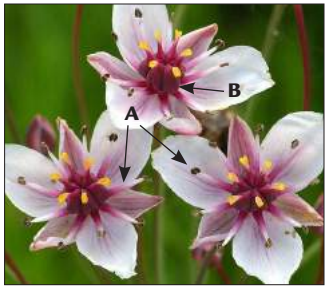

FIGURE 3. Close-up of flower - (A) Stamens, 9 total; (B) Carpels, 6 total. (photo by Christian Fischer)

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Despite the name, not all flowering rush plants flower regularly. The plant occurs as two types: one that flowers regularly and produces viable seed, and a second type that flowers occasionally, but the flowers are sterile. Populations in Montana are the latter type; in some years flowering will occur sporadically, but in other years plants will not flower at all. For an explanation on the biology behind these types, see 'Genetics of fertile and sterile flowering rush' on page 7. When not flowering, identification can be difficult with only the large, sedge-like leaves. Refer to SpeedyWeed ID, and contact your county Extension agent or weed coordinator for assistance.

SpeedyWeed ID

You might have heard the saying 'sedges have edges, rushes are round', but unfortunately this memory jogger is not useful for flowering rush. Despite its common name, only the flowering stalks are round. While the leaves have edges like sedges, flowering rush is not a sedge either, but belongs to its own family, Butomaceae. Although it could be confused with sedges, flowering rush is typically much larger. Additionally, the leaves feel spongy and rebound when squeezed.

Leaves
- Twist spirally at tips (when emerged).
- Spongy and compressible.
- Upright, triangular in cross section (Figure 2) and up to 6 feet (1.8 m) long (leaves of the submersed form are limp and may be up to 10 feet [3 m]).

Flowers
- Umbrella-like form with 20-50 flowers per cluster (cover photo).
- Six pink petals per flower (Figure 3).
- Nine stamens per flower (Figure 3).

Roots
- Fleshy, rhizomatous.

Accurately identifying invasive species is critical prior to initiating any control program. For example, the native bristly sedge *(Carex comosa)* resembles flowering rush (but is typically smaller), and it is a species of concern in Montana. There is only one known location in the state - the shore of Flathead Lake.

If you think you've found flowering rush, contact the Montana Department of Agriculture at (406) 444-3140, the Montana Fish, Wildlife and Parks Aquatic Nuisance Species Coordinator at (406) 444-2449 or your county Extension agent or weed coordinator.

Life History

Flowering rush grows as a perennial. The fertile type of flowering rush has four different methods for reproduction. It can reproduce by seed, vegetative **bulbils** on the rhizomes, vegetative bulbils on the flowers, and by fragmentation of the rhizomes. The sterile type typically reproduces by rhizome fragmentation only. Rhizome fragmentation is facilitated by a constriction that develops between a bud and the main rhizome. This allows sections to break off easily with minor disturbances such as moving water, waves, passing boats or waterfowl.

Rhizomes initiate growth earlier in the spring than native aquatic plants. Over a three year period, emergence dates ranged from February 26th to April 15th on Flathead Lake in northwestern Montana. Plants continue growth throughout the season, and flowering occurs from early summer to mid-fall. With fall frosts, leaves collapse instead of remaining upright (like cattails).

ECOLOGY

Habitat

Flowering rush grows along lake shores, slow moving waters, irrigation ditches and in wetlands. It typically grows in shallow waters, but can survive and grow across a range of water levels. It has been observed in very clear water up to 20 feet (6.1 m) deep in Flathead Lake. When depths are greater than approximately 10 feet (3 m), it modifies its growth form. Submersed leaves persist, but they become limp and more ribbon-like.

FIGURE 4. Rhizome fragments are buoyant allowing long distance dispersal. (photo by Peter Rice)

Spread and Establishment Potential

While the sterile type of flowering rush cannot spread through reproductive means, spread by rhizome fragmentation is substantial. The buoyant rhizome fragments (Figure 4) facilitate long distance dispersal. Ideal conditions for rhizome establishment are shallow, sparsely vegetated or unvegetated silty substrates and water currents less than 2 mph. The large amount of carbohydrates stored in the rhizome fragments increases the probability of establishment.

More information is needed on the potential of native vegetation to suppress or outcompete flowering rush. In the Czech Republic under stable water levels, reeds were observed to provide a barrier to the advancement of flowering rush; flowering rush formed a band around the reeds, but did not advance into the reed patch.

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Few water bodies have stable water levels, and research shows that water level draw downs promote the establishment and expansion of flowering rush. A decrease in water levels typically exposes unvegetated or sparsely vegetated substrate, and the shallow waters or exposed sediment warm quickly. These two conditions promote sprouting and accelerate growth of rhizome fragments.

On Flathead Lake, the timing of water level draw downs in relation to flowering rush growth and native plant growth can provide an additional advantage to flowering rush. Seasonal water levels are regulated by Kerr Dam to meet the needs of summer recreationists and to generate electrical power. Prior to dam operations, low water conditions occurred during mid to late summer, and native emergent vegetation dominated the low water zones. Since Kerr Dam became operational in 1935, lake levels have been held at full pool through the summer and are at low pool in the late winter-early spring. Flowering rush emerges and grows rapidly in response to shallow waters and warming temperatures at low pool in late winter-early spring. It receives little to no competition from native wetland and emergent species that evolved under and are adapted to low pool in the late summer and fall.

Flowering rush is established in the river channel and backwaters of the lower Flathead River where water levels are also affected by dam operations. Several dams on the Columbia River maintain similar seasonal pool levels and create suitable habitat for flowering rush. A large infestation in an irrigation system spills into American Falls Reservoir on the Snake River in Idaho. This is near the headwaters of the southern reach of the Columbia River system. This large infestation is expected to continue to spread downstream and infest much of the main stem of the Columbia River system.

FIGURE 6. Chaining flowering rush to increase water availability in the Aberdeen-Springfield Canal System near American Falls, Idaho. (photo by Steve Howser)

FIGURE 7. Flowering rush at the mouth of Dayton Creek (a tributary to Flathead Lake), a previously unvegetated zone that is historic spawning habitat for migratory cutthroat trout. (photo by Alvin Mitchell)

Genetics of fertile and sterile flowering rush

The difference between the fertile and typically sterile types of flowering rush corresponds to differences in chromosome numbers. Fertile types are diploid, meaning they have two pairs of chromosomes, while sterile types are triploid, meaning they have three sets of chromosomes. In a Montana study, only 1 in 1,000 plants flowered. In another area, even though flowering rush flowered prolifically; none of the seeds were viable. It appears that the Montana triploid genotype is incapable of sexual reproduction. It also rarely creates flower or rhizome bulbils. Research is ongoing to fully understand the unusual reproductive biology of this species.

Damage Potential

Flowering rush grows prolifically in irrigation canals and can impede the distribution of irrigation water (cover photo). An infested irrigation canal system in Idaho must be chained every two or three years to reduce densities and increase water delivery and availability (Figure 6). Flowering rush also impacts recreational activities through colonization of previously open waters. Plants interfere with boat propellers, swimming, and fishing. Flowering rush also creates ideal habitat for the great pond snail that hosts parasites that cause swimmer's itch.

Flowering rush can adversely impact native fish species by forming dense stands in waters previously unvegetated or sparsely vegetated by aquatic plants (Figure 7). Some fish native to Flathead Lake such as cutthroat and bull trout are adapted to open water habitats. By contrast, introduced fish like largemouth bass, yellow perch, and northern pike prefer or require vegetated substrate to spawn. Piscivorous (fish-eating) species like largemouth bass and northern pike are ambush predators and the upright foliage of flowering rush creates cover for these introduced species. It has been documented that northern pike are significantly depredating cutthroat and bull trout in the Flathead River and impairing the recovery of these natives.

CURRENT DISTRIBUTION AND STATUS

Flowering rush is native to Eurasia. It was first recorded in North America on the St. Lawrence River in 1897 and spread to Lake Ontario and Lake Champlain. A second population, recorded in southwestern Lake Erie in 1918, spread to Michigan, Ohio and southwestern Ontario. Flowering rush was reported in the Snake River near Idaho Falls in 1949 and on the north shore of Flathead Lake in 1964 (Figure 8).

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Since 1964 flowering rush has spread to the upper Flathead River (Figure 9). Rhizomes discharged through Kerr Dam have established in the lower Flathead River and populations continue down the Clark Fork River reaching the Clark Fork delta at the head of Lake Pend Oreille (Idaho). Estimates of acreages infested with flowering rush in Montana are approximately 2000 acres on Flathead Lake, 28 acres in Thompson Falls Reservoir, 46 acres in Noxon Reservoir and there are small, but not quantified, occurrences in Cabinet Gorge Reservoir. There is no current quantitative estimate for flowering rush in the Flathead and Clark Fork Rivers, but it occurs in sloughs, backwater eddies, low flow areas, and near boat launches.

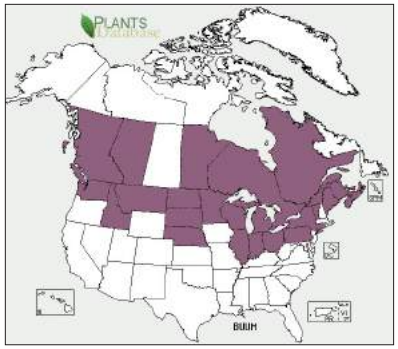

FIGURE 8. States and provinces in North America where flowering rush has been reported. (NRCS Plants Database, http://plants.usda.gov/)

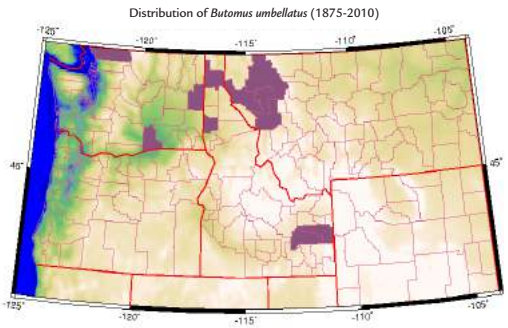

FIGURE 9. Counties in Montana, Wyoming, Idaho, Oregon, and Washington where flowering rush has been reported. (INVADERS Database System, http://invader.dbs.umt.edu)

MANAGEMENT ALTERNATIVES

Mechanical Control

Hand digging to remove all root fragments may be feasible for very small infestations, especially when water levels are low. Repeated digging will probably be required. Because hand digging can result in increased density, which occurred at a boat mooring area on Flathead Lake, it must be done very carefully and diligently. *Raking* will only disturb the root system and create rhizome fragments, therefore it is not recommended. Properly installed and maintained *bottom barriers* can effectively restrict flowering rush growth in small areas below boat moorings. Mechanical control that disturbs the bed of a lake or river and bottom barriers may require permits from the state, tribe, or agency.

Cutting flowering rush below the water surface is not recommended. It can temporarily reduce abundance, but it will not kill the plant so repeated cuttings are necessary, and all cut plant material must be removed

Responsible water gardening:
Prevent plants in water features from escaping

Like yellowflag iris, purple loosestrife, and Eurasian watermilfoil, flowering rush was introduced intentionally to North America for water gardens. While water gardens can be a rewarding addition to a backyard, homeowners must purchase and dispose of plant materials responsibly. To avoid accidentally introducing non-native plants to surrounding water bodies, water gardens should never be placed near, or allowed to overflow into wetlands, streams or rivers. Non-native water garden plants should never be dumped into natural water bodies. Before purchasing plants, speak with a knowledgeable horticulturalist or local Extension agent to verify the aquatic plant is not invasive.

from the water. Ten years of mechanical harvesting in the Detroit Lakes (Minnesota) system only made the problem worse, and at great expense.

Cultural Control

Flowering rush quickly fills in areas without aquatic plants, but it appears to invade areas with existing vegetation more slowly. Any management that increases the abundance and vigor of native plants and reduces available habitat for flowering rush is recommended.

Biological Control

There are currently no biological control agents available for flowering rush.

Chemical Control

Currently there are no herbicides labels that have recommendations for flowering rush, but research is underway to find the most effective herbicides, rates, and application timings. Researchers at the University of Montana and Salish Kootenai College have investigated the use of a number of herbicides applied at low and high water levels. Preliminary results suggested that spring applications when 5-7 inches (12.7-17.8 cm) of leaves had emerged and plants were above the water line were most effective. Habitat® and Clearcast®* provided season long control, but none of these one-time herbicide applications provided a high level of rhizome kill, so reapplication would likely be necessary. Water column injection herbicide treatments may be more effective for killing rhizomes.

*Herbicides mentioned here are still being researched and are not listed as recommendations. Check www.greenbook.net for herbicide label updates. When herbicides do become available, note that a 308 permit from Montana Department of Environmental Quality is required before applying aquatic herbicides to water.

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INTEGRATED WEED MANAGEMENT (IWM)

Prevention of further spread and education are the main priorities for flowering rush. Thoroughly wash all recreational equipment and remove any plant parts wrapped around boat propellers and stuck to trailers. Dispose of plant material away from the shores. This should reduce the probability of spreading flowering rush to other water bodies. Learn to identify flowering rush, keep a vigilant eye when recreating in Montana waters and report any findings to the Montana Department of Agriculture; Montana Fish, Wildlife and Parks; or your county Extension agent or weed coordinator.

Beyond prevention, education, and hand digging of small infestations, there are not enough tools available at this time to recommend a more comprehensive integrated weed management strategy. Ongoing research by the University of Montana, Salish Kootenai College and other organizations will help to develop effective management strategies in the future. Inventorying and predictive mapping will help estimate the current extent of infestation and predict areas susceptible to future invasion.

GLOSSARY

Bulbil - a small, bulb-like structure that separates from the parent plant and functions in vegetative reproduction.

Carpel - seed-bearing structure that constitutes the innermost whorl of a flower. Fertilization of an egg within a carpel by a pollen grain from another flower results in seed development within the carpel.

Diploid - having two homologous copies of each chromosome, usually one from the mother and one from the father.

Rhizomatous - growing from a rhizome, which is a horizontal, underground stem that sends out both roots and shoots.

Sepals - petal-like structures that surround the flower, are typically smaller than the petals but can occasionally be colorful like the petals.

Stamen - pollen-bearing reproductive organ of a flower.

Triploid - having three complete sets of chromosomes.

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MONTANA STATE UNIVERSITY EXTENSION

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Appendix G. US Army Corps of Engineers Regional Flowering Rush Programmatic Environmental Assessment & Biological Opinion

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FINAL FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Integrated Letter Report/Programmatic Environmental Assessment
Flowering Rush Control in Idaho, Montana, Oregon, and Washington
through the Aquatic Plant Control Program

February 2021

The U.S. Army Corps of Engineers, Walla Walla District (Corps), proposes to share the costs with the states of Washington, Oregon, Idaho, and Montana to treat invasive flowering rush infestations on non-Federal lands (Recommended Plan). Flowering rush is invasive and displaces native aquatic plants in a variety of habitats. Flowering rush is indigenous to Europe and Asia where the plant thrives in areas of slow-moving or relatively stagnant water. In the United States, it converts diverse native plant communities into monocultures that provide excellent habitat for nonnative, warm water fish, often predators of native, threatened, and endangered salmon and steelhead.

The Corps, on a reimbursable basis, and the Pacific States Marine Fisheries Commission (PSMFC), acting on behalf of the four member states, would each contribute 50 percent of the costs for flowering rush control operations. Annual program expenses would be documented in Statements of Work submitted each year by the PSMFC in advance of treatment. The goal of flowering rush control is to prevent or minimize the impacts of flowering rush invasion on habitat, irrigation, and recreation. The aim is to eradicate known and future flowering rush populations and provide continued subsequent control at a much-reduced effort.

The proposal to cost share control of flowering rush would be authorized under the Aquatic Plant Control (APC) Program, Section 104 of the River and Harbor Act of 1958, as amended, and codified at 33 U.S.C. §610. Of amounts appropriated for the APC Program in Fiscal Year (FY) 2018 and FY 2019, specific allocations were provided for the control of flowering rush. The Consolidated Appropriations Act, 2018 (P.L. 115-141), and the Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019 (P.L. 115-244), each allocated $1,000,000 in funds for activities for the control of flowering rush.

PURPOSE AND NEED:

The purpose of the Recommended Plan is to prevent, control, and progressively eradicate flowering rush infestations within the Four State Area (FSA) by establishing an APC program and cost-sharing surveys, treatments, and monitoring with states, Tribes, and non-governmental organizations under Section 104 of the River and Harbor Act of 1958 (33 United States Code [U.S.C.] § 610), as amended. The Recommended Plan is needed to reduce the negative impacts of flowering rush—an existing invasive noxious

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and nuisance weed, in navigable waters, tributary streams, connecting channels, and other allied waters of the United States located within the FSA—which has the potential to have a major significant economic impact if its populations continue to grow and spread. Screening criteria for measures is discussed in Section 3.4 of the *Flowering Rush Control in Idaho, Montana, Oregon, and Washington Letter Report/Environmental Assessment* (LR/EA). Identified Alternatives must (1) increase effectiveness of aquatic pest control programs within the FSA, (2) efficiently reduce negative impacts of flowering rush, and (3) be environmentally acceptable.

SUMMARY OF ALTERNATIVES CONSIDERED:

Two alternatives were evaluated in the LR/EA. The No Action Alternative and Alternative 2 – Cost-shared Flowering Rush Control Program (the Recommended Plan). The No Action Alternative does not satisfy the project's purpose and need, but the National Environmental Policy Act (NEPA) requires analysis of the No Action Alternative to set the baseline from which to compare other alternatives.

SUMMARY OF POTENTIAL EFFECTS:

The No Action Alternative and the Recommended Plan were analyzed for potential effects to the following resources: fisheries and aquatic resources, wildlife and terrestrial resources, vegetation, threatened and endangered species, water quality, recreation, wetlands and the aquatic environment, historic and cultural resources, and socioeconomics and environmental justice (Table 1). This analysis is detailed in Section 4 of the LR/EA. The analysis concluded there would be no significant effects to any of the resources from implementation of the Recommended Plan.

Table 1. Environmental Effects of the No Action Alternative and Recommended Plan.

	Insignificant effects	Insignificant effects as a result of mitigation	Resource unaffected by action
Fisheries and Aquatic Resources	☒	☐	☐
Wildlife and Terrestrial Resources	☒	☐	☐
Vegetation	☒	☐	☐
Threatened and Endangered Species	☒	☐	☐
Water Quality	☒	☐	☐
Recreation	☒	☐	☐
Wetlands and Aquatic Environmental	☒	☐	☐
Historic and Cultural Resources	☒	☐	☐
Socioeconomics and Environmental Justice	☒	☐	☐

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The No Action Alternative and the Recommended Plan would both have minor to moderate short-term negative impacts to the resources assessed; however, long-term effects would be beneficial. The Recommended Plan would allow the Corps to cost-share flowering rush control with the PSMFC. Increased flowering rush treatment funding would have beneficial long-term impacts because it allows for increased treatment efforts and expended treatment locations and areas compared to the No Action Alternative. For this reason, the Recommended Plan is the least environmentally damaging alternative in the long-term.

COMPENSATORY MITIGATION:

No compensatory mitigation is required.

OTHER ENVIRONMENTAL AND CULTURAL COMPLIANCE REQUIREMENTS:

NATIONAL ENVIRONMENTAL POLICY ACT

The LR/EA was prepared pursuant to regulations implementing NEPA (42 U.S.C. § 4321 et seq.). Completion of the LR/EA and signing of a Finding of No Significant Impact (FONSI), if appropriate, fulfills the requirements of NEPA. The LR/EA and associated draft FONSI were sent out for a 30-day public review and comment period that began on June 24, 2019 and concluded on July 24, 2019. Five comments were received during the comment period, all of which have been resolved in the LR/EA.

ENDANGERED SPECIES ACT (ESA)

Initial scopes of work discussed in the LR/EA, Section 1.2 (project location) have been consulted on with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (collectively the Services) in 2019, and determined "not likely to adversely affect threatened or endangered species." Initial consultation was completed upon receipt of Letters of Concurrence from the Services in 2019.

Further, the Corps would conduct standard Section 7 consultation with the Services for each new flowering rush treatment scope of work, until programmatic ESA consultation is completed. If potential, adverse effects are identified, the Corps would first attempt to modify any action affecting threatened or endangered species to avoid or minimize those impacts. Iterative consultation is necessary because in the absence of programmatic ESA coverage, the small annual changes in treatment locations and methods prevent consulting on the program over a longer timeframe. As new populations are discovered, or new treatment methods proposed, they would be reflected in the annual submitted statements of work, at which time ESA compliance would be conducted for those actions. As the Services do not amend Letters of Concurrence or Biological Opinions, new elements of a statement of work would require new consultation.

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May Affect, Not Likely to Adversely Affect: Pursuant to section 7(a) of the Endangered Species Act of 1973, as amended, the Corps determined the Recommended Plan May Affect, but is not likely to adversely affect bull trout, yellow-billed cuckoo, grizzly bear, upper Columbia River (UCR) Spring-run Chinook, UCR steelhead, and middle Columbia River steelhead.

No Effect: Pursuant to section 7(a) of the Endangered Species Act of 1973, as amended, the Corps determined there would be no effect to Puget Sound Chinook, dolly varden, Canada lynx, golden paintbrush, gray wolf, marbled murrelet, North American wolverine, northern spotted owl, Oregon spotted frog, Roy Prairie pocket gopher, Spalding's catchfly, streaked horn lark, Ute ladies'-tresses, water howellia, and whitebark pine.

CLEAN WATER ACT

Section 401 and Section 402: Section 401 of the Clean Water Act requires that any Federal activity that may result in a discharge of a pollutant or dredged or fill material to waters of the United States must first receive a water quality certification from the state in which the activity would occur. Section 402, the National Pollutant Discharge Elimination System (NPDES) program, regulates the discharge of pollutants, to include stormwater. Application of aquatic herbicides would require a NPDES permit, either the EPA 2016 Pesticide General Permit (PGP) for treatments in Idaho, Washington, or on Tribal Reservations; the Montana Pollutant Discharge Elimination System Permit (MTG870000) in Montana; or the Oregon Department of Environmental Quality Pesticide General Permit (2300A) in Oregon. The cost-share partner agencies are required to obtain the appropriate NPDES permit, specific to their action and location.

Section 404: The discharge of dredged or fill material below the line of ordinary high water requires evaluation under Section 404. Proposed benthic barrier application may be considered fill material discharged below the line of ordinary high water. Application would require approval for use under one of the Nationwide Permits or through individual Section 404 permit(s). Cost-share partner agencies would secure appropriate permits prior to the application of benthic barriers.

NATIONAL HISTORIC PRESERVATION ACT

The Corps would conduct standard Section 106 consultation with the relevant Tribes (listed in Section 5) and State Historic Preservation Officers (SHPOs) for each submitted flowering rush treatment scope of work. If potential, detrimental effects are identified, the Corps would first attempt to modify any action affecting historic/cultural properties to avoid or minimize any potential impacts. If adverse effects are identified, the Corps would identify appropriate mitigation and enter into an appropriate Memorandum of Agreement with the SHPO or Advisory Council on Historic Preservation.

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FINDING

Based on the LR/EA, the reviews and input by other federal, state and local agencies, Tribes, and the public, best scientific information available, and the review by my staff, it is my determination that implementation of the Recommended Plan would not significantly affect the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required. The Corps will proceed to fund the Recommended Plan under the authority of Section 104 of the River and Harbor Act of 1958, when funds are made available for that purpose.

_____	16 February 2021
RICHARD T. CHILDERS, P.E., PMP	Date
Lieutenant Colonel, EN	
Commanding	

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US Army Corps of Engineers ®
Walla Walla District
BUILDING STRONG®

AQUATIC PLANT CONTROL PROGRAM
SECTION 104 OF THE RIVER AND HARBOR ACT OF 1958
(33 U.S.C. §610), AS AMENDED

FLOWERING RUSH CONTROL

WASHINGTON, IDAHO, OREGON, MONTANA

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

In compliance with the
National Environmental Policy Act of 1970

ADMINISTRATIVE RECORD – DO NOT DESTROY

PROJECT FILE NUMBER: PPL-C-2018-0102

June 2019

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Acronyms

ALS	Acetolactate Synthase (plant enzyme)
APC	Aquatic Plant Control
ATV	All-Terrain Vehicle
AVR	Aquatic Vegetative Rake
BMP	Best Management Practices
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
CRB	Columbia River Basin
DASH	Diver Assisted Suction Harvesting
EA	Environmental Assessment
EDRR	Early Detection And Rapid Response
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FSA	Four-State Area
L	Liter
LOC	Levels of Concern
MBTA	Migratory Bird Treaty Act
Mg	milligram
MRB	Missouri River Basin
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NPDES	National Pollutant Discharge Elimination System
ODA	Oregon Department of Agriculture
PL	Public Law
Ppb	Parts per Billion
Ppm	Parts per Million
PSMFC	Pacific States Marine Fisheries Commission
Pt	Pint
RHA	River and Harbor Act
RQ	Risk quotients
SHPO	State Historic Preservation Office
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agricultural
USFWS	U.S. Fish and Wildlife Service
USGCRP	S. Global Change Research Program
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife
WDNR	Wisconsin Department of Natural Resources
WSDE	Washington Department of Ecology
WIIN ACT	Water Infrastructure Improvements for the Nation Act
WRRDA	Water Resources and Reform Development Act

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1 - Project Description

1.1 Project Name

Aquatic Plant Control Program, Flowering Rush Control, Washington, Idaho, Oregon, and Montana

1.2 References

a. Section 104 of the River and Harbor Act of 1958, as amended and codified at 33 U.S.C. §610
b. 40 C.F.R. Parts 1500-1508 Regulations for the Procedural Provisions of the National Environmental Policy Act
c. ER 200-2-2 (33 C.F.R. Part 230) Environmental Quality Procedures for Implementing the National Environmental Policy Act
d. ER-113-2-500 Project Operations Partners And Support (Work Management Policies)

1.3 Purpose and Need

The US Army Corps of Engineers, Walla Walla District (Corps), proposes to implement a Flowing Rush Control Cost Share Program to aid the states of Washington, Oregon, Idaho, and Montana in the control and treatment of an invasive aquatic plant, flowering rush (*Butomus umbellatus*). The purpose of the proposed action is to treat and control current and future flowering rush infestations within the four-state area (FSA) – Idaho, Montana, Oregon, and Washington, under Section 104 of the River and Harbor Act of 1958 (33 U.S.C. §610), as amended. The proposed action is needed to reduce the negative impacts of flowering rush, an invasive noxious and nuisance weed, in state waterways. Flowering rush converts diverse native plant communities into monocultures that provide excellent habitat for nonnative, warm-water fish including northern pike, walleye, smallmouth bass, and other aggressive, nonnative juvenile salmonid predators (Muhlfeld et al. 2008). Flowering rush also interferes with boating, swimming, fishing, and other recreational opportunities along rivers and lake shores. Additionally, flowering rush supports habitat for the great pond snail (*Lymnaea stagnalis*) that hosts parasites that can burrow into the skin of swimmers and waders, causing Cercarial Dermatitis. Flowering rush can also invade irrigation canals where it blocks flow and requires expensive herbicide and mechanical treatments to maintain the water conveyance system.

This EA was prepared in accordance with Engineer Regulation (ER) 200-2-2, *Procedures for Implementing NEPA,* and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA),* Title 40 Code of Federal Regulations (CFR), Parts 1500-1508. The objective of the EA is to evaluate potential environmental effects of the proposed action. If such effects are relatively minor, a Finding of No Significant Impact (FONSI) will be issued and the Corps will proceed with the Federal action. If the environmental effects

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are determined to be significant, an Environmental Impact Statement (EIS) will be prepared before a decision is reached on whether to implement the proposed action. Applicable laws under which these effects will be evaluated include, but are not limited to, NEPA, the Endangered Species Act, the Clean Water Act, the Clean Air Act, and the National Historic Preservation Act.

The National Environmental Policy Act is a *full disclosure* law, providing for public involvement in the NEPA process. All persons and organizations that have a potential interest in this proposed action – including the public, other Federal agencies, state and local agencies, Native American tribes, and interested stakeholders – are encouraged to participate in the NEPA process.

1.4 Project Location

This Programmatic Environmental Assessment (EA) evaluates control of the aquatic invasive plant, flowering rush (*Butomus umbellatus*), in waters of the four-state area (FSA - Washington, Idaho, Oregon, and Montana). In the Northwest, the introduction of flowering rush is believed to originate from an invasion in Peaceful Bay, Flathead Lake, Montana, in 1964. From there it was carried along the Flathead River and Clark Fork River to Lake Pend Oreille in Idaho. The Pend Oreille River then continued to carry the plant into Washington State waters in the late 1990s (WSDE 2008 and Jacobs 2011).

The three watersheds of focus for flowering rush treatment in the FSA currently are the Columbia River Basin (CRB), Missouri River Basin (MRB), and Puget Sound Basin (PSB). However, it is reasonable to assume not all flowering rush invasion sites have been located and that new sites will emerge throughout different watersheds in the FSA. The FSA is also home to extensive aquatic resources outside the CRB, including the Rouge River Basin in Oregon and numerous small coastal drainages throughout western Oregon and Washington, all of which are susceptible to an invasion of flowering rush.

Columbia River Basin

The CRB drains more than 250,000 square miles and includes the southeastern portion of the Canadian province of British Columbia, most of the U.S. states of Idaho, Oregon, and Washington, the western part of Montana, and very small portions of three other states. The Columbia Basin extends from the Rocky Mountains in the east through the Cascade Range to the Columbia River's outflow at the Pacific Ocean in the west (Figure 1-1).

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Figure 1-1. Columbia River Basin

Missouri River Basin

The Missouri River Basin (MRB) is more than 500,000 square miles, includes portions of 10 states and one Canadian province, and encompasses approximately one-sixth of the United States. The Missouri River flows 2,341 miles from the Rocky Mountains in Montana to the confluence with the Mississippi River near St. Louis, Missouri (Figure 1-2).

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Figure 1-2. Map of the Missouri River Basin

Puget Sound Basin

The waters of Puget Sound receive all of the drainage from surrounding watersheds that cover more than 16,988 square miles, collectively referred to as the Puget Sound Basin. This basin is bordered on the east by the Cascade Mountains and on the west by the Olympic Mountains. The Puget Sound area consists of the nearshore zone of the Puget Sound Basin including Puget Sound, the Strait of Juan de Fuca, and southern portions of the Strait of Georgia that occur within the borders of the United States (Figure 1-3). While the basin occurs largely within northwestern Washington State, two of its headwater drainages originate in Canada. The basin is roughly 80 percent land and 20 percent water. The total water area covers nearly 3,090 square miles at mean high water.

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Figure 1-3. Map of the Puget Sound Basin

Known Locations of Flowering Rush Invasion

Today, flowering rush is reported along the shores of Flathead Lake, portions of the Flathead River, Thompson Falls Reservoir, Noxon Reservoir, Cabinet Gorge, and the Clark Fork River in Montana (Figure 1-4). The Pend Oreille watershed in northern Idaho (Figure 1-5) and the Snake and Blackfoot Rivers and canal systems in eastern Idaho (Figure 1-6) are the two primary areas of flowering rush infestation reported in Idaho. Flowering rush was first documented in Washington State at Silver Lake in Whatcom county in 1997 and is currently present in 11 Washington State counties including populations in the Yakima and Columbia Rivers (Figure 1-7).

Currently, the only place flowering rush occurs in Oregon is on Federal land in the McNary Reservoir. However, Flowering rush has been discovered at the initial stages of invasion at multiple locations in Lake Umatilla behind John Day Dam on the Columbia River. The U.S. Army Corps of Engineers, Portland District treated seven locations on Lake Umatilla in September 2016 with an Early Detection and Rapid Response (EDRR) method. The source of the Lake Umatilla plants is believed to be the Yakima River in

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Washington. Efforts led by the Bureau of Reclamation are underway to reduce that river's flowering rush populations.

Flowering rush is primarily found throughout the CRB in Washington, Idaho, and Montana (Figure 1-8).

Figure 1-4. Locations of flowering rush (*Butomus umbellatus*) populations in western Montana. Flowering rush is currently found around the shores of Flathead Lake, portions of the Flathead River, Thompson Falls Reservoir, Noxon Reservoir, Cabinet Gorge and the Clark Fork River.

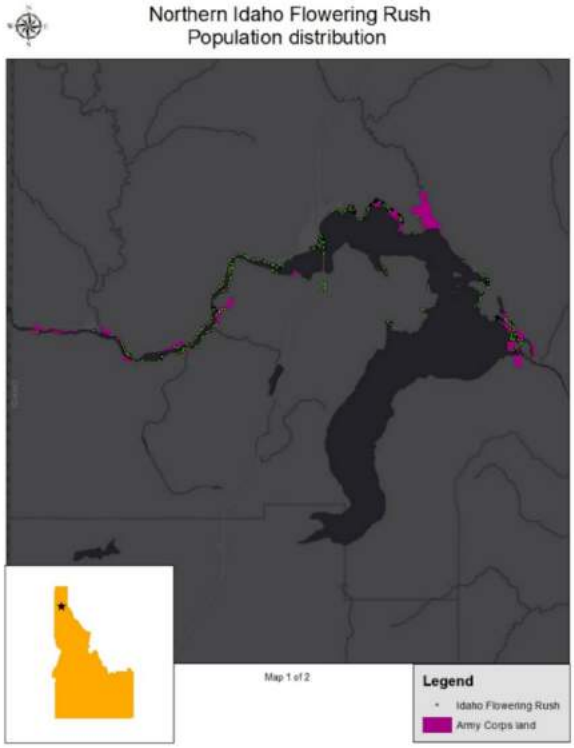

Figure 1-5. Flowering rush (*Butomus umbellatus*) populations in the Pend Oreille watershed in northern Idaho.

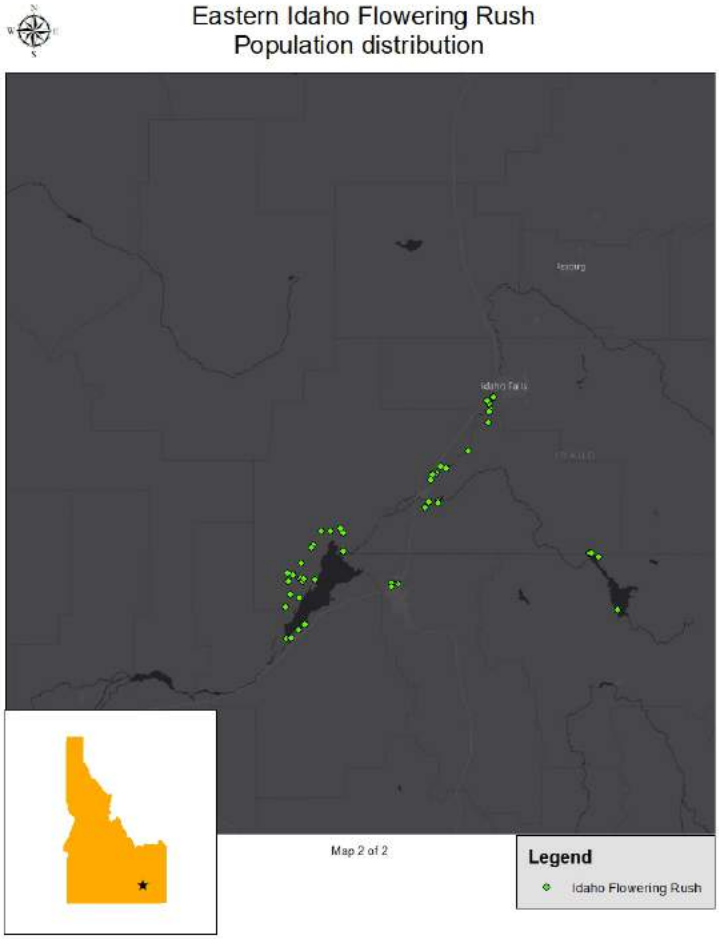

Figure 1-6. Locations of flowering rush (*Butomus umbellatus*) populations in the Snake and Blackfoot Rivers and canal systems in eastern Idaho.

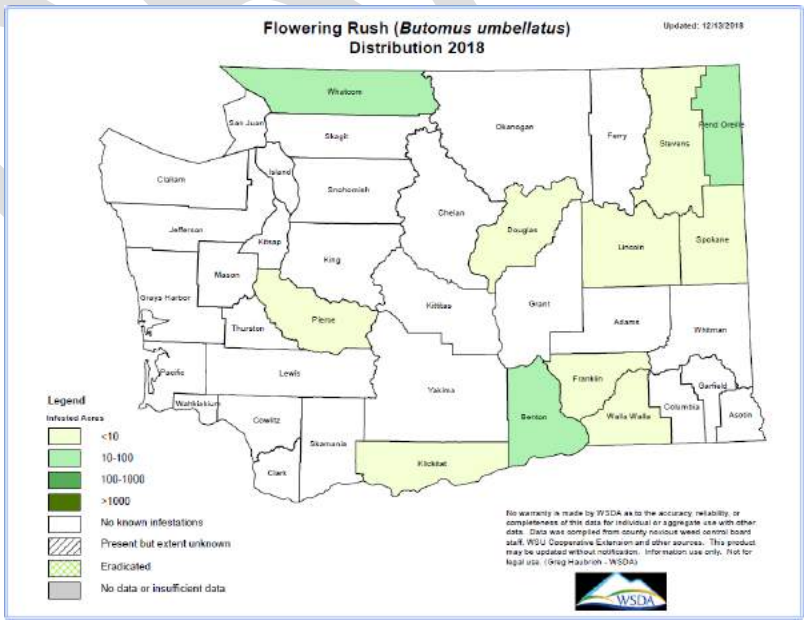

Figure 1-7: County-level distribution of flowering rush (*Butomus umbellatus*) in Washington.

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Figure 1-8. Flowering rush (*Butomus umbellatus*) populations in the Columbia River Basin. The red lines indicate areas of known flowering rush invasion.

1.5 Background Information

Flowering rush is an aquatic perennial plant that can grow submersed in water up to six meters deep or as an emergent on damp shorelines. At intermediate depths up to three meters it will often grow to the surface with the leaf tip sticking above the water surface (Jacobs et al. 2011). Leaves are typically about 1 m long when flowering rush is growing fully emerged along shorelines, but can be up to 3 m long when growing fully submersed. Leaves of emergent plants tend to twist. Flowering rush grows from horizontal underground stems which put out lateral shoots (rhizomes) in the sediment and form an extensive mat that comprises most of the biomass of the plant (ODA 2014).

Flowering rush mainly disperses through buds, fragments of the plant's rhizome, and occasionally small bulblike structures in the flowers (Eckert et al. 2003 and Kliber and Eckert 2005). The rhizomes develop lateral buds that break off easily, and disperse the plant. The rhizomes also become brittle with age and develop structurally weak constrictions that spontaneously fragment or break readily following minor disturbances from waves, passing boats, waterfowl, people, etc. that also lead to dispersal of the plant (Hackett and Monfils 2014). Both rhizomes and rhizome buds float, which aids in rapid dispersal by water currents. Flowering rush has invaded irrigation canals where it

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blocks flow and requires expensive herbicide and mechanical treatments to maintain the water conveyance system (Perkowski 2014).

Flowering rush exhibits a seasonal growth pattern. It is dormant in winter, with the leaves dying back leaving only the rhizome. It starts growth in early spring; in Flathead Lake Montana it has been recorded to start growth between late February and mid-April. This is typically earlier in the spring than most native aquatic plants. Vegetative growth is continuous throughout the season and into fall. Plants flower from early summer to mid-fall. Fall frosts cause leaves to collapse as opposed to remaining upright through the winter like cattails. Leaf growth is rapid, peaking in mid-summer, then dying, usually in September to October (Jacobs et al. 2011).

Flowering rush is invasive and displaces native aquatic plants in a variety of habitats. Flowering rush is indigenous to Europe and Asia where the plant thrives in areas of slow-moving or relatively stagnant water (Core 1941). Flowering rush converts diverse native plant communities into monocultures that provide excellent habitat for nonnative, warm water fish (Perkowski 2014). A study in Montana showed flowering rush dominated areas near the lake shore are the preferred habitat for northern pike, an aggressive, nonnative juvenile salmonid predator (Muhlfeld et al. 2008). Flowering rush also interferes with boat propellers, swimming, and fishing thus reducing recreational opportunities along rivers and lake shores. Additionally, flowering rush supports habitat for the great pond snail (*Lymnaea stagnalis*) that hosts parasites that cause swimmers' itch (Jacobs et al. 2011).

Flowering rush control is likely to provide a benefit to aquatic species like juvenile anadromous salmonids by restoring native vegetation, maintaining suitable rearing habitat, and thereby restoring ecosystem and riparian function. In terms of ESA-listed salmon, steelhead, and chars, the restoration of riparian habitat incidental to the proposed action would benefit juveniles by improving shallow water, migration, and rearing habitat, and reducing piscivorous fish habitat. Adult bull trout may benefit from restored riparian habitats through increased prey species that would colonize the improved ecosystem. Consequently, most potential adverse effects are expected to be short-term and offset by benefits to riparian function that would improve the long-term viability of listed species. Positive changes to the riparian and benthic habitat caused by flowering rush control would benefit fish and habitats in the action area.

1.6 Authority

Section 104 of the River and Harbor Act (RHA) of 1958 (33 United States Code [U.S.C.] §610), as amended, authorizes the Corps to administer a comprehensive program to provide for the prevention, control, and progressive eradication of noxious aquatic plant growths and aquatic invasive species from the navigable waters, tributary streams, connecting channels, and other allied waters of the U.S. *See* 33 U.S.C. §610(a). This program is known as the Aquatic Plant Control (APC) Program and annually receives appropriations. Of amounts provided for the APC Program in Fiscal Year (FY) 2018 and FY 2019, specific allocations were provided for the control of flowering rush. The Consolidated Appropriations Act, 2018 (P.L. 115-141), and the Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act,

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2019 (P.L. 115-244), each allocated $1,000,000 in funds "for activities for the control of the flowering rush."

It is the policy of the Corps of Engineers that the APC Program shall be maintained to control specific types of aquatic plant infestations of major economic significance (such as the spread of flowering rush), or weed infestations that have potential for reaching such economic significance, in navigable waters, tributaries, streams, connecting channels and all allied waters. Specific guidance on the development of cost-sharing agreements, planning studies, and funding requests can be found in Chapter 14 of Engineer Pamphlet 1130-2-500.

On July 27, 2018, the Pacific States Marine Fisheries Commission (PSMFC) requested a cost share agreement with the Corps to control flowering rush in the States of Idaho, Montana, and Washington. Flowering rush has not yet been found outside of Federal waters in Oregon, but should it be discovered costs could be shared with Oregon through PSMFC under this authority and EA.

The PSMFC is acting on behalf of the States of Idaho, Montana, and Washington and the following related institutions:

- Idaho State Department of Agriculture
- Washington Department of Fish and Wildlife
- Washington Department of Ecology
- Washington Department of Agriculture
- Benton County, Washington
- Kalispel Tribe
- Chelan County Noxious Weed Board
- Pend Oreille Noxious Weed Board
- Whatcom County Noxious Weed Board
- Salish Kootenai College
- University of Montana
- Others may be included in the future.

The project would be implemented under the authority of Section 104 of the RHA of 1958, as amended.

1.7 Timeline

Flowering Rush control would commence shortly after the Corps signs the FONSI, if deemed appropriate. The Corps estimates that the first application period would begin in July 2019. Activities covered in this Environmental Assessment (EA) would be reviewed when necessary, but at least every five years, by the Corps Environmental Compliance Section to determine if the criteria in Section 1502.9 compel preparation of a supplemental EA, which is required when there has been a substantial change in a proposed action or if there are significant new circumstances or information relevant to environmental concerns. During that review, the Corps would also determine if

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compliance with other applicable environmental laws, regulations or executive orders are needed.

2 - Alternatives

Two alternatives are evaluated in this EA; Alternative 1 - the No Action Alternative and Alternative 2 - Flowering Rush Control (the Proposed Action Alternative). The statutory objectives/scheme supporting an action can serve as a guide to determine the reasonableness of objectives outlined in the EA – in this case the Consolidated Appropriations Act of 2018 and the Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act of 2019, each allocated $1,000,000 for flowering rush control cost shares under the Aquatic Plant Control Program, with additional allocations expected. Additionally, an agency's obligation to consider alternatives under an EA is a lesser one than under an Environmental Impact Statement. Consequently, only the No Action and Proposed Action Alternatives were analyzed further. The No Action Alternative does not satisfy the project's purpose and need, but NEPA requires analysis of the No Action Alternative to set the baseline from which to compare other alternatives. No Action does not mean there would be no environmental impacts from this alternative.

2.1 Alternative 1: No Action – No Change to Current Practice

Under the No Action Alternative the Corps would not share costs with the PSMFC to control flowering rush. State agencies, municipalities, and landowners currently control flowering rush under a variety of state and local programs, measures, and methods. Under the no action alternative, these various control operations would continue or cease based on state, local, and private needs and funding. In the event, some or all of these current operations cease or are cut back, flowering rush could grow prolifically in those areas and cause adverse effects, as detailed in Section 1.5.

2.2 Alternative 2: Cost Share Flowering Rush Control (Proposed Action)

The Corps proposes to share the costs with the Pacific States Marine Fisheries Commission (PSMFC) to treat flowering rush infestations on non-Federal lands. The goal of flowering rush control is to prevent and/or minimize the impacts of flowering rush invasion on habitat, irrigation, and recreation. The aim is to eradicate known and future flowering rush populations and provide continued subsequent control at a much-reduced effort. Using Corps funding, the PSMFC would assume the following obligations:

1. The PSMFC would perform control activities in cooperation with state, local, and tribal agencies in Washington, Idaho, Oregon, and Montana. Statements of Work (SOW) would be submitted annually by the acting agencies, through PSMFC. SOWs would detail treatment locations, timeline, and methodologies.

2. During the annual statement of work preparation, the PSMFC and the state/local/tribal agency aquatic invasive species coordinators and cooperators would

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engage in an evaluation process to determine whether flowering rush control strategies (e.g. locations and methods) should be adjusted in 2019 and beyond.

3. Flowering rush control methods would fall within that which are outlined in this EA, including any listed impact minimization measures. Should there be a desire on the part of the states to use treatment protocols not detailed here, supplemental NEPA analysis would be required.

Initial SOWs for treatment in 2019 (with locations, times, and methodologies consistent with those outlined in this EA) have already been received by the Corps.

In general, treatment areas would not cover large tracts in a single season. The decision as to which treatment method to use would be according to the treatment area's patch density, land ownership, permit requirements, water level, water movement, and time of year. To facilitate the best results of the treatment method selected, all assigned treatment areas would have an onsite pre-treatment evaluation. This pre-treatment evaluation would occur two weeks to six months prior to application. This wide range is needed to capture and use the best information impacting the treatment area. Three categories of flowering rush control are proposed: manual, mechanical, and chemical. All treatments areas would additionally have a post-treatment survey conducted to evaluate the effectiveness of the applied control method.

2.2.1 Chemical Control

Aquatic herbicides are applied as concentrated liquids, granules, or pellets. Liquid treatments are mixed with water to facilitate application and to ensure even distribution. Aquatic herbicides are applied to the entire water column to control the submersed weeds. Aquatic herbicide applicators must measure the volume of the water to be treated before applying aquatic herbicides to ensure that the appropriate and effective amount of herbicide is used.

The aquatic-labeled herbicides evaluated in this EA are: ammonium salt of imazamox, diquat dibromide, endothall (salt of dipotassium), glyphosate, Imazapyr, colorants (dyes), and Agridex (a surfactant). Chemical specific application rates and chemical half-life in water are listed in Table 1. Proposed application rates for each chemical were taken from Gettys et al. 2009. Some adjuvant, dye, and surfactant data was lacking, but it is reasonable to assume that the proposed adjuvants, dyes, and surfactants would be used in chemical applications.

Submerged applications are typically up to five-acre treatment blocks for efficacy. Emergent treatments occur in patches or strips within a treatment area, specifically selecting the target species, and are typically up to two-acre treatments within a treatment area.

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Table 2-1. Chemical specific application rates and chemical half-life in water.

Active Ingredient	Emergent Application Rate (pt/acre)	Submerged Application Rate (pt/acre foot of water)	Typical Period of Chemical Activity
Ammonium salt of imazamox	0.02 to 8 pints	1.0625 to 10.8125 pints	6.8 – 7 hours
Imazapyr	2 to 6 pints	Not for submerged	7 hours
Diquat dibromide	4 to 16 pints	2 to 4 pints	48 hours
Endothall	3.6 to 25.6 pints	3.6 to 25.6 pints	2.5-12 days
Glyphosate	1.5 to 7 pints	Not for submerged	1 – 1.5 days

2.2.2 Chemical Application Methods

The Corps proposes the following application methods for chemical control.

Hand/Select

Any of the following hand/select methods would be employed.

Wicking and Wiping. Involves using a sponge or wick on a long handle to wipe herbicide onto foliage and stems. Use of a wick eliminates the possibility of spray drift or droplets falling on non-target plants, although herbicide can drip or dribble from some wicks. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle, a thick, waxy layer present on leaves and stems of most plants.

Stem Injection. Herbicides would be injected into herbaceous stems using a needle and syringe.

Spot

The most common chemical applications are spot treatments made by either ground-based sprayers [mounted to ATVs or trucks], a boat, or with backpack sprayers. Applicator type ranges from motorized vehicles with spray hoses, to backpack sprayers, to hand-pumped spray or squirt bottles. Hand-pumped spray and squirt bottles can target very small plants or parts of plants. Most spot applications treat areas that range in size from less than one-tenth acre to 1 ½ acres where herbicide is sprayed directly onto small patches or individual target plants.

Broadcast

Herbicides would be sprayed via ground vehicles with hose sprayers using an array of spray nozzles. This equipment is most commonly used for broadcast spraying of roads, but can also be used on all-terrain vehicles for broadcast or spot spray in remote areas.

Submerged flowering rush would be treated from a workboat using an injection system. Injection application consists of two large herbicide storage tanks, a GPS controlled herbicide flow system for precision application and from six to eight drop-hoses with

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variable depth herbicide discharge points. This allows for uniform placement of the targeted application rate throughout the horizontal and vertical profile.

Aerial

No aerial treatments are proposed.

Marker Dye

Marker dyes would be used to assure only target plants are sprayed.

Advantages of Chemical Control

- Aquatic herbicide application can be less expensive than other aquatic plant control methods.
- Aquatic herbicides are easily applied around underwater obstructions and structures, such as docks.
- Aquatic herbicides can be applied directly to problem areas of all size scales.
- Aquatic herbicides are deemed safe by EPA for intended use when used as directed.

Disadvantages of Chemical Control

- Some herbicides have swimming, drinking, and water use restrictions.
- Herbicide use may have unwanted impacts to people who use the water and to the environment.
- Non-targeted plants as well as nuisance plants may be adversely impacted by some herbicides.
- Depending on the herbicide used, it may take several days to weeks or several treatments during a growing season before the herbicide controls or kills treated plants.
- Rapid-acting herbicides may cause low oxygen conditions to develop as plants decompose.
- To be most effective, herbicides must be applied to specific stages of the plants, (i.e. young shoots, flowering stages).
- Some expertise in using herbicides is necessary in order to be successful and to avoid unwanted impacts. Therefore, permits are required for certain types of herbicides.
- Many people have strong feelings against using herbicides in water. Having the public involved and educated in the treatment process is beneficial.

Some local jurisdictions have policies forbidding or discouraging the use of aquatic herbicides. As policies change, updates/revisions would be made to this EA and flowering rush control practices would adjust.

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2.2.3 Chemical Descriptions

There are five herbicides proposed for chemical control and evaluated in this EA. Descriptions of each herbicide are found below. The herbicides listed are either contact herbicides (which kill only the plant parts contacted by the chemical) or systemic herbicides (which are absorbed by the roots or foliage and then spread throughout the plant).

Ammonium salt of imazamox

Imazamox is available in both liquid and granular forms and is used to control submerged, emergent, and floating leaf plants. It is a selective, systemic herbicide that moves throughout plant tissue and prevents the plant from producing a necessary enzyme, known as acetolactate synthase (ALS) enzyme, which is not found in animals. Susceptible plants will stop growing soon after treatment, with plant death and decomposition occurring over several weeks.

Imazamox should be applied to plants that are actively growing when used as a post-emergence herbicide. It can also be used during drawdown as a pre-emergent herbicide to prevent plant regrowth.

Imazamox is only moderately persistent, and it degrades aerobically in the soil to a non-herbicidal metabolite which is immobile or moderately mobile. Imazamox also degrades in the water by aqueous photolysis. Hazard to non-target organisms is considered to be minimal. Imazamox is practically nontoxic to avian species, finfish, aquatic invertebrates, and honeybees (EPA 1997).

Liquid imazamox can be applied to the surface of the water using a sprayer or injected below the water surface. When treating emergent or floating plants, imazamox must be used with a spray adjuvant. Spray adjuvants generally consist of surfactants, oils, and fertilizers and enhance the effectiveness of herbicides. The Corps only authorizes use of aquatic registered adjuvants which are not petroleum-based, non-toxic, and do not contain metals.

Imazapyr

The active ingredient in Imazapyr is isopropylamine salt of imazapyr. Imazapyr is used for control of emergent vegetation. It is not recommended for control of submersed vegetation. Imazapyr is a systemic herbicide that moves throughout the plant tissue and prevents plants from producing a necessary enzyme, ALS, which is not found in animals. Susceptible plants would stop growing soon after treatment and become reddish at the tips of the plant. Plant death and decomposition would occur gradually over several weeks to months. Imazapyr should be applied to plants that are actively growing. If applied to mature plants, a higher concentration of herbicide and a longer contact time would be required.

Imazapyr is broken down in the water by light and has a half-life (the time it takes for half of the active ingredient to degrade) ranging from three to five days. Three

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degradation products are created as imazapyr breaks down. These are pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid (quinolinic acid), and nicotinic acid. These degradates persist in water for approximately the same amount of time as imazapyr. Imazapyr doesn't bind to sediments, so leaching through soil into groundwater is likely. Imazapyr is practically non-toxic (the U.S. Environmental Protection Agency's (EPA) lowest toxicity category) to fish, invertebrates, birds, and mammals and it does not bioaccumulate in animal tissues.

There are no restrictions on recreational use of treated water, including swimming and eating fish from treated water bodies. If application occurs within a ½ mile of a drinking water intake, then the intake must be shut off for 48 hours following treatment. There is a 120-day irrigation restriction for treated water, but irrigation can begin sooner if the concentration falls below one part per billion (WDNR 2012a).

Imazapyr could be applied using handguns at two to six pints per acre of herbicide, with one quart methylated seed oil, and an aquatic labeled colorant. All-terrain vehicles (ATV) applications could be made using the same herbicide rates with 100 gallon/acre water in open areas not restricted by docks, marinas, and boat ramps.

Diquat dibromide

Diquat is the common name for the chemical 6,7-dihyropyrido[1,2-a:2',1'-c] pyrazinediium. It is commonly formulated as a dibromide salt. Diquat inhibits photosynthesis and oxidizes cell membranes. It is rapidly absorbed by plants, and symptoms appear within hours (Senseman 2007). Diquat is a good choice for submersed weeds, but it is not especially effective on emergent weeds (Helfrich et al. 2009). Diquat is used to control submersed plants in small treatment areas or in areas where dilution may reduce the period of time that plants are exposed to the herbicide. Diquat is generally considered to be a "broad-spectrum" product that kills a wide range of plant species. However, the susceptibility of different submersed species can vary significantly.

Diquat is slow to degrade in the environment, but will rapidly be adsorbed by soil particles (Hofstra et al. 2001, Poovey and Getsinger 2002, and World Health Organization 2004). Diquat can be rapidly inactivated when treating "muddy" or turbid water and the speed of this inactivation can interfere with plant control. In pond studies, diquat was quickly eliminated from the water column and was present at very low levels within 14 days and undetectable after 38 days (Langeland and Warner 1986; Parsons et al. 2007; Robb et al. 2014).

High acute risk to birds is not expected from the use of diquat.

Diquat should be applied before plant growth becomes dense and when plants are actively growing. Application of this herbicide can be made by spraying it onto the water surface, by pouring into the water, or using an injection system.

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Endothall

Endothall is the common name of the active ingredient endothal acid. Endothall is available in both liquid and granular forms. Two types of endothall are available, dipotassium salt and monoamine salts; the monoamine salt form of endothall is not covered for use of flowering rush treatment under this EA. Endothall is a contact herbicide that prevents certain plants from making the proteins they need. Factors such as density and size of the plants present, water movement, and water temperature determine how quickly endothall works. Under favorable conditions, plants begin to weaken and die within a few days after application. Endothall disperses with water movement and is broken down by microorganisms into carbon, hydrogen, and oxygen.

For effective control, endothall should be applied when plants are actively growing. Endothall is used primarily to control submersed plants. Most submersed weeds are susceptible to dipotassium salt formulations. The choice of liquid or granular formulations depends on the size of the area requiring treatment. Granular is more suited to small areas or spot treatments, while liquid is more suitable for large areas. If endothall is applied to a pond or enclosed bay with abundant vegetation, no more than 1/3 to 1/2 of the surface should be treated at one time because excessive decaying vegetation may deplete the oxygen content of the water and kill fish. Untreated areas should not be treated until the vegetation exposed to the initial application decomposes (WDNR 2012b).

Liquid endothall products can be sprayed on the water or injected below the water surface. It may be applied as a concentrate or diluted with water depending on the equipment used. Granular endothall products must be spread as evenly as possible in the area to be treated (State of Connecticut Department of Energy & Environmental Protection 2014).

Glyphosate

Glyphosate is a broad spectrum, systemic herbicide that moves throughout the plant tissue and works by inhibiting an important enzyme needed for multiple plant processes, including growth. Glyphosate is effective only on plants that grow above the water. It would not be effective on plants that are submerged or have most of their foliage under water, nor would it control regrowth from seed. Three salts of glyphosate are used as active ingredients in registered pesticide products and together, they are the most widely used pesticides by volume. Glyphosate should be applied to plants that are actively growing and after flowers have formed, usually around midsummer. Following treatment, plants will gradually wilt, appear yellow, and die in approximately two to seven days. Occasionally, effects are not seen on the plant the year it is applied, but the plants do not appear the next season.

In water, the concentration of glyphosate is reduced through dispersal by water movement, binding to sediments, and break-down by microorganisms. Glyphosate adsorbs strongly to soil and is readily degraded to carbon dioxide by soil microbes (Sprankle et al. 1975). Glyphosate does not degrade in distilled water, but is rapidly

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adsorbed by suspended sediment and subsequently degraded to Aminomethylphosphonic Acid (Zaranyika and Nyandoro 1993).

Glyphosate is no more than slightly toxic to birds and is practically non-toxic to fish, aquatic invertebrates and honeybees (Folmar et al. 1979, Howe et al. 2004, Mensah et al. 2015, and Takacs et al. 2002). Based on available data, the EPA has determined that the effects of glyphosate on birds, mammals, fish and invertebrates are minimal (EPA 1993).

Glyphosate may be applied as a broadcast spray. This application method is effective for most species in large stands. In very small stands, an alternative method of glyphosate application is to wipe the entire plant (wearing personal protective equipment) with a wet rag or using a wick type applicator. When using glyphosate, an appropriate surfactant must be mixed with the product before application to ensure that the glyphosate “sticks” to the plant surfaces, increasing the rate of absorption. Sometimes in very small stands, one can brush cut the plant down and use an eye dropper to place glyphosate into the interior of the cut stem. The herbicide will travel from the cut stem down into the roots and kill the remaining portion of the plant.

2.2.4 Manual and Mechanical Control

Physical removal is effective for small quantities of plants near shorelines. Techniques include hand pulling, diver assisted suction harvesting (DASH), benthic mats, and Vegetation Rakes. Vegetation Rakes can only be used on screened canals. Mechanical methods could treat up to five acres of submerged vegetation and two acres of emergent vegetation per day.

2.2.4.1 Hand-Pulling

Hand-pulling aquatic plants is similar to pulling weeds out of a garden. It involves removing entire plants (leaves, stems, and roots) from the area of concern and disposing of them in on land away from the shoreline. In water less than three feet deep, no specialized equipment would be required, although a spade, trowel, or long knife may be needed if the sediment is packed or heavy.

In deeper water, hand pulling would be best accomplished by divers. The divers would use mesh bags for the collection of plant fragments. Some sites may not be suitable for hand pulling such as areas where deep flocculent sediments may cause a person hand pulling to sink deeply into the sediment (WSDE 2003).

Hand pulling has the potential to increase turbidity in the area of removal (WSDE 2003). The removal of these plants could result in increased erosion along the shoreline since there would no longer be any roots holding the sediment in place. It is suggested that native species be replanted in place of the exotics which have been removed. This would not only act to stabilize the shoreline, but would also inhibit the regrowth of some exotic species (Corps 2013).

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2.2.4.2 Diver Assisted Suction Harvesting (DASH)

Hand harvesting paired with a vacuum hose is a standard removal process for aquatic plants. The operation involves literally hand-pulling the weeds from the lake bed and feeding them to a suction hose. It requires water pumps to move a large volume of water to maintain adequate suction of materials that the divers are processing. The material placed by the divers into the suction hose along with the water is deposited into onion bags with water leaving through the holes in the bag mesh. The bags must have a large enough 'mesh' size so that silts, clay, leaves, and other plant material being collected do not immediately clog the bags and block water movement.

The basic removal technique is similar to hand-pulling, but DASH replaces collection bags with portable suction hoses. Hose nozzles often feature handles for divers to hold to ease underwater navigation. Once a hose is carefully navigated to a flowering rush patch, divers hold the nozzle steady and slowly input flowering rush plants and fragments into the suction hose. Divers shake root crowns away from the suction nozzle to minimize debris and sediments that may collect in above-water holding tanks (Lake Ellwood Association 2017). Divers must be sure locate and collect any fragments that may have resulted from hand-pulling and shaking. Hoses would be moved underwater from one spot to another with ease and diminish the likelihood of hose entanglement. The hose would also be utilized to suction debris that may be compromising visibility; however, drawing up large amounts of sediments such as small rocks or mud can clog filters and reduce suction capabilities.

Vacuums are typically around six inches in diameter and carry the flowering rush that is pulled underwater up to the surface, either to a stationary boat or a land mass where the plants are collected, sorted, and stored appropriately. The methods associated with filtering and separating plant material above the surface may vary greatly, along with individual DASH system set-ups. There is no uniform construction of DASH mechanisms, but systems generally share the basic components mentioned above.

Systems are costly to build and the manual labor, fuel, and upkeep costs prevent some organizations from employing this method of removal. DASH, along with hand-pulling, typically requires years of continued use to significantly diminish flowering rush infestations. Despite a few drawbacks, these devices improve visibility and transport plants quicker than hand-pulling and bagging.

Advantages of Manual Methods

- Manual methods are easy to use around docks and swimming areas.
- Hand pulling allows the flexibility to remove undesirable aquatic plants while leaving desirable plants.
- These methods are considered safe to the environment.

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Disadvantages of Manual Methods

- Treatment may need to be repeated several times each summer as plants regrow or recolonize the cleared area from fragments.
- May not be practical for large areas or for thick weed beds because these methods are labor intensive.
- Difficult to collect all plant fragments even with the best containment efforts. Flowering rush can regrow from fragments.
- The massive rhizomes of flowering rush are difficult to remove by hand pulling.
- Pulling weeds and raking stirs up the sediment and makes it difficult to see remaining plants.
- Hand pulling and raking disturbs bottom-dwelling animals.

2.2.4.3 Vegetation Rakes – screened canals only

Mini excavators, excavators, and backhoe loaders can attach and operate vegetation rakes with several different sizes and functions (Figure 2-1). Vegetation rakes can either be operated from the land or water. The vegetation rake can remove nuisance vegetation and bottom debris from water depths ranging from 18 inches to 10 feet. Duration of treatment could take two to three years or longer for flowering rush due to the well-developed root systems.

Figure 2-1. Vegetation Rake at work in a canal.

During the removal process, the vegetation rake would extract the plant in its entirety, as well as its attached rhizome structure lain beneath the water's surface. Vegetation raking results in fragments of the plant, which, if not captured by the vegetation rake, must be hand collected to eliminate the possibility of spreading the plant to new areas (Corps 2013).

Vegetation rakes can cut and collect several acres per day depending on plant density and storage capacity of the equipment. Harvesting speeds for typical machines range from 0.5 to 1.5 acres per hour. The vegetation rake deposits each rake full (maximum

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500 pounds) of material directly on-shore. Vegetation Rakes can provide sufficient plant reduction, especially when combined with herbicide management options.

It is important to make sure that the vegetation rake has been thoroughly cleaned and inspected before allowing it to be launched into a waterbody. This is extremely important if the vegetation rake has been working in waterbodies known to be infested with noxious species such as Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla spp.*), Brazilian elodea (*Egeria densa*), or with exotic animals such as the zebra mussel (*Dreissena polymorpha*).

Advantages:

- Removes plants and debris at the sediment-water interface.
- Results in immediate open areas of water.
- Removes plants and roots systems, as well as decaying organic matter, soft sediment, and debris.
- Provides anywhere from one to three years or longer of nuisance plant control through only one service, depending on conditions.
- Clears selective areas including beaches as well as boating and fishing lanes.
- Offers an environmentally friendly solution with no water use restrictions, since chemicals are not used.
- Helps preserve shoreline landscapes.
- Acts as a budget-friendly alternative to traditional dredging.

Disadvantages

- Similar to mowing a lawn; the plant grows back and may need to be harvested several times during the growing season.
- Off-loading sites and disposal areas for cut plants must be available. On heavily developed shorelines, suitable off-loading sites may be few and require long trips by the harvester.
- Small fish, invertebrates, and amphibians are often collected and killed by the harvester.
- Creates plant fragments, which may increase the spread of flowering rush throughout the waterbody.
- Although vegetation rakes collect plants as they are cut, not all plant fragments or plants may be picked up.
- Vegetation Rakes are expensive and require routine maintenance.

2.2.5 Benthic Barriers

Benthic barriers (bottom screen) installation would be subject to timing restrictions from State agencies, which would require installation in the winter.

Bottom barriers are semi-permanent materials laid over the top of flowering rush beds and are analogous to using landscape fabric to suppress the growth of weeds in yards.

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A benthic barrier covers the sediment like a blanket, compressing aquatic plants while reducing, or blocking light. Materials such as burlap, plastics, perforated black Mylar, and woven synthetics can all be used as benthic barriers. Some people report success using pond liner materials. There is also a heavy, felt-like polyester fabric bottom screen commercial material, which is specifically designed for aquatic plant control.

An ideal bottom screen should be durable, heavier than water, reduce or block light, prevent plants from growing into and under the fabric, be easy to install and maintain, and should readily allow gases produced by rotting weeds to escape without "ballooning" the fabric upwards. It is very important to anchor the benthic barrier securely to the bottom, because even the most porous materials, such as window screen, will billow due to gas buildup. Unsecured screens could create navigation hazards and are dangerous to swimmers. Anchors must be effective in keeping the material down and must be regularly checked. Natural materials such as rocks or sandbags are preferred as anchors.

The duration of weed control depends on the rate that weeds can grow through or on top of the bottom screen, the rate that new sediment is deposited on the barrier, and the durability and longevity of the material. For example, burlap may rot within two years; plants can grow through window screening material, and can grow on top of felt-like fabric. Regular maintenance is essential and can extend the life of most bottom barriers.

In summer, cutting or hand pulling the plants first would facilitate bottom screen installation. The less plant material that is present before installing the screen, the more successful the screen would be in staying in place. Bottom screens may also be attached to frames rather than placed directly onto the sediment. The frames may then be moved for control of a larger area.

Advantages

- Installation of a benthic barrier creates an immediate open area of water.
- Benthic barriers are easily installed around docks and in swimming areas.
- Properly installed benthic barriers can control up to 100 percent of aquatic plants.
- Screen materials are readily available and can be installed by divers.

Disadvantages

- Benthic barriers are only suitable for localized control because they reduce habitat by covering the sediment.
- For safety and performance reasons, benthic barriers must be regularly inspected and maintained.
- Harvesters, fishing gear, propeller backwash, or boat anchors may damage or dislodge benthic barriers.
- Improperly anchored benthic barriers could create safety hazards for boaters and swimmers.

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- Swimmers may be injured by poorly maintained anchors used to pin benthic barriers to the sediment.
- Some benthic barriers are difficult to anchor on deep muck sediments.
- Benthic barriers interfere with fish spawning and bottom-dwelling animals.
- Without regular maintenance, aquatic plants may quickly colonize the bottom screen.

2.2.6 Early Detection and Rapid Response (EDRR)

Rapid response and eradication primarily focuses on newly established invasive species. EDRR would primarily consist of active treatment for two to three years and then monitoring to ensure pest species have been eradicated. New detections in all areas would be subject to the EDRR process described in this section. EDRR treatments would be conducted using the same methods and tools described throughout the proposed action of this document.

EDRR refers to newly inventoried flowering rush infestations, including previously undiscovered flowering rush infestations over the life of this project. Ongoing inventory and monitoring occurring through annual applications would look for infestations of new invasive plant species or new locations of existing weeds. Newly discovered infestations or sites would receive a high priority for treatment to eradicate the invasive plants while the infestation is small and easily treatable (USDA 2010). The proposed action would allow treatment of new detections, as long as the treatment method is within the scope described in this document. Limitations associated with treatments would apply to new as well as existing sites.

3 - Affected Environment and Environmental Effects

This section describes the existing affected environment (existing condition of resources) and evaluates potential environmental effects on those resources for each alternative. Although only relevant resource areas are specifically evaluated for impacts, the Corps did consider all resources in the proposed project area and made a determination as to which ones to evaluate. The following resource areas were evaluated: Water Quality, Aquatic Resources, Vegetation, Wildlife, Threatened and Endangered Species, Historic and Cultural Resources, Recreation, and Cumulative Impacts. It was determined that it was not necessary to evaluate Aesthetics/Visual Quality, Noise, Geology and Soils, Air Quality, Climate Change, Socioeconomics, Environmental Justice, or Land Use as implementation of the proposed action would have No or Negligible Impacts to these resources.

The following descriptors are used in the body of this chapter for consistency in describing impact intensity in relation to significance:

• No or Negligible Impact: The action would result in no impact or the impact would not change the resource condition in a perceptible way. Negligible is defined as of such little consequences as to not require additional consideration or mitigation.

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• Minor Impact: The effect to the resource would be perceptible; however, not major and unlikely to result in an overall change in resource character.

• Moderate Impact: The effect to the resource would be perceptible and may result in an overall change in resource character. Moderate impacts are not significant due to their limited context (the geographic, biophysical, and social context in which the effects would occur) or intensity (the severity of the impact, in whatever context it occurs).

3.1 Environmental Resources Considered, but Not Evaluated

Aesthetics/Visual Quality. Aesthetics or visual resources are the natural and cultural features of the landscape that can be seen and that contribute to people's appreciative enjoyment of the environment. The aesthetic quality of an area is a subjective measure of one's perception. Some might find the inflorescence of flowering rush aesthetically pleasing; however, despite the name, not all flowering rush plants flower regularly. Emergent flowering rush without flowers looks similar to the native rushes growing in the area that would not be treated or removed and therefore not changing the aesthetics of the area. Treated plants that are submerged would not be seen.

Flowering rush invasions and subsequent treatments occur in patches of habitat where flowering rush is introduced. Treatment locations would be primarily located at boat ramps, boat basins, marinas, and other similar access points. The majority of these locations would not be considered pristine natural areas, or areas that had not been modified for human use. Typically, these sites are a mix of natural elements (waterbodies, shoreline, riparian zones) and human elements (roads, parking lots, vehicles, boats, docks, etc.). Impacts to aesthetics or visual quality from either alternative would be negligible and are not analyzed in further detail in this EA because no large scale flowering rush invasions or removals in pristine areas are proposed.

Noise. The project areas would be located in areas frequently used for recreation such as lake shores, boat ramps, or fishing sites. Access to treatment sites would be infrequently made by foot, ATV, work truck, or boat. Methods of flowering rush treatment such as back pack sprayers, mounted sprayers, or hose sprayers would have a negligible impact on ambient noise.

Vegetation rakes would be operated by backhoes in screened irrigation canals near where tractors or farm equipment already operate. The added noise from vegetation rakes would be negligible. Impacts to noise from either alternative would be negligible and are not analyzed in further detail in this EA.

Geology and Soils. Aquatic herbicides would degenerate in sediments or bind to the sediments in an inert form. There is no alteration of the topography caused by the performance of either alternative. Impacts to geology and soils would be negligible and are not analyzed in further detail in this EA.

Air Quality. Herbicide treatment methods would employ conservation measures for pesticide applications to include the use of additives to reduce evaporation or volatilization as well as sizing of nozzles to produce larger droplets and orienting of

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nozzles to reduce or prevent spray drift of pesticides (Section 3.12). Herbicide application would not occur when wind speeds exceed 10 miles per hour and there would be no aerial spraying of herbicides. All vehicles used would add de minimus emissions to the air having a negligible impact on air quality.

Flowering rush control activities would not introduce any new stationary sources of air emissions to the region or contribute to a violation of any Federal, state, or local air regulations. Impacts to air quality from either alternative would be negligible and are not analyzed in further detail in this EA.

Climate Change. Climate change, including gradual changes to the climate and extreme climatic events, are already affecting natural resources, cultural identity, quality of life, infrastructure, and health of residents in the Pacific Northwest. Strong climate variability is likely to persist for the Northwest, owing in part to the year-to-year and decade-to-decade climate variability associated with the Pacific Ocean (USGCRP 2018).

Changes in snowpack and stream flows are already occurring in the Pacific Northwest and future climate change would likely continue to influence these changes. Although flowering rush growth varies due to changes in seasonal weather, the impacts from climate change would be negligible to the alternatives and are not analyzed in further detail in this EA.

The alternatives have no activities that produce significant emissions. Vehicular traffic used for the control of flowering rush would be similar to the vehicular traffic of surrounding lands for recreational, agricultural, rural, and commercial activities. Impacts to climate change would be negligible and are not analyzed in further detail in this EA.

3.2 Water Quality

The physical, chemical, or biological condition of water is referred to as water quality. Water quality affects whether water should be used by humans, aquatic organisms, or wildlife. The quality of water in the FSA is important for several reasons: fish and aquatic plants require relatively clean water to live; treatment costs for drinking and industrial supplies are higher if water is polluted; people want clean, attractive water for recreation; farmers need clean water to irrigate crops; and wildlife depend on rivers for clean, safe drinking water.

3.2.1 Affected Environment

CRB

Water quality in the CRB is generally good. The Columbia River carries a large volume of relatively unpolluted surface water. Compared to many other rivers in the United States, there are fewer sources of industrial and municipal wastes. Nevertheless, past studies by Federal and state agencies have shown increased levels of heavy metals such as arsenic, lead, cadmium, copper, mercury and zinc, and other contaminants like dioxins and furans in the rivers (EPA 2006). Several factors could be contributing to the

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water quality issues in the basin, including: (1) nonpoint source additions, (2) water withdrawal for irrigation, (3) impoundments, and (4) point source effluents.

Nonpoint source pollution comes from a wide variety of sources; including irrigation return flows, forestry practices, malfunctioning septic systems, urban runoff, and mining leaches. Irrigation is the dominant nonpoint source of pollutants in the CRB.

Impoundments (reservoirs) have interrupted the free-flowing river system and altered the seasonal variations in water discharge patterns. Some water quality conditions affected by reservoirs include water temperature, dissolved oxygen, nutrient availability, dispersion of hazardous chemicals, turbidity, and sanitary quality. Water temperatures can increase or decrease downstream of a dam. Compared to natural inflows, large reservoirs typically release cooler water in the spring and summer, and warmer water in the fall and winter.

Waste effluents from municipal and industrial plants can constitute a continuous source of water pollution. Municipal sewage treatment plant effluents primarily affect water bodies in urban areas, while mining wastes can seriously affect aquatic communities in rural areas.
Water temperatures in the Columbia and lower Snake Rivers sometimes approach the upper limits of tolerance for cold water fishes, including salmon and steelhead. These warmer temperatures are higher than temperature water quality standards established for the Columbia and lower Snake Rivers by Oregon, Washington, Idaho, and the Colville and Spokane Tribes. Because of these temperature standard exceedances, both rivers are included on the Clean Water Act §303(d) lists of impaired waters established by Oregon, Washington, and Idaho (EPA 2018a). The locations of these impaired waters are illustrated in Figure 3-1.

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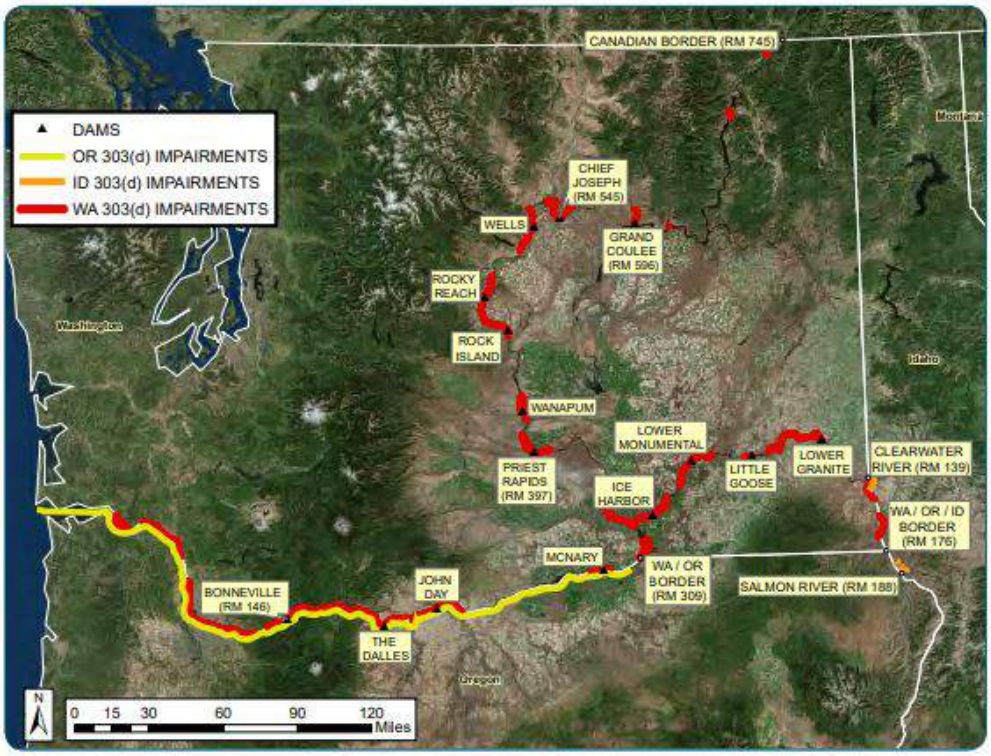

Figure 3-1. Temperature Impairments in the Columbia and Lower Snake Rivers. Source: EPA 2018.

MRB

Current water quality in the Missouri River is considered good. Prior to dam construction, the Missouri River was a dynamic, free-flowing river. As such, continuous bank erosion was common, and the Missouri River naturally tended to be a turbid river. Many of the native fish species in the Missouri River, such as the pallid sturgeon, are specially adapted for life in turbid waters like those that were present in the historic river. Currently, as a result of the upstream reservoirs being constructed in the mid-20th century, turbidity is lower than the natural condition. The suspended sediment load has decreased by 69 to 99 percent, depending on location and proximity to the main stem dams.

Water quality management for the Upper Missouri River in Montana is under the jurisdiction of the Montana Department of Environmental Quality (MDEQ). Montana DEQ develops water quality standards that designate the beneficial uses to be made of surface waters and the water quality criteria to protect the assigned uses. Inorganic nitrogen and total phosphorus levels within the Missouri River exceeded the recommended levels set by MDEQ. It is possible that high nutrient levels are the biggest threat that the Upper Missouri River is facing at present (Peterson et al. 2018). Primary sources of pollution in the Missouri River include runoff of fertilizer, pesticides, and herbicides from the predominantly agricultural watershed, as well as discharges from municipal wastewater treatment facilities and other urban industrial operations; however, reports do not suggest any major impairment to the river due to pollution.

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PSB

Puget Sound, as in most large water bodies, has a great deal of variability with respect to water quality parameters across different parts of the water body. Additionally, water quality is influenced a great deal by natural variability, and discerning natural changes from anthropogenic changes is an ongoing challenge. The most recent monitoring data from the Puget Sound Partnership indicates that marine water quality as a whole continues to decrease relative to the baseline.

The most recent data show the top 50 meters water layer to be warmer than usual from about January to June and cooler than normal in the latter part of the calendar year. Surface temperatures (0-2 meters) in the Central Basin were at or slightly below the long-term average. Water bodies were measured to be slightly saltier than the previous 3 years, although these values did not approach the values observed in the mid-2000s. Salinities in the Central Basin specifically were typical compared to the long-term average except in May through July, when increased freshwater inputs from snowmelt decrease the overall salinity.

3.2.2 Environmental Consequences

3.2.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Chemical Treatment Methods:

Pesticide applications have an inherent potential to affect water quality when in contact with the water table or surface water. Flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore are assumed to be less than significant. However, accidental applications (overspray) and spray drift still have the potential to degrade water quality.

Adverse impacts to water quality would be minor to moderate in the short-term due to potential water quality degradation from the use of herbicides to control invasive species. Additionally, there would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and native species would reestablish.

The No Action Alternative does not employ the added conservation measures listed in Section 3.12 of this document to further reduce impacts of chemical treatment to water quality.

Manual and Mechanical Treatment Methods:

Application of manual/mechanical weed control methods could increase the potential for erosion and sedimentation into surface waters. However, generally large infestations would be treated with herbicides, while small infestations would be treated with

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manual/mechanical control, thus reducing the potential for erosion and sedimentation. The exception would be the use of vegetation rakes to remove large infestations of flowering rush in irrigation canals.

The vegetation rakes would create turbidity as the rake removes vegetation from beneath the water's surface. Removing the sediment structure provided by flowering rush rhizomes could increase erosion by creating instability in stream beds and stream banks. Erosion would further increase turbidity. Using vegetation rakes to remove infestations of flowering rush could have minor impacts in the short-term. Impacts would be limited to the immediate area where vegetation removal would occur. As dense monocultures of flowering rush prevent waterbodies from full ecological function, water quality would be only slightly impaired beyond its prior (infested) condition.

However, removing the flowering rush would allow for native plants to recolonize and stabilize the stream banks and stream beds. There may also be areas where flowering rush was removed that would remain as open flowing water improving habitat for native salmonids and removing habitat for predatory fish species. Ultimately, removal of flowering rush would have beneficial effects to water quality.

Impacts on water quality due to erosion from manual/mechanical treatments would range from negligible to minor depending on method used. Hand-pulling and DASH would have negligible adverse impacts to water quality in the short-term. Vegetation rakes could have minor adverse impacts on water quality in the short term. Long-term impacts are expected to be beneficial to the system for the reasons discussed above.

Benthic Barriers:

Installing benthic barriers would temporarily increase turbidity in the water. Benthic barriers would only be used in small localized areas and not disturb large areas of sediment. The turbidity increase caused by benthic barriers would have a minor impact to water quality in the short-term and negligible to no impact to water quality in the long-term.

3.2.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. Differences in chemical use include fewer chemicals approved for use (Section 2.2.3) and more conservation measures (Section 3.12). Additionally, the Proposed Action Alternative restricts the use of vegetation rakes to screened irrigation canals. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Chemical Treatment Methods:

The Corps would only fund chemical flowering rush control using five aquatic herbicides known to have minor effects to water quality, although some of the approved herbicides have drinking and irrigation water use restrictions discussed below. The use of a limited

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number of herbicides reduces the intensity of chemical use and the potential of adversely impacting water quality. Additional control methods would reduce or eliminate chemical misapplications, spills, overspray, and spray drift (as discussed in the No Action Alternative).

The following restrictions apply to the approved herbicides:

Imazapyr cannot be applied within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half mile of an active potable water intake in a standing body of water, such as a lake, pond, or reservoir. If application occurs within one-half mile of a drinking water intake, then the intake must be shut off for 48 hours following treatment. There is also a 120-day irrigation restriction for Imazapyr treated water, but irrigation can begin sooner if the concentration falls below one part per billion (ppb).

Diquat bromide treated water should not be used as drinking water for one to three days, depending on the concentration used in the treatment. Diquat bromide treated water cannot be used for pet or livestock drinking water for one day following treatment. The irrigation restriction for diquat bromide treated water on food crops is five days.

Endothall cannot be used within 600 feet of drinking water intakes.

Glyphosate treatment would require potable water intakes within one-half mile to be turned off for 48 hours after application.

Chemical flowering rush control under the Proposed Action Alternative would have a minor effect on water quality, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Manual and Mechanical Treatment Methods:

The Corps would only cost share the use of vegetation rakes in screened irrigation canals. Due to equipment size and operation costs, vegetation rakes would likely only be chosen for use in areas of extreme infestations where monocultures of flowering rush exist and irrigation canal function has been compromised. The use of vegetation rakes would increase turbidity and sedimentation in irrigation canals which could clog turnouts (point at which the control of the water changes from the irrigation district to the customer), reduce water and sediment conveyance capacity, raise water levels, and reduce discharge capacities (Lawrence and Atkinson 1998 and Depeweg and Mendez V 2002). Any additional sediment deposits in irrigation canals would need to be removed to maintain irrigation supplies.

Water conveyance and discharge capacities would improve in the irrigation canals once the flowering rush has been removed. With the flowering rush removed, irrigation canal turbidity would return to background levels and sediment would be transported downstream reducing accumulation.

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This alternative would not allow the use of vegetation rakes in rivers, streams, lakes, or ponds limiting impacts to screened irrigation canals, thus limiting the context in which this method may be used and its impacts to natural environmental resources. Mechanical methods of flowering rush treatment under the Proposed Action Alternative would have a moderate effect to water quality, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Benthic Barriers:

Impacts would be the same as the No Action Alternative, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

3.3 Wetlands and Aquatic Vegetation

3.3.1 Affected Environment

Wetlands improve water quality by filtering sediments and toxins; reducing flooding and erosion by acting like a sponge to absorb water during spring runoff and releasing it later in the year. Wetlands also provide critical habitat for fish and wildlife. In fact, more than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half use wetlands at some point in their lives (EPA 2018b).

Wetlands are the transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land must support predominantly hydrophytes (wetland plants); (2) the substrate is predominantly undrained hydric soil (i.e. adapted to a wet environment); and (3) rocky, gravelly, or sandy areas that are saturated with or covered by shallow water at some time during the growing season (Cowardin et al. 1979).

It is estimated that over 50% of the wetland areas in the U.S. have disappeared in the past 200 years and National Audubon Society estimates that over 100,000 acres of American wetlands continue to be destroyed annually (Montana Audubon 2019). Wetlands are threatened by both direct and indirect impacts related to land use.

Wetland loss by state is displayed in Table 3-1. The original wetland acreage was measured in the 1780's and the remaining wetland acreage was measured in the 1980's. Wetland losses during the 200 year period ranged from 27% in Montana to 56% in Idaho (Table 3-1). Today the most complete inventories show wetlands only make up 1 to 3 percent of the total land mass for each state in the FSA (Montana Natural Heritage Program 2015, Deinarowicz 2019, The Wetland Conservancy 2019, and WSDE 2019).

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Table 3-1.Wetland Losses in the United States 1780's to 1980's (Dahl 1990).

State	Original Wetland Acreage	Remaining Wetland Acreage	Acreage Lost	Percent Lost
Washington	1,350,000	938,000	412,000	31%
Idaho	877,000	385,700	491,300	56%
Oregon	2,262,000	1,393,900	868,100	38%
Montana	1,147,000	840,3000	306,700	27%

Flowering rush invasions can have long-term detrimental impacts on wetland ecosystems. Weeds crowd out native plants and animals, interfere with or alter natural processes such as water flow and evapotranspiration and lead to loss of native plant biomass and biodiversity. Flowering rush does not tolerate salt water, so no coastal or estuary wetlands were analyzed in this document.

CRB

The majority of wetlands in the CRB are riverine wetlands. Riverine wetlands are associated with freshwater rivers and their tributaries. The Columbia and Snake River wetlands develop in the few areas where floodplains are wide enough for sediment to accumulate and support emergent vegetation. These wetlands are sustained by ground-water discharge and river flooding. Flowering rush invasion in riverine wetlands would most likely occur below the average water mark in the intermittently and permanently flooded zones where water is still or moderately flowing (Figure 3-2).

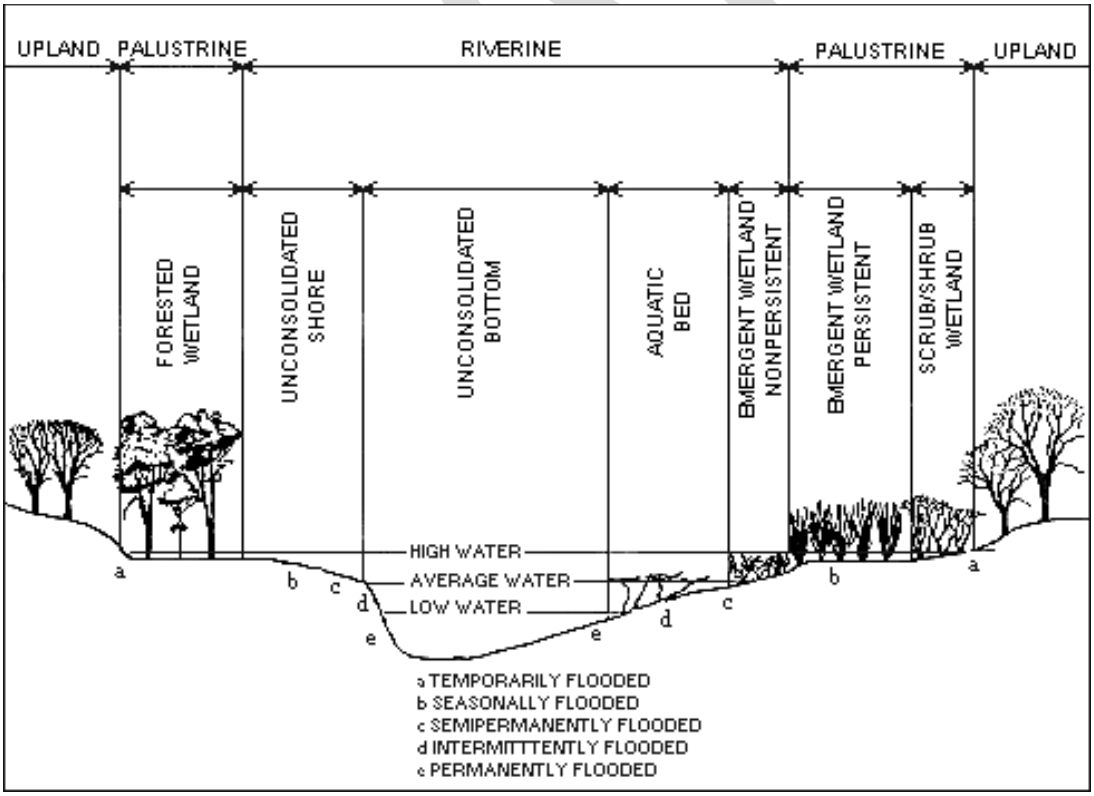

Figure 3-2. Riverine wetland complex (Coward et al 1979).

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MRB

Historically the Missouri River represented one of North America's most diverse ecosystems with a dynamic complex of braided channels, riparian lands, chutes, sloughs, islands, sandbars, wetlands, and backwater areas. The river has been transformed from a free-flowing river into a system of main stem reservoirs and reaches influenced by self-channelization, bank stabilization and regulated flows. Much of the river's habitat diversity and balance has been lost, including wetlands.

PSB

Wetlands are present in the shallows of many landforms in Puget Sound including barrier estuaries, barrier lagoons, closed marshes and lagoons, and large river deltas. Many of these wetlands have severely declined or been lost due to anthropogenic stressors. Wetlands provide foraging and rearing habitat to a variety of organisms in Puget Sound. Three types of vegetated wetland classes are present: estuarine mixing, oligohaline transition, and tidal freshwater.

Freshwater tidal or surge plain wetlands were once common throughout the Puget Sound nearshore zone. Unique to the freshwater extent of river deltas, the water levels rise and fall with the tides but the water is fresh (less than 0.5 parts per trillion salt). Generally these are high-nutrient and high-energy systems (Kunze 1994). The analysis of changes in distributions of wetlands between the late 1800s and circa 2000 indicates that less than 10 percent of the historical area of tidal freshwater wetlands remains in Puget Sound (Simmental et al. 2009). The Washington Natural Heritage Program identifies freshwater tidal wetlands as highly vulnerable with a substantial decline. Loss of freshwater tidal wetlands can be attributed to sea dikes and levees, filling of estuaries for agriculture production, and commercial and residential development.

3.3.2 Environmental Consequences

3.3.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in wetland habitats would result in the reduction of or prevention of expanding infestations and ultimately enhance native wetland plant communities. Enhancing native wetland vegetation would eventually provide higher quality habitat for wildlife and aquatic species and improve wetland function. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Chemical Treatment Methods:

Management options for flowering rush are highly dependent upon the hydrology of the system. Winter drawdown allows for bareground herbicide treatment that can be effective if water levels are low enough to expose the whole plant, although repeated applications may be necessary and timing of treatments is critical. Treatment of emergent foliage of plants growing in water was most effective if at least 5-7 inches of

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leaves had emerged and plants were above the water line (Parkinson et al. 2010). Water column injection herbicide treatments may be more effective for killing rhizomes (Parkinson et al. 2010). Submersed plants are often treated with Diquat however, herbicide treatment of submersed plants in deep water is complicated by water movement and reduced contact times, although there are several aquatic labeled herbicides that have not been tried on flowering rush.

Herbicide application could have adverse impacts to wetland plant species diversity and total plant cover (native wetland plants and flowering rush). A reduction in total plant cover could increase sedimentation and change the hydrologic conditions necessary for floodwater storage. A reduction in total plant cover could also lead to an increase in water temperature and impair important wildlife habitat.

The risks of impacting non-target plant species and reducing total plant cover is higher with the non-selective herbicides. Non-selective herbicides would kill most plants in water. Misapplications and spills are the leading cause of impacts to non-target plant species. Accidental applications (overspray) and spray drift can degrade water quality in wetlands and damage non-target vegetation.

The No Action Alternative does not employ the added conservation measures listed in Section 3.12 of this document to further reduce impacts of chemical treatment to wetlands.

Minor to moderate adverse effects to wetlands could be observed in the short-term due to adverse effects to non-target plant species and water quality degradation from the use of herbicides, but the impacts would not last after the herbicide become inert. However, flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore effects are assumed to be less than significant. Additionally, there would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and native species would reestablish.

Manual and Mechanical Treatment Methods:

Application of manual/mechanical methods could increase the potential for erosion and sedimentation into surface waters. Manual/mechanical methods could also create plant fragments, which may increase the spread of flowering rush throughout the wetland and temporarily increase turbidity.

DASH is an efficient manual/mechanical method, but may disturb native wetland organisms. Vacuum harvesting does not only collect plants that are directly placed into the hose, but it also collects anything that meets the nozzle including native plants. Impacts on water quality from manual/mechanical methods would be minor to moderate, because generally only small infestations would be treated with manual/mechanical control, thus reducing the potential for erosion.

Manual/mechanical control of weeds would range from minor to major adverse impacts to wetlands in the short term. Impacts would be limited to the immediate area where vegetation removal would occur. Regrowth of vegetation would occur within a few

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growing seasons. Long-term impacts would be beneficial as it is anticipated native wetland species would become reestablished in treated areas.

Benthic Barriers:

Benthic barriers reduce wetland habitat by covering the sediment. The growth of both flowering rush and non-target plants would be prohibited while the benthic barrier remains anchored and intact. Benthic barriers are only suitable for localized control. Adverse impacts to wetlands would be minor to moderate in the short-term due to potential negative affects to non-target plant species.

3.3.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions.

Chemical Treatment Methods:

The only non-selective herbicides that would be used for cost shared flowering rush would be Imazapyr, Diquat dibromide, and Glyphosate. The three listed non-selective herbicides do not persist long in the environment due to exposure to light (Imazapyr, half-life is 3-5 days) and rapid absorption by soils or break-down by microorganisms (Diquat and Glyphosate), thus limiting the exposure of non-target plants to these chemicals.

Conservation measures (Section 3.12) would be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift (as discussed in the No Action Alternative). Minimizing application methods would reduce impacts to water quality in wetlands and limit the damage to non-target vegetation.

The impacts of chemical methods under the Proposed Action would be minor to moderate in the short-term because there is still the potential for water quality degradation and impact on non-target plants. These effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative. There would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and native species would reestablish.

Manual and Mechanical Treatment Methods:

Impacts from manual/mechanical methods would be similar to impacts under the No Action Alternative; with one major exception, vegetation rakes would not be used in wetlands. Manual/mechanical methods would have minor to moderate adverse impacts on wetlands in the short term and minor to moderate beneficial impacts in the long term. These effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

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Benthic Barriers:

Impacts would be the same as the No Action Alternative. These effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

3.4 Aquatic Wildlife

3.4.1 Affected Environment

The biological aquatic resources include fish species, reptiles, amphibians, and mollusks that depend on the freshwater ecosystems within the project area for some or all of their life cycles. Fish are either resident fish that do not migrate out to the ocean or anadromous fish, born in fresh water, spend most of its life in the sea, then return to fresh water to spawn. Amphibians begin their life in freshwater with gills and tails and as they grow, they develop lungs and legs for their life on land. Freshwater mollusks are confined to permanent bodies of water, including creeks, rivers, ponds, and lakes. Aquatic insects are abundant in most freshwater habitats and often exhibit high diversity. In aquatic food webs, they serve as food items for nearly the full range of vertebrate and invertebrate predators, and many function as predators themselves.

CRB

The CRB provides habitat for hundreds of species of native and non-native aquatic organisms. The CRB has been significantly altered as a result of hydroelectric and agricultural development. Disturbance in the region is greater than a 15% equivalent clear-cut area within the Middle Columbia River watershed. Currently there is only a thin band of riparian vegetation along the Columbia River as the natural riparian and floodplain was inundated. Historically, the Columbia River may have had a larger riparian area and small floodplain.

While the Columbia River dams are run-of-river dams that generally pass the incoming river volume, the forebay pools act much like one large pool. The reservoirs are much deeper and wider than the pre-impoundment Columbia River. Furthermore, upstream dams alter the movement of sediment through the action area, resulting in few accumulations of suitable spawning gravels, most of the substrate consists entirely of sand. In many places no riparian trees are present at all along the Columbia River, often replaced by levees and riprap. Levees were constructed to confine the river and prevent the river from accessing the floodplain.

In the CRB, flowering rush has been found growing in a wide range of substrate types, from rock to sand to muck (Rice and Dupuis 2009 and Jacobs et al. 2011). It will also grow in still to moderately flowing water. Water level fluctuations can promote its growth, though it would also thrive where water levels are stable (Hroudova 1989 and Hroudova et al. 1996).

The most notable fish species migrating and spawning throughout the CRB are salmon and steelhead. The altered conditions of the Columbia River with sandy bottoms, rocky

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stream banks, and slow-moving fluctuating pools may facilitate flowering rush invasion reducing spawning habitat for salmonids and increasing habitat for predatory fish. Salmon are discussed in more detail because of their ecological, cultural, and economic importance in the CRB.

The most well-known anadromous fish in the CRB are salmonids (salmon, trout, and char). Several agencies monitor salmonid populations due to the ecological and economic importance and declining numbers (warranting the listing of several species on the Endangered Species List). Known as a keystone species (Willson and Halupka 1995), Pacific salmon are a food source for many marine, freshwater, and land animals and provide marine nutrients to freshwater environments post-spawning (Cederholm et al. 1999).

MRB

The Missouri River ecosystem experienced a marked ecological transformation during the twentieth century. At the beginning of the century, the Missouri River was notorious for large floods, for a sinuous and meandering river channel that moved freely across its floodplain, and for massive sediment transport. Seven large dams were constructed along the Missouri River during the twentieth century and floodplain areas along the upper Missouri were inundated by the reservoirs. Large areas of native vegetation communities in downstream floodplains were converted into farmland. Many native fish species experienced substantial reductions while nonnative fishes thrived is some areas (National Research Council 2002).

The clear water in the reservoirs provided an advantage to “sight feeding” native species, such as the walleye, which was a species in relatively low abundance whose numbers increased dramatically with habitat changes caused by the reservoirs. Just as these environmental changes made conditions better for some species, other species that were better adapted to pre-regulation conditions, such as the sauger (*Stizostedion canadense)*, experienced declines with the replacement of a free-flowing river by the system of reservoirs (National Research Council 2002).

PSB

Fifteen native species of anadromous fish use marine and freshwater of the Puget Sound area. These include all five species of Pacific salmon (Chinook (*Oncorhynchus tshawytcha*), pink (*O. gorbuscha*), Coho (*O. kisutch*), chum (*O. keta*), and sockeye (*0.Nerka*)), two species of native char (bull trout (*Salvelinus confluentus)* and Dolly Varden (*S. malma*), steelhead (*Oncorhynchus mykiss*) and coastal cutthroat trout (*O. clarki*), longfin smelt (*Spirinchus Thaleichthys*), eulachon (*Thaleichthys pacificus*), white sturgeon (*Acipenser transmontanus*), and green sturgeon (*A. medirostris*), and two species of lamprey.

Fish species

CRB: Chinook salmon, Sockeye salmon, Coho salmon, Chum salmon, pink salmon, rainbow trout (*O. mykiss*), Cutthroat trout, steelhead, bull trout, Dolly Varden, western

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brook lamprey (*Lampetra richardsoni*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey (*L. tridentata*), and white sturgeon, as well as a variety of minnow, suckers, catfish, and sport fish.

MRB: shovelnose sturgeon (*Scaphirhynchus platorynchus*), pallid sturgeon (S. albus), paddlefish (*Polyodon spathula*), burbot (*Lota lota*), sauger, walleye (*Sander vitreus*), northern pike (*Esox lucius*), a variety of minnows, suckers, catfish, and sport fish.

PSB: Chinook salmon, Sockeye salmon, Coho salmon, Chum salmon, pink salmon, steelhead, bull trout, Dolly Varden, longfin smelt, eulachon, western brook lamprey, Pacific lamprey, white sturgeon, and green sturgeon.

Reptile Species

CRB: painted turtle (*Chrysemys picta*)

MRB: western spiny softshell (*Trionyx spiniferus*) and painted turtle

PSB: western pond turtle (*Clemmys marmorata*) and painted turtle

Amphibian species

CRB: western toad (*Bufo boreas*), bullfrog (*Lithobates catesbeianus*), woodhouse toad (*Bufo woodhouseii*), Pacific tree frog (*Pseudacris regilla*), Columbia spotted frog (*Rana luteiventris*), Great Basin spadefoot (*Spea intermontana*), leopard frog (*Rana pipiens*), and long-toed salamander (*Ambystoma macrodactylum*).

MRB: tiger salamander (*A. tigrinum*), plains spadefoot (*Spea bombifrons*), Woodhouse's toad (*Bufo woodhousii*), Great Plains toad (*B. cognatus*), western chorus frog (*Pseudacris triseriata*), and northern leopard frog (*Rana pipens*).

PSB: Pacific giant salamander (*Dicamptodon tenebrosus*), Cope's giant salamander (*D. copei*), Olympic torrent salamander (*Rhyacotriton olympicus*), northwestern salamander (A. gracile), long-toed salamander (*A. macrodactylum*), rough-skinned newt (*Taricha granulosa*), Oregon ensatina (*Ensatina escholtzii*), western red-backed salamander (*Plethodon vehiculum*), tailed frog (*Ascophus truei*), western toad (*Bufo boreas*), Pacific tree frog, bullfrog, red-legged frog (*R. aurora*), Cascades frog (*R. cascadae*), and Oregon spotted frog (*R. pretisosa*).

Mollusk species

Snails, mussels, and clams. Examples include: Western ridged mussel (*Gonidea angulate*), fingernail clams and pea clams (Family *Sphaeriidae*), non-native Asian clams (*Corbicula fluminea*) and the great pond snail.

Common aquatic insects include: mayflies (*Ephemeroptera* spp.), caddisflies (*Trichoptera* spp.), dragonflies (*Odonata* spp.), and stoneflies (*Plecoptera* spp.).

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3.4.2 Environmental Consequences

3.4.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in freshwater habitats would result in the reduction of or prevention of expanding infestations and ultimately enhance freshwater habitats. Enhancing freshwater habitats would benefit aquatic species and improve ecological function. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Without any treatment, flowering rush would have greater effects on fish habitat by forming dense stands in previously un-vegetated or sparsely-vegetated aquatic environments (Jacobs et al. 2011). Dense stands of flowering rush would be a disadvantage to native salmonid species that require open water to spawn, and actually be an advantage to introduced fish that prey upon native fish (Perkowski 2014). For example, largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), and northern pike (*Esox Lucius*) spawn in vegetated substrata. Largemouth bass and northern pike are ambush predators that hide in flowering rush vegetation. Introduced predatory fish species are depredating native fish populations and impairing the recovery of native salmonids in the Columbia River watershed (Tabor et al. 1993, Fritts and Pearsons 2004, and Bonar et al. 2005).

Chemical Treatment Methods:

Chemical toxicity from pesticide applications can directly impact aquatic wildlife. Aquatic species may encounter pesticides through direct application, drift, overspray, or consumption of insects that may accumulate pesticides through its diet. Additionally, rapid-acting herbicides may cause low oxygen conditions to develop as plants decompose which may result in fish kills in ponds or lakes. Herbicides can also kill salmonid species directly or through continued exposure (OPEN1999). Adverse effects to aquatic wildlife are dependent on a number of factors including the dosage, duration, or exposure, and particular species being exposed.

Site isolation would prevent effective concentrations of treatment chemicals from occurring outside intended treatment areas. Therefore, the effects of the proposed treatments are anticipated only for the specific, isolated treatment area, and are not applicable to the remainder of the waterbody or associated species populations.

Adverse effects to aquatic species could be seen in the short-term due to the potential negative effects discussed above and water quality degradation (Section 3.2) from the use of herbicides. However, flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore are assumed to be less than significant. Additionally, there would be beneficial, moderate impacts over the long-term as herbicides would control invasive plants and improve aquatic habitat quality.

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Manual and Mechanical Treatment Methods:

Nonchemical control can also be effective. Mechanical control using a vegetation rake has provided multiple years of control in Idaho irrigation canals. Raking creates abundant rhizome fragments, however, and may lead to colonization of downstream sites; for this reason raking should only be used on screened canals. Hand-pulling by divers and covering the treated area with bottom barriers have both been effective methods, but are only economically viable on small patches of plants. Vegetation rakes may collect small fish, amphibians, turtles, and aquatic insects in the bucket as plants are scooped and ripped from the sediment.

Vacuum harvesting may collect small aquatic organisms that meet the nozzle. Small organisms may be drawn into the hose and relocated from their natural habitat. Sound and vibration disruptions produced could also place stress on organisms above and below the surface.

Manual and mechanical methods under the No Action Alternative have the potential to adversely affect aquatic species through disturbance, increased turbidity, increased water temperature, and food resource impacts. Manual/mechanical control of weeds would range from minor (hand-pulling and DASH) to moderate (vegetation rakes) adverse impacts to aquatic species in the short term and beneficial impacts in the long term as it is anticipated aquatic species would become reestablished in treated areas.

Benthic Barriers:

Benthic barriers interfere with fish spawning and bottom-dwelling animals. Benthic barriers are only suitable for localized control so potential adverse impacts to aquatic species would be minor to moderate in the short-term due to the displacement of bottom-dwelling animals and the potential loss of small areas of spawning habitat. Short-term impacts would be minor.

3.4.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The beneficial effects of flowering rush control to aquatic resources would be greater than those seen in the No Action Alternative, if cost share partners are able to treat additional locations due to the additional funding. The adverse effects of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions.

Chemical Treatment Methods:

Conservation measures (Section 3.12) would be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. The minimizing application methods would reduce impacts to aquatic species. The following chemicals, discussed in Section 2.2.3 (Chemical Descriptions), are covered for use under this method.

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Ammonium salt of imazamox is practically nontoxic to finfish and aquatic invertebrates. Acute fish toxicity occurs in rainbow trout (cold water species) at concentrations greater than 122 mg/L and in bluegill sunfish (warm water species) at concentrations greater than 119 mg/L. Aquatic invertebrate toxicity occurs at concentrations greater than 122 ppm (EPA 1997). Fish would not be exposed to concentrations equal to or greater than the amounts discussed above, therefore Ammonium salt of imazamox expected to pose only a minimal risk to aquatic organisms from exposure.

Imazapyr is practically non-toxic to freshwater fish (lethal concentration required to kill 50% of the population is greater than 100 mg/L), and to freshwater invertebrates (concentration with a response halfway between the baseline and maximum (EC50) is greater than 100 mg/L). No Observed Adverse Effect Concentration (NOAEC) for the early life-stage and full life cycle in fish range was between 118 and 120 mg/L. Chronic toxicity testing in freshwater invertebrates showed the NOAEC was 97.1 mg/L (EPA 2003). Imazapyr is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

Diquat dibromide may pose acute or chronic risk to aquatic organisms, but the probability that exposure would occur is relatively low because diquat is rapidly absorbed by plants and soils. Diquat dibromide is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

The presence of diquat products at concentrations effective against weeds in wetland environments may adversely affect these environments. Dilution should mitigate the effects of diquat so that it does not affect non-target animals. The presence of diquat in the lotic environment, due to outflow from a lake or pond, may kill aquatic plants favorable to sunfish, minnows, and bass. The subsequent habitat, with a low level of aquatic weed cover and a bottom consisting primarily of sand and gravel would be more appropriate to the production of salmonids (WSDE 2002).

Endothall dipotassium salt is applied directly to the aquatic environment. On an acute basis, the dipotassium salt is considered to be slightly toxic to practically non-toxic to freshwater fish and invertebrates (EPA 2005). At recommended rates, the dipotassium salts do not have any apparent short-term effects on the fish species that have been tested. In addition, numerous studies have shown the dipotassium salts induce no significant adverse effects in aquatic invertebrates (such as snails, aquatic insects, and crayfish) when used at label application rates (Table 2-1).

Glyphosate is practically nontoxic to fish and aquatic invertebrates (EPA 1993). Studies of the effects of glyphosate on salmonid species have found that when used at recommended rates it poses little or no risk of acute toxicity. The effects of glyphosate formulations on four species of frogs suggested that effects were largely due to the surfactant, citing no significant acute toxicity from glyphosate itself and the highest toxicity from the surfactant POEA, which is used in the common form of glyphosate known as Roundup (Howe et. al. 2004). Similarly, a study of the effects of Rodeo (glyphosate) found that moderate toxicity to larval frogs was from the surfactant R-11 and not Rodeo (Trumbo 2005). Glyphosate is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

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Impacts to aquatic species using chemical methods under the Proposed Action Alternative would be moderate to negligible in the short-term due to the restriction in chemicals, the conservation measures (Section 3.12), and the fact that applicators must follow all EPA label restrictions. No significant impacts to aquatic species are expected as a result of this action. Long-term impacts would be moderately beneficial.

Manual and Mechanical Treatment Methods:

Manual and mechanical methods would have similar effects to aquatic species as those described under the No Action Alternative, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative. The difference is that vegetation rakes would be limited to screened irrigation canals to minimize impacts to fish. Limiting the use of vegetation rakes to screened irrigation canals would reduce the range of adverse impacts to aquatic organisms to minor or moderate in the short term.

Benthic Barriers:

Benthic barriers would have the same effects to aquatic species as those described under the No Action Alternative, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Long-term benefits of flowering rush treatment

Long-term benefits of flowering rush treatment include improved habitat, reduced predatory fish habitat, and increased ambient light. Promotion of native habitats would help reduce available spawning and rearing habitat for predatory fish, and improve access for foraging, rearing, refugia, and migration. Flowering rush stands can alter ambient light in treatment areas. Controlling infestations would help avoid and reduce the negative effects of altered ambient light regimes from pest species. Changes to the ambient light regime and riparian and benthic habitat resulting from flowering rush control would benefit fish behaviors and juvenile survivability. To the extent that a reduced financial burden would allow state and local agencies to more effectively combat flowering rush, the Proposed Action would have greater long-term benefits than the No Action Alternative.

3.5 Vegetation

3.5.1 Affected Environment

Riparian, lotic, and wetland plant communities within the FSA vary across the landscape based on the environmental factors such as elevation, climate, and physical and chemical characteristics present at each location.

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Columbia and Missouri River Basins

High elevation sites within the watersheds are typically dominated by lodgepole pine (*Pinus contorta*), Drummond's willow (*Salix drummondiana*), Geyer's willow (*S. geyeriana*), Booth's willow (*S. boothii*), Sitka willow (*S. sitchensis*), green alder (*Alnus viridis*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), grey alder (*A. incana*), northern black currant (*Ribes hudsonianum*), twinberry honeysuckle (*Lonicera invulcrata*), thimbleberry (*Rubus parviflorus*), huckleberry (*Vaccinium membranaceum*), mountain rush (*Juncus balticus*), mountain boykinia (*Boykinia major*), Kentucky bluegrass (*Poa pratensis*), Nebraska sedge (*Carex nebrascensis*), Canby's licorice-root (*Ligusticum canbyi*), and fireweed (*Chamerion angustifolium*) (Hough-Snee et al. 2015).

Low elevation watersheds can be dominated by western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), ponderosa pine (*Pinus ponderosa*), black cottonwood (*Populus* balsamifera *trichocarpa*), Rocky Mountain maple (*Acer glabrum*), black hawthorn (Crataegus douglasii), shinning willow (S*. lucida*), mock orange (*Philadelphus lewisii*), snowberry (*Symphoricarpos albus*), northern oak fern (*Gymnocarpium dryopteris*) and lady fern (*Athyrium filix-femina*), Canada thistle (*Cirsium arvense*), threeleaf foamflower (*Tiarella trifoliate*), Alpine enchanter's-nightshade (*Circaea alpine*), panicled bulrush (*Scirpus microcarpus*), and spike-rush (*Eleocharis palustris*) (Hough-Snee et al. 2015).

Heavily forested watersheds can be dominated by watermelon berry (*Streptopus amplexifolius*), prickly currant (*Ribes lacustre*), creeping dogwood (*Cornus canadensis*), and twinflower (*Linnaea borealis*) (Hough-Snee et al. 2015).

PSB

Riparian vegetation characteristic of Puget Sound lowlands includes coniferous trees such as western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga menziesii*), and western red cedar. Pacific madrone (*Arbutus menziesii*) occurs in drier areas. Native deciduous trees such as red alder (*A. rubra*), big leaf maple (*Acer macrophylla*), and vine maple (*Acer circinatum*) are present if there is disturbance, minimal soil development, and a local seed source to facilitate colonization. Shrubs and understory plants such as ocean spray (*Holodiscus discolor*), Oregon grape (*Mahonia spp.*), Indian plum (*Oemlaria cerasiformis*), and sword ferns (*Polystichum munitum*) are common in riparian areas (Brennan 2007).

In large river deltas, the majority of the forested wetlands and riparian zones are entirely devoid of trees or consist of sparse, narrow, and patchy strips of small-to medium-sized cottonwood, willow, and alder. River channelization and bank stabilization with levees have required vegetation removal, which results in the majority of the stabilized banks being covered with grasses and invasive species of low value to the native fish and wildlife. Invasive shrubby species such as Himalayan blackberry (*Rubus armenicus*), butterfly bush (*Buddleja davidii*), reed canary grass (*Phalaris arundinacea*), and Japanese knotweed (*Polygonum spp.*) commonly invade disturbed areas, often so aggressively that they inhibit establishment of native vegetation.

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3.5.2 Environmental Consequences

3.5.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in the FSA would result in the reduction of or prevention of expanding infestations and ultimately enhance native plant communities. Enhancing native vegetation would eventually provide higher quality habitat for wildlife and aquatic species and improve watershed function. The primary methods of treatment would remain chemical, manual, or mechanical methods.

Chemical Treatment Methods:

Chemical misapplications, spills on land, overspray, and spray drift would cause direct impacts to native or non-target terrestrial plants. Indirect impacts to terrestrial plants would occur if herbicides in the water were taken up by shoreline vegetation with roots extending into the water. Potential impacts to terrestrial plants include mortality, reduced productivity, and abnormal growth. Impacts would be minor to moderate depending on the sensitivity of the plant species to the specific herbicide and the dose to which the plant was subjected. Individual plants could perish entirely, but less than significant effects would be seen in vegetation communities overall. Impacts would be limited to the immediate area where vegetation removal would occur. Regrowth of vegetation would occur within a few growing seasons.

Manual and Mechanical Treatment Methods:

Vegetation rakes operated from the shorelines would have moderate adverse effects to shoreline vegetation due to crushing, breaking, or removal. The severity of the impact would depend on the amount of vegetation present. Impacts would be limited to the immediate area where vegetation removal would occur, and trampled vegetation would be expected to regrow within two seasons. However, it is not likely that vegetation rakes would be operated from the shoreline in heavily vegetated areas. Aquatic vegetation rakes (AVR) would be used instead. Aquatic vegetation rakes can best be described as a floating barge upon which a backhoe is mounted. The AVR can operate in water as shallow as 1.0 foot and can remove nuisance vegetation and bottom debris from water depths ranging from 18 inches to 10 feet. Because the AVR works from the water rather than land, plant species along the shoreline are not impacted. Raking creates abundant rhizome fragments, however, and may lead to colonization of downstream sites impacting native plant communities downstream. Impacts of vegetation rakes could range from negligible to moderate. Hand-pulling and DASH control methods would have negligible to no impacts on terrestrial plant species.

Benthic Barriers:

Benthic barriers would have no impacts to terrestrial vegetation.

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3.5.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Chemical Treatment Methods:

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Impacts would be minor to moderate due to the conservation measures, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Manual and Mechanical Treatment Methods:

Vegetation rakes would only be used in screened irrigation canals. The impacts of operating the vegetation rake from the shoreline would be minor to moderate due to the fact that treatment would take place in disturbed landscapes through which the irrigation canals run, but these effects may potentially be spread over a greater number of locations than are affected under the No Action Alternative.

Benthic Barriers:

Benthic barriers would have no impacts to terrestrial vegetation.

3.6 Terrestrial Wildlife

3.6.1 Affected Environment

Riparian corridors (rivers, streams, and adjacent lands) are particularly valuable habitats for wildlife. This includes many of what are ordinarily thought of as "upland" species as well as wetland species. Many mammals, birds, and reptiles are dependent on undeveloped, vegetated riparian areas along rivers and streams for movement corridors, hiding cover, hunting, and drinking.

Mammal species dependent upon on the habitats provided by rivers, streams and associated ponds and wetlands include mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), river otter (*Lontra canadensis*), American water shrew (*Sorex palustris*), American beaver (*Castor canadensis*), and moose (*Alces alces*). Many other species, however, spend much of their lives within the habitats immediately surrounding the waterways; they are dependent on mixed upland and lowland habitat. Species in this category include everything from raccoon (*Procyon lotor*) to deer, which often forage in the water. Bats often forage on insects above the water. All of these species, as well as many others, occasionally use river corridors as travel routes.

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Riparian and wetland habitat provides essential habitat for migrating birds and waterfowl. Many other shorebird species occur along rivers where appropriate mud bars develop. Belted kingfishers (*Megaceryle alcyon*) patrol rivers from the headwaters to the sea in search of small fish. Osprey (*Pandion haliaetus*) flourish along rivers and many species of herons and bittern depend to a large extent on riparian corridors for food, roosting and nesting sites. Bald eagles (*Haliaeetus leucocephalus*) frequent riverine corridors in search of fish and roosting areas. Birds such as cormorants, night herons, and gulls follow river systems for many miles inland in search of good feeding areas. River corridors are also major migration routes for many species of songbirds such as vireos, flycatchers, thrushes, tanagers, and wood warblers.

Reptiles are far less mobile than birds and mammals. Many of the reptiles associated with riparian and wetland habitats in the United States (turtles, snakes, and a few lizards) are the opposites of amphibians in life history strategy. They differ by using riparian and wetland areas for food and cover, but move to the habitat edge or to drier land to deposit eggs (Clark 1979).

3.6.2 Environmental Consequences

3.6.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. The effects of flowering rush control on wildlife would likely include displacement of mammals, birds, and reptiles as a result of staging and operation of equipment. Application could also cause direct and indirect injuries to wildlife.

Any loss of shoreline vegetation as discussed in Section 3.5 would affect wildlife habitat by reducing cover, perching, foraging, and nesting opportunities. Impacts of flowering rush treatment on terrestrial wildlife would range from minor to moderate depending on the size of the treatment site, the time of year treatment took place, the amount of wildlife present, duration of treatment, and scarcity of similar habitat for displaced wildlife. Long-term impacts of flowering rush treatment would benefit terrestrial wildlife due to increased water quality, return of native vegetation, and improved ecological function.

Chemical Treatment Methods:

Herbicides have been designed to target biochemical processes, such as photosynthesis, that are unique to plants and are not typically acutely toxic to animals (Tatum 2004). Most health problems in animals result from exposure to excessive quantities of herbicides because of improper or careless use or disposal of containers. When herbicides are used properly, poisoning problems in are rare. Vegetation treated with herbicides at proper rates would not be hazardous to animals; particularly after the herbicides have dried on the vegetation (Gupta 2019).

However some herbicides can have subtle physiological, developmental, and behavioral effects on animals if they come in contact. There are four pathways through which

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wildlife can be impacted by herbicides: Acute poisoning, chronic poisoning, secondary poisoning, and indirect effects.

Acute toxicity may kill or sicken wildlife. Acute toxicity is rare and would only occur if an animals gained direct access to the product (Gupta 2019). Acute poisoning to wildlife takes place over a relatively short time, impacts a very localized geographical area, and is linked to a single pesticide.

Chronic poisoning happens after exposure to pesticides over an extended period of time. The most well-known example of a chronic effect in wildlife is that of the organochlorine insecticide DDT (via the metabolite DDE) on reproduction in certain birds of prey.

Secondary poisoning occurs when an animal consumes food that contains pesticide residues. Examples of secondary poisoning are (1) birds of prey becoming sick after feeding on an animal that is dead or dying from acute exposure to a pesticide, and (2) the accumulation and movement of persistent chemicals in wildlife food chains.

Indirect impacts occur when pesticides modify part of an animal's habitat or food supply. For example, herbicides may reduce food, cover, and nesting sites needed by insect, bird, and mammal populations.

Wildlife and non-target plant species may be unintentionally impacted during normal application of an aquatic herbicide as a result of direct spray, contact with leaves after herbicide application, or consumption of food items sprayed during application. These exposures may occur within the application area (direct spray) or outside of the application area (consumption of terrestrial food items sprayed by aquatic herbicide) (BLM 2005).

Accidental spills, overspray, and spray drift can damage non-target vegetation and directly impact wildlife species; however, the more common routes of exposure for terrestrial wildlife to aquatic applications of herbicides are indirect such as: drinking water treated with herbicides, eating aquatic plants or plants along a shoreline that have been treated accidentally by overspray, or by eating fish or other aquatic organisms from the treatment site (WSDE 2002).

Some species could experience adverse impacts through direct or indirect exposure to pesticides while other species would encounter beneficial impacts through improved habitat. Due to the unknown application procedures of herbicides under the No Action Alternative, impacts to terrestrial wildlife could range from minor to moderate in the short-term for the reasons discussed above.

Manual and Mechanical Treatment Methods:

Vacuum harvesting may collect small reptiles in the water which meet the nozzle. Vegetation rakes may collect small reptiles in the bucket as plants are scooped and ripped from the sediment. Additionally, sound and vibration disruptions produced by the staging and operation of equipment could also place stress on organisms above and

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below the surface. Impacts to terrestrial wildlife could range from minor (Hand-pulling and DASH) to Moderate (vegetation rakes) in the short-term.

Benthic Barriers:

Benthic barriers would have negligible impacts to terrestrial wildlife.

3.6.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Migratory bird nesting season and flowering rush control would overlap in areas of the FSA. Flowering rush control would take place during flowering rush growing season which begins in February and ends with the fall frost. Migratory birds nesting season begins April 1 and ends August 15. It has been shown that impacts to birds from herbicide spraying have largely been tied to changes in vegetation composition and not direct impacts to birds themselves (Solberg and Higgins 1993). Any direct damage to terrestrial vegetation, and thus indirect impact to birds, would be from the misapplication of the aquatic herbicides and be localized to the area of the spill or overspray.

If a Corps funded flowering rush treatment is expected to impact any migratory bird species, coordination with the U.S. Fish and Wildlife Service (USFWS) would be initiated in order to minimize any impacts to these species. Minimization measures provided by the Services after consultation would help ensure the effect of flowering rush treatment on migratory birds would be minor.

Chemical Treatment Methods:

Impacts to terrestrial wildlife due to chemical applications are expected to be less than the impacts described under the No Action Alternative. The lesser impacts are due to fewer chemicals used than under the No Action Alternative and conservation measures (Section 3.12) to reduce or eliminate chemical misapplications, spills, overspray, and spray drift; however, wildlife could still be indirectly exposed to aquatic herbicides as discussed under the No Action Alternative. Impacts of each chemical are discussed below. Most data are on mammals and birds with little information regarding the toxicity of herbicides to reptiles; however, no significant exposures are anticipated to any terrestrial wildlife.

Imazamox has been subject to a standard and relatively extensive series of acute, subacute, and chronic studies in mammals. There is little doubt that imazamox is practically nontoxic to mammals. Data on the toxicity of imazamox to birds are less extensive but include both acute toxicity and reproduction studies that fail to identify any potential hazards to birds. For other groups of animals the toxicity data are very limited, but fail to suggest any hazards (Durkin 2010).There would be no significant exposures are anticipated to any terrestrial wildlife.

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Similarly, imazapyr is believed to be virtually non-toxic to mammals with no significant bioaccumulation reported (WSDA 2009). Acute, subchronic, and chronic toxicity studies on imazapyr do not demonstrate adverse effects that are unequivocally attributable to exposure. This uncertainty or a lack of knowledge has a relatively minor impact on this risk assessment, because the available toxicity studies are relatively complete—chronic studies in three mammalian species (dogs, rats, and mice) and several reproduction studies in two mammalian species (rats and rabbits)—indicate that imazapyr is not likely to be associated with adverse effects at relatively high-dose Levels. The available avian studies on imazapyr do not report any signs of toxicity (Durkin 2011). There would be no significant exposures are anticipated to any terrestrial wildlife.

Diquat dibromide is moderately toxic to mammals and ranges from moderately toxic to practically nontoxic to birds, depending on the species (EPA 1986). Diquat is poorly absorbed from the gastrointestinal tract of rats, cows, and goats and mainly eliminated via the feces during the first 24 hours, the small part that is absorbed would be eliminated via the urine (FAO/WHO 1994). Diquat could have minor impacts to terrestrial wildlife.

Excessive exposures to endothall are most likely to be associated with portal of entry effects—i.e., Oral exposure could damage to the gastrointestinal tract, dermal exposure could lead to skin irritation, inhalation exposure could lead to respiratory tract irritation. Because endothall is used only as an aquatic herbicide in Corps funded applications, any exposures are likely to involve the consumption of contaminated water. The most plausible effects of exposure are likely to involve irritation of the gastrointestinal tract. Birds appear to be less sensitive than mammals to potential effects of endothall exposure (Durkin 2009). There could be minor impacts to terrestrial wildlife.

The application of glyphosate-based herbicides in forest vegetation management is not considered to pose a significant risk of direct toxicity to small mammals or birds. Indirect effects resulting from alteration of vegetative habitat or food availability do occur, however these are transient effects and depend on individual species preferences (Durkin 2011). There would be no significant exposures to any terrestrial wildlife.

Manual and Mechanical Treatment Methods:

Impacts to terrestrial wildlife would be the same as under the No Action Alternative, but may occur at a greater number of treatment locations.

Benthic Barriers:

Benthic barriers would have negligible impacts to terrestrial wildlife.

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3.7 Threatened and Endangered Species

3.7.1 Affected Environment

CRB

The Corps reviewed the lists of threatened and endangered species from the states of Washington (1EWFW00-2019-SLI-0789), Oregon (01EOFW00-2019-SLI-0323), Idaho (1EIFW00-2019-SLI-0932), and Montana (06E11000-2019-SLI-0325) that pertain to the CRB area under the jurisdiction of the USFWS (Appendix A Threatened and Endangered Species Lists). Threatened and Endangered species lists were also gathered for species under National Marine Fisheries Service (NMFS) jurisdiction and compiled into the analysis below. The analysis only discusses species that occur in or around the lakes, streams, rivers, and wetlands of the CRB; upland, coastal, and saltwater species are not included.

Terrestrial

Threatened and endangered mammal species in the CRB are the Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos horribilis*), North American wolverine (*Gulo gulo luscus*), woodland caribou (*Rangifer tarandus caribou*), Columbia white-tailed deer (*Odocoileus virginianus leucurus*), and fisher (*Pekania pennant*).

Threatened and endangered birds in the CRB are the Northern streaked horned lark (*Eremophila alpestris strigata*), Northern spotted owl (*Strix occidentalis caurina*), yellow-billed cuckoo (*Coccyzus americanus*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*).

The only endangered insect is the Fender's blue butterfly (*Icaricia icarioides fender*).

Aquatic

Threatened and endangered fish species under USFWS jurisdiction are Columbia River bull trout (*Salvelinus confluentus*), Coastal-Puget Sound bull trout, dolly varden (*S. malma*), and Lahontan cutthroat trout (*O. clarkii henshawi*).

Threatened and endangered fish species under NMFS jurisdiction are Upper Columbia spring run Chinook salmon (*Oncorhynchus tshawytscha*), Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Upper Columbia River distinct population segment (DPS) steelhead (*O. mykiss*), Middle Columbia River DPS steelhead, Snake River DPS steelhead, Snake River Evolutionary Significant Unit (ESU) Sockeye salmon (*O. nerka*), and white sturgeon (*Acipenser transmontanus*).

The only threatened amphibian species in the CRB is the Oregon spotted frog (*Rana pretiosa*). There are two proposed threatened insects, meltwater lednian stonefly

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(*Lednia tumana*) and Western glacier stonefly (*Zapada glacier*). There are three endangered snails in the CRB, Banbury Springs limpet (*Limpet lanx sp.*), Bruneau hot spring physa (*Pyrgulopsis bruneauensis*), Snake River physa snail (*Physa natricina*), and one threatened snail, Bliss Rapids snail (*Taylorconcha serpenticola*).

Vegetation

Threatened and endangered flowering plant species in the CRB are the Ute ladies'-tresses (*Spiranthes diluvialis*), water howellia (*Howellia aquatilis*), Willamette daisy (*Erigeron decumbens*), Bradshaw's desert parsley (*Lomatium bradshawii*), Howell's spectacular thelypody (*Thelypodium howellia ssp. Spectabilis*), and Wenatchee Mountains Checkermallow (*Sidalcea oregana var. clava*).

MRB

The Corps reviewed the lists of threatened and endangered species from the state of Montana (06E11000-2019-SLI-0326) that pertain to the MRB area under the jurisdiction of the USFWS (Appendix A Threatened and Endangered Species Lists). The analysis only discusses species that occur in or around the lakes, streams, rivers, and wetlands of the MRB; upland species are not included.

Terrestrial

Threatened and endangered mammal species in the MRB are the Canada lynx, gray wolf, grizzly bear, and North American wolverine. Threatened and endangered birds in the MRB are the least tern (*Sterna antillarum*), piping plover, red knot, and whooping crane.

Aquatic

Threatened and endangered fish species under USFWS jurisdiction are bull trout and pallid sturgeon (*Scaphirhynchus albus*).

Vegetation

Ute ladies'-tresses is the only threatened flowering plant species.

PSB

The Corps reviewed the lists of threatened and endangered species from the state of Washington (01EWFW00-2019-SLI-0788) that pertains to the PSB area under the jurisdiction of the USFWS (Appendix A Threatened and Endangered Species Lists). Threatened and Endangered species were also gathered for species under NMFS jurisdiction and compiled into the analysis below. The analysis only discusses species that occur in or around the lakes, streams, rivers, and wetlands of the PSB; upland, coastal, and saltwater species are not included.

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Terrestrial

Threatened and endangered mammal species in the CRB are the Canada lynx, gray wolf, grizzly bear, North American wolverine, fisher, Olympia pocket gopher (*Thomomys mazama pugetensis*), Roy Prairie pocket gopher (*T. mazama glacialis*), Tenino pocket gopher (*T. mazama tumuli*), and Yelm pocket gopher (*T. mazama yelmensis*).

Threatened and endangered birds in the PSB are streaked horned lark, Northern spotted owl, yellow-billed cuckoo, and marbled murrelet (*Brachyramphus marmoratus*).

There are two endangered insect species, the island marble butterfly (*Euchloe ausonides insulamus*) and Taylor's checkerspot (*Euphydryas editha taylori*).

Aquatic

Threatened and endangered fish species under USFWS jurisdiction are the Coastal-Puget Sound bull trout and Dolly Varden.

Threatened and endangered fish species under NMFS jurisdiction are the Puget Sound Chinook ESU, Puget Sound steelhead DPS, eulachon (*Thaleichthys pacificus*), and North American green sturgeon (*Acipenser medirostris*).

The only threated amphibian in the PSB is the Oregon spotted frog.

Vegetation

Water howellia and Nelson's checker-mallow (*Sidalcea nelsoniana*) are threatened plant species in the PSB and marsh sandwort (*Arenaria paludicola*) is the only endangered flowering plant species.

3.7.2 Environmental Consequences

3.7.2.1 Alternative 1: No Action Alternative

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Weed management in the FSA would result in the reduction of or prevention of expanding infestations and ultimately enhance native plant communities. Enhancing native vegetation would eventually provide higher quality habitat for wildlife and aquatic species and improve watershed function. The primary methods of treatment would remain chemical, manual, or mechanical.

Chemical Treatment Methods:

Aquatic Threatened or Endangered Species

Application of chemicals to or near surface water has the potential to expose threatened or endangered aquatic species to herbicides, resulting in potential chemical toxicity that may impact the animal or their habitat. Effects from toxicity are a function of exposure

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to the toxic substance (herbicide), at a concentration, and for duration of exposure, sufficient to cause an effect. This is also dependent upon the composition and mode of action of the toxicant. The exposure depends on the application method, and the route of exposure (e.g. direct application, drift, or misapplication). Negative impacts of chemical treatments on threatened or endangered aquatic species would depend on the concentration, duration of exposure, species present, life stage of the listed species, and toxicity of the herbicide and associated compounds, but would range from minor to moderate.

Sub-lethal effects to aquatic threatened or endangered species include changes in behavior that render them susceptible to predation, compromised immune system, and effects to organs. Sub-lethal effects can also include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could impact reproductive success or juvenile to adult survival. Effects of sub-lethal exposure to threatened or endangered aquatic species are expected to be minor.

Threatened or endangered aquatic species may be indirectly affected if their food source is impacted. Most herbicides have no effect on wildlife, but some may be irritants as described in Sections 3.4 (Aquatic Wildlife) and Section 3.5 (Terrestrial Wildlife). Pesticide treatments can be toxic to terrestrial and aquatic insects that are a source of food for listed aquatic species. The magnitude and duration of the potential stressor on riparian insects is related to the sensitivity of the invertebrate to the herbicide, the time the herbicide is in the environment, the extent of the area treated, the toxicity of the herbicide, and the life stages of the invertebrates affected by the herbicide.

Aquatic plants are a significant producer of macroinvertebrates, but treatments would not target native plant species or remove a proportion of vegetation great enough to adversely affect the overall habitat value. While aquatic plants are producers of macroinvertebrates, it is unlikely that the loss of flowering rush would result in a reduction in available food resources. Additionally, invasive plants host substantially less diverse invertebrate communities than native vegetation and provide impoverished food resources in comparison to native aquatic plants (Kovalenko et al. 2010; Phillips 2008; Wigginton et al. 2014). Native vegetation is typically able to reestablish quickly in the absence of invasive vegetation and abundance and diversity of macroinvertebrates can rapidly return to pre-invasion patterns (Beltman 1987; Kovalenko and Dibble 2011; Poovey et al. 2013; Roerslett and Johansen 1996).

Given the relatively small areas of food resources impacted during any one treatment cycle, food resource impacts would not reach a magnitude to cause responses in threatened or endangered aquatic species that may be present in the treatment area. Impacts to aquatic food sources would range from minor to moderate.

Use of chemicals may result in avoidance of treatment areas, or impacted olfactory function, resulting in delayed or affected migration of individuals in the immediate vicinity of treatment locations. However, given the size of the treatment areas in proportion to the lake or river, individuals would have opportunities to escape these areas, and use other, unaffected, portions for migration. Such disturbances could result

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in delayed migration for up to a few hours, but exposure to these disturbances are not likely to reduce individual performance. Impacts of chemical treatment on threatened or endangered fish migration would be minor.

Flowering rush treatment activities have the potential to decrease dissolved oxygen (DO) in the vicinity of the treatment area, which may affect threatened or endangered aquatic species. Aquatic plants generate DO and any large-scale loss of plants can reduce the amount of DO available. Die-off and decomposition of submerged plants can also contributes to low DO. This can be a problem with larger-scale treatments in treatment areas with slow moving water, such as in enclosed bays and more problematic during warmer summer months when DO is already lower due to warmer temperatures. However, given the minimal amount of DO that could be lost as a result of the proposed action, the impact of chemical treatments on DO would be moderate. Due to the exchange of water in all currently proposed treatment sites (Section 1.4) and likely areas of future occurrences in lake fringes, canals, or slow-moving river pools, exposure to the stressors produced is not likely to cause responses in listed aquatic species sufficient to reduce their individual performance. Therefore, response to this stressor would likely be minor.

Terrestrial Threatened or Endangered Species

Noise and human presence associated with flowering rush control could disturb threatened or endangered terrestrial species and cause them to evacuate the treatment site. Flowering rush treatments could also both directly and indirectly affect threatened or endangered terrestrial species through drinking water treated with products containing herbicides, eating aquatic plants or plants along a shoreline that have been accidentally treated by overspray, and by eating fish or other aquatic organisms from the treatment site (WSDE 2002). Impacts to terrestrial threatened or endangered species would be minor in the short-term for the reasons discussed above.

Threatened or Endangered vegetation

Effects to threatened or endangered vegetation would be the same or similar as the effects discussed in Section 3.5 (Vegetation). Impacts could be minor to moderate depending on the sensitivity of the plant species to the specific herbicide and the dose to which the plant was subjected. It is unlikely that state agencies would apply herbicides in the vicinity of threatened or endangered plants.

Manual and Mechanical Treatment Methods:

Manual and mechanical treatment activities occurring adjacent to or in occupied river or stream channels have the potential to disturb threatened or endangered aquatic species. This disturbance would be caused by the physical presence of people traveling immediately adjacent to or in streams or rivers to complete treatments. Impacts of manual and mechanical flowering rush treatment are further discussed in Section 3.4 (Aquatic Wildlife).

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Threatened or Endangered Aquatic Species

Mechanical treatment activities such as DASH or vegetation rakes have the potential to injure or kill threatened or endangered aquatic species that may be present in treatment areas during treatments. These activities are associated with use of equipment that could strike the fish, or inadvertently capture fish. Exposure to these activities is inherently limited, because most aquatic species would move out of the area due to the disturbance associated with these activities, snails or larval insects as possible exceptions. Injury or death caused by mechanical treatment of flowering rush is moderate due to the low likelihood death or injury and the low number of individuals likely to be injured or killed.

Manual and mechanical treatment activities occurring adjacent to or in occupied river or stream channels have the potential to interfere with the migration of juvenile and adult fish. Interference may result in delayed migration or avoidance of the treatment area, resulting in altered migration patterns in localized areas. This would primarily occur when larger equipment is employed such as vegetation rakes or DASH. However, other treatments resulting in disturbance have the potential to result in interference in migration, albeit on a much smaller scale. The magnitude of this effect is related to the intensity and extent of flowering rush treatment. Mechanical treatments could have up to moderate effects on aquatic threatened or endangered species while manual treatments are likely to have minor impacts.

Threatened or Endangered Terrestrial Species

Noise and human presence associated with manual or mechanical flowering rush control could disturb or displace threatened or endangered terrestrial species. Manual or mechanical treatments could also directly affect prey species through trampling if treatments are conducted from the shoreline or displace prey species if they use emergent flowering rush as habitat. These effects would likely be insignificant as terrestrial threatened or endangered species generally have large foraging ranges and flowering rush treatments would be small in scale and occur only in localized patches along the riparian zone. It is unlikely there would be a noticeable change in an overall prey availability. Effects from reduced food sources from manual or mechanical treatment would be minor.

Threatened or Endangered Vegetation

Effects to threatened or endangered vegetation would be the same or similar as the effects discussed in Section 3.5 (Vegetation). Impacts of vegetation rakes could range from negligible to moderate. Hand-pulling and DASH control methods would have negligible to no impacts on terrestrial plant species. It is extremely unlikely that state agencies would deploy vegetation rakes in the vicinity of endangered or threaten plants.

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Benthic Barriers:

Threatened or Endangered Aquatic Species

Benthic barriers interfere with fish spawning and bottom-dwelling animals. Benthic barriers are only suitable for localized control so potential adverse impacts to aquatic species would be minor to moderate in the short-term due to the displacement of bottom-dwelling animals and the potential loss of small areas of spawning habitat. Long-term impacts would be beneficial due to improved spawning habitat and reduced predator habitat from the removal of flowering rush.

Threatened or Endangered Terrestrial Wildlife and Vegetation

Benthic barriers would have negligible impacts to terrestrial wildlife and vegetation.

3.7.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Life history, biological requirements, distribution, critical habitat, common threats, and species specific effect determinations can be found in the individual Biological Assessments (Corps 2019a and Corps 2019b). Effects analysis for the other listed species listed above would be conducted in future biological analysis based on submitted scopes of work. The Corps would engage with the Services when new treatment areas are proposed to 1) confirm no effects to species and 2) receive new terms and conditions that would be adhered to.

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. Any additional proposed treatment areas would be evaluated for effects to threatened and endangered species and consulted on with the Services if necessary.

The following stipulations are restrictions and conservation measures to avoid take of threatened or endangered species under the Proposed Action Alternative.

Ute Ladies’-tresses Avoidance

- Prior to engaging in cost-shared flowering rush treatments in the Snake River watershed upstream of American Falls Reservoir, a survey for Ute ladies’-tresses shall be conducted at the prospective treatment site by a qualified botanist.
- All flowering rush control activities will be conducted a minimum of 15 feet from known populations of Ute ladies’-tresses.
- Spot chemical treatment of flowering rush would be conducted a minimum of 100 feet from known populations of Ute ladies’-tresses.
- Broadcast chemical treatment of flowering rush would be conducted a minimum of 300 feet from known populations of Ute ladies’-tresses.
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Yellow-billed Cuckoo Nesting Season Avoidance

- No treatments shall be conducted under the proposed cost share at the proposed action areas on or near the Snake and Blackfoot Rivers during the May 1 to August 31 nesting season.

Watershed Broadcast Treatment Temperature Restriction

- Broadcast application of herbicides in the Lake Pend Oreille or the Pend Oreille River shall be conducted only when water temperature at the treatment location is greater than 65 degrees Fahrenheit / 18.5 degrees Celsius.

Chemical Treatment Methods:

The impacts of chemical treatment on threatened or endangered species are the same as the impacts discussed under the No Action Alternative with the following exceptions:

Ammonium salt of imazamox

Threatened or Endangered Aquatic Species

Application rates (Table 2-1) of ammonium salt of imazamox would be well below that which would cause adverse effects to threatened or endangered fish. Spot treatments with imazamox would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazamox would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water.

In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 8 pints/ acre would result in a concentration of 3.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 4.2 ppm. Aquatic invertebrate toxicity occurs at concentrations greater than 122 ppm (EPA 1997). Negative impacts on threatened and endangered aquatic wildlife from flowering rush treatment using imazamox would be minor.

Threatened or Endangered Terrestrial Species

A wildlife risk assessment conducted by US EPA for imazamox to estimate the dietary exposure values from possible ingestion of imazamox or residues from vegetation or prey items found no adverse effects at the highest concentrations and concluded that there were no adverse effects to birds from the labeled use of imazamox (EPA 2008). As stated in Section 3.6 (terrestrial Wildlife) there is little doubt that imazamox is practically nontoxic to mammals. Negative impacts on threatened and endangered terrestrial wildlife from flowering rush treatment using imazamox would be negligible.

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Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Imazapyr

Threatened or Endangered Aquatic Species

Considering the established application rates for imazapyr (Table 2-1), the toxicological data (discussed in Section 3.4 Aquatic Wildlife), the scale of proposed actions, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of imazapyr is expected to pose only a minimal risk to threatened or endangered aquatic organisms from exposure. Negative impacts to threatened or endangered aquatic species would be minor.

Threatened or Endangered Terrestrial Species

Imazapyr is not likely to be associated with adverse effects to threatened or endangered mammals at relatively high-dose Levels and the available avian studies on imazapyr do not report any signs of toxicity (as shown in Section 3.6 Terrestrial Wildlife). Negative impacts to threatened or endangered terrestrial species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Diquat dibromide

Threatened or Endangered Aquatic Species

Application rates (Table 2-1) of diquat dibromide would be well below that which would cause adverse effects to threatened or endangered fishes. Spot treatments with diquat would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with diquat would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water.

In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 16 pints/acre would result in a concentration of 6.1 ppm once the chemical has diffused through the

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top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 1.5 ppm. This is safely below concentrations demonstrated to be safe for fish. Diquat dibromide is also expected to pose only a minimal risk to aquatic organisms from exposure (as discussed in Section 3.4 Aquatic Wildlife). Negative impacts to threatened or endangered aquatic species would be minor.

Threatened or Endangered Terrestrial Species

Diquat is therefore expected to pose only a minimal risk to threatened or endangered fishes from exposure. Diquat dibromide may pose acute or chronic risk to aquatic organisms, but the probability that exposure would occur is relatively low because diquat is rapidly absorbed by plants and soils. Diquat is poorly absorbed from the gastrointestinal tract of terrestrial wildlife (as discussed in Section 3.6 Terrestrial Wildlife). Negative impacts to threatened or endangered terrestrial species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Endothall

Threatened or Endangered Aquatic Species

Endothall dipotassium salt is considered to be slightly toxic to practically non-toxic to freshwater fish and invertebrates on an acute basis as discussed in Section 3.4 (Aquatic Wildlife). Negative impacts of endothall dipotassium salt on aquatic threatened or endangered species would be minor.

Threatened or Endangered Terrestrial Species

In its dipotassium salt form, endothall is practically non-toxic to birds. Dietary LD50 values for quail and mallards are greater than 1,475 ppm (SERA 2009). Endothall is not used to treat emergent flowering rush, so the only route of exposure for terrestrial species would be direct ingestion of treated water or consumption of prey from treated areas. Label application rates are far below levels of concern for adverse effects to avian species (SERA 2009). Negative impacts to terrestrial threatened or endangered species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate

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chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Glyphosate

Threatened or Endangered Aquatic Species

Glyphosate is practically nontoxic to fish and aquatic invertebrates as discussed in Section 3.4 (Aquatic Wildlife). Glyphosate is therefore expected to pose only a minimal risk to aquatic organisms from exposure.

Impacts to aquatic species using chemical methods under the Proposed Action Alternative would be moderate to negligible in the short-term due to the restriction in chemicals, the conservation measures (Section 3.12), and the fact that applicators must follow all EPA label restrictions. Negative impacts to threatened or endangered aquatic species would be minor.

Threatened or Endangered Terrestrial Species

Glyphosate is no more than slightly toxic to birds. Oral LD50 values for quail and mallards are greater than 4,460 ppm (Tomlin, 2009). There is no published information regarding dermal glyphosate exposure thresholds in birds, but glyphosate is nonirritating in dermal applications to rabbits (Beste 1983). The US EPA notes in the draft reregistration review of glyphosate that label applications of glyphosate are well below the levels where adverse effects to avian species would be seen (Blankinship and Hetrick 2015). No studies report an adverse effect on birds, with most indicating an increase in avian abundance due to greater open water habitat (Linz et al. 1997, 1996, 1994; Linz and Blixt 1997; Solberg and Higgins 1993). Negative impacts to threatened or endangered terrestrial species would be negligible.

Threatened or Endangered Vegetation

Chemical treatment methods under the Proposed Action Alternative would be similar in scope but fewer chemicals would be used than under the No Action Alternative. Conservation measures (Section 3.12) would also be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Negative impacts to threatened or endangered plants would be negligible.

Manual and Mechanical Treatment Methods:

The impacts of manual and mechanical treatment on threatened or endangered species are the same as the impacts discussed under the No Action Alternative with the following exceptions:

Threatened or Endangered Aquatic Species

Stressors would be produced by this activity, but the Corps has determined that ESA-listed fish species are not certain to be exposed to or respond to those stressors due to

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the scale and timing of the activity, and avoidance of flowering rush habitat by ESA-listed fishes (Hillman et al. 1987; Tiffan et al. 2006).

Because of the low potential for ESA-listed fishes to be in the treatment area, the minimal acreage treated at one location, and the long-term benefit to critical habitat from the removal of invasive plants, the Corps has determined that potential adverse effects would range from minor to moderate in the short-term. Impacts to other threatened or endangered aquatic species Manual and mechanical methods would have the same or similar effects to aquatic species as those described in Section 3.4 (Aquatic Wildlife).

Threatened or Endangered Terrestrial Species

Effects to terrestrial species from manual or mechanical methods would be the same or similar as the No Action Alternative.

Threatened or Endangered Vegetation

Vegetation rakes would only be used in screened irrigation canals. The impacts of operating the vegetation rake from the shoreline would be minor to moderate due to the fact that treatment would take place in disturbed landscapes through which the irrigation canals run.

Benthic Barriers:

Impacts of benthic barriers to threatened and endangered species under the Proposed Action Alternative would be the same as the impacts under the No Action Alternative.

3.8 Historic/Cultural Resources

3.8.1 Affected Environment

CRB

Prehistoric riverine cultures were located along the rivers and tributaries in the CRB up until the middle and late 19th century when they were relocated to reservations (Walker Jr. 1998). During their extensive occupation along the rivers and tributaries of the Columbia River, Native Americans subsisted on the abundant salmon and aquatic resources available. Traditional Cultural Properties (TCPs) and Historical Properties of Religious and Cultural Significance to Indian Tribes (HPRCSITs) reflect important fishing locations and fishing villages native peoples occupied for collecting such resources.

When the first European settlers arrived, the CRB was reformed to support agricultural practices. This, in return, brought more and more settlers to the region and continued to transform the region into the agricultural and industrial superpower it is today. This transformation was aided through the impoundment of water by creating reservoirs within the major rivers of the CRB. This was done so through the construction of dams, locks and other facilities throughout the CRB. The benefits of water impoundment

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include water storage for irrigation and flood protection, raising water levels to promote barge navigation, hydroelectric power production, along with many others.

The construction of these structures began as far back as the late 19th century and continued into the mid-20th century, as dams were desired to control the rivers. Many of these dams are complex units with intakes, fish passages, locking mechanisms, and countless other components; all of which can be considered in evaluating their eligibility for the National Register of Historic Places.

MRB

Over the course of thousands of years of occupation, Indigenous Peoples have established and maintained cultures and traditions that revolve around the natural resources of, and wildlife attracted by, the Missouri River ecosystem. This ecosystem and its well-being continue to be crucial to the worship practices and life ways of contemporary Indigenous Peoples. There is a direct relationship between the environment, traditional worship practices, and the continued survival of diverse indigenous groups. Animals such as the buffalo, eagle, wolf, turtle, migratory and non-migratory birds, a variety of fish and aquatic plants and animals, as well as several species of trees, shrubs, and plants are central to traditional worship beliefs and practices. Within the Missouri River corridor, important natural springs exist which are sacred to Indigenous Peoples and have been considered so for thousands of years.

Known cultural and historic sites in the Missouri River Basin located in Montana consist of lithic scatters, bison kill sites and corrals, tipi rings, stone effigies, campsites, Lewis and Clark campsites, trails, early homesteaders' cabins, hunting cabins, stage routes, railroads, shanty towns from the dam construction era, and other construction camp era buildings. These sites are associated with the Gros Ventre, the Assiniboine bands of Canoe Paddler and Red Bottom, the Sioux divisions of Sisseton/Wahpetons, the Yantonais, and the Heton Hunkpapa, the Blackfoot, early Euro-American explorers, homesteaders, the antebellum Civil war period, and industrial development; river transportation; and dam building and river control.

PSB

Puget Sound has played a vital role in the development and growth of Native American settlement within the Northwest Coast region. Native American tribes relied heavily upon Puget Sound and its vast marine and lacustrine resources as an integral part of their culture by contributing heavily to subsistence strategies as well as transportation and trading routes. Hundreds of prehistoric and historic archaeological sites have been found on the historical shorelines of Puget Sound, providing insight about these coastal-based cultures. Distinguishing characteristics of prehistoric groups include a heavy reliance on abundant marine organisms and anadromous fish, highly skilled woodworking and fishing technology, and complex social organization.

Between 14,000 and 15,000 years ago, the glaciers surrounding the Northwest Coast began to recede, allowing the settlement of the region by migrating people from the north and the south. However, while much of the region was ice free, little, if any,

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cultural material dates from within this period. Early sites throughout the region are composed primarily of lithic assemblages that become increasingly complex through time. Due to a lack of faunal material at these sites, it is believed that subsistence strategies during this period focused primarily on terrestrial mammals, with increased reliance on marine food sources over time.

The first large shell midden sites date from the period between 5,500 and 3,500 years before present, accompanying an increase in population, a diversification of artifact types, specialized technological adaptations for fishing and marine mammal hunting, woodworking, artwork, and wealth and status objects. This pattern of increased specialization in technology and site composition continued until approximately 1,500 years before present, when artifact diversity began to decline, while Coast Salish structures and cultural practices began to emerge.

Euro-Americans started venturing into the Puget Sound region in increased numbers during the 1850s. The draw for most was the region's vast forests of giant fir, spruce, cedar, and hardwoods, building materials that were in high demand down the Pacific Coast at the burgeoning California city of San Francisco. In 1852, the fledgling settlement that became Seattle took root at the Sound's premier inlet, Elliot Bay. A lumber mill was in operation at Seattle within a year, and logging camps and mills soon dotted the landscape throughout the region.

The timber industry significantly aided early agricultural activities as loggers cleared fertile bottomlands of trees. Many loggers and mill workers turned to subsistence farming as means to feed their family. By the mid-1860s, only a few settlers had looked to the low-lying river deltas, estuaries, and sloughs along the coast as potential farmland. Preparing those otherwise swampy tidal lands for agricultural uses required the construction of ditches and earthen dikes to drain and hold back rising tides and the seasonal floodwater of rivers.

3.8.2 Environmental Consequences

3.8.2.1 Alternative 1: No Action Alternative

Chemical Treatment Methods:

Chemicals would have no impact on historic or cultural resources.

Manual and Mechanical Treatment Methods:

The use of a vegetation rake from the stream bank could unintentionally impact cultural resources due to digging out the flowering rush rhizomes and any subsequent erosion due to the temporary loss of soil structure. Additionally, vacuum harvesting may collect small cultural artifacts if they are near the surface of the sediment. Flowering rush treatment under the No Action Alternative would still be subject to State Historic Preservation Officer (SHPO), and possibly tribal, consultation. The impacts to cultural resources range from no effect to moderate depending on location and method.

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Benthic Barriers:

Benthic Barriers would have no impact on historic or cultural resources.

3.8.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Chemical Treatment Methods:

Chemicals would have no impact on historic or cultural resources.

However, the Corps would conduct standard Section 106 consultation with the relevant tribes (listed in Section 5) and state SHPO for each submitted flowering rush treatment scope of work (SOW). If possible detrimental effects are identified, supplemental/tiered NEPA analysis would be required, or projects would be modified.

Manual and Mechanical Treatment Methods:

The effects of mechanical methods would be similar to the No Action Alternative, but could potentially occur at a greater number of locations. The Corps would conduct standard Section 106 consultation with the relevant tribes and state SHPO for each submitted flowering rush treatment SOW. If possible detrimental effects are identified, supplemental/tiered NEPA analysis would be required, or projects would be modified to avoid effects.

Benthic Barriers:

Benthic Barriers would have no impact on historic or cultural resources.

3.9 Socioeconomics and Environmental Justice

3.9.1 Affected Environment

The population of the FSA has grown continually over the last 20 years with a trend of migration from rural areas into urban centers. While population densities are relatively low, the FSA has experienced rapid growth since 1980, paced by Idaho, the fastest growing state in the United States from July 1, 2016 to July 1, 2017 (Figure 3-3). The FSA is generally rural in nature with generally low population densities. The main population centers in the FSA are Boise, Idaho; Portland, Eugene, and Salem, Oregon; Seattle, Tacoma, and Spokane, Washington; and Billings and Missoula, Montana.

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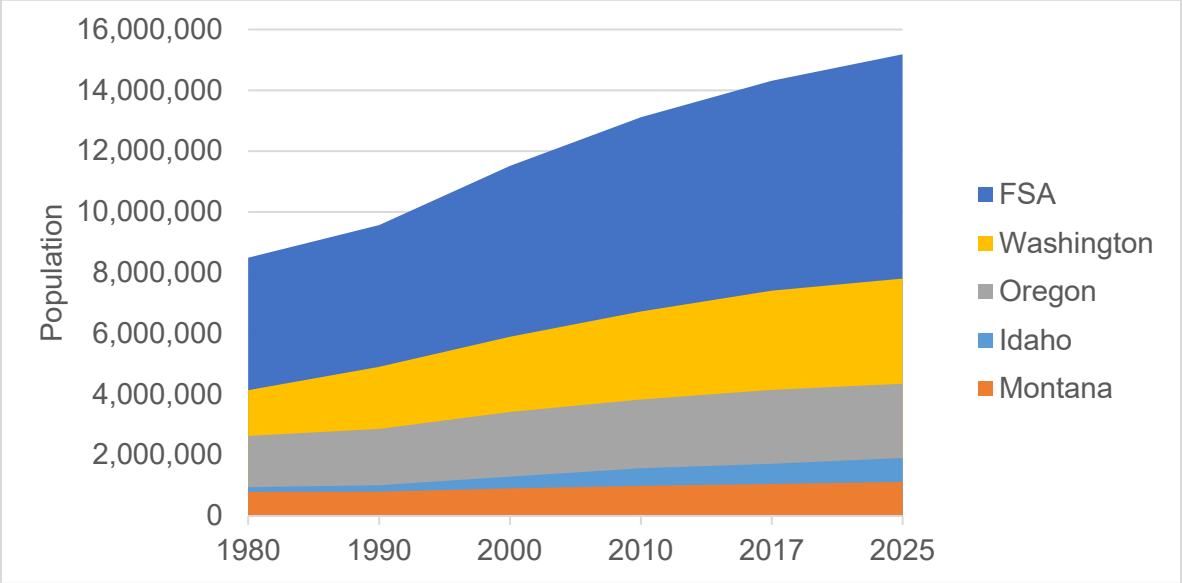

Figure 3-3. Population trends in the four-state area, 1980 - 2025.

Population and Demographics

The population of the FSA is less racially diverse than the national average, but similar to national averages in most other demographic measures (Table 3-3). Area employment has largely recovered from the national recession in 2008-2010, and incomes have continued to increase throughout the region. Washington is currently the only state in the FSA with a median household income above the national and FSA averages. Racial diversity, household income, and higher education were all greater in the coastal states (Oregon and Washington) than the two interior states.

Table 3-2. Education and Income in the Four-State Area compared (U.S. Census Bureau 2016)

	Idaho	Montana	Oregon	Washington	FSA
Population	1,716,943	1,050,493	4,142,776	7,405,743	14,315,955
Persons under 18	25.8%	21.8%	21.1%	22.2%	22.3%
Persons Over 65	15.4%	18.1%	17.1%	15.1%	15.9%
Percent Minority	18.0%	13.8%	24.2%	31.3%	26.4%
High School Graduates	90.0%	92.9%	90.0%	90.6%	90.5%
Bachelors Degree or Higher	26.2%	29.9%	31.4%	33.6%	31.8%
Percent In Labor Force	62.3%	63.2%	61.9%	63.3%	62.8%
Median Household Income	$49,174	$48,380	$53,270	$62,848	$57,375
Persons in Poverty	14.4%	13.3%	13.3%	22.2%	18.0%

Environmental Justice

As outlined in Executive Order 12898, Federal agencies must evaluate environmental justice issues related to any project proposed for implementation. This evaluation

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includes identification of minority and low-income populations, identification of any negative project impacts that would disproportionately affect these low-income or minority groups, and proposed mitigation to offset the projected negative impacts. The evaluation of environmental justice issues includes an identification of high minority and low-income populations in the watershed study area.

While less racially diverse than other areas of the country, the FSA is home to people of a broad variety of races. The majority of the population in the four-state area is white. The second highest racial identity is Hispanic or Latino in all states except Montana. The second highest racial identity in Montana is American Indian (Table 3-4).

Table 3-3. Racial Identification in the FSA. Note that percentages do not add to 100, as categories are not mutually exclusive (U.S. Census Bureau 2016).

State	Idaho	Montana	Oregon	Washington
White	91.30%	89.10%	85.10%	77.30%
Black or African American	0.60%	0.40%	1.90%	3.60%
American Indian and Alaskan Native	1.30%	6.60%	1.10%	1.30%
Asian	1.30%	0.70%	4.00%	7.80%
Native Hawaiian and Other Pacific Islander	0.10%	0.10%	0.40%	0.60%
Hispanic or Latino	12.00%	3.40%	12.40%	12.10%

All four states have similar poverty levels for children and working age groups (Ages 0-64), while Idaho and Montana have higher poverty levels for seniors over 65. Oregon has the highest overall percentage of people living in poverty in the FSA (Table 3-5).

Table 3-4. State Population Poverty Percent by Age Group (U.S. Census Bureau 2016).

Age Group	Idaho	Montana	Oregon	Washington
0-17	15%	14.4%	15.9%	13.7%
18-64	13%	13%	13.4%	10.5%
65+	10%	10%	7.5%	7.6%
All Ages	12.8%	12.8%	13.2%	11.2%

3.9.2 Environmental Consequences

3.9.2.1 Alternative 1: No Action Alternative

Under the No Action Alternative there would be no additional funds available for flowering rush control. The No Action Alternative would not alter new wages, alter the characteristics of the population in the project areas, or impact the local economy.

Flowering rush control activities are tied to industry standard health and safety protocols that minimize hazardous exposure to applicators and nearby populations, so there would be no adverse effect on human health or safety and no disproportionate adverse

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impacts on minority and low-income populations. Socioeconomic and environmental justice impacts would be negligible.

3.9.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. Opposite of the No Action Alternative, the Proposed Action Alternative could create additional jobs, alter new wages, or positively impact the local economy.

Further, herbicide application conservation measures (Section 3.12) would further reduce potential hazardous exposure to applicators and nearby populations. Adverse impacts to socioeconomics and environmental justice under the Proposed Action Alternative would be negligible, but there is the potential for minor beneficial impacts to the economy.

3.10 Recreation

3.10.1 Affected Environment

The FSA provides a variety of opportunities for outdoor recreation, which in turn provides intrinsic value to residents as well as economic opportunities through tourism. Estimates of the economic value of outdoor recreation reports that outdoor recreation generates 522,000 jobs, $57.5 billion in consumer spending, $17.2 billion in wages, and $3.3 billion in state and local tax revenue in the four-state area. In addition to generating tourism and economic benefits, approximately 75% of FSA residents participate in outdoor recreational activities (OIA 2017).

Recreation facilities and land available for recreation in the FSA are managed and operated by the Corps, USFWS, local and state recreation agencies, and public port authorities. Recreation sites in the FSA include parks, rivers, trails, forests, lakes/reservoirs, marinas, boat ramps, and wildlife areas. The Corps owns most of the water-based recreation areas and facilities located along reservoirs and manages many of them. Some Corps-owned facilities are managed under lease agreements by other agencies or organizations.

Research on recreational usage shows that swimming, fishing, and boating occur primarily spring through fall, with prime recreational season from Memorial Day to Labor Day. Flowering rush treatment would largely overlap with water related recreation. Other recreational opportunities that take place around water resources include picnicking, sightseeing, camping, hiking, wildlife viewing, and hunting.

3.10.2 Environmental Consequences

3.10.2.1 Alternative 1: No Action Alternative

Although recreational opportunities may be temporarily inconvenienced during herbicide application or mechanical operations, flowering rush control would not adversely affect

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long-term public access. Adverse impacts on recreation due to flowering rush control would be minor to moderate depending on location and number of people present.

Flowering rush also interferes with boat propellers, swimming, and fishing thus reducing recreational opportunities along rivers and lake shores. Removing flowering rush from state waterways would provide moderate long-term benefits to recreation.

State agencies, municipalities, and landowners would continue their current program to control flowering rush invasion. Flowering rush control could restrict access to or temporarily close recreational sites used for fishing, swimming, or boating. Potential impacts by treatment method are discussed below.

Chemical Treatment Methods:

Most of these herbicides can be used with relatively little risk (as long as label directions are followed), some are extremely toxic and require special precautions. Aquatic herbicide use could result in chemical exposure through contact, ingestion, or inhalation during activities such as boating, fishing, or swimming.

Contact exposure results in absorption immediately after a pesticide contacts skin or eyes. Absorption will continue as long as the pesticide remains in contact with the skin. The rate at which dermal absorption occurs is different for each part of the body.

Ingestion may result in serious illness, severe injury, or even death, if an herbicide is swallowed.

Inhalation is particularly hazardous because herbicide particles can be rapidly absorbed by the lungs into the bloodstream. Herbicides can cause serious damage to nose, throat, and lung tissue if inhaled in sufficient amounts. Vapors and very small particles pose the most serious risks. The hazard from inhaling pesticide spray droplets is fairly low when dilute sprays are applied with low pressure application equipment. This is because most droplets are too large to remain airborne long enough to be inhaled.

Determining the toxicity of herbicides to humans is not easy. An herbicide that is poisonous to lab rats, is not necessarily poisonous to people; toxicity studies are only guidelines. Some pesticides are dangerous after one large dose (exposure). Others can be dangerous after small, repeated doses.

All pesticides in a given chemical group generally affect the human body in the same way; however, severity of the effects vary depending on the formulation, concentration, toxicity and route of exposure of the pesticide.

The effects of chronic toxicity, as with acute toxicity, are dose-related. In other words, low-level exposure to chemicals that have potential to cause long-term effects may not cause immediate injury, but repeated exposures through careless handling or misuse can greatly increase the risk of chronic adverse effects.

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Some aquatic herbicides restrict swimming or fish consumption for a certain time period after application for the reasons described above. Flowering rush control under the No Action Alternative must still follow all EPA label restrictions and therefore impacts of chemical treatment on recreation are assumed to be less than significant.

Manual and Mechanical Treatment Methods:

The presence of personnel and machinery performing flowering rush control could detract from the recreational experience through temporary visual and auditory intrusions.

Benthic Barriers:

The installation of benthic barriers could temporarily restrict recreation opportunities in the area of application. Flowering rush treatment using benthic barriers would have a minor short-term impact on recreation.

3.10.2.2 Alternative 2: Proposed Action – Cost Share Flowering Rush Control

Flowering rush control cost shared with the PSMFC could treat up to double the acreages as under the No Action Alternative, if state and local agencies fully maximized their budgets. The impacts of chemical, manual, or mechanical flowering rush treatment are the same as discussed under Alternative 1 with the following exceptions:

Chemical Treatment Methods:

Proper signage and notices would be posted in treatment areas to warn swimmers, boaters, and fishers about potential chemical exposure. There are no fishing restrictions for any of the five chemicals approved for use by this document. The use of Endothall would restrict swimming in the treatment area for 24 hours. The use of chemicals for flowering rush treatment under the Proposed Action Alternative would have minor to moderate effects to recreation, but these effects could potentially occur at a greater number of treatment locations.

Manual and Mechanical Treatment Methods:

Vegetation rakes would only be used in screened irrigation canals and not around recreational sites. This would reduce visual and auditory intrusions for recreational users. Manual and Mechanical methods of flowering rush treatment under the Proposed Action Alternative would have a minor impact on recreation, but these effects could potentially occur at a greater number of treatment locations.

Benthic Barriers:

The impacts of benthic barriers would be the same as under the No Action Alternative, but these effects could potentially occur at a greater number of treatment locations.

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3.11 Cumulative Impacts

The NEPA and CEQ regulations implementing the Act require Federal agencies to consider the cumulative impacts of their actions. Cumulative effects are defined as, "the impact on the environment which results from the incremental impact of an action when added to other past, present and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR § 1508.7). Cumulative impacts can result from individually small, but collectively significant actions taking place over a period of time.

The primary goal of a cumulative effects analysis is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and reasonably foreseeable future actions. The Corps used the technical analysis conducted in this EA to identify and focus on cumulative effects that are "truly meaningful" in terms of local and regional importance. While the EA addresses the effects of alternatives on the range of resources representative of the human and natural environment, not all of those resources need to be included in the cumulative effects analysis – just those that are relevant to the decision to be made on the proposed action. This section evaluates the cumulative effects of actions that could potentially affect the same environmental resources as those discussed earlier in this EA.

The Corps has identified the following resources that are notable for their importance to the area and potential for cumulative effects. Those resources are:

- Water Quality
- Wetlands and Aquatic Vegetation
- Aquatic Resources – Aquatic Wildlife and Threatened and Endangered Aquatic Species

3.11.1 Geographic and Temporal Scope of Cumulative Effects Analysis

Resources are discussed in terms of their cumulative effect boundary (spatial and temporal). The timeframe of 55 years was identified based on the first discovered invasion of flowering rush in the FSA in 1964. A timeframe of five years into the future has been considered. Only actions that are reasonably foreseeable are included. To be reasonably foreseeable, there must be a strong indication that an action/event will occur or be conducted.

Table 3-5. Summary of geographic and temporal boundaries used in this cumulative effects analysis

Geographic Boundary	Temporal Boundary
Columbia River, Missouri River, and Puget Sound Basins	55 years

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3.11.2 Affected Environment

Past actions that have affected natural resources in the FSA include building numerous dams throughout the watershed and the subsequent formation of their reservoirs, conversion of landscapes for agricultural uses, and extensive timber harvest. While the vast majority of human alterations has occurred outside the temporal boundaries of this analysis, development in the past ten years has contributed to vegetation loss due to increased timber harvest, agriculture, and urbanization. As development increases the amount of human-caused impacts on the rivers and associated resources are also expected to increase.

3.11.3 Environmental Consequences

Cumulative Effects to Water Quality

While water quality in the FSA is generally considered excellent, cumulative human-caused disturbances can affect water quality. Urban, industrial, and agricultural development have in the past and would continue to create sediment, nutrient, and chemical loading in waters of the FSA.

For example, timber harvests in riparian forest led to large-scale habitat loss and degradation affecting both terrestrial and aquatic species. Timber harvest has resulted in altered water flow, sediment load, and higher water temperatures.

A variety of contaminants enter rivers from point and non-point sources such as industrial discharges and runoff from urban, agricultural, and de-forested areas. Runoff of irrigation water polluted with pesticides and fertilizers can contribute excessive nutrients, elevated levels of chemicals, and substantial amounts of sediment to natural waterways further degrading the water quality of the system.

Recreational activities like boating can also contribute pollutants and increase sediments in surface waters. Watercraft using docks or boat ramps could adversely affect water quality along the shoreline and many watercraft leak small amounts of fuel and oil. Engines and hydraulic components also leak petroleum products into the bilge water, which is ultimately pumped into the water.

Flowering rush control methods discussed in this document would have a cumulative impact on water quality. Applied indiscriminately, these effects could be more than moderately adverse, especially if treatments are repeated in a given location over several years, but the conservation measures discussed below in Section 3.12 would reduce these effects. Given the vastness of the action area, the generally excellent water quality conditions in the basins, and the expected impacts of flowering rush treatment discussed above, cumulative impacts on water quality are expected to be minor to moderate in the short-term. Flowering rush treatment would have a positive cumulative benefit to water quality in the long-term by allowing native plant communities or natural habitats to reestablish in areas previously infested.

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Cumulative Effects to Wetlands and Aquatic Vegetation

Wetlands are not isolated from each other, but rather interact with each other by way of the waters and organisms that connect them. While cumulative impacts can occur within individual wetlands (e.g., repetitive spraying of a pesticide within a wetland, multiple nonpoint-source pollution inputs to a wetland), the concept of cumulative impacts is generally used when there are many impacts to multiple wetlands (Johnston 1994).

The loss of wetland areas as a result of human activities is a general indicator that cumulative impacts are occurring. The wetland losses in the FSA over time (discussed in Section 3.3) are one measure of cumulative impacts to wetlands. In addition to the direct losses of wetlands, alterations have occurred from human activities such as diking, draining, and agricultural practices (Washington State Department of Natural Resources 1998). These changes, even if small on an individual basis, can have cumulative impacts on wetland function. Wetland impacts that seem minor on an individual basis may become major when considered collectively over time and space (Johnston 1994).

Flowering rush treatment in wetlands would have minor to moderate adverse cumulative impacts to wetlands in the short-term. Conservation measures (Section 3.12) would be applied to reduce or eliminate chemical misapplications, spills, overspray, and spray drift. Minimizing application methods would reduce impacts to wetlands and limit the damage to non-target vegetation. The removal of flowering rush infestations would have a long-term beneficial cumulative impacts to wetlands by removing invasive species and allowing native plant communities to re-establish.

Cumulative Effects to Aquatic Resources

Aquatic species, and especially migratory fish, including ESA listed salmon and steelhead, are exposed to a host of biological and physical stressors that reduce their survival and fitness (Johnson et al. 2012). Aquatic species within impounded or altered rivers are affected by an array of environmental conditions and changes such as increasing water temperature, changes to water quality parameters, changes to water velocity, habitat degradation, changing turbidity, shifting seasonal patterns, changing volumes of river flow, passage effects at dams, changes in predators and predation rates, and overfishing.

Aquatic resources have also been affected in the FSA by urbanization, industrialization, croplands, irrigation, overgrazing, and the creation of impervious surfaces. All of which can create point and nonpoint source water pollution. These actions have been ongoing for at least the last 55 years and are reasonably certain to continue.

The proposed action, while a fraction of the volume of cumulative chemical and nutrient inputs to aquatic systems in the FSA, still has the potential to act in concert with existing and future pollution sources to adversely affect aquatic resources. Mixtures of pesticides and other aquatic pollutants often act in concert to have deleterious effects not seen in laboratory-based assessments of individual chemicals or pollutants (Laetz et

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al. 2009). Cumulative effects from multiple treatments would be species- and watershed-specific, but treatments would have to occur simultaneously or consecutively within the same subbasin sufficient to damage a large enough proportion of habitat that restoration would be unable to recover the damages within an appropriate amount of time.

Additionally, a number of accidentally and intentionally released aquatic species can be found in the basins. These aquatic invasive species can impact the health of the water systems and the native aquatic species that live there. Populations of exotic, temperate mesotherms (intermediate between warm-blooded and cold-blooded) and eurytherms (species that can tolerate a wide range of temperatures) seem to thrive in reservoirs once established and can have a detrimental impact on native fish populations. For example, non-indigenous predatory fish such as smallmouth bass and walleye could have a large impact on native salmonid populations through increased predation on out-migrating juveniles (Draheim et al. 2007).

The magnitude of cumulative effects from river modifications, pollutants, and invasive species impart a profound impact on aquatic resources. The cumulative effects of flowering rush treatment could have adverse impacts to aquatic species, especially if treatments are repeated in a given location over several years. However, conservation measures discussed in Section 3.12 would be employed to reduce the cumulative impacts of flowering rush treatment.

Given the vastness of the action area and the expected impacts of flowering rush treatment on aquatic resources and Threatened and Endangered species discussed above (Sections 3.4 and 3.7), cumulative impacts on aquatic resources and threatened and endangered species are expected to be minor to moderate in the short-term. Flowering rush treatment would have a positive cumulative benefit to aquatic resources and threatened and endangered species in the long-term by allowing native plant communities or natural habitats to reestablish in areas previously infested.

3.12 Conservation Measures

The Corps proposes the following conservation measures as part of the proposed action in order to reduce potential adverse effects related to implementation of the proposed action. These conservation measures are not meant to be mitigation for the proposed action, but are integral to the reduction of impacts (potential adverse effects) that may be incidental to the proposed action, and must be considered when analyzing the potential effects of the proposed action.

In terms of intentional and purposeful development of measures designed to minimize impacts to ESA-listed species and designated critical habitats from potential stressors of the proposed action, the Corps has considered a comprehensive list of impact minimization measures [best management practices (BMPs)], that have been integrated into the proposed action as conservation measures. These measures all effectively and drastically reduce the exposure profile of all listed species, as well as the designated critical habitats in the action area.

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The following impact minimization measures would be required by the Corps as part of the proposed action.

1. *General Practices:*
    a. *Licensing/Certification:* All applicators shall be state licensed or certified, or under the direct visual supervision of a state licensed or certified applicator.
    b. All applicators shall comply with all applicable Federal, state, and herbicide manufacturer's directions and requirements for handling pesticides, including storage, transportation, application, container disposal, and spill cleanup.
    c. Herbicide application shall be according to the chemical manufacturer's label recommendations for best results. Applicators shall use caution to minimize the application of herbicides to non-target species and structures within the application areas.
    d. Clean and inspect all mechanical equipment after using in a waterbody. This is extremely important if the vegetation rake has been working in waterbodies known to be infested with noxious species such as Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla spp*.), Brazilian elodea (*Egeria densa*), or with exotic animals such as the zebra mussel (*Dreissena polymorpha*).
    e. Post proper signage and notices in treatment and adjacent areas warning of potential chemical exposure through contact, ingestion, or inhalation during activities such as boating, fishing, or swimming.

2. *Calibration/Maintenance:*
    a. All application equipment (e.g. booms, back packs, etc.) shall be properly calibrated according to the chemical manufacturer's suggested application rates printed on the chemical label prior to use. Equipment and settings shall be properly maintained for the duration of the contract performance period.
    b. Dyes shall be used to reduce the potential for over-application.
    c. Appropriate sized nozzles shall be used to minimize the potential for drift.
    d. Application equipment would be maintained to ensure proper application rates, minimize leakage, reduce drift, and ensure applicator safety. Equipment would be maintained, and visually inspected prior to each application.

3. *Spill Management:*
    a. All applicators shall carry a Spill Prevention and Control Plan. The Plan shall provide detailed descriptions on how to prevent a spill or ensure effective and timely containment of any chemical spill. The Spill Prevention and Control Plan shall include spill control, containment, clean up, and reporting procedures.
    b. A spill kit must be available to all applicators and shall be within 150 feet of the application site.
    c. Equipment refueling will not occur within 100 feet of open water. This includes ATVs, trucks, and tractors.

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d. All concentrated or mixed solution pesticides shall be placed in locked storage in closed containers with watertight lids, and placed in secondary containment vessels of 100% plus freeboard (worst annual rain event, which for this area is one inch over a square yard, which equals 2.385 gallons). A good rule of thumb is 110% of capacity.
e. All mixing for spray bottles, and backpack sprayers shall be done within secondary containment of 110% capacity of the liquid.

4. *Disposal:*
   a. Disposal of waste materials shall occur in accordance with the label and in accordance with all applicable Federal, state, and county laws regulations, as well as label restrictions and instructions.

5. *Water Quality:*
   Only aquatic approved herbicides and surfactants would be authorized for use within 15 feet of "live" waters or areas with shallow water tables.

4 – Compliance with Applicable Environmental Laws and Regulations

4.1 Treaties and Native American Tribes

Treaties are legally binding contracts between sovereign nations that establish those nations' political and property relations. Treaties between Native American tribes and the United States confirm each nation's rights and privileges. In most of these treaties, the tribes ceded title to vast amounts of land to the United States, but reserved certain lands (reservations) and rights for themselves and their future generations. Like other treaty obligations of the United States, Indian treaties are considered to be "the supreme law of the land," and they are the foundation upon which Federal Indian law and the Federal Indian trust relationship is based.

There are many treaties with Native American Tribes which may be applicable to flowering rush control in the FSA. These include treaties with 35 Tribes in the FSA (listed in Section 5). These Tribes explicitly reserved certain rights, including the exclusive right to take fish in streams running through or bordering reservations, the right to take fish at all usual and accustomed (U&A) places in common with citizens of the territory, and the right of erecting temporary buildings for curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands. The treaty rights and resources potentially affected by the proposed action primarily relate to fishing and aquatic plant gathering.

The proposed action could have short-term impacts on treaty rights or temporarily diminish treaty resources. Flowering rush treatment could result in temporary restricted access to U&A fishing locations during flowering rush treatment. There would be no fishing restrictions once flowering rush treatment is complete. Flowering rush treatment also has the potential to impact non-target aquatic plant species that may be harvested as food. These impacts would be limited to the treatment area and the impacts to non-target aquatic plant species would be reduced through conservation measures. The

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long-term effects of the Proposed Action would support treaty rights through the enhancement of aquatic habitats and the preservation of native fish and plant species.

4.2 Federal Laws

4.2.1 National Environmental Policy Act

This Environmental Assessment (EA) was prepared pursuant to regulations implementing NEPA (42 U.S.C. §4321 et seq.). NEPA provides a commitment that Federal agencies will consider the environmental effects of their proposed actions prior to implementing those actions. Completion of this EA and signing of a Finding of No Significant Impact (FONSI), if applicable, fulfills the requirements of NEPA. This EA and a draft FONSI will be sent out for a 30-day comment period beginning on or about June 24, 2019 and concluding on or about July 24, 2019. If a FONSI is signed, it will be posted to the Corps website and available to the public.

Conservation measures, stipulations, best management practices, or environmental commitments identified in this document ensure compliance with the laws, regulations, and Executive Orders (EOs) reviewed.

4.2.2 Endangered Species Act

The Endangered Species Act (ESA) established a national program for the conservation of threatened and endangered fish, wildlife and plants and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS and NMFS, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(c) of the ESA and the Federal regulations on endangered species coordination (50 CFR §402.12) require that Federal agencies prepare biological assessments of the potential effects of major actions on listed species and critical habitat.

The Corps has determined that impacts to threatened and endangered species from the proposed flowering rush treatment methods, as described above, would range from no effect to may affect, but not likely to adversely affect depending on species present and treatment methods. Initial scopes of work discussed in Section 1.4 (project location) have been consulted on with the USFWS and NMFS in 2019 and the methods described in this document were determined to “not likely to adversely affect threatened or endangered species.” Initial consultation will be considered complete upon reception of Letters of Concurrence from the Services.

The Corps would conduct standard Section 7 consultation with the relevant Services (USFWS or NMFS, listed in Section 5) for each submitted flowering rush treatment Scope of Work. If possible adverse effects are identified, the Corps would first attempt to modify any project potentially affecting threatened or endangered species to avoid or minimize any potential impacts.

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The USFWS was consulted through their Information for Planning and Consultation (IPaC) website to coordinate the identification of potential listed and protected resources in the FSA.

4.2.3 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions, primarily for Native American Tribes. Take under this Act includes both direct taking of individuals and take due to disturbance.

Bald and golden eagles are common throughout much of the action area. Nesting, roosting, or foraging eagles may be present near a treatment site during Plan implementation. In some locations, eagles that may occupy treatment sites frequently are likely accustomed to the daily human activities and related noise levels such as vehicles, equipment, and boat and foot traffic, while in other areas, eagles may rarely have human interaction.

In the case of a treatment site occurring where eagles have relatively little human interaction, eagles are likely to avoid the immediate treatment site. In addition, suitable roosting and foraging habitat is expected to be available adjacent to the treatment site outside of a range of disturbance. The Plan would be implemented with BMPs to avoid nests in accordance with the USFWS Bald Eagle Management Guidelines and Conservation for the Pacific Region (USFWS 2015b). Therefore, the Corps has determined there would be no disturbance or take of eagles as a result of the Proposed Action.

4.2.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712, as amended) prohibits the taking of and commerce in migratory birds (live or dead), any parts of migratory birds, their feathers, or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof.

Migratory bird nesting season and flowering rush control would overlap in areas of the FSA. Flowering rush treatment would occur during the growing season (February through the first fall frost). Migratory birds nesting season begins April 1 and ends August 15. Corps funded flowering rush treatment is not expected to impact (directly or indirectly) any migratory bird species, but if such take becomes anticipated for any treatment/management action coordination with the USFWS would be initiated in an effort to avoid such impacts.

4.2.5 Fish and Wildlife Coordination Act of 1958

The Fish and Wildlife Coordination Act (FWCA) of 1934, as amended (16 USC 661 et seq.) requires consultation with USFWS when any water body is impounded, diverted, controlled, or modified for any purpose. The USFWS and state agencies charged with

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administering wildlife resources are to conduct surveys and investigations to determine the potential damage to wildlife and the mitigation measures that should be taken. The USFWS incorporates the concerns and findings of the state agencies and other Federal agencies, including NMFS, into a report that addresses fish and wildlife factors and provides recommendations for mitigating or enhancing impacts to fish and wildlife affected by a Federal project.

The proposed action would not impound, divert, control or modify any body of water and would not involve activities subject to the Fish and Wildlife Coordination Act.

4.2.6 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966 as amended directs Federal agencies to assume responsibility for all cultural resources under their jurisdiction. Section 106 of NHPA requires agencies to consider the potential effect of their actions on properties that are listed, or are eligible for listing, on the National Register of Historic Places (NRHP). The NHPA implementing regulations, 36 Code of Federal Regulations (CFR) Part 800, requires that the Federal agency consult with the State Historic Preservation Officer (SHPO), Tribes and interested parties to ensure that all historic properties are adequately identified, evaluated and considered in planning for proposed undertakings.

The Corps has determined that the proposed flowering rush treatment methods, as described above, would have no to moderate impacts to cultural and historic resources based on location and method. The Corps would conduct standard Section 106 consultation with the relevant tribes (listed in Section 5) and state SHPO for each submitted flowering rush treatment Scope of Work. If possible detrimental effects are identified, the Corps would first attempt to modify any project potentially affecting historic/cultural properties to avoid or minimize any potential impacts. If adverse effects are identified, the Corps would identify appropriate mitigation and enter into an appropriate MOA with the SHPO or ACHP.

Initial Scopes of Work submitted by PSMFC for cost sharing in 2019 were evaluated by Corps archeologists. Actions requested for cost sharing by the State of Washington did not have potential to affect historic or cultural resources. The Corps determined that some activities in the SOW submitted by the state of Montana may have a potential to effect historic or cultural resources. The Corps initiated consultation with the Confederated Salish and Kootenai Tribes Historic Preservation Officer in June of 2019. NHPA compliance for the 2019 SOWs will be considered complete upon the successful completion of consolation. No funds would be shared with Montana until that time.

4.2.7 Clean Water Act

The Federal Water Pollution Control Act on 1972 (33 U.S.C. §1251 et seq., as amended) is more commonly referred to as the Clean Water Act. The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

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Section 401 of the Federal Clean Water Act requires that any Federal activity that may result in a discharge of a pollutant or dredged or fill material to waters of the United States must first receive a water quality certification from the state in which the activity would occur. If a permit under either Section 402 or 404 is needed for an action, Section 401 Water Quality Certification is also needed. In this case, application of chemical treatments would be covered by existing programmatic general permits, not new permits and Section 401 Certification would not be required.

Section 402 of the Act, the National Pollutant Discharge Elimination System (NPDES) program, pertains to discharge of pollutants. Aquatic pesticide application would require approval for use under a NPDES permit, either the EPA's 2016 Pesticide General Permit (PGP) for treatments in Idaho, Washington, or on Tribal Reservations; the Montana Pollutant Discharge Elimination System Permit (MTG870000) in Montana, or the Oregon Department of Environmental Quality Pesticide General Permit (2300A).

4.2.8 Wild and Scenic Rivers Act of 1974

The National Wild and Scenic Rivers System was created by Congress (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Designation as a wild and scenic river is not the same designation as a National Park, and does not generally confer the same level of protection as a Wilderness Area designation. Instead of enacting strict and mandatory conservation measures, the goal is often to preserve the character of a river.

Of 12,754 miles of designated rivers in the United States, 3,394 are in the proposed action area. In Idaho, designated rivers include Battle Creek, Big Jacks Creek, the Bruneau River, the West Fork Bruneau River, the Middle Fork Clearwater River, Cottonwood Creek, Deep Creek, Dickshooter Creek, Duncan Creek, the Jarbridge River, Little Jacks Creek, the Owyhee River, the North Fork Owyhee River, the South Fork Owyhee River, the Rapid River, the St, Joe River, the Middle Fork Salmon River, Sheep Creek, the Snake River, and Wickahoney Creek for a total of 891 miles.

In Oregon, designated rivers include Big Marsh Creek, the Chetco River, the Clackamas River, the South Fork Clackamas River, the Collawash River, Crescent Creek, the Crooked River, the North Fork Crooked River, the Deschutes River, Donner and Blitzen River, Eagle Creek (Mt. Hood National Forest), Eagle Creek (Wallowa-Whitman National Forest), the Elk River, Elkhorn Creek, Fifteenmile Creek, Fish Creek, the Grande Ronde River, the East Fork Hood River, the Middle Fork Hood River, the Illinois River, the Imnaha River, the John Day River, the North Fork John Day River, the South Fork John Day River, Joseph Creek, the Klamath River, the Little Deschutes River, the Lostine River, the Malheur River, the North Fork Malheur River, the McKenzie River, the Metolius River, the Minam River, the North Powder River, the North Umpqua River, the Owyhee River, the North Fork Owyhee River, the Powder River, Quartzville Creek, the River Styx, the Roaring River, the South Fork Roaring River, the Rogue River, the Upper Rogue River, the Salmon River, the Sandy River, the North Fork Smith River, the Snake River, the Sprague River, Squaw Creek, the Sycan River, the Wallowa River, the Wenaha River, the West Little Owyhee River, Whychus Creek, the White River,

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Wildhorse & Kiger Creeks, the North Middle Fork Willamette River, and the Zigzag River, for a total of 1,918 miles.

In Montana designated rivers include east Rosebud Creek, the Flathead River, and the Missouri River for a total of 388 miles; and in Washington, designated rivers include Illabot Creek, the Klickitat River, the Pratt River, the Skagit River, the Middle Fork Snoqualmie River, and the White Salmon River, for a total of 197 miles.

Flowering rush is likely to colonize Wild and Scenic Rivers. However, due to fewer boat access points than the more heavily trafficked rivers in the FSA, such as the Columbia and mainstem Snake Rivers, it is less likely treatment actions would occur on these systems. Should such a treatment occur, the Corps would consult with the Bureau of Land Management, National Park Service, USFWS, or U.S. Forest Service, depending on jurisdiction, to ensure water quality is not degraded and to determine mitigation as necessary.

4.2.9 Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), along with the Reduction of Lead in Drinking Water Act and 40 CFR Part 141 - National Primary Drinking Water Regulations, are the Federal laws that protect public drinking water supplies throughout the nation. SDWA authorizes the US EPA to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water.

The Proposed Action would not involve public drinking water systems or groundwater injection and is therefore not subject to the Acts.

4.2.10 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act requires that regulated activities conducted below the Ordinary High Water Mark elevation of navigable waters of the U.S. be approved/permitted by the Corps of Engineers Regulatory Division. Regulated activities include the placement/removal of structures, work involving dredging, disposal of dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway.

The Proposed Action would be covered by existing programmatic general permits, not new permits and Section 401 Certification would not be required.

4.3 Executive Orders

4.3.1 Executive Order 11988, Floodplain Management

This Executive Order outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency must evaluate the potential effects of actions on floodplains and avoid undertaking actions that directly or indirectly induce development in the floodplain or adversely affect natural floodplain values.

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Conservation measures have been carefully considered and listed in Section 3.12 to ensure the proposed action would result in only minor to moderate impacts to floodplains.

4.3.2 Executive Order 11990, Protection of Wetlands

This order directs Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. It has been the goal of the Corps to avoid or minimize wetland impacts associated with their planned actions.

Conservation measures have been carefully considered and listed in Section 3.12 to ensure the proposed action would result in only minor to moderate impacts to wetlands.

4.3.3 Executive Order 12898, Environmental Justice

This order requires Federal agencies to consider and address environmental justice by identifying and assessing whether agency actions may have disproportionately high and adverse human health or environmental effects on minority or low-income populations. Disproportionately high and adverse effects are those effects that are predominantly borne by minority or low-income populations and are appreciably more severe or greater in magnitude than the effects on nonminority or non-low income populations.

This EA considers activities related to the treatment of flowering rush in the FSA. The proposed action is not expected to disproportionately affect any particular demographic group.

4.3.4 Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species

This EO states that it is the policy of the United States to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. The order directs Federal agencies to refrain from authorizing, funding, or implementing actions that are likely to cause or promote the introduction, establishment, or spread of invasive species in the United States unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. Conservation measures (Section 3.12) would be implemented to ensure that the Proposed Action would comply with EO 13751.

Section 5 – Consultation, Coordination and Public Involvement

The scoping period for the Proposed Action was from February 28, 2019 to March 30, 2019. Due to the large potential action area, scoping letters were sent to congressional delegates, Federal and state agencies, Tribes, and stakeholders. The Corps received three comments during the scoping period. The Washington State Department of

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Ecology and a private citizen from Portland State University each commented that the No Action Alternative should address the potential economic damages associated with flowering rush treatment and the environmental effects of flowering rush infestation on native species. The third comment is from an archaeologist with Confederated Tribes of the Umatilla concerned about impacts associated with treatment of flowering rush on treaty protected rights and resources and how the project would impact cultural resources protected under both NEPA and the NHPA. All comments have been addressed in this EA.

The draft Finding of No Significant Impact (FONSI) and this EA are being distributed to Federal, state, and local agencies, Tribes, and the public for a 30-day review and comment period beginning on or about June 24, 2019 and concluding on or about July 24, 2019. It is available on the Walla Walla District Corps of Engineers website at www.nww.usace.army.mil/Missions/Environmental-Compliance. The distribution list includes the following:

Federal Agencies:

National Marine Fisheries Service
U.S. Bureau of Indian Affairs
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service Region 1
U.S. Forest Service Region 6
U.S. Bureau of Land Management Idaho State Office
U.S. Bureau of Land Management Oregon/Washington State Office
U.S. Bureau of Land Management Montana/Dakotas State Office
U.S. Bureau of Reclamation Great Plains Region
U.S. Bureau of Reclamation Pacific Northwest Region
Natural Resources Conservation Service Washington Office
Natural Resources Conservation Service Oregon Office
Natural Resources Conservation Service Idaho Office
Natural Resources Conservation Service Montana Office
National Park Service

State Agencies:

Idaho Department of Commerce
Idaho Department of Environmental Quality
Idaho Department of Water Resources
Idaho Governor's Office
Idaho Office of Species Conservation
Idaho Parks and Recreation
Idaho Soil and Water Conservation Commission
Idaho State Historic Preservation Officer
Montana Department of Environmental Quality
Montana Department of Natural Resources and Conservation
Montana Fish, Wildlife, and Parks
Montana Office of the Governor
Montana State Historic Preservation Officer
Oregon Department of Agriculture
Oregon Department of Energy
Oregon Department of Environmental Quality
Oregon Governor's Office

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Oregon Parks and Recreation Department
Oregon State Police
Oregon State Historic Preservation Officer
Washington Department of Agriculture
Washington Department of Natural Resources
Washington Department of Ecology
Washington State Historic Preservation Officer
Washington Office of the Governor

Tribes:

Confederated Colville Tribes
Confederated Salish Kootenai Tribe
Confederated Tribes and Bands of the Yakama Nation
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Warm Springs Indian Reservation
Cowlitz Tribe
Grand Ronde Tribe
Kalispel Tribe
Kootenai Tribe
Nez Perce Tribe
Shoshone Paiute Tribe
Shoshone-Bannock Tribes
Spokane Tribe
Upper Snake River Tribes
Lummi Nation
Nooksack Indian Tribe
Upper Skagit Swinomish Indian Tribe
Stillaguamish Tribe of Indians
Sauk-Suiattle Tribe
Tulalip Tribes
Port Gamble S'Klallam Tribe
Muckleshoot Tribe
Nisqually Tribe
Chehalis Confederated Tribes
Squaxin Island Tribes
Skokomish Tribe
Quinault Indian Tribe
Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Blackfeet Nation
Crow Nation
Fort Peck Assiniboine and Sioux Tribes
Fort Belknap Assiniboine and Gros Ventre Tribes
Chippewa Cree Tribe
Northern Cheyenne Tribe

Other:

American Association of Port Authorities
Association of Pacific Ports
Audubon Society of Portland
Beyond Toxics
Bitterroot River Protection Association
Blue Mountains Land Trust
Columbia River Inter-Tribal Fish Commission
Columbia River Steamship Operators' Association
Columbia Riverkeeper
Conservation Northwest
CREATE, a Columbia Riverkeeper Affiliate
Eastside Audubon Society
Friends of the Clearwater
Golden Eagle Audubon Society
Idaho Conservation League
Idaho Foundation for Parks and Lands
Idaho Native Plant Society
Idaho Rivers United
Idaho Wildlife Federation
Inland Northwest Land Conservancy
Institute for Applied Ecology
Lower Columbia Basin Audubon Society
Lower Columbia Fish Recovery Board
Merchant's Exchange of Portland
Northwest Center for Alternatives to Pesticides
Northwest Indians Fisheries Commission
Northwest Marine Terminal Association
Northwest Power and Conservation Council

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Northwest Steelheaders
Oregon Cultural Trust
Oregon Invasive Species Council
Oregon Watershed Enhancement Board
Pacific Northwest Waterways Association
Palouse Audubon Society
Palouse-Clearwater Environmental Institute
Save Our Wild Salmon
Sierra Club Idaho
Sierra Club Oregon
Sierra Club Washington
Snake River Waterkeeper
Spokane Riverkeeper
The Freshwater Trust
The Nature Conservancy
Toxic-Free Future
Tri-State Steelheaders
Upper Columbia Salmon Recovery Board
Upper Missouri Waterkeeper
Washington Native Plant Society
Washington Public Ports Association
Washington Recreation and Conservation Office
Washington Wild
WaterWatch of Oregon
Willamette Riverkeeper
Wood River Land Trust

In accordance with the Corps supplemental NEPA regulations (33 CFR §230.11), the Corps will provide Notice of Availability of the EA and the FONSI (if/when signed) to concerned agencies, organizations, and the interested public through a news release issued to all area newspapers. The EA and signed FONSI would also be posted to the Corps website at http://www.nww.usace.army.mil/Missions/Environmental-Compliance/.

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BUILDING STRONG®

USACE WATER RESOURCES REFORM AND DEVELOPMENT ACT OF 2014: FLOWERING RUSH CONTROL

WALLA WALLA DISTRICT
WASHINGTON

DRAFT Federal Natural Resources Law Compliance
and
Programmatic Framework Biological Assessment

ADMINISTRATIVE RECORD – DO NOT DESTROY

FILE NUMBER: PPL-C-2018-0102

October 2019

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EXECUTIVE SUMMARY

This Biological Assessment (BA) is prepared pursuant to section 7(a)(2) of the Endangered Species Act (ESA) to evaluate the effects of the U.S. Army Corps of Engineers, Walla Walla District (Corps), proposed Flowering Rush Control Cost Share Program (Program) on listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS). The Corps was authorized by Section 104 of the River and Harbor Act (RHA) of 1958 (33 United States Code [U.S.C.] §610), as amended, to develop the Program to protect the Columbia River Basin from invasive flowering rush.

This BA considers implementation of the Program, where the Corps proposes to co-funding flowering rush treatments at multiple locations in Washington, Idaho, and Montana. Proposed treatment approaches include mechanical removal of flowering rush as well as treatments with aquatic registered herbicides.

The Corps concludes that the proposed action “may affect, but is not likely to adversely affect three evolutionarily significant units of salmon and steelhead under the jurisdiction of NMFS, and three ESA-listed species under the jurisdiction of USFWS. The Corps further concludes the proposed action “may affect, but is not likely to adversely affect” applicable critical habitat for these species. A complete list of species, critical habitats, and effects determinations are provided in Table 1. Best management practices and conservation measures are proposed to minimize and avoid effects.

In addition, this document analyzes the project's likely effects on essential fish habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and the Fish and Wildlife Coordination Act. The Corps has also determined the proposed Program would result in no take of species protected by the Migratory Bird Treaty Act, and no disturbance or take under the Bald and Golden Eagle Protection Act.

The Corps requests informal consultation on Program implementation.

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Table 1. Effects determination summary for Plan implementation. "NA" represents not applicable as no critical habitat is designated or occurs within the action area.

Species	Species Determination	Critical Habitat Determination
NMFS		
UCR Spring-run Chinook	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Puget Sound Chinook	No Effect	No Effect
UCR Steelhead	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
MCR Steelhead	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Puget Sound Steelhead	No Effect	No Effect
USFWS		
Bull trout	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Dolly Varden	No Effect	N/A
Canada Lynx	No Effect	No Effect
Golden Paintbrush	No Effect	N/A
Gray Wolf	No Effect	No Effect
Grizzly Bear	May Affect, Not Likely to Adversely Affect	No Effect
Marbled Murrelet	No Effect	No Effect
North American Wolverine	No Effect	N/A
Northern Spotted Owl	No Effect	No Effect
Oregon Spotted Frog	No Effect	No Effect
Roy Prairie Pocket Gopher	No Effect	No Effect
Spalding's Catchfly	No Effect	N/A
Streak Horned Lark	No Effect	No Effect
Ute Ladies'-tresses	No Effect	N/A
Water Howellia	No Effect	N/A
Whitebark Pine	No Effect	N/A
Yellow-billed Cuckoo	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect

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Acronyms and Abbreviations

ac	Acre
ATV	All-Terrain Vehicle
BA	Biological Assessment
BCNWCB	Benton County Noxious Weed Control Board
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practices
C	Celsius
cm	Centimeter
Corps	U.S. Army Corps of Engineers
DASH	Diver-Assisted Suction Harvesting
DPS	Distinct Population Segments
EFH	Essential Fish Habitat
EPA	United States Environmental Protection Agency
ERA	Environmental Risk Assessment
ERDC	U.S. Army Engineer Research and Development Center
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
F	Fahrenheit
ft	Foot
FWCA	Fish and Wildlife Coordination Act
ha	Hectare
in	Inch
JBLM	Joint Base Lewis-McChord
km	Kilometer
LC50	Lethal Concentration
MBTA	Migratory Bird Treaty Act
MCR	Middle Columbia River
mi	Mile
MPFI	Matrix of Pathways and Indicators
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NISC	National Invasive Species Council
NLM	National Library of Medicine
NMFS	National Marine Fisheries Service
PBF	Physical and Biological Features
POCNWCB	Pend Oreille County Noxious Weed Control Board
PFMC	Pacific Fishery Management Council
RHA	Rivers and Harbors Act
RQ	Risk Quotient
UCR	Upper Columbia River
USFWS	U.S. Fish and Wildlife Service
WCNWCB	Whatcom County Noxious Weed Control Board
WDOE	Washington State Department of Ecology

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WIIN	Water Infrastructure Improvements for The Nation Act
WRDA	Water Resources Reform and Development Act
WSNWCB	Washington State Noxious Weed Control Board

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1. Background

The US Army Corps of Engineers, Walla Walla District (Corps), proposes to provide matching funds (cost share) to the States of Idaho, Montana, Oregon, and Washington for the removal of flowering rush (*Butomus umbellatus L.*) from non-Federal waters within the four-state area (FSA).

This biological assessment (BA) was created to comply with Section 7(a)(2) of the Endangered Species Act (ESA) and analyzes potential effects of the proposed action on ESA-listed species and their designated critical habitats under the jurisdiction of both the National Marine Fisheries Service's (NMFS) and U.S. Fish and Wildlife Service's (USFWS) (henceforth referred to collectively as the Services).

Flowering rush is affecting private landowner access and use of property, as well as public sites with high value for conservation and recreation throughout the FSA. Manual and chemical treatments by the state agencies, county noxious weed control boards, and the Native American Tribes have been providing annual control of flowering rush, restoring recreational use, reducing rhizome spread, and returning open water. The Corps proposes to share the expense of these ongoing treatments.

1.1. Authority

Section 104 of the River and Harbor Act (RHA) of 1958 (33 United States Code [U.S.C.] §610), as amended, authorizes the Corps to administer a comprehensive program to provide for the prevention, control, and progressive eradication of noxious aquatic plant growths and aquatic invasive species from the navigable waters, tributary streams, connecting channels, and other allied waters of the U.S. See 33 U.S.C. §610(a). This program is known as the Aquatic Plant Control (APC) Program and annually receives appropriations. Of amounts provided for the APC Program in Fiscal Year (FY) 2018 and FY 2019, specific allocations were provided for the control of flowering rush. The Consolidated Appropriations Act, 2018 (P.L. 115-141), and the Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019 (P.L. 115-244), each allocated $1,000,000 in funds "for activities for the control of flowering rush."

It is the policy of the Corps of Engineers that the APC Program shall be maintained to control specific types of aquatic plant infestations of major economic significance (such as the spread of flowering rush), or weed infestations that have potential for reaching such economic significance, in navigable waters, tributaries, streams, connecting channels and all allied waters. Specific guidance on the development of cost-sharing agreements, planning studies, and funding requests can be found in Chapter 14 of Engineer Pamphlet 1130-2-500.

On July 27, 2018, the Pacific States Marine Fisheries Commission (PSMFC) requested a cost share agreement with the Corps to control flowering rush in the States of Idaho, Montana, and Washington. Flowering rush has not yet been found outside of Federal waters in Oregon, but should it be discovered costs could be shared with Oregon through PSMFC under this authority and BA.

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The PSMFC is currently acting on behalf of the States of Idaho, Montana, and Washington and the following related institutions:

- Idaho State Department of Agriculture
- Washington Department of Fish and Wildlife
- Washington Department of Ecology
- Washington Department of Agriculture
- Benton County, Washington
- Kalispel Tribe
- Chelan County Noxious Weed Board
- Pend Oreille Noxious Weed Board
- Whatcom County Noxious Weed Board
- Salish Kootenai College
- University of Montana
- Others may be included in the future.

The project would be implemented under the authority of Section 104 of the RHA of 1958, as amended.

1.2. Flowering Rush Presence and Life History

Flowering rush is an emergent invasive plant native to Europe and Asia and now found scattered throughout the northern portion of the United States, with significant populations found in the Great Lakes and upper Mississippi River system (EDDMapS, 2019). The species was first discovered in North America near 1897 in the St. Lawrence River, and has likely been introduced as an ornamental multiple times (Les and Mehrhoff, 1999). Flowering rush was found in western Lake Erie by 1933 and first discovered in the Mississippi River basin in 1971 (Roberts, 1972).

In the Northwest, flowering rush is currently present in Idaho, Montana, Washington, and Oregon (Figure 1). In Idaho it is found in two clusters – in southeast Idaho in the Snake and Blackfoot rivers. In Montana, it is found primarily in the shallows of Flathead Lake, as well as in the irrigation canals of the Flathead Irrigation District. In Oregon, flowering rush is present in the Columbia River between John Day Dam and the Washington Border. In Washington it is presently known in the Columbia River near the Tri-Cities and near Orondo, Washington, the lower Yakima River, the Pend Oreille River, Silver Lake in Whatcom County, Lake Spokane and Nine Mile Reservoir in the Spokane River drainage, and on Joint Base Lewis-McChord (JBLM) near Olympia, Washington.

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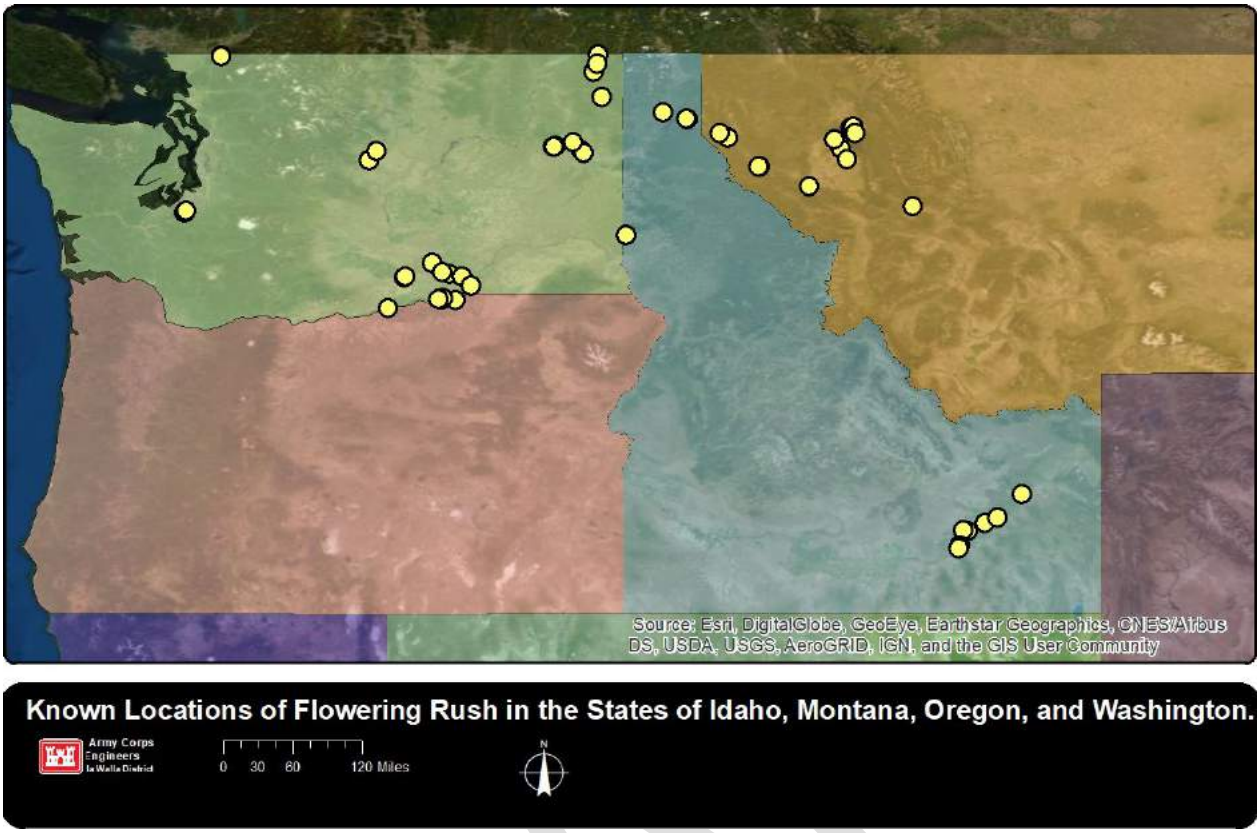

Figure 1. Distribution of flowering rush in the FSA

Flowering rush (Figure 2) is a wetland obligate perennial with both emerged and fully submerged forms, found in a variety of shallow water habitats, especially the shorelines of lakes and slow moving rivers (Jacobs, 2011). Not a true rush or member of family Juncaceae, it is the sole representative of family Butomaceae. It has spread through The United States via both the ornamental trade and by wildlife, which can spread the plant via consumption or by dislodging the plant from the sediment (Les and Mehrhoff, 1999).

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Figure 2. Flowering rush (*Butomus umbellatus*). Image courtesy of the Invasive Species Council of British Columbia.

Flowering Rush has sedge-like triangular leaves (Figure 3) and round rush-like stems (Figure 4). It is most easily identified when in bloom, when flowers composed of three white to pink petals grow in umbrella shaped clusters. The flowers (Figure 2) are approximately one inch (2.5 centimeters) wide with three small, green sepals, six pink petals, nine stamens, and six pistils that can produce about 200 seeds each. Between 20 and 50 flowers cluster on a round stalk. There are two genetically distinct flowering types; a diploid type that flowers regularly and produces viable seed, and a triploid type that flowers infrequently and produces sterile flowers. Both types appear to be present in the FSA, with the triploid type occurring with much greater abundance (Harms and Shearer, 2015).

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Figure 3. The triangular leaves of flowering rush. Image courtesy of Ben Legler.

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Figure 4. Flowering rush stem. Image courtesy of the Washington State Noxious Weed Control Board (WSNWCB).

Flowering rush grows from a creeping rootstalk, or rhizome (Figure 5). The rhizomes of flowering rush form weak constrictions between vegetative buds. Minor disturbances including waves, water movement, waterfowl, and wildlife can break the rhizomes at these points. Once broken, the freed fragments drift away and can establish new populations (Hackett and Monfils, 2014). This is the sole means of reproduction for the triploid type.

Flowering rush habitat includes lakeshores, slow moving waterways, irrigation ditches, and wetlands. It is most often found in shallow waters, but can survive and grow across a range of water depths, up to 6 meters (Jacobs, 2011).

Fluctuating water levels promote flowering rush establishment and population expansion. As water levels ebb, sparsely-vegetated substrata are exposed to colonization aided by the quick warming of shallow waters and exposed substrates (Hroudová et al., 1996). On controlled systems where water levels are maintained at full pool throughout the summer and lowered in winter and early spring, flowering rush is able to outcompete native vegetation as it is adapted to emerge and grow rapidly at this time (Jacobs, 2011).

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Figure 5. Flowering rush rhizome. Image courtesy of WSNWCB.

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2. Federal Action

2.1. Proposed Action

2.1.1. Action Area

Ultimately, flowering rush treatments could be cost shared at any location in the states of Idaho, Montana, Oregon, or Washington. However, due to its presence at known locations and the need for multi-year treatment regimes, potential treatment locations can de predicted with a high degree of certainty.

For the purpose of this programmatic framework biological assessment, the proposed action consists of co-funding flowering rush treatments at any of the known locations of flowering rush in the states of Idaho, Montana, or Washington (Figure 6), excluding those waters managed by the Corps or other federal agencies operating under their own treatment programs. Corps managed waters would be treated by the Corps, according to the USACE Aquatic Pest Management Plan (NMFS Opinion WCRO-2018-00389; USFWS Opinion 01EWFW00-2018-F-1271). Known flowering rush locations near Olympia Washington are located on Joint Base Lewis-McCord and are being treated under Department of Defense protocols. There would be no cost-shared treatments at JBLM.

The Corps would provide matching funds to State agencies to implement treatment at the specified locations (Figure 6). Each location would have individualized treatment protocols and acting agencies, but only treatments outlined in this BA would be cost-shared. Specifics of individual treatment locations, including acreages treated would be detailed in annually submitted site-specific abbreviated biological assessments (ABA). A sample ABA is included as Appendix A. Should flowering rush be discovered in new locations and treatments at these new locations be proposed for cost-sharing, they would be covered in an amendment to this BA.

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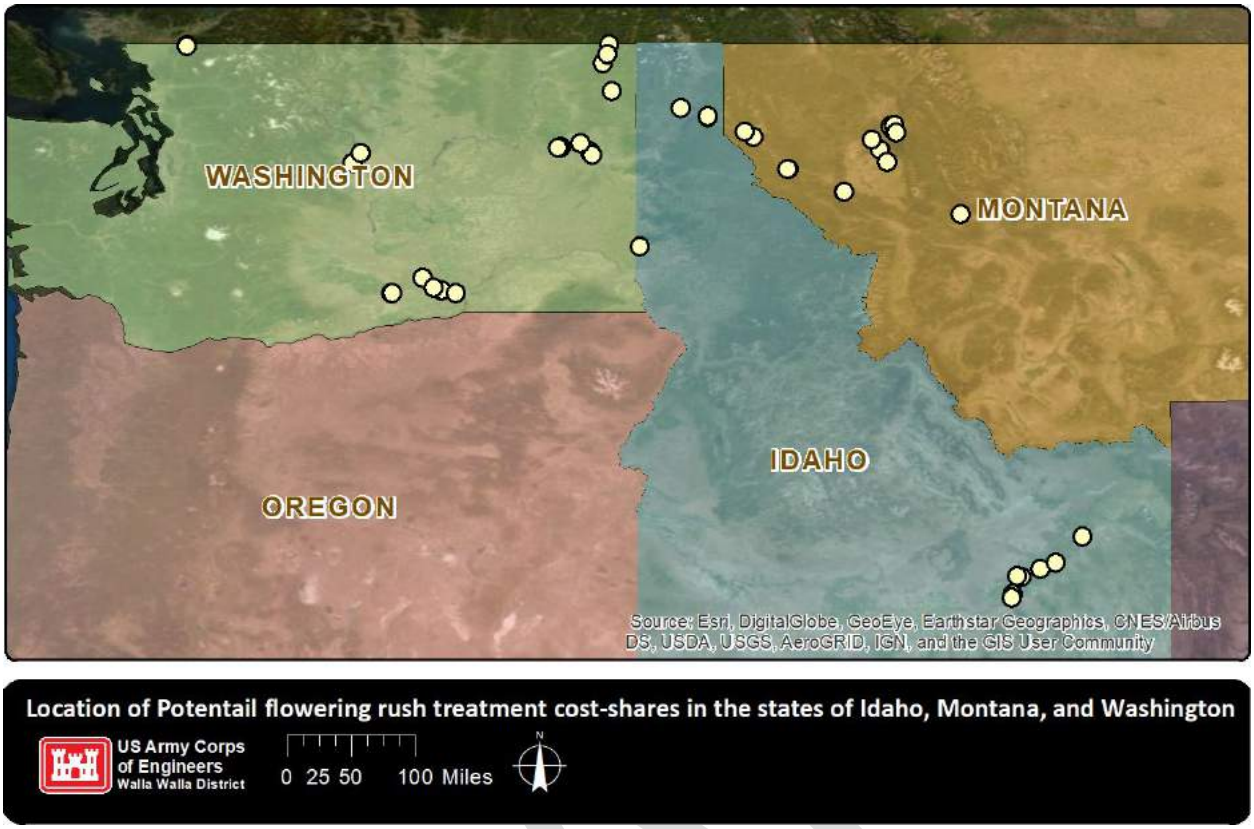

Figure 6. Locations of proposed flowering rush control actions in the four-state area.

i. Montana – Flathead Lake and Flathead Irrigation District

Flowering rush was first observed at the north end of Flathead Lake in 1964. It has since spread throughout the lake, infesting over 2,000 acres in the lake. From Flathead Lake, flowering rush has also spread 12 miles upstream in the Flathead River, and 165 miles downstream, into the Clark Fork River and to Lake Pend Oreille in Idaho. Regulation of water levels in Flathead Lake promote the growth and establishment of flowering rush by creating large, dewatered flats that quickly warm in the late winter and early spring, allowing flowering rush to establish and quickly form dense monocultures. Similar fluctuations in water level have allowed flowering rush to flourish in the irrigation canals of the nearby Flathead Irrigation District.

ii. Idaho – Pend Oreille Lake and River

Flowering rush has spread downstream through the Clark Fork River into Lake Pend Oreille, Idaho, rapidly displacing the previously abundant invasive Eurasian water milfoil. Presently, approximately 86 miles of shoreline in the Pend Oreille system are infested with flowering rush. Populations are concentrated in the Clark Fork and Pack River deltas, Oden Bay, and Kootenei bay in Lake Pend Oreille. Flowering rush occurs along most of the length of the Pend Oreille River above Albeni Falls Dam.

iii. Idaho – Snake and Blackfoot River

Flowering rush is also established in the Snake and Blackfoot rivers in southeastern Idaho. Approximately 223 river miles of shoreline are infested in this region, which

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populations concentrated at the southern end of American Falls Reservoir, the southern end of Blackfoot Reservoir, and in the irrigation canals near the confluence of the Snake and Blackfoot rivers. These locations, especially near American Falls Reservoir are those nearest recent observations of yellow-billed cuckoo.

iv. Washington - Silver Lake

Silver Lake in Whatcom County, Washington is located about 40 miles east of the town of Bellingham, and about 3 miles south of the Canadian border, in the foothills of the Cascade Mountains. The 157.3-acre lake is approximately three miles upstream of Maple Falls, a natural passage barrier, on Maple Creek, and is the site of Silver Lake Park – a popular county park with camping, fishing, and day use activities. While ESA-listed anadromous salmon and steelhead, as well as bull trout/Dolly Varden are known to occur in Maple Creek below Maple Falls, their presence has not been documented above the falls or in Silver Lake. This is the only location among the potential action areas where Dolly Varden may occur nearby.

Flowering rush was first discovered in Silver Lake in 1997, and was already well established in about 50 acres in the northern half of the lake when discovered. Silver Lake has been the subject of flowering rush control trials and efforts since 2008. As a result, flowering rush has been reduced, but has not been eliminated.

v. Washington - Columbia River near Orondo

This flowering rush population is in the main channel of the Columbia River near Orondo in Douglas County. It is located upstream of Rocky Reach Dam, which is managed by Chelan Public Utilities District. It is approximately 192 River Miles upstream from McNary Lock and Dam; a Corps of Engineers managed facility.

This flowering rush population was reported in 2014. Flowering rush control treatments in this section of the Columbia River are conducted by the Chelan County Noxious Weed Board. The identification was verified in the summer of 2015 and control by diver hand pulling, and covering began late that summer. The control work has continued using Diver-Assisted Suction Harvesting (DASH) and covering with benthic barriers in 2016 and 2017. It is likely there will still be a few plants in the area, so control work is again planned for 2019.

The location of the flowering rush is just south of the Orondo Park boat launch, present as scattered individual plants and small patches in about a 1 acre area. In September 2017 approximately 10 locations were controlled within that 1 acre.

vi. Washington - Yakima River

This flowering rush population is in the lower Yakima River - from Prosser, at approximately River Mile 46, to the boundary of Corps of Engineers jurisdiction of Lake Wallula at approximately River Mile XX. Flowering rush control in the Yakima River has been conducted as a combined effort of several state and county agencies since 2015. Different treatment approaches have been used at specific locations in the Yakima River.

vii. Washington - Pend Oreille River

Flowering rush is present in scattered submersed and emergent patches through the length of the Pend Oreille River in Washington State. The source is up-river at Lake

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Pend Oreille in Idaho, and that population originated from Flathead Lake, Montana. Flowering rush control in the Pend Oreille River, Washington State portion, has been on-going since 2011. The work has mainly been orchestrated by Pend Oreille County Noxious Weed Control staff, with additional work on Kalispel Tribal Land performed by the Kalispel Tribe.

viii. Washington - Lake Spokane and Nine Mile Reservoir

Flowering rush was documented and mapped in Lake Spokane by the Washington Department of Ecology (WADOE) in 2010, when approximately 100 locations of the plant were identified. Avista Utilities has been managing the infestation since then, removing as many as 1,000 plants annually using suction assisted harvesting(Avista Corporation, 2016).

Flowering rush was first identified in Nine Mile Reservoir in 2012 during surveys by both WADOE and Avista. As many as 1,150 plants were mapped in 2014 (Avista Corporation, 2015), and Avista has been managing treatments since that time, focused on the most densely vegetated areas of the reservoir. Only manual treatments have been employed at Nine Mile Reservoir.

2.1.2. Project Activities

Specific treatments of flowering rush will be determined at a local level by participating states and cooperating county noxious weed control boards. However, only treatments as described below would be eligible for cost-sharing by the Corps and would fall, broadly, into two categories: manual/mechanical control and chemical control.

i. Manual and Mechanical Control

Physical removal is effective for small quantities of plants near shorelines. Techniques include hand pulling, diver-assisted suction harvesting (DASH), benthic mats, and Aquatic Vegetation Rakes (AVR). Aquatic Vegetation Rakes would only be used on screened canals.

Hand-Pulling

Hand-pulling aquatic plants is similar to pulling weeds out of a garden. It involves removing entire plants (leaves, stems, and roots) from the area of concern and disposing of them in on land away from the shoreline. In water less than three feet deep, no specialized equipment would be required, although a spade, trowel, or long knife may be needed if the sediment is packed or heavy.

In deeper water, hand pulling would be best accomplished by divers. The divers would use mesh bags for the collection of plant fragments. Some sites may not be suitable for hand pulling such as areas where deep flocculent sediments may cause a person hand pulling to sink deeply into the sediment.

Hand pulling could be conducted at any of the proposed sites. If needed, workboats would be launched from established boat ramps and any staging would be done at the boat ramp parking lots or other paved areas. Men and equipment would travel to the site via established roads and there would be no need to establish any new access to the water or shoreline. No riparian vegetation would be removed.

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Diver-Assisted Suction Harvest (DASH)

Hand harvesting paired with a vacuum hose is a standard removal process for aquatic plants. The operation involves literally hand-pulling the weeds from the lake bed and feeding them to a suction hose. It requires water pumps to move a large volume of water to maintain adequate suction of materials that the divers are processing. The material placed by the divers into the suction hose along with the water is deposited into onion bags with water leaving through the holes in the bag mesh. The bags must have a large enough 'mesh' size so that silts, clay, leaves, and other plant material being collected do not immediately clog the bags and block water movement.

The basic removal technique is the similar to hand-pulling, but DASH replaces collection bags with portable suction hoses. Hose nozzles often feature handles for divers to hold to ease underwater navigation. Once a hose is carefully navigated to a flowering rush patch, divers hold the nozzle steady and slowly input flowering rush plants and fragments into the suction hose. Divers shake root crowns away from the suction nozzle to minimize debris and sediments that may collect in above-water holding tanks. If a root crown is shaken, divers must be sure to locate and collect any fragments that may have resulted from hand-pulling. Using this approach, hoses can be moved underwater from one spot to another with ease and diminish the likelihood of hose entanglement. The hose can also be utilized to suction debris that may be compromising visibility.

Vacuums are typically around 6 inches in diameter and carry the flowering rush that is pulled underwater up to the surface, either to a stationary boat or to a land mass where the plants are collected, sorted, and stored appropriately. The methods associated with filtering and separating plant material above the surface may vary greatly, along with individual DASH system set-ups. There is no uniform construction of DASH mechanisms, but many systems generally share basic components. The DASH system works like a vacuum system in which pumps, motors, hydraulics, and various filtering devices work simultaneously to provide an efficient plant transportation process.

DASH is efficient, but may disturb native organisms. Vacuum harvesting does not only collect plants that are directly placed into it, but it also collects anything that meets the nozzle. This can include native plants, small aquatic organisms, and bottom sediments. Drawing up large amounts of sediments such as small rocks or mud can clog filters and reduce suction capabilities. Small organisms may be drawn into the hose and relocated from their natural habitat. Sound and vibration disruptions produced by DASH place stress on organisms above and below the surface.

Systems are costly to build and the manual labor, fuel, and upkeep costs prevent some organizations from employing this method of removal. DASH, along with hand-pulling typically require years of continued use to significantly diminish flowering rush infestations. Despite a few drawbacks, these devices improve visibility and transport plants quicker than hand-pulling and bagging.

DASH could be utilized at the any of the proposed sites. When deployed, workboats would be launched from established boat ramps and any staging would be done at the boat ramp parking lots or other paved areas. Men and equipment would travel to the

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site via established roads and there would be no need to establish any new access to the water or shoreline. No riparian vegetation would be removed.

Benthic barriers

Bottom barriers are semi-permanent materials laid over the top of flowering rush beds and are analogous to using landscape fabric to suppress the growth of weeds in yards. A bottom screen or benthic barrier covers the sediment like a blanket, compressing aquatic plants while reducing, or blocking light. Materials such as burlap, plastics, perforated black Mylar, and woven synthetics can all be used as bottom screens. Some people report success using pond liner materials. There is also a heavy, felt-like polyester fabric bottom screen commercial material, which is specifically designed for aquatic plant control.

An ideal bottom screen should be durable, heavier than water, reduce or block light, prevent plants from growing into and under the fabric, be easy to install and maintain, and should readily allow gases produced by rotting weeds to escape without "ballooning" the fabric upwards. Even the most porous materials, such as window screen, will billow due to gas buildup. Therefore, it is very important to anchor the bottom barrier securely to the bottom. Unsecured screens can create navigation hazards and are dangerous to swimmers. Anchors must be effective in keeping the material down and must be regularly checked. Natural materials such as rocks or sandbags are preferred as anchors.

The duration of weed control depends on the rate that weeds can grow through or on top of the bottom screen, the rate that new sediment is deposited on the barrier, and the durability and longevity of the material. For example, burlap may rot within two years; plants can grow through window screening material, and can grow on top of felt-like Texel™ fabric. Regular maintenance is essential and can extend the life of most bottom barriers.

Installation is easier in winter or early spring when plants have died back. In summer, cutting or hand pulling the plants first will facilitate bottom screen installation. Research has shown that much more gas is produced under bottom screens that are installed over the top of aquatic plants. The less plant material that is present before installing the screen, the more successful the screen will be in staying in place. Bottom screens may also be attached to frames rather than placed directly onto the sediment. The frames may then be moved for control of a larger area.

Benthic barriers may be utilized at any of the proposed sites. If needed, workboats would be launched from established boat ramps and any staging would be done at the boat ramp parking lots or other paved areas. Men and equipment would travel to the site via established roads and there would be no need to establish any new access to the water or shoreline. No riparian vegetation would be removed.

Aquatic Vegetation Rake – screened irrigation canals only

The Aquatic Vegetation Rake can best be described as a backhoe mounted with several different size and functioning rake attachments (Figure 7). To treat irrigation canals, it would be operated from the shore. The AVR can operate in water as shallow as one foot and can remove nuisance vegetation and bottom debris from water depths

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ranging from 18 inches to 10 feet. Two to three of repeated treatments or longer are optimal for flowering rush control due to the well-developed root systems.

Figure 7. An Aquatic Vegetation Rake at Work in an Idaho Canal.

During the removal process, the AVR will extract the plant in its entirety, as well as its attached rhizome structure lain beneath the water's surface. Aquatic Vegetation Raking results in fragments of the plant, which, if not captured by the AVR, must be hand collected to eliminate the possibility of spreading the plant to new areas. Along with plants, AVRs also collect a large number of small fish and invertebrates. Amphibians and turtles have been known to be collected as well. While operating an AVR, the operator is watchful for fish as the cut plants are removed from the water. AVR would only be used in screened irrigation canals, where there is no presence of ESA listed fishes.

Aquatic Vegetation Rakes can cut and collect several acres per day depending on plant density and storage capacity of the equipment. Harvesting speeds for typical machines range from 0.5 to 1.5 acres per hour. The AVR deposits each rake full (maximum 500 pounds) of material directly on-shore. The material is dewatered on shore, bagged, and hauled away for upland disposal in an approved location.

ii. Chemical Control

Herbicide treatment may be more effective than manual controls, especially where there are large stands of flowering rush, or where physical removal may be impractical. Four

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herbicides would be approved for cost-sharing: Ammonium salt of imazamox, imazapyr, diquat dibromide, and glyphosate (Table 1).

The choice of herbicide and application technique would be dictated by the specifics of a given flowering rush infestation site. In eastern Idaho flowering rush occurs in isolated patches, chemical application would be by hand and spot application methods. In the Flathead Lake watershed flowering rush occurs both in isolated patches and in extensive stands, chemical application would be by hand, spot, and broadcast methods.

Table 1. Herbicides That May Be Used for Flowering Rush Control in cost-shared treatments covered in this BA.

Active Ingredient	Emergent Application Rate (pints per acre)	Submerged Application Rate (pints per acre foot of water)
Imazapyr	2 to 6 pints	Not for submerged
Ammonium salt of imazamox	0.02 to 8 pints	1.0625 to 10.8125 pints
Diquat dibromide	4 to 16 pints	2 to 4 pints
Glyphosate	1.5 to 7 pints	Not for submerged

The Corps proposes the following application methods for chemical control.

Hand

Any of the following hand/select methods may be employed.

Wicking and Wiping. Involves using a sponge or wick on a long handle to wipe herbicide onto foliage and stems. Use of a wick eliminates the possibility of spray drift or droplets falling on non-target plants. Herbicide can drip or dribble from some wicks. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle, a thick, waxy layer present on leaves and stems of most plants.

Stem Injection. Herbicides can be injected into herbaceous stems using a needle and syringe.

Spot

The most common chemical applications are spot treatments made by either ground-based sprayers [mounted to small all-terrain vehicles (ATVs), trucks or tractors], a boat, or with backpack sprayers. Most spot applications treat areas that range in size from less than one-tenth acre to 1 ½ acres where herbicide is sprayed directly onto small patches or individual target plants. Applicator type ranges from motorized vehicles with spray hoses, to backpack sprayers, to hand-pumped spray or squirt bottles. Hand-pumped spray and squirt bottles can target very small plants or parts of plants.

Broadcast

Herbicides may be sprayed via ground vehicles with hose sprayers or booms using an array of spray nozzles. This equipment is most commonly used for broadcast spraying of roads, but can also be used on all-terrain vehicles for broadcast or spot spray of bare

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ground in drawn-down areas of reservoirs in the late fall and winter. Broadcast application of herbicides would only be used to target dewatered flowering rush on exposed reservoir bottoms or monocultures of emergent or riparian flowering rush. When used to treat emergent or riparian flowering rush, broadcast applications would only be performed after June 1 of any year.

Submerged flowering rush may be treated from a workboat using an injection system, weighted trailing hoses, or from boom sprayers with submersed nozzles. Injection application consists of two large herbicide storage tanks, a GPS controlled herbicide flow system for precision application and from six to eight drop-hoses with variable depth herbicide discharge points. This allows for uniform placement of the targeted application rate throughout the horizontal and vertical profile.

Herbicides

Four herbicides would be approved for cost-sharing: imazapyr, ammonium salt of imazamox, diquat dibromide, and glyphosate

Imazapyr

Imazapyr is a non-selective herbicide registered for control of a broad range of vegetation including grasses, herbs, and woody plants in upland, riparian, and emergent settings. Imazapyr controls plant growth through inhibition of plant-specific enzyme acetolactate synthase (ALS) (Senseman, 2007; Tu et al., 2001). It has been shown to be effective in the control of a variety of hard to control species including alligatorweed, parrotfeather, common reed, giant reed, smooth cordgrass, melaleuca, and Carolina willow (Madsen et al., 2013), and is among the most effective herbicides for control of flowering rush (Cahoon, 2018; Madsen et al., 2017).

In plants, ALS catalyzes the production of the amino acids valine, leucine, and isoleucine. In the absence of these amino acids, plants are unable to synthesize protein and cell growth is inhibited (Tu et al., 2001). Susceptible plants will stop growing soon after treatment, but plant death and decomposition will occur over several weeks. ALS catalyzed production of these essential amino acids is unique to the plant kingdom. Animals require these amino acids, but obtain them by eating plants and other animals, as such, imazapyr is not highly toxic to animals (Fisher et al., 2003; Tu et al., 2001).

Imazapyr is broken down in the water by light and has a half-life (the time it takes for half of the active ingredient to degrade) ranging from three to five days. Three degradation products are created as imazapyr breaks down. These are pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid (quinolinic acid), and nicotinic acid. These degradates persist in water for approximately the same amount of time as imazapyr. Imazapyr doesn't bind to sediments, so leaching through soil into groundwater is likely. Imazapyr is practically non-toxic (the U.S. Environmental Protection Agency's (EPA) lowest toxicity category) to fish, invertebrates, birds, and mammals and it does not bioaccumulate in animal tissues.

Imazapyr would be used for treatment of emergent flowering rush only. The application rate would be up to six pints per acre (pt/ac). An approved aquatic marker dye, would be applied with imazapyr at the manufacturer's recommended rate. Imazapyr could be sprayed somewhat akin to spot treatments, where applicators would directly spray small

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patches of emergent flowering rush with backpack and handheld sprayers, from the shoreline or from workboats. Large-scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, could be performed by All-terrain vehicle (ATV) using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of six pt/ac or less. Imazapyr could also be broadcast over emergent flowering rush from a workboat. Broadcast aquatic application of imazapyr would only be conducted when local water temperature exceeds 65° Fahrenheit / 18.5° Celsius.

Ammonium salt of imazamox

Ammonium salt of imazamox (imazamox) is a non-selective herbicide registered for aquatic use under the trade name Clearcast®. Like imazapyr, imazamox inhibits the production of ALS in plants, leading to plant death within several weeks of application. Imazamox is used to treat a variety of nuisance aquatic vegetation and hard to kill plants, and is becoming a typical treatment option for flowering rush control (Madsen et al., 2017; Wersal et al., 2014). Like imazapyr, imazamox is practically non-toxic to animals.

Imazamox is only moderately persistent, and it degrades aerobically in the soil to a non-herbicidal metabolite which is immobile or moderately mobile. Imazamox also degrades in the water by aqueous photolysis. Hazard to non-target organisms is considered to be minimal. Imazamox is practically nontoxic to avian species, finfish, aquatic invertebrates, and honeybees (USEPA, 2008).

Liquid imazamox can be applied to the surface of the water using a sprayer or injected below the water surface. When treating emergent or floating plants, imazamox must be used with a spray adjuvant. Spray adjuvants generally consist of surfactants, oils, and fertilizers and enhance the effectiveness of herbicides. The Corps only authorizes use of aquatic registered adjuvants which are not petroleum-based, non-toxic, and do not contain metals.

Imazamox could be used for treatment of emergent and submerged flowering rush. The application rate would be up to eight pt/ac for emergent flowering rush and up to 10.88125 pints per acre-foot (pt/ac-ft) for submerged flowering rush. An approved aquatic marker dye, would be applied with imazamox at the manufacturer's recommended rate. Individual treatments sites would be treated as spot treatments, where applicators would directly spray small patches of emergent flowering rush with backpack and handheld sprayers. Large-scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of six pt/ac or less. Imazamox could be broadcast over emergent or submerged flowering rush from a workboat or injected into the water column to control submerged flowering rush, exclusively. Broadcast aquatic application of imazamox would only be conducted when local water temperature exceeds 65° Fahrenheit / 18.5° Celsius.

Diquat bromide

Diquat is the common name for the chemical 6,7-dihyropyrido[1,2-a:2',1'-c] pyrazinediium. It is commonly formulated as a dibromide salt. Highly soluble in water, it

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is widely used in spot and broadcast treatments to control ornamental, turf, noncrop, and aquatic weeds. Diquat inhibits photosynthesis and oxidizes cell membranes. It is rapidly absorbed by plants, and symptoms appear within hours (Senseman, 2007).

For aquatic use, it is a standard treatment for many emergent and floating plants, such as American frogbit, duckweed, watermeal, and waterlettuce (Madsen, 2000; Wersal and Madsen, 2009). Diquat is, however, rapidly adsorbed by soil, so turbidity and suspended sediment diminishes its efficacy (Hofstra et al., 2001; Poovey and Getsinger, 2002). Diquat requires a brief exposure time and is not strongly affected by temperature.

Diquat is slow to degrade in the environment, but will rapidly be adsorbed by soil particles (World Health Organization, 2004). In pond studies, diquat was quickly adsorbed from the water column, and was present at very low levels within hours to days and undetectable in 7 to 38 days (Langeland and Warner, 1986; Parsons et al., 2007; Robb et al., 2014). Diquat has a strong affinity for soils and once adsorbed, while it degrades very slowly it does not leach into ground or surface waters (Khan, 2016; Simsiman and Chesters, 1976).

Diquat could be used to treat emergent or submerged flowering rush. Diquat dibromide could be broadcast over emergent flowering rush at the rate of up to 16 pt/ac and injected below the water surface to treat submerged flowering rush at the rate of up to four pt/ac-ft. Broadcast treatment would be applied from backpack sprayers, floating platforms (workboats) with hose sprayers or booms using an array of spray nozzles, or shored based sprayers where access has been previously developed. Broadcast aquatic application of diquat would only be conducted when local water temperature exceeds 65° Fahrenheit / 18.5° Celsius. Diquat would not be used in eastern Idaho.

Glyphosate

Glyphosate is a non-selective herbicide registered for use on many food and non-food field crops as well as non-crop areas where total vegetation control is desired. When applied at lower rates, glyphosate also is a plant growth regulator (Senseman, 2007).

Three salts of glyphosate are used as active ingredients in registered pesticide products and together, they are the most widely used pesticides by volume. By 2010, over 100,000,000 acres of cropland were treated with glyphosate annually (Woodburn, 2000). In 2014 enough glyphosate was used in agriculture to apply nearly one half pound of glyphosate to every acre of cropland worldwide (Benbrook, 2016). The largest uses include hay/pasture, soybeans, and field corn.

Glyphosate adsorbs strongly to soil and is readily degraded by soil microbes to carbon dioxide (Sprankle et al., 1975). Glyphosate does not degrade in distilled water, but is rapidly adsorbed by suspended sediment and subsequently degraded to carbon dioxide (Zaranyika and Nyandoro, 1993). Glyphosate has a strong affinity for soils and once adsorbed, while it degrades very slowly it does not leach into ground or surface waters (Khan, 2016; Sprankle et al., 1975; Zaranyika and Nyandoro, 1993).

Glyphosate could be used for spot treatment of emergent flowering rush at application rates up to seven pt/ac. An approved aquatic marker dye, would be applied with glyphosate at the manufacturer's recommended rate. Glyphosate could be sprayed

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somewhat akin to spot treatments, where applicators would directly spray small patches of emergent flowering rush with backpack and handheld sprayers, from the shoreline or from workboats. Large-scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, could be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of seven pt/ac or less.

2.1.3. Timeframe

Flowering rush treatments described in this BA would occur from January 1, 2020 to December 31, 2025 year. Site specific conditions would dictate time of treatment within the overall treatment window. Aquatic treatments would primarily occur after flowering rush has emerged in summer to fall. Treatment to exposed flowering rush stands in reservoirs would primarily occur during winter reservoir drawdown periods.

For example, as part of the normal water management regime, Lake Pend Oreille undergoes an eleven foot draw down every fall and winter to a surface elevation of 2,150 feet above mean sea level for prepare for spring freshet storage and flood control, usually starting around October 1 and finishing around November 15. The lake remains drawn down until after spring runoff, at which time it is brought up to the summer pool level of 2,062 feet above mean sea level. During this time, flowering rush plants are exposed and easily accessible. Most flowering rush treatment, especially large scale treatments to well-established stands of flowering rush in the Pend Oreille watershed would be conducted during this time. Treatment of isolated patches of flowering rush in the Pend Oreille watershed via spot chemical or manual methods may be done at any time of the year. Flathead Lake is operated in a similar manner, and all treatment conducted by state and local agencies in Flathead Lake has been done “in the dry”, that is on exposed, dewatered stands of flowering rush.

Manual or Chemical removal of flowering rush in screened irrigation canals may be conducted at any time of year.

2.1.4. Conservation Measures

The Corps proposes the following conservation measures as part of the proposed action in order to reduce potential adverse effects related to implementation of the proposed action. These conservation measures are not meant to be mitigation for the proposed action, but are integral to the reduction of impacts (potential adverse effects) that may be incidental to the proposed action, and must be considered when analyzing the potential effects of the proposed action.

In terms of intentional and purposeful development of measures designed to minimize impacts to ESA-listed species and designated critical habitats from potential stressors of the proposed action, the Corps has considered a comprehensive list of effects minimization measures [best management practices (BMPs)], that have been integrated to the proposed action as conservation measures. These all effectively and drastically reduce the exposure profile of all listed species, as well as the designated critical habitats in the action area.

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The following impact minimization measures will be implemented by the Corps and their partners as part of the proposed action.

1. General Practices:
    a. Licensing/Certification: All applicators shall be state licensed or certified, or under the direct visual supervision of a state licensed or certified applicator.
    b. All applicators shall comply with all applicable federal, state, and herbicide manufacturer's directions and requirements for handling pesticides, including storage, transportation, application, container disposal, and spill cleanup.
    c. Herbicide application shall be according to the chemical manufacturer's label recommendations for best results. Applicators shall use caution to minimize the application of herbicides to non-target species and structures within the application areas.
    d. Treatment seasons and applicable state or local season or protocols that are more restrictive than those listed in this BA will be followed.
    e. Broadcast applications will only be used on monocultures of emergent target plants after June 1.
    f. Applicators will use the lowest practical chemical application rates which will effectively control flowering rush yet minimize adversity to native plants, listed salmonids and their prey.
    g. Broadcast applications would not be made when wind velocity exceeds 10 mph.
    h. Herbicide formulations used will not include petroleum or heavy metals.
    i. Aquatic Vegetation Rakes will only be used in screened irrigation canals.

2. Calibration/Maintenance:
    a. All application equipment (e.g. booms, back packs, etc.) shall be properly calibrated according to the chemical manufacturer's suggested application rates printed on the chemical label prior to use. Equipment and settings shall be properly maintained for the duration of the contract performance period.
    b. Dyes shall be used to reduce the potential for over-application.
    c. Appropriate sized nozzles shall be used to minimize the potential for drift.
    d. Application equipment will be maintained to ensure proper application rates, minimize leakage, reduce drift, and ensure applicator safety. Equipment will be maintained, and visually inspected prior to each application.

3. Spill Management:
    a. All applicators shall carry a Spill Prevention and Control Plan. The Plan shall provide detailed descriptions on how to prevent a spill or ensure effective and timely containment of any chemical spill. The Spill Prevention and Control Plan shall include spill control, containment, clean up, and reporting procedures.

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   b. A spill kit will be available to all applicators and shall be within 150 feet of the application site.
   c. Equipment refueling will not occur within 100 feet of open water. This includes ATVs, trucks, tractors, aircraft, etc.
   d. All concentrated or mixed solution pesticides shall be placed in locked storage in closed containers with watertight lids, and placed in secondary containment vessels of 110% of capacity.
   e. All mixing for spray bottles, and backpack sprayers shall be done within secondary containment of 110% capacity of the liquid.

4. Disposal:
   a. Disposal of waste materials shall occur in accordance with the label and in accordance with all applicable federal, state, and county laws regulations, as well as label restrictions and instructions.

5. Water Quality:
   a. Only aquatic approved herbicides and surfactants will be authorized for use within 15 feet of “live” waters or areas with shallow water tables. For example, only the aquatic formulations of glyphosate will be used within 15 feet of water.

6. Special Status Plants:
   a. Potential project areas would be assessed to determine presence or absence of populations or habitats for plants that are listed as threatened, endangered, or proposed for listing under the Act, or candidates for listing. Surveys of proposed project areas within Potential Habitat would be performed by botanically qualified staff to determine the presence/absence of the species.
   b. Where special status plants are present, only manual treatment methods would be permitted.
   c. Where special status plants are present, applicators would coordinate with botanically qualified staff to determine measures that would minimize disturbance to special status plants. This could include limiting the number of people implementing treatments and the amount of time present in the habitat or the use of only non-motorized access.

7. Yellow-billed Cuckoo (southeastern Idaho and western Montana):
   a. In southeastern Idaho and western Montana, surveys of suitable habitat will be conducted prior to treatments that may impact yellow-billed cuckoo during the nesting season (May 1 through August 31). Surveys would be performed by a qualified biologist holding a current survey permit.
   b. If nesting yellow-billed cuckoo are present, flowering rush control would be restricted to outside of the breeding season – prior to May 1 or after August 31.

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8. Monitoring and Reporting
    a. At the conclusion of each treatment year, entities participating in the cost share will submit a report to the Corps detailing, at minimum, the following information:
        i. The global positioning system (GPS) location, size, and distribution of mechanical and substrate mat treatments.
        ii. For chemically treated sites:
            1. GPS coordinates, dates, and acres of application of chemical treatments.
            2. Aquatic acres of each site treated chemically.
            3. Application rate (lbs/acre) of chemicals used.
            4. Approximate nozzle depth used during submerged application.
            5. Formulation used.
            6. Approximate depth of water during application.
            7. Approximate flow rate during application.
            8. Areas and sites of native vegetation in treatment areas.
    b. The Corps shall provide an annual report to the Services which both summarizes total treatments and details individual chemical applications no later than May 1st each year.

2.2. Consultation Request

The Corps requests informal, programmatic framework consultation of both Services on implementation of the Flowering Rush Control Cost Share Plan (Plan). The Plan represents a congressionally directed program to aid states eradicated flowering rush infestations in the CRB, generally under a cost-share agreement with the states of Washington, Oregon, Idaho, and Montana. The Plan would apply to any water related site in the action area proposed for treatment by the states where flowering rush is identified or becomes established, as well as other listed species in those areas.

This Plan and consultation does not preclude or supplant the Corps Aquatic Pest Management Program and associated consultations (NMFS WCRO-2018-00389; USFWS 01EWFW00-2018-F-1271) for treatments on Corps Walla Walla District owned and managed lands.

The Corps requests the Concurrences endorse stepped-down consultation procedures for site-specific flowering rush control actions under the Plan. Such consultations will be tiered to the programmatic framework consultation.

The Corps proposes the following tiered consultation procedures:

1. Site-specific abbreviated biological assessments (ABA) would be submitted by the Corps to the Services prior to treatment. The ABAs would be submitted 90 days prior to the proposed actions. The proposed ABA (see Appendix C

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example) would include a brief description of the following requirements for ESA consultation (per the Consultation Handbook):

a. a description of the action being considered;

    i. Including any access development, the specific treatment selected for this site, monitoring to be conducted, any mitigation to be completed in addition to conservation measures in the BA.

b. a description of the specific area that may be affected by the action;

    i. Including area specific location, treatment area size, other geographic descriptors, such as water depth may be included if pertinent and known.

c. a description of any listed species or critical habitat that may be affected by the action;

    i. Which is likely to refer to the BA and not reiterate species information in detail.

d. a description of the manner in which the action may affect any listed species or critical habitat, and an analysis of any cumulative effects;

    i. Which is likely to refer the BA and not reiterate species information in detail.

e. relevant reports, including any environmental impact statements, environmental assessments, biological assessment or other analyses prepared on the proposal;

    i. The ABA will reference this BA and the associated EA/FONSI, as well as any new reference information developed over time, such as flowering rush risk assessments or monitoring reports.

f. any other relevant studies or other information available on the action, the affected listed species, or critical habitat.

    i. Including any new relevant scientific information the Corps is aware of.

2. The Services agree to form review and issuance of a concurrence, if necessary, within 60 calendar days of receipt of the ABA from the Corps.

3. The Corps would implement our proposed conservation measures and reporting requirements.

The follow on consultation would be completed through the ABA (Appendix C), or a similar form developed collaboratively with the Services, which would provide the site-specific details of the treatment needed.

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3. Listed Species

3.1. Listed Species in the Action Area

The Corps reviewed the list of threatened and endangered species that pertain to the action area under the jurisdiction of NMFS and USFWS on 12 July 2019. Species lists were provided by the Washington Fish and Wildlife Office of USFWS, with Consultation Codes 01EWFW00-2019-SLI-0297, 01EWFW00-2019-SLI-0298, 01EWFW00-2019-SLI-0314, 1EWFW00-2019-SLI-0315, and 01EWFW00-2019-SLI-0316. There are seventeen species considered under the jurisdiction of the USFWS, and two species of salmon and steelhead under the jurisdiction of NMFS considered in this BA (Table 2).

Table 2. Endangered Species Act proposed, threatened, and endangered species considered in this BA. Critical habitat designations are also listed. Under the Species Status column, E = Endangered, T = Threatened, PT = Proposed Threatened, C = Candidate.

Common Name	Scientific Name	Status	Critical Habitat
Mammals			
Canada Lynx	*Lynx canadensis*	T	Final
Gray Wolf	*Canis lupus*	E	Final
Grizzly Bear	*Ursus arctos horribilis*	T	Proposed
North American Wolverine	*Gulo gulo luscus*	PT	NA
Roy Prairie Pocket Gopher	*Thomomys mazama glacialis*	T	Final
Fish			
Bull Trout	*Salvelinus confluentus*	T	Final
Chinook Salmon	*Oncorhynchus tshawytscha*	T/E	Final
Dolly Varden	*Salvelinus malma*	PT	NA
Steelhead	*Oncorhynchus mykiss*	T	Final
Birds			
Marbled Murrelet	*Brachyramphus marmoratus*	T	Final
Northern spotted owl	*Strix occidentalis caurina*	T	Final
Streak Horned Lark	*Eremophila alpestris strigata*	T	Final
Yellow-billed Cuckoo	*Coccyzus americanus*	T	Proposed
Amphibians			
Oregon spotted frog	*Rana pretiosa*	T	Final
Plants			
Golden paintbrush	Castilleja levisecta	T	Final
Spalding's catchfly	Silene spaldingii	T	Proposed
Ute ladies' tresses	Spiranthes diluvialis	T	NA
Water howellia	Howellia aquatilis	T	NA
Whitebark pine	Pinus albicaulis	C	NA

3.1.1. NMFS Species and Critical Habitat Status

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The potential action area contains numerous threatened and endangered salmonid species, however, treatments are only likely at locations with known populations of flowering rush. Only species that occur at locations outside of Corps managed waters with currently known populations of flowering rush are considered in this BA. Should flowering rush be discovered at a new location in the four-state area, and a cost-share proposed by a partner agency, an amendment to this BA would be written and submitted for consultation if the newly proposed area contains listed species not discussed below.

i. Chinook Salmon

The proposed action area contains two evolutionarily significant units (ESU) of Chinook salmon – Upper Columbia River spring-run Chinook salmon and Puget Sound Chinook salmon.

Listing History

The Upper Columbia River spring-run Chinook salmon ESU was listed as Endangered in 1999 (64 FR 14308). The Puget Sound Chinook salmon ESU was listed as Threatened in 1999 (64 FR 14308). Both listings were reaffirmed in 2005 and 2014.

Life History and Biological Requirements

Chinook salmon historically ranged in North America from the San Joaquin River, California to Kotzebue Sound, Alaska. They typically spawn in large to medium rivers in coastal and inland locations. Chinook salmon hatch the largest fry of any salmon at emergence, and display two patterns as juveniles. Ocean-type Chinook salmon outmigrate immediately after emergence or after a few months in river and then reside in estuaries for a few weeks or more. Stream-type Chinook salmon rear in their natal river for a full year, and upon migration to the sea, rapidly exit the estuary. Ocean-type Chinook are found exclusively south of 56° North Latitude and spawn in lower reaches of rivers. Where they overlap, stream-type Chinook are found further inland. In the ocean, Chinook salmon feed for from one to five years, though two to four years is most common. Chinook salmon display multiple run types, with Spring-run Chinook entering freshwater in late spring and sexually maturing in freshwater, while Fall-run Chinook salmon enter freshwater later in the year in an advanced state of maturity. Run type typically co-varies with juvenile type and length of spawning migration. Fall-run Chinook spawn in lower stream reaches and coastal rivers and frequently produce ocean-type juveniles, where spring and summer-run Chinook salmon spawn further inland and usually produce stream-type juveniles. All Chinook salmon spawn in the fall on a declining temperature cycle (Quinn, 2018).

Distribution and Critical Habitat

Critical Habitat was designated for the two ESUs as follows.

Upper Columbia River spring-run Chinook: September 2, 2005

Puget Sound Chinook: September 2, 2005

The Upper Columbia River spring-run Chinook ESU includes all natural-origin, stream-type Chinook salmon originating from Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam, excluding the Okanogan River subbasin (Figure 8). Six artificial supplementation programs also contribute to the

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Upper Columbia River spring-run Chinook salmon ESU: the Twisp River Program; Chewuch River Program; Methow Program; Winthrop National Fish Hatchery Program; Chiwawa River Program; and the White River (NMFS, 2016a).

The Puget Sound Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington. Twenty-six artificial propagation programs also contribute to this ESU [(NMFS, 2016b) (Figure 9)].

Table 3 presents the physical and biological features (PBF) of anadromous salmonid critical habitat.

Table 3. Physical and biological features of critical habitat designated for anadromous species, and corresponding species life history events.

Physical and Biological Features			
Site Type		Site Attribute	Life History Event
1	Freshwater spawning	Substrate, water quality, water quantity	Adult spawning, embryo incubation, alevin development
2	Freshwater rearing	Floodplain connectivity, forage, natural cover, water quality, water quantity	Fry emergence, fry/parr growth and development
3	Freshwater migration	Free of artificial obstructions, natural cover, water quality, water quantity	Adult sexual maturation, adult upstream migration and holding, kelt seaward migration, fry/parr seaward migration
4	Estuarine areas	Forage, free of obstruction, natural cover, salinity, water quality, water quantity	Adult sexual maturation, adult "reverse smoltification", kelt seaward migration, fry/parr seaward migration, fry/parr smoltification, smolt growth and development, smolt seaward migration
5	Nearshore marine areas	Forage, free of obstruction, natural cover, water quality, water quantity	Adult sexual maturation, smolt/adult transition
6	Offshore marine areas	Forage	Adult growth and development

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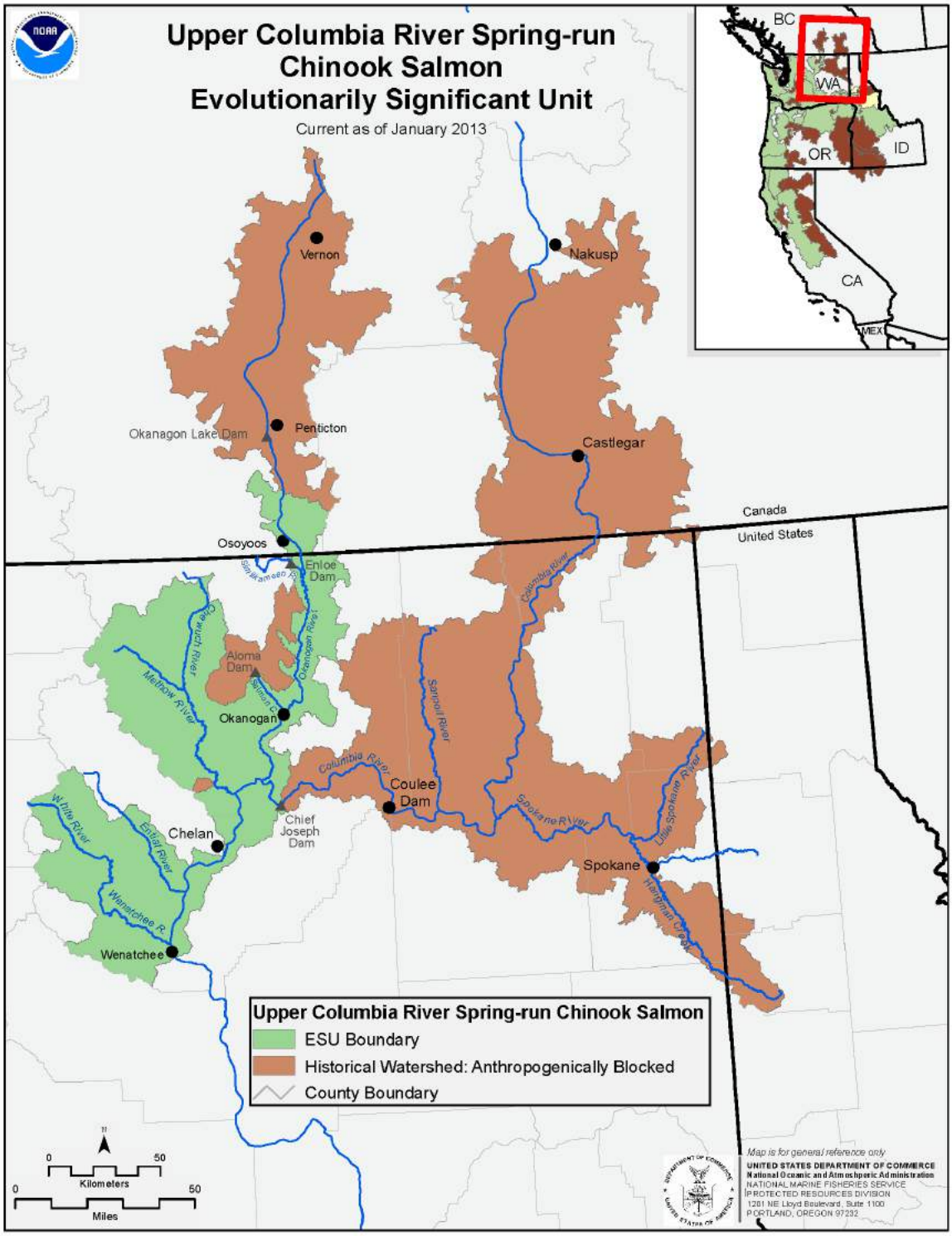

Figure 8. Upper Columbia River spring run Chinook salmon ESU.

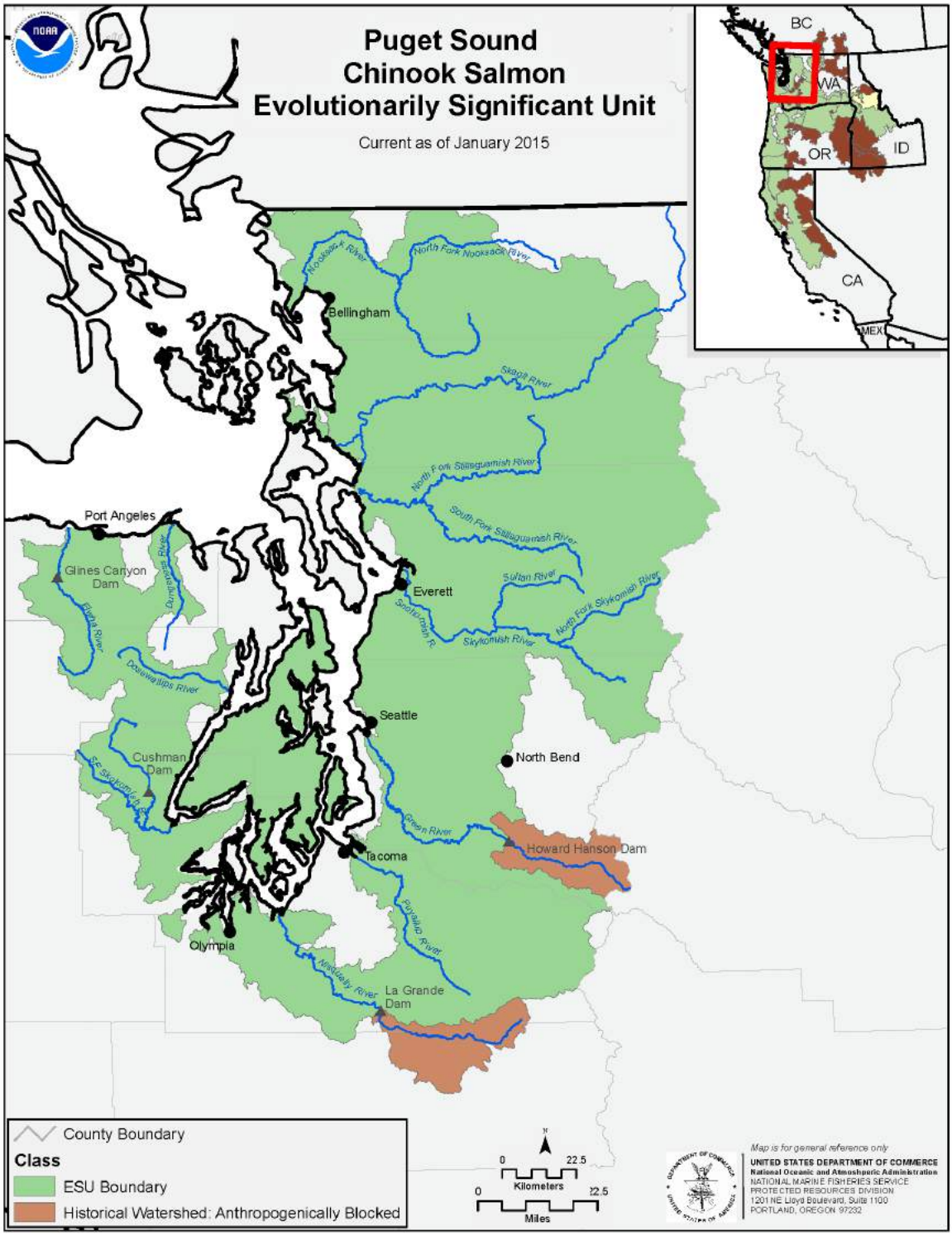

Figure 9. Puget Sound Chinook salmon ESU.

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ii. Steelhead

The proposed action area contains three Distinct Population Segments (DPS) of steelhead –Middle Columbia River steelhead, Upper Columbia River steelhead, and Puget Sound steelhead.

Listing History

The Middle Columbia River steelhead DPS was listed as Threatened in 1999 (64 FR 14517) and reaffirmed in 2006 and 2014. The Upper Columbia River steelhead DPS was listed as Endangered in 1997 (62 FR 43937), reclassified as Threatened in 2006 (71 FR 834) and this determination was reaffirmed in 2009 and 2014. The Puget Sound steelhead DPS was listed as Threatened in 2007 (72 FR 26722) and reaffirmed in 2014.

Life History and Biological Requirements

Steelhead historically ranged from Malibu Creek, California to the Kuskowim River, Alaska, with non-anadromous populations of rainbow trout as far south as northwestern Mexico. Steelhead spawn in spring unlike other Pacific salmon. Fry emerge in late spring or early summer. Juveniles initially reside in streams and may reside there for one to three years before expressing a fluvial, adfluvial, or anadromous life histories. Adults typically spend one to three years at sea. Steelhead express two different anadromy strategies, ocean-maturing and stream-maturing, or “winter” and “summer” steelhead. Ocean-maturing steelhead enter freshwater in an advanced state of sexual maturity in late winter or early spring, spawning rapidly. Stream-maturing steelhead enter freshwater summer or fall, mature over winter, and spawn in spring. Ocean-maturing steelhead are often found in low elevation and coastal streams with fall-run Chinook, while summer steelhead are typically found in interior systems with spring-run Chinook. Unlike other Pacific salmon, steelhead are iteroparous and may spawn repeatedly, though the proportion of summer steelhead that survive to spawn a second or third time is low (Quinn, 2018).

Distribution and Critical Habitat

Critical habitat was designated for the three ESUs as follows.

- Middle Columbia River steelhead: September 2, 2005
- Upper Columbia River steelhead: September 2, 2005
- Puget Sound steelhead: February 24, 2016

The Middle Columbia River steelhead DPS includes all naturally spawning populations of steelhead in drainages upstream of the Wind River, Washington, and the Hood River, Oregon, up to, and including, the Yakima River, Washington (Figure 10). Major drainages in this DPS are the Deschutes, John Day, Umatilla, Walla Walla, Yakima, and Klickitat river systems. The Cascade Mountains form the western border of the plateau in both Oregon and Washington, while the Blue Mountains form the eastern edge. The southern border is marked by the divides that separate the upper Deschutes and John Day basins from the Oregon High Desert and drainages to the south. The Wenatchee Mountains and Palouse areas of eastern Washington border the Middle Columbia on the north (NMFS, 2016c).

The Upper Columbia River steelhead DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers from the Columbia River

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and its tributaries upstream of the Yakima River to the U.S.-Canada border (Figure 11). Six artificial propagation programs contribute to this DPS: the Wenatchee River; Wells Hatchery; Winthrop National Fish Hatchery; Omak Creek; and the Ringold Hatchery Programs (NMFS, 2016a).

The Puget Sound steelhead DPS includes all naturally spawned steelhead populations, in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River and to the north by the Nooksack River and Dakota Creek as well as the Green River natural and Hamma Hamma winter-run hatchery stocks [(NMFS, 2016b) (Figure 12)]. Table 3 presents the physical and biological features (PBF) of anadromous salmonid critical habitat.

Threats to Anadromous Species

Numerous pressures have contributed to the decline and currently impair the recovery of listed pacific salmon. Water withdrawals, diversion, and storage have reduced habitat, impeded passage, and entrained juveniles. Modification of natural hydrographs has elevated stream temperatures, altered trophic structure, and reduced flows needed for migration, spawning, gravel recruitment, and transport of large woody debris. Land use activities associated with urban development, extractive industries, agriculture, and recreation have impaired salmonid habitat quality and reduced the amount of available habitat. Commercial and recreational fisheries have contributed significantly to reductions in salmonid abundance. Establishment of non-native species including smallmouth bass (*Micropterus dolomieu*), walleye (*Sander vitreus*), and northern pike (*Esox lucius*) has increased predation on juvenile salmonids, while habitat modifications have increased the effectiveness of native predators including piscivorous birds and pinnipeds.

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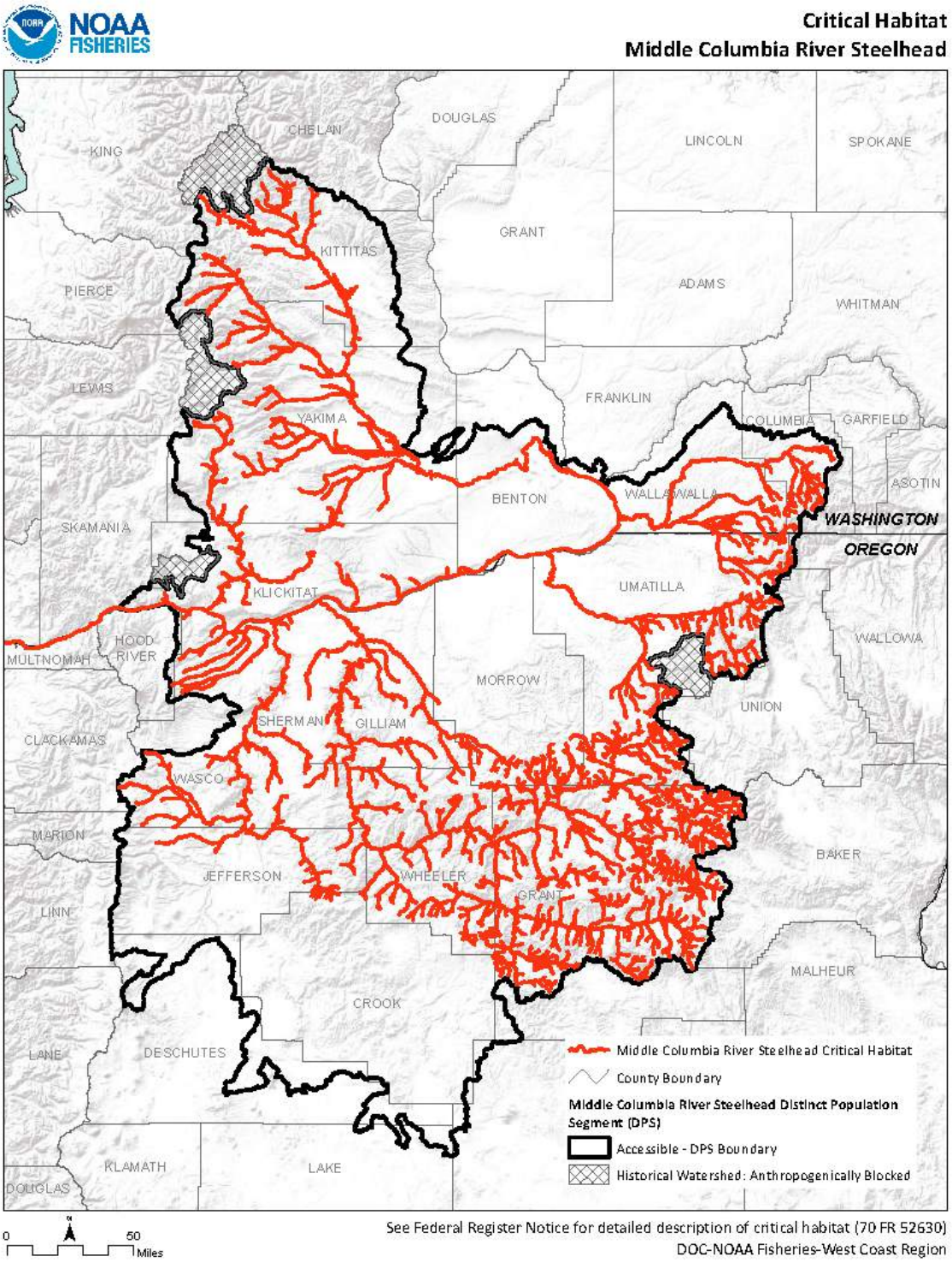

Figure 10. Middle Columbia River steelhead critical habitat.

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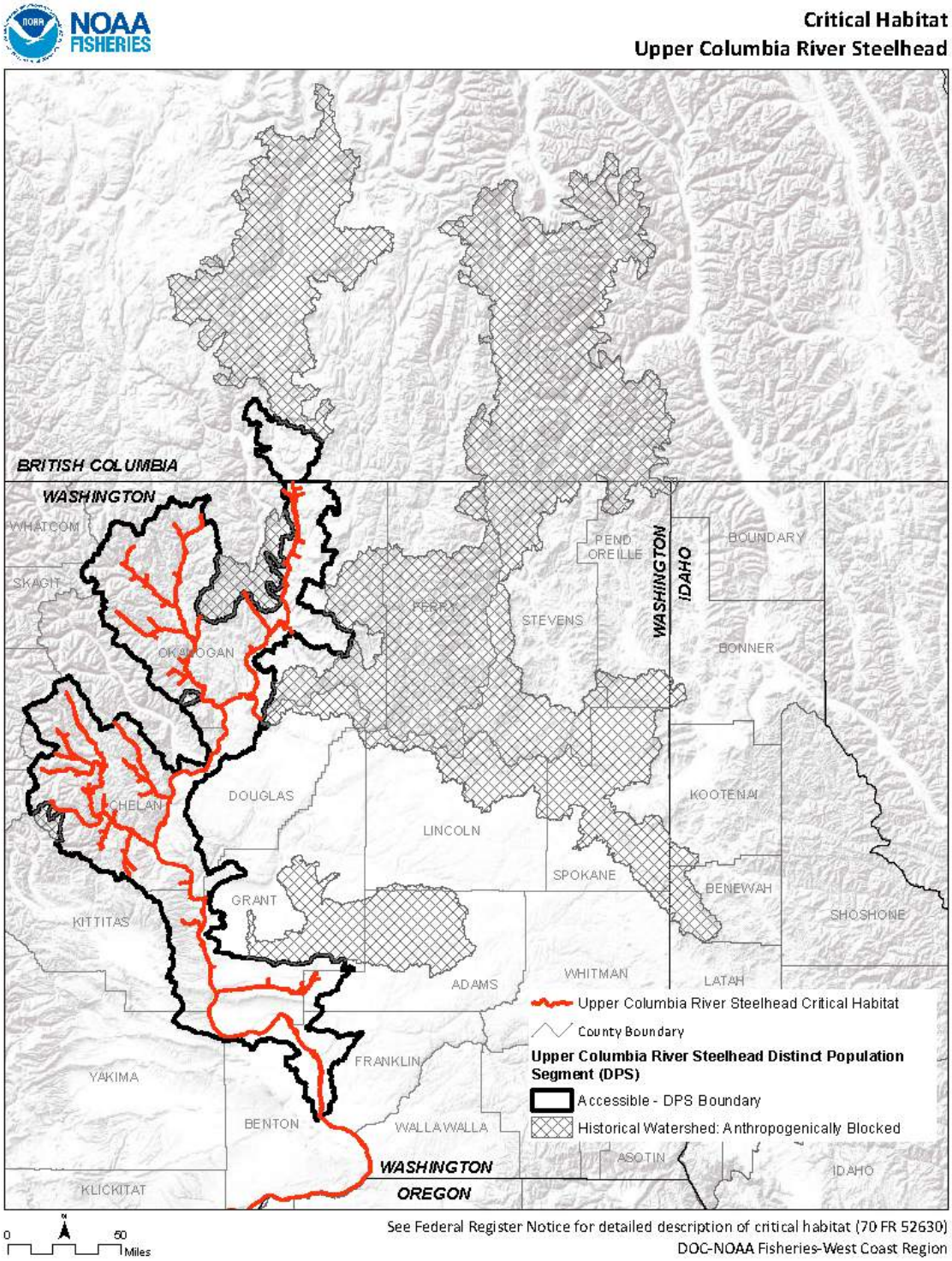

Figure 11. Upper Columbia River steelhead critical habitat.

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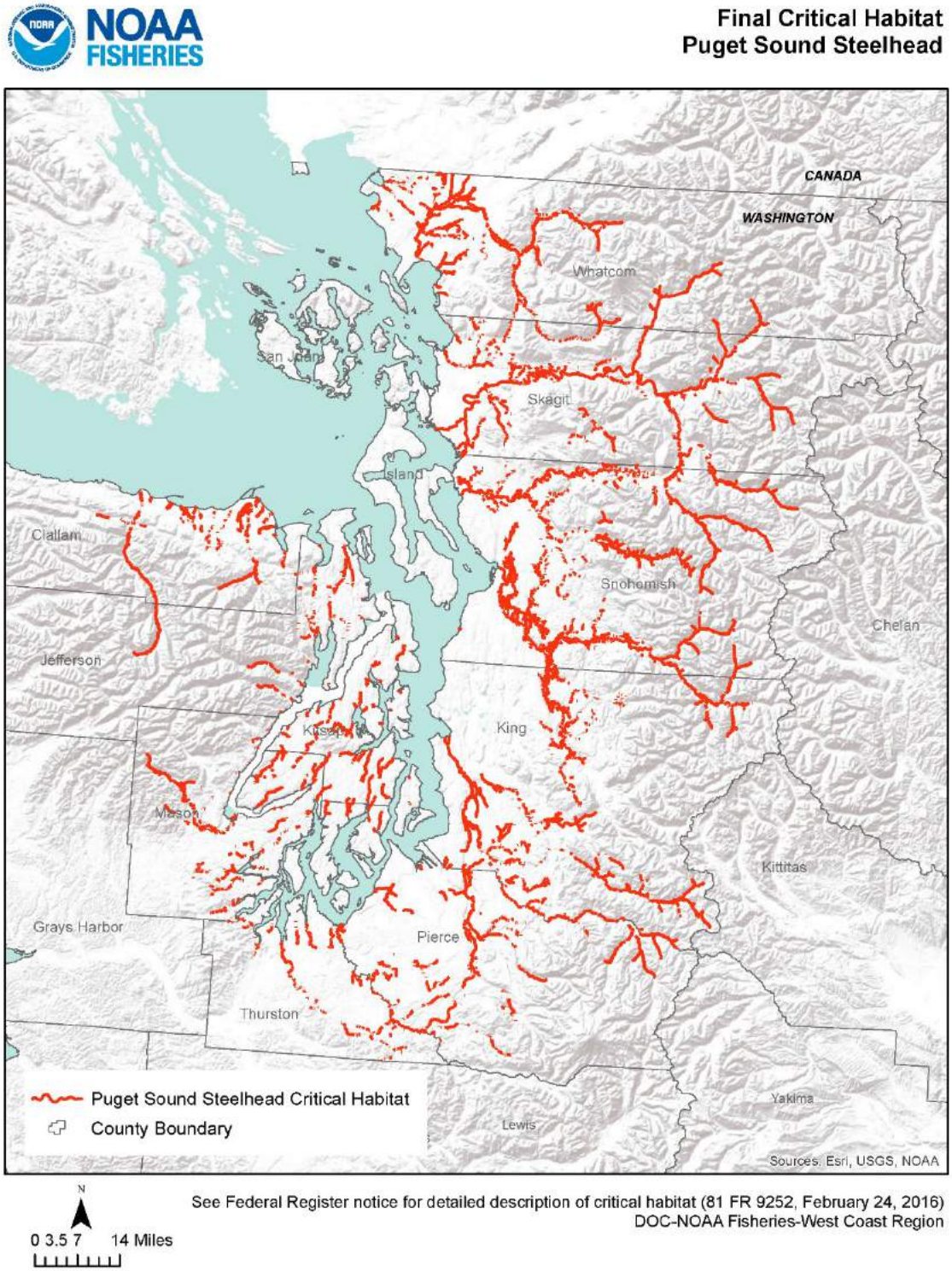

Figure 12. Puget Sound steelhead critical habitat.

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3.1.2. USFWS Species and Critical Habitat Status

Only species that occur at locations outside of Corps managed waters with currently known populations of flowering rush are considered in this BA. Should flowering rush be discovered at a new location in the four-state area, and a cost-share proposed by a partner agency, an amendment to this BA would be written and submitted for consultation if the newly proposed area contains listed species not discussed below.

i. Bull Trout

Listing History

The USFWS issued a final rule listing the Columbia River population of bull trout as threatened on June 10, 1998, while critical habitat for this species was listed on October 18, 2010. Bull trout are currently listed throughout their range in the United States as a threatened species.

Life History/Biological requirements

Individual bull trout may exhibit resident or migratory life history strategies. Resident bull trout carry out their entire life cycle in the stream in which they spawn and rear. Migratory bull trout spawn in tributary streams, but eventually travel to larger streams (or lakes) where they mature. Habitat components that appear to influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates and migratory corridors (with resting habitat). All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and deep pools (Wydoski and Whitney, 2003).

Bull trout normally reach maturity in four to seven years and may live as long as twelve years (Wydoski and Whitney, 2003). Migratory bull trout may travel over one hundred miles to their spawning grounds. They generally spawn from August to November during periods of decreasing water temperatures. Egg incubation is normally 100 to 145 days and fry remain in the substrate for several months.

Bull trout are opportunistic feeders. Their diet requirements vary depending on their size and life history strategy. Juvenile bull trout prey on insects, zooplankton, and small fish while adults and migratory bull trout are dominantly piscivorous.

Distribution and Critical Habitat

Bull trout critical habitat was designated on October 18, 2010. In the Columbia River Basin, bull trout historically were found in about 60% of the basin. They now occur in less than half of their historic range. Populations remain in portions of Oregon, Washington, Idaho, Montana, and Nevada (Figure 13). Physical and biological features of bull trout critical habitat are listed in Table 4. Habitat degradation and loss, connectivity among populations, and nonnative fishes are identified among the primary threats to bull trout.

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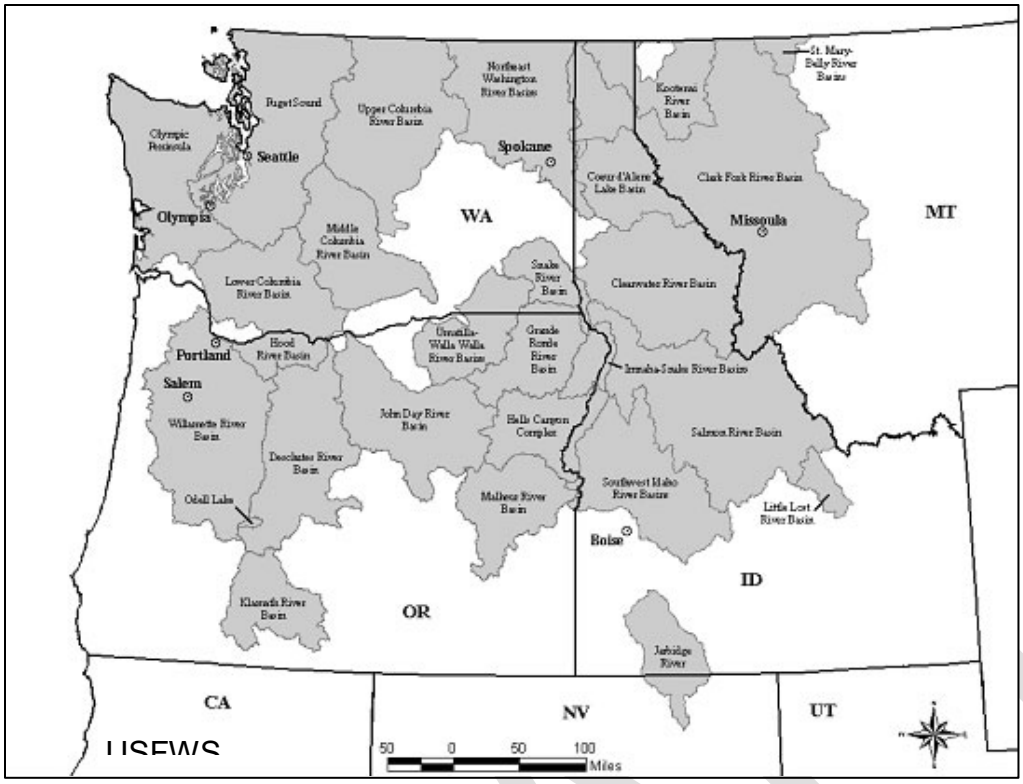

Figure 13. Bull trout distribution and recovery units in the northwest U.S.

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Table 4. Physical and Biological Features of critical habitat designated for bull trout.

PBFs		
1	Water Quality	Springs, seeps, groundwater sources, and subsurface water connectivity (hyporehic flows) to contribute to water quality and quantity and provide thermal refugia.
2	Migration Habitat	Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
3	Food Availability	An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
4	Instream Habitat	Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these environments, with features such as large wood, side channels, pools, undercut banks and clean substrates, to provide a variety of depths, gradients, velocities, and structure.
5	Water Temperature	Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
6	Substrate Characteristics	In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount (e.g., less than 12 percent) of fine substrate less than 0.85 mm (0.03 in.) in diameter and minimal embeddedness of these fines in larger substrates are characteristic of these conditions.
7	Stream Flow	A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.
8	Water Quantity	Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
9	Nonnative Species	Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

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ii. Canada Lynx

As summarized in USFWS (2017a)

Listing History

Canada lynx was listed as Threatened March 24, 2000 due to potential impacts to lynx habitat and the availability of snowshoe hare and other prey populations within the lynx range. However, on September 12, 2014, the U.S. DPS was revised to include a New Mexico population. The USFWS recommended delisting Canada lynx in their most recent 5-year status review (USFWS, 2017a).

Life History/Biological requirements

Canada lynx prefer boreal forest with snowy winters (Apps, 2000; Aubry et al., 1999) and a supply of snowshoe hare as a prey base (Apps, 2000; Mowat et al., 1999). Lynx survivorship, productivity, and population dynamics are closely related to snowshoe hare density in all parts of its range with high natural mortality and low to no reproduction coinciding with the minimum cyclic hare densities (Mowat et al., 1999). In the U.S., lynx inhabit conifer and mixed conifer-hardwood stands that support snowshoe hare.

Distribution and Critical Habitat

Critical habitat was designated November 9, 2006. However, on September 12, 2014, critical habitat was again revised to include a New Mexico population. Canada lynx in the U.S. are at the southern end of their range, which expands across Canada and Alaska, the center of which is north-central Canada. The U.S. populations cover six populations and seven states (Figure 14).

Threats

Habitat loss and destruction that may influence snowshoe hare populations, including climate change.

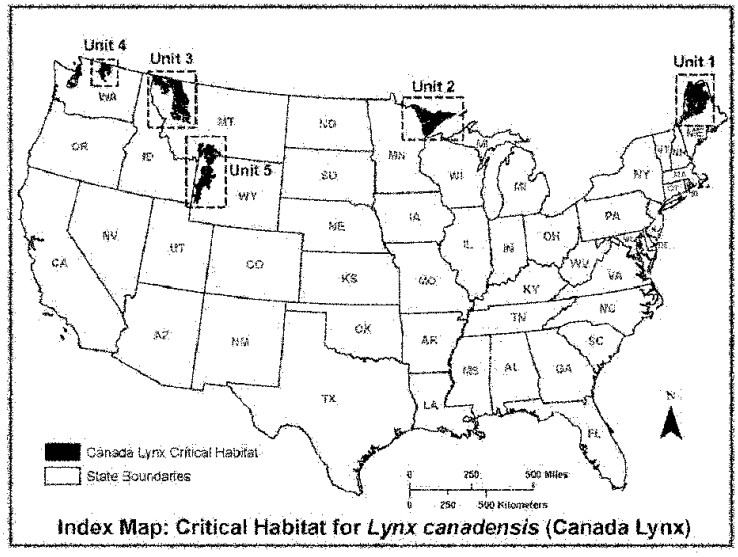

Figure 14. Canada lynx critical habitat in the U.S. New Mexico population not shown.

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iii. Dolly Varden

As summarized at https://wdfw.wa.gov/fishing/char/.

Listing History

January 9, 2001, the USFWS proposed to list the Dolly Varden as threatened based on the similarity of appearance to threatened bull trout.

Life History/Biological requirements

Dolly Varden are very similar to bull trout, and some scientists argue that there is no distinction between the two fishes. They prefer deep pools of cold rivers, lakes, and reservoirs. Streams with abundant cover (cut banks, root wads, and other woody debris) and clean gravel and cobble beds provide the best habitat. Their preferred summer water temperature is generally less than 54.8 °F (12.7 °C), while temperatures less than 40 °F (4.4 °C) are tolerated. Spawning during fall usually starts when water temperatures drop between 39.2-44.6 °F (4-7 °C). Cold, clear water is required for successful reproduction.

Dolly Varden have complex, but similar life histories. Anadromous, fluvial, and resident populations often journey long distances in summer and fall, migrating to the small headwater streams where they hatched to spawn. Mature adults with these characteristics are generally four to seven years old and 18-22 in (45.7-55.8 cm) in length when they make their first spawning run.

The adults on their spawning runs can undergo some impressive journeys. Fish in the Skagit River system may travel more than 115 mi (185 km) from the river mouth and ascend to an elevation of more than 3,000 ft (914 m). The spawning area may be upstream of areas used by any other anadromous species.

Newly-hatched fish emerge from the gravel the following spring. Those that migrate down to the main rivers, reservoirs and saltwater normally leave the headwater areas as two year olds. But complicating the picture even more are the resident stream populations that exhibit limited movements, living their entire lives in the same stretch of headwater stream. These fish may not mature until they are seven to eight years old, and rarely reach sizes greater than 14 in (35.5 cm) in length. Biologists have observed these local residents spawning side-by-side with their much larger anadromous kin.

Dolly Varden are opportunistic feeders, eating aquatic insects, shrimp, snails, leeches, fish eggs and fish.

Distribution and Critical Habitat

No critical habitat has been designated for Dolly Varden. Dolly Varden are more abundant in the north Puget Sound area (Figure 15), but statewide their populations are low and in some cases declining.

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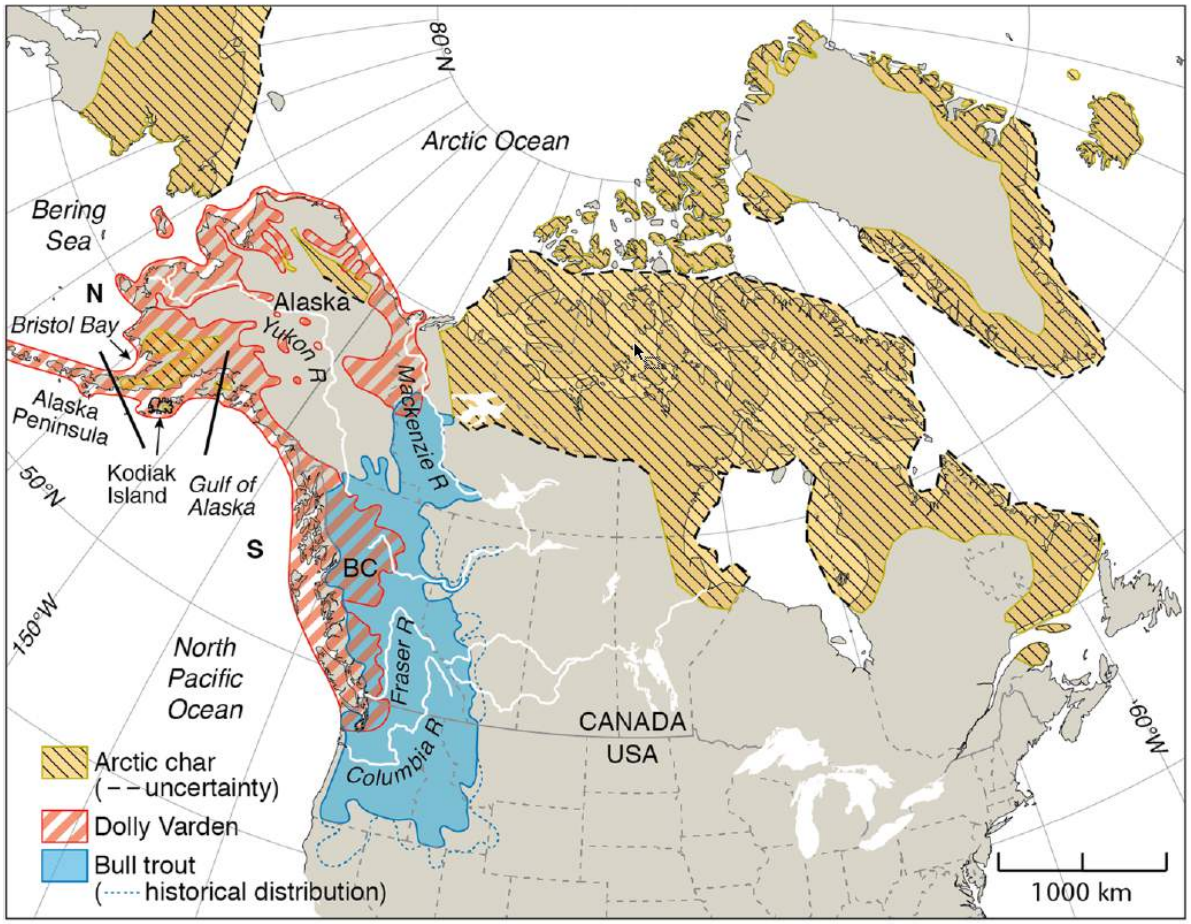

Figure 15. Range of the Dolly Varden, bull trout, and arctic char in the Pacific Northwest.

Threats

Habitat loss and over-harvest have both contributed to the decline of bull trout and Dolly Varden in Washington. Protection of spawning and juvenile rearing habitat, regulating harvest, and controlling poaching are required in order to maintain or increase populations. The threat of global warming is especially alarming for Dolly Varden because of limited areas with low enough temperatures for spawning. Non-native fishes such as brook trout also pose a threat through resource competition and potentially genetic dilution through hybridization.

iv. Golden paintbrush

As summarized in (USFWS, 2000).

Listing History

Golden paintbrush (*Castilleja levisecta)* was listed as threatened on June 11, 1997 (62 FR 31740).

Life History/Biological requirements

Golden paintbrush is a short-lived perennial herb with 5 to 15 unbranched spreading or erect stem. Plants are up to 12 inches (30 cm) tall and are covered with soft, sticky hairs. Individual plants typically do not survive longer than six years, and as many as

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20 percent of plants in a given population may perish annually. It reproduces exclusively by seed. Plants emerge in early March. By mid-April, the plant is in bud, flowering generally begins the last week in April and continues until early June. Fruits mature from June to mid-July, by mid-July, the plants are in senescence. Capsules persist on the plants well into August. Based on historical collections and observations by the authors, flowering seems to occur about the same time throughout the species' range.

Distribution and Critical Habitat

Golden paintbrush occurs in the Puget Trough Ecoregion in Washington and Vancouver Island at elevations below 330 feet (100 meters) above sea level. It also historically occurred in the Willamette Valley of Oregon. Golden paintbrush is found on open grasslands on glacial outwash prairies and does not tolerate shade from nearby trees, shrubs or even tall nonnative grasses (Figure 16). The mainland population in Washington occurs in a gravelly, glacial outwash prairie. Other populations occur on clayey soils derived from either glacial drift or glacio-lacustrine sediments. All of the extant populations are on soils derived from glacial origins. No critical habitat has been designated for this species.

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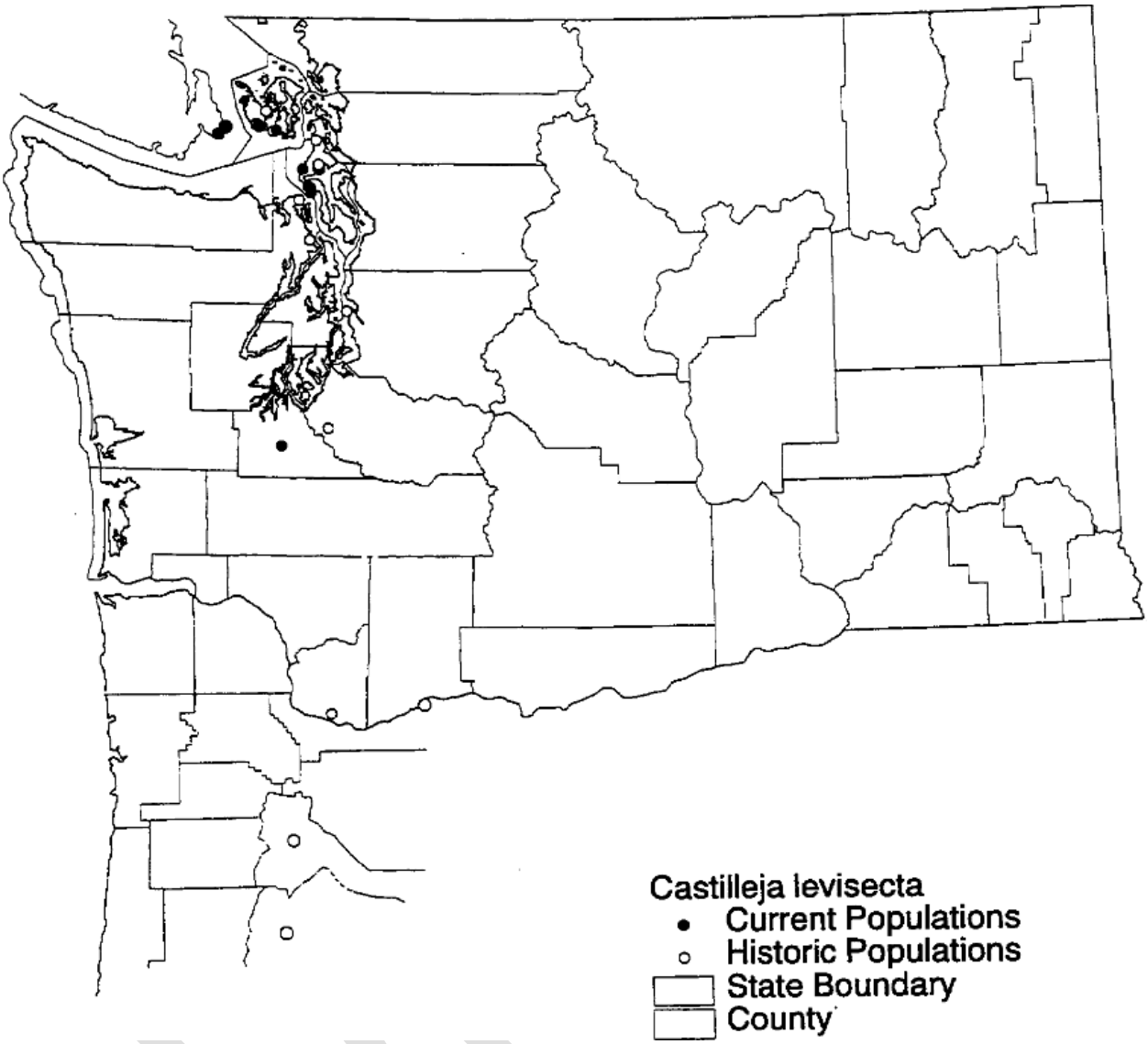

Figure 16. Currently known populations of golden paintbrush.

Threats

Threats to golden paintbrush include habitat modification, loss of prairies and grasslands; development of property for commercial, residential, and agricultural use; low potential for expansion of golden paintbrush populations and their refugia; and recreational picking and herbivory.

v. Gray Wolf

As summarized in USFWS (2011a).

Listing History

The gray wolf was listed as an endangered species on January 4, 1974. On May 5, 2011, the USFWS announced they were proposing to delist the gray wolf in the Northern Rocky Mountains, in accordance with the April 15, 2011 legislation reinstating

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the Service's 2009 decision to delist biologically recovered gray wolf populations. Presently, gray wolves outside of the Northern Rocky Mountains DPS remain listed.

Life History/Biological requirements

Wolves are live in groups called packs, which typically include a breeding pair (the alpha pair), their offspring, and non-breeding adults. Wolves are capable of mating by age two or three and occasionally forming lifelong bonds. Lifespan is around 13 years and breed past 10 years of age. On the average, five pups are born in early spring and are cared for by the entire pack.

For the first six weeks, pups are reared in burrows called dens. Dens are often used year after year. Pups depend on their mother's milk for the first month, then are gradually weaned and fed regurgitated meat brought by pack members. By the time pups are seven to eight months old they are almost fully grown and begin traveling with the adults. After a year or two, young wolves may leave to try to find a mate and form a pack. Lone, dispersing wolves have traveled as far as 594 mi (965.6 km) in search of a mate or territory.

Their territories range in size from 50 mi² (80.5 km²) to more than 1,000 mi² (1,609.3 km²), depending on the available prey and their seasonal movements. Wolves travel over large areas to hunt, as far as 30 mi (48.2 km) in a day (USFWS, 2011a).

Distribution and Critical Habitat

Critical habitat has been designated in Michigan and Minnesota March 9, 1978, but not within the Action Area. Gray wolves once ranged from coast to coast and from Alaska to Mexico. They were absent from the Southeast, which was occupied by red wolves (*Canis rufus*), and from the large deserts of the Southwest. Wolves occur presently in the Blue and Cascade Mountain ranges of Washington and Oregon, and throughout the Rocky Mountains in Idaho, Montana, and Wyoming (Figure 17).

Threats

Threats to western gray wolves include the integrity of prey species populations, and their habitats, as well as humans. Controversy over predation on livestock and game animal populations makes illegal hunting an ongoing threat.

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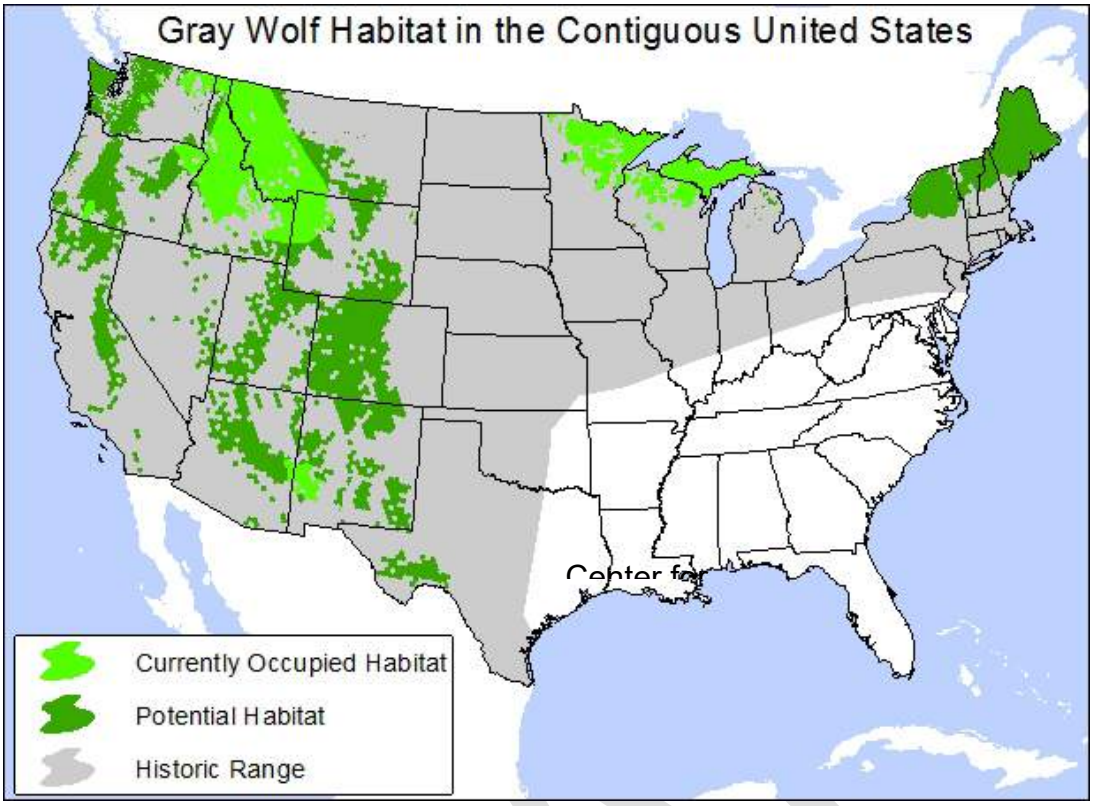

Figure 17. Gray wolf historic and present range.

vi. Grizzly Bear

As summarized in USFWS (1993)

Listing History

Grizzly bear in the lower 48 were listed as threatened July 28, 1975. The Greater Yellowstone ecosystem population has been delisted due to recovery June 30, 2017. An experimental population occurs in the Bitterroot ecosystem of Montana and the North Cascades ecosystem population is currently under review for listing.

Life History/Biological requirements

Grizzlies are omnivorous with a broad adaptability to food sources. Grizzlies are also opportunistic feeders and scavengers that prey on almost any available food. They prefer forest cover with full canopies, but access within 0.6 mi (1 km) to open meadows is also preferable.

Grizzlies den up in winter to hibernate during periods of deep snow, cold temperatures, and low to no food availability. The onset of hibernation appears to correlate with shortening photoperiod and inclement weather.

Age and sex structures are variable, determined mainly by factors such as habitat condition. Mating occurs late May through mid-July, with a peak in mid-June.

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Distribution and Critical Habitat
Critical habitat for the grizzly bear was proposed November 5, 1976, but a final rule was never published and the current status of the proposal is unknown.

Historically, grizzlies occupied the mid-west plains west to the California coast, and south into Texas and Mexico; however, through human disturbance and eradication efforts, the grizzly range in lower 48 is confined to large expanses of wilderness in Montana and Idaho, the Northern Cascades, and Yellowstone National Park (Figure 18).

Threats
Human conflict and habitat loss remain the greatest threats to grizzly bears. Through unregulated hunting and habitat destruction, the approximately 50,000 grizzly bears that historically roamed the lower 48 have been reduced to only a few thousand among the various populations.

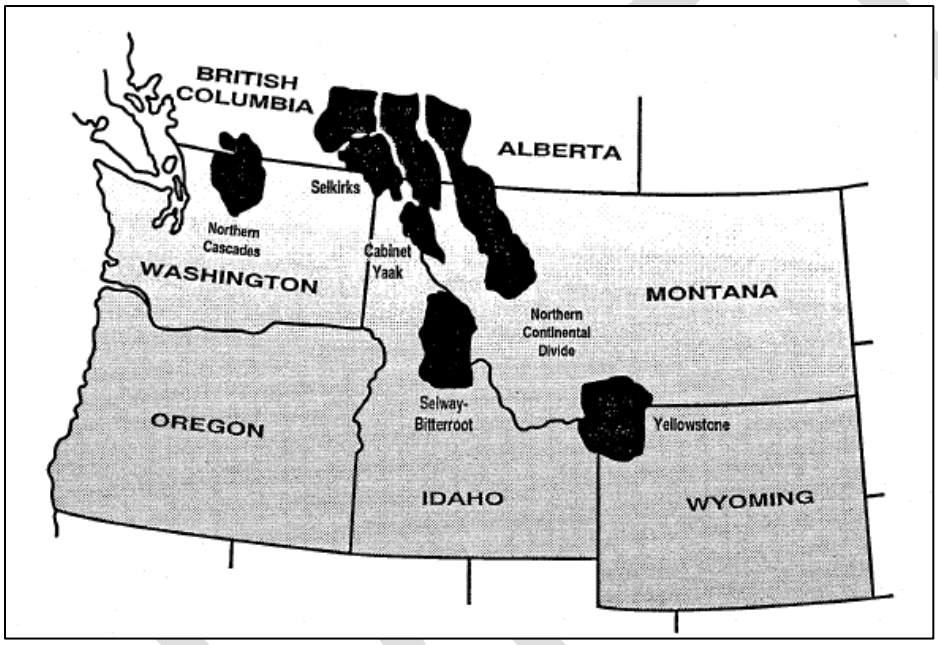

Figure 18. Present grizzly bear range in the U.S. and southern Canada.

vii. Marbled Murrelet
As summarized in USFWS (1997).

Listing History
Due to the substantial loss and modification of nesting habitat (older forest) and mortality from net fisheries and oil spills, the Washington, Oregon, and California vertebrate population segment of marbled murrelet was federally listed as threatened October 1, 1992.

Life History/Biological requirements
Marbled murrelets use forests that primarily include typical old-growth forests (characterized by large trees, a multistoried stand, and moderate to high canopy

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closure), but also use mature forests with an old-growth component. Trees must have large branches or deformities for nest platforms, with the occurrence of suitable platforms being more important than tree size alone. Throughout the Pacific Northwest the amount of older forests have decreased substantially due to timber harvest, fires, and wind throw. The earliest possible recovery time for nesting habitat, once lost, is generally 100-200 years.

Specific nesting habitat requirements and life-history strategy, a low reproductive rate, a low current breeding success and recruitment rate (based on juvenile:adult ratios) are likely to yield a decreasing population, which cannot easily recover should numbers be further depleted by additional catastrophic events. Because marbled murrelets feed primarily on fish and invertebrates in nearshore marine waters, they require nearshore marine habitats with sufficient prey resources.

Distribution and Critical Habitat

Critical habitat was designated for the species on May 24, 1996. Marbled murrelets range along the Pacific coast from Alaska to California; the southern end of the breeding range is in central California. Their at-sea distribution becomes more discontinuous in California. Some wintering birds are found in southern California and as far south as northern Baja California, Mexico. Nesting behavior has been documented beyond 50 mi (80 km) inland, though most nesting habitat likely occurs within 50 mi (80 km) of shore throughout the breeding range. Currently, breeding populations are not distributed continuously throughout the forested portion of the Pacific Northwest (Figure 19).

Threats

The principal factor considered to affect the marbled murrelet throughout the southern portion of its range (from British Columbia south to California) is the loss of nesting habitat (older forests). Timber harvest and natural disasters pose the greatest threats as habitat loss is largely permanent.

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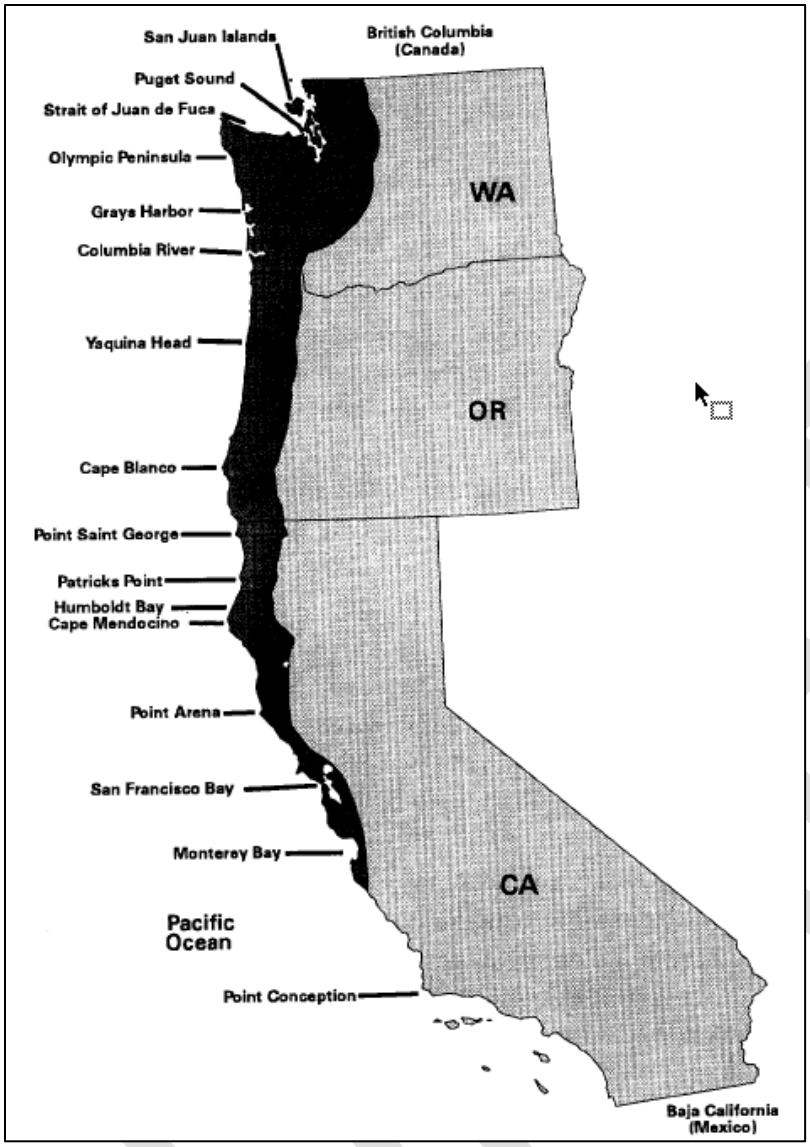

Figure 19. Distribution of marbled murrelet in the Pacific Northwest.

viii. North American Wolverine

As summarized in (USFWS, 2011b).

Listing History

Since 1985, the wolverine has been a candidate species under consideration for listing as threatened.

Life History/Biological requirements

Wolverines occur in a wide variety of alpine, boreal, and arctic habitats including boreal forests, tundra, and western mountains in North America. They do not appear to specialize on specific vegetation or geological habitat aspects, but instead select areas that are cold and receive enough winter precipitation to reliably maintain deep persistent snow late into the warm season. The requirement of cold, snowy conditions means

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that, in the southern portion of the species' range where ambient temperatures are warmest, wolverine distribution is restricted to high elevations, while at more northerly latitudes wolverines are present at lower elevations and even at sea level in the far north.

Wolverines are opportunistic feeders and consume a variety of foods depending on availability. They primarily scavenge carrion, but also prey on small animals and birds, and eat fruits, berries, and insects. Wolverines have an excellent sense of smell that enables them to find food beneath deep snow.

Breeding generally occurs from late spring to early fall. Females undergo delayed implantation until the following winter to spring, when active gestation lasts from 30 to 40 days. Litters are born from mid-February through March, containing one to five kits, with an average in North America of between one and two kits. Female wolverines use natal (birthing) dens that are excavated in snow. Persistent, stable snow greater than 5 feet (1.5 m) deep appears to be a requirement for natal denning, because it provides security for offspring and buffers cold winter temperatures.

Distribution and Critical Habitat

Critical habitat has not been designated for the North American wolverine. Currently, wolverines appear to be distributed as functioning populations in two regions in the contiguous United States: the North Cascades in Washington, and the northern Rocky Mountains in Idaho, Montana, and Wyoming (Figure 20). Wolverines were likely extirpated, or nearly so, from the entire contiguous United States in the first half of the 20th Century. The available evidence suggests that, in the second half of the 20th Century and continuing into the present time, wolverine populations have expanded in the North Cascades and the northern Rocky Mountains, but that populations have not been reestablished in the Sierra Nevada Range or the southern Rocky Mountains. We conclude that the current range of the species in the contiguous United States includes the North Cascades Mountains, the northern Rocky Mountains, the southern Rocky Mountains, and the Sierra Nevada Mountains, but that reestablishment of populations in the southern Rocky Mountains and Sierra Nevada has not yet occurred.

Threats

The USFWS has identified the following factors that threaten the wolverine: 1) Climate change, 2) human use and disturbance, 3) dispersed recreational activities, 4) infrastructure development, 5) transportation corridors, and 6) land management. Trapping has been a primary cause of wolverine mortality and unregulated trapping is believed to have played a role in their decline as additive mortality.

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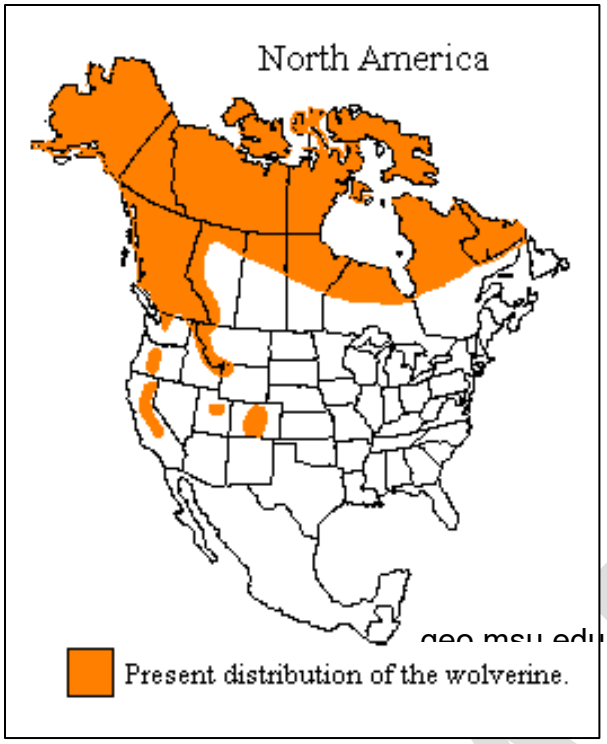

Figure 20. Present wolverine range in North America.

ix. Northern Spotted Owl

As summarized in USFWS (2011c).

Listing History

Northern spotted owl was listed as threatened June 26, 1990.

Life History/Biological requirements

Scientific research and monitoring indicate spotted owls generally rely on mature and old-growth forests because these habitats contain the structures and characteristics required for nesting, roosting, and foraging. Although spotted owls can disperse through highly fragmented forested areas, the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not been thoroughly evaluated or described.

The most important food items for the spotted owl are flying squirrels and woodrats. In areas where woodrats make up the bulk of the diet, the owl has a smaller home range. The spotted owl also eats bats and other owls(USFWS, 2011c) .

Distribution and Critical Habitat

Critical habitat was designated January 5, 1992, and most recently revised June 1, 2012. The northern spotted owl ranges from northern California to British Columbia (Figure 21).

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Figure 21. Distribution of the northern spotted owl.

Threats

The spotted owl was listed as threatened throughout its range "due to loss and adverse modification of spotted owl habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms". More specifically, threats to the spotted owl included low populations, declining populations, limited habitat, declining habitat, inadequate distribution of habitat or populations, isolation of populations within physiographic provinces, predation and competition, lack of coordinated conservation measures, inadequacy of regulatory mechanisms and vulnerability to natural disturbance.

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x. Oregon Spotted Frog

As summarized in 79 FR 51658.

Listing History

The Oregon spotted frog was listed as threatened August 29, 2014.

Life History/Biological requirements

Adult Oregon spotted frogs begin to breed by 1 to 3 years of age, depending on sex, elevation, and latitude. Males may breed at 1 year at lower elevations and latitudes, but generally breed at 2 years of age. Females breed by 2 or 3 years of age, depending on elevation and latitude.

Breeding occurs in February or March at lower elevations and between early April and early June at higher elevations. Males and females separate soon after egg-laying, with females returning to fairly solitary lives. Males often stay at the breeding site, possibly for several weeks, until egg-laying is completed. Females may deposit their egg masses at the same locations in successive years.

The Oregon spotted frog life cycle requires shallow water areas for egg and tadpole survival; perennially deep, moderately vegetated pools for adult and juvenile survival in the dry season; and perennial water for protecting all age classes during cold wet weather. The Oregon spotted frog inhabits emergent wetland habitats in forested landscapes, although it is not typically found under forest canopy. Historically, this species was also associated with lakes in the prairie landscape of the Puget lowlands. This is the most aquatic native frog species in the Pacific Northwest, as all other species have a terrestrial life stage. Post-metamorphic Oregon spotted frogs are opportunistic predators that prey on live animals, primarily insects, found in or near the water.

Distribution and Critical Habitat

Critical habitat was designated for the Oregon spotted frog May 11, 2016. Historically, the Oregon spotted frog ranged from British Columbia to the Pit River basin in northeastern California. Currently, the Oregon spotted frog is found from extreme southwestern British Columbia south through the Puget Trough and in the Cascades Range from south-central Washington at least to the Klamath Basin in southern Oregon (Figure 22). Oregon spotted frogs occur in lower elevations in British Columbia and Washington and are restricted to high elevations in Oregon.

Threats

Habitat alteration appears to be the primary threat to the Oregon spotted frog. Breeding locations makes Oregon spotted frogs acutely vulnerable to fluctuating water levels, disease, predation, poor water quality, and extirpation from stochastic events. Hydrologic changes, resulting from activities such as water diversions and removal of beavers, increase the likelihood of fluctuating water levels and temperatures, and may also facilitate predators.

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Figure 22. Present Oregon spotted frog distribution.

xi. Roy Prairie Pocket Gopher

Listing History

The Roy Prairie pocket gopher, along with three other subspecies of Mazama Pocket gopher were originally considered a candidate for listing October 30, 2001, and a final rule listing the species as threatened was published April 9, 2014, along with a critical habitat designation.

Life History/Biological requirements

Roy Prairie pocket gophers are well adapted for life underground. They have short tubular bodies and strong arms equipped with long pointed claws that allow them to move a tremendous amount of dirt, which brings seeds in the soil to the surface and provides a place for plants to germinate. All of their teeth grow continuously throughout their lives, because they use their teeth along with their long curved claws to sift the roots of plants out of the dirt as they dig their tunnels. Although their vision is poor, their highly sensitive tails may assist in navigation through tunnels. They use their cheek

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pouches to transport food and nesting material to special caches in their tunnel systems, which are vital to their survival, since they do not hibernate during winter months, but stay active all year long. Pocket gophers even have a special way to deal with waste: they use a tiny den in their tunnel system as a latrine and when the time comes, they block off the tunnel, which in turn enriches the soil with nutrients.

Pocket gophers remain in their home ranges year round. The average home range size likely varies based on factors such as soil type, climate, and density and type of vegetative cover.

Roy Prairie pocket gophers breed from March through July, and young are reared with adults until September. Most young do not survive to breeding age due to high predation rates. Most depredation of subterranean rodents occurs when they are surface feeding, pushing soil out of burrows, or dispersing, especially young of the year that are inexperienced at avoiding predators. Juvenile dispersal occurs each year and in each direction from natal sites (unless there are barriers). Dispersal occurs across varied cover types. This dispersal pattern allows for colonization of unoccupied sites, increasing density on occupied sites, and a constantly shifting mosaic of occupied sites.

Distribution and Critical Habitat

Critical habitat was designated for Olympia, Roy Prairie, Tenino, and Yelm pocket gophers April 9, 2014; however, critical habitat was designated for the Roy Prairie pocket gopher. All proposed subunits occupied by Roy Prairie pocket gophers occur on Department of Defense lands at JBLM based on the completion of an endangered species management plan (ESMP) under their 2006 Integrated Natural Resources Management Plan (INRMP) that the USFWS has determined, in writing, provides a conservation benefit to the Roy Prairie pocket gopher.

Threats

The Service has determined that large-scale changes in population and habitat status, including local extirpations and range contraction, threaten the Roy Prairie pocket gopher. Threats to Roy Prairie pocket gopher result from habitat loss and fragmentation (development, succession to unsuitable habitat conditions), loss or curtailment of natural disturbance processes that maintain habitat (e.g. fire), predation, and low genetic diversity. The threats combine to result in the loss of a majority of historical habitat, and the loss of access to suitable habitat.

xii. Spalding's Catchfly

As summarized in USFWS (2007)

Listing History

Spalding's catchfly was listed as a threatened species under the Endangered Species Act on October 10, 2001.

Life History/Biological requirements

Spalding's catchfly is an herbaceous perennial plant in the pink family (Caryophyllaceae). It is a long-lived species that expresses prolonged dormancy for up to six years without leaves if conditions are unfavorable (Lesica, 1997; Lesica and Crone, 2007). Lesica and Crone (2007) found that prolonged dormancy may increase

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plant fitness providing a way to obtain below-ground resources, limiting flower and fruit production.

Little is known about seed productivity, seed bank viability, or dispersal, but it can be assumed that the capsules of Spalding's catchfly serve as an open cup from which seeds are likely carried by the wind, jostled out by passing wildlife, or tossed when plants are knocked over (USFWS, 2007). Seeds are small, flat, and somewhat winged. Plant height and seed characteristics suggest that short-distance wind dispersal may be common.

The plant is found at elevations ranging from 400-1,766.6 yds (365.7-1,615.4 m), usually in deep, productive loess soils (fine, windblown soils). Plants are generally found in swales or on northwest to northeast facing slopes where soil moisture is relatively higher.

Distribution and Critical Habitat

No critical habitat has been designated for this species. In 2007, there were 99 documented populations of Spalding's catchfly (USFWS 2007). Within the United States, Spalding's catchfly is known from four counties in Idaho (Idaho, Latah, Lewis, and Nez Perce), four counties in Montana (Flathead, Lake, Lincoln, and Sanders), one county in Oregon (Wallowa), and five counties in Washington (Adams, Asotin, Lincoln, Spokane, and Whitman) (Figure 23).

Threats

Spalding's catchfly continues to be impacted by habitat loss due to human development and agriculture, habitat degradation associated with adverse grazing and trampling by domestic livestock, and invasions of aggressive nonnative plants. Other impacts include changes in fire frequency and seasonality, off-road vehicle use, and herbicide spraying and drift.

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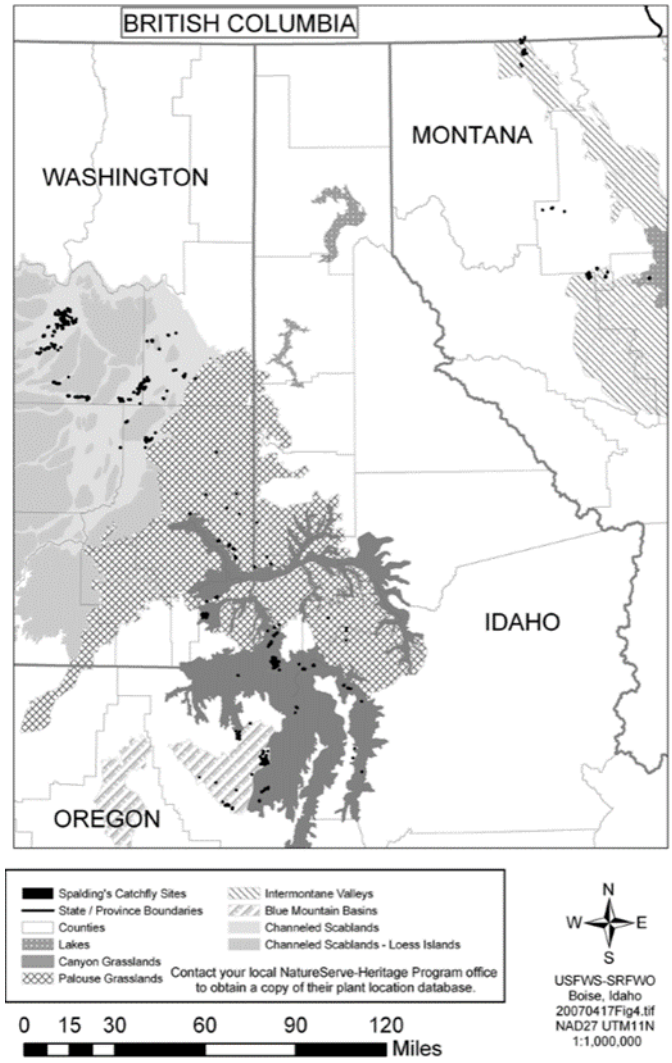

Figure 23. Distribution of Spalding's catchfly.

xiii. Streaked Horned Lark

As summarized in (USFWS, 2017b).

Listing History

The streaked horned lark was listed as a threatened species on October 3, 2013.

Life History/Biological requirements

Habitat used by streaked horned larks is generally flat with substantial areas of bare ground and sparse low-stature vegetation primarily composed of grasses and forbs. Suitable habitat is generally 16-17% bare ground and may be even more open at sites selected for nesting. Vegetation height is generally less than 13 in (33 cm). A key attribute of habitat used by larks is open landscape context. Our data indicate that sites used by larks are generally found in open (i.e., flat, treeless) landscapes of 300 ac (121.4 ha) or more.

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Horned larks forage on the ground in low vegetation or on bare ground; adults feed on a wide variety of grass and weed seeds, but feed insects to their young. Larks eat a wide variety of seeds and insects and appear to select habitats based on the structure of the vegetation rather than the presence of any specific food plants.

Male streaked horned larks arrive in the Puget lowlands in mid-February, and females arrive by early March. The nesting season for streaked horned larks begins in early April and ends mid- to late August. Clutches range from one to five eggs, with a mean of three eggs. After the first nesting attempt in April, streaked horned larks will often re-nest in late June or early July. Young streaked horned larks leave the nest 8-10 days after hatching, and are cared for by the parents until they are about four weeks old when they become independent.

Horned larks form pairs in the spring and establish territories approximately 2 ac (0.8 ha) in size [range 1.5-2.5 ac (0.6 to 1.0 ha)]. Horned larks create nests in shallow depressions in the ground and line them with soft vegetation. Female horned larks select the nest site and construct the nest without help from the male. Streaked horned larks establish their nests in areas of extensive bare ground, and nests are placed adjacent to clumps of bunchgrass.

Distribution and Critical Habitat

Critical habitat was designated for the streaked horned lark October 3, 2013, for 16 sites; in the Willamette Valley, designated critical habitat is located on the Service's Willamette Valley National Wildlife Refuge Complex at the William R. Finley, Ankeny, and Baskett Slough units. The current range and distribution of the streaked horned lark can be divided into three regions: 1) the south Puget Lowlands in Washington; 2) the Washington coast and lower Columbia River islands (including dredge spoil deposition and industrial sites near the Columbia River in Portland, Oregon); and 3) the Willamette Valley in Oregon (Figure 24).

Streaked horned larks currently breed on eight sites in the south Puget Sound. Five of these sites are on Joint Base Lewis McChord: 13th Division Prairie, Gray Army Airfield, McChord Field, and two locations on the 91st Division Prairie – Artillery Impact Area. The largest population of streaked horned larks in Washington breeds at the Olympia Regional Airport.

Most streaked horned larks winter in the Willamette Valley (72%) and on the islands in the lower Columbia River (20%); the rest spend the winter on the Washington coast (8%) or in the south Puget Sound.

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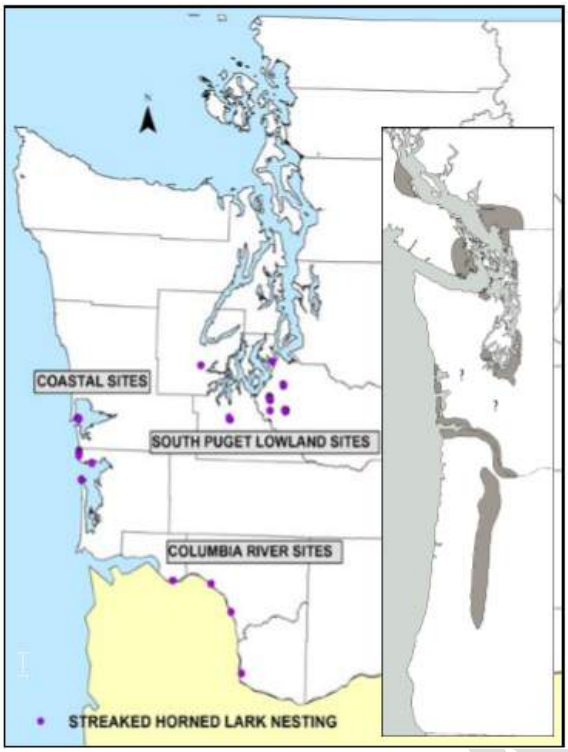

Figure 24. Distribution of the streaked horned lark in Washington.

Threats

The streaked horned lark was listed as a threatened species because of the following:

1) The streaked horned lark has disappeared from all formerly documented locations in the northern portion of its range, the Oregon coast, and the southern edge of its range.
2) There are currently estimated to be fewer than 1,600 streaked horned larks range-wide, and population numbers are declining.
3) Their range is small and may be continuing to contract;
4) Their habitat is threatened throughout their entire range from loss of natural disturbance regimes, invasion of unsuitable vegetation that alter habitat structure, and incompatible land management practices.
5) Large winter congregations are limited to one region, Oregon's Willamette Valley, which may put larks at risk from stochastic weather events.
6) Most sites currently used by larks require some level of disturbance or management to maintain the habitat structure they need. The natural processes that previously provided this disturbance no longer operate.

xiv. Ute Ladies'-tresses

As summarized in USFWS (1995).

Listing History

Ute ladies'-tresses was listed as threatened on January 17, 1992. On October 12, 2004 there was a petition filed to delist Ute ladies'-tresses. The petition states that there is substantial new information indicating that the population size and distribution are much

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larger than known at the time of listing; there is more information on life history and habitat needs, allowing for better management, and threats are not as great in magnitude or imminence as understood at the time of listing. This plant remains listed as threatened.

Life History/Biological requirements

Ute ladies'-tresses is a perennial herb with erect, glandular-pubescent stems 5-24 in (12.7 to 61 cm) tall arising from tuberous-thickened roots. It reproduces exclusively by seed. The plant's life cycle consists of four main stages: seedling, dormant, vegetative, and reproductive. Fruits are produced in late August or September with seeds shed shortly thereafter. Seeds are microscopic, dust-like, and readily dispersed by wind or water. This plant may remain dormant for eight to eleven years and may revert to below ground existence for one to four or more growing seasons before re-emerging with new above-ground shoots.

The vegetative shoots are produced in October and persist through the winter as small rosettes. These resume growth in the spring and develop into short-stemmed, leafy plants. It blooms from early July to late October. Flowering typically occurs earlier in sites that have an open canopy and later in well-shaded sites. Bees are the primary pollinators of Ute ladies'-tresses, particularly solitary bees.

In perennial streamside populations Ute ladies'-tresses typically occur on shallow sandy loam, silty-loam, or clayey-silt alluvial soils overlying more permeable cobbles, gravels, and sediments. It is dominated by perennial graminoids and forbs, *particularly Agrostis stolonifea, Elymus repens, Juncus balticus*, and *Equisetum laeigatum*. Ute ladies'-tresses populations may persist for a short time in the grassy understory of woody riparian shrublands, but do not appear to thrive under these conditions (Ward and Naumann, 1998).

Distribution and Critical Habitat

No critical habitat has been designated for this species. Populations of Ute ladies'-tresses orchids are known from three broad general areas of the interior western United States—near the base of the eastern slope of the Rocky Mountains in southeastern Wyoming and adjacent Nebraska and north-central and central Colorado; in the upper Colorado River basin, particularly in the Uinta Basin; and in the Bonneville Basin along the Wasatch Front and westward in the eastern Great Basin, north-central and western Utah, extreme eastern Nevada, and southeastern Idaho. The species is also known to occur in Bonneville, Fremont, Jefferson, and Madison counties along the Snake River, has been discovered in southwestern Montana, and in the Okanogan area and along the Columbia River in North Central Washington (Figure 25).

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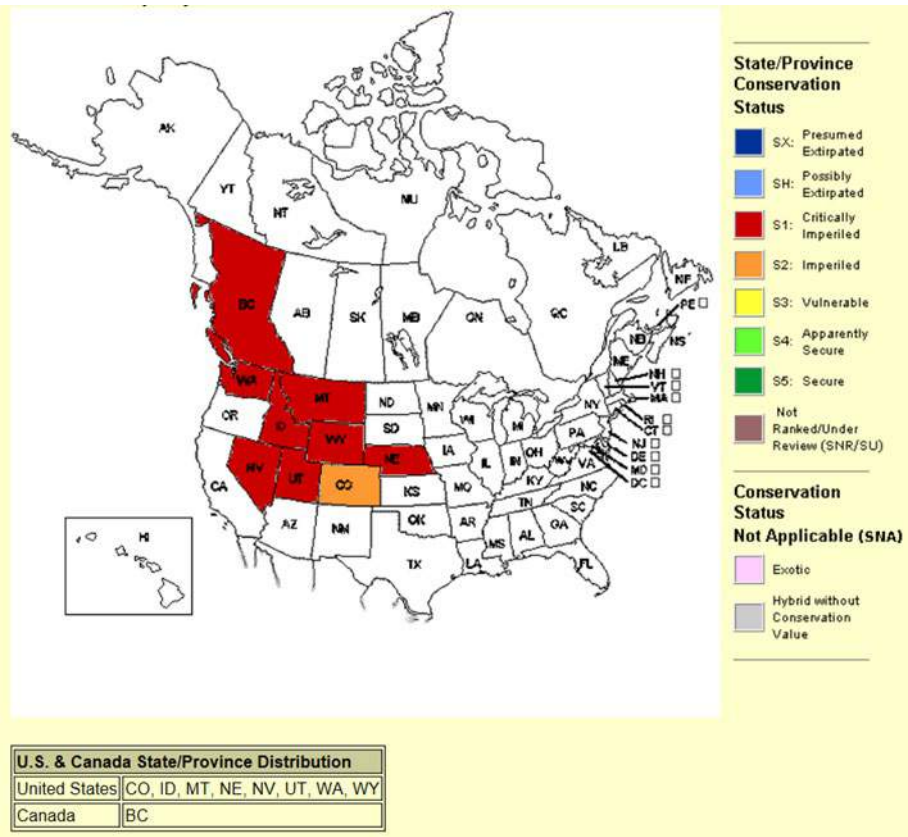

Figure 25. General distribution of Ute ladies'-tresses in North America.

Threats

Alteration of suitable riparian and wetland habitat can affect Ute ladies'-tresses, though after listing, this plant was found in greater numbers than estimated at the time of listing. The overall known population is higher than once thought.

Current threats are drought caused reduction in water table and lake levels, competition from non-native plants, and grazing impacts.

xv. Water Howellia

As summarized in at: https://www.fws.gov/oregonfwo/articles.cfm?id=149489516.

Listing History

Water howellia was listed as threatened on July 14, 1994.

Life History/Biological requirements

Water howellia is an annual aquatic species in the bellflower family (Campanulaceae). Individuals are mostly submerged and rooted in bottom sediments. Stems branch near the soil surface and are 1.5-2.8 in (4-7 cm) long. The leaves are numerous and linear to linear-filiform, measuring 0.4-0.6 in (1-5 cm) long, with an entire margin or with a few teeth. The flowers are axillary, 0.08-0.11 in (2-2.7 mm) long, and a corolla is present (in emergent flowers) or lacking (in underwater flowers). The corolla is white to pale lavender and is deeply cleft on one side. The fruit is 0.3-0.4 in (8-10 mm) long. The

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seeds number 1-5 and are 0.08-0.2 in (2-4 mm) long. This species typically blooms May through August.

Information on herbarium labels or Oregon collections describe the habitat as "ponds in woods", "pond in shaded woods", and "stagnant ponds in the timber". Information from other locales indicate that this species is restricted to small, vernal, freshwater wetlands, glacial pothole ponds, or former river oxbows that have an annual cycle of filling with water over the fall, winter and early spring, followed by drying during the summer months. These habitats are generally small [< 2.47 ac (1 ha)] and shallow [< 3.3 ft (1 m deep)]. Bottom surfaces are reported as firm, consolidated clay, and organic sediments. Most locations were surrounded by deciduous trees and howellia was found in shallow water or around the edges of deep ponds. Associated species include duckweed (*Lemna* spp.), water starworts (*Callitriche* spp.), water buttercup (*Ranununculus aquaticus*), yellow water-lily (*Nuphar polysepalum*), bladderwort (*Utricularia vulgaris*), and pondweeds (*Potamogeton* spp.)

Distribution and Critical Habitat

No critical habitat has been designated for this species. Historically, water howellia was known to occur in one location in Mendocino County, California, four locations in northwest Oregon, two additional locations in Washington, and one location in northern Idaho.

As of drafting the recovery plan for this species in 1995, water howellia was known to occur in six location; one in Idaho, three in Washington, and one in Montana, and one in California (Figure 26).

Threats

Habitat destruction appears to be the main threat and cause for decline of water howellia. Road and pasture development, grazing and trampling, timber harvest, invasive species, and wetland succession have been documented as potential factors.

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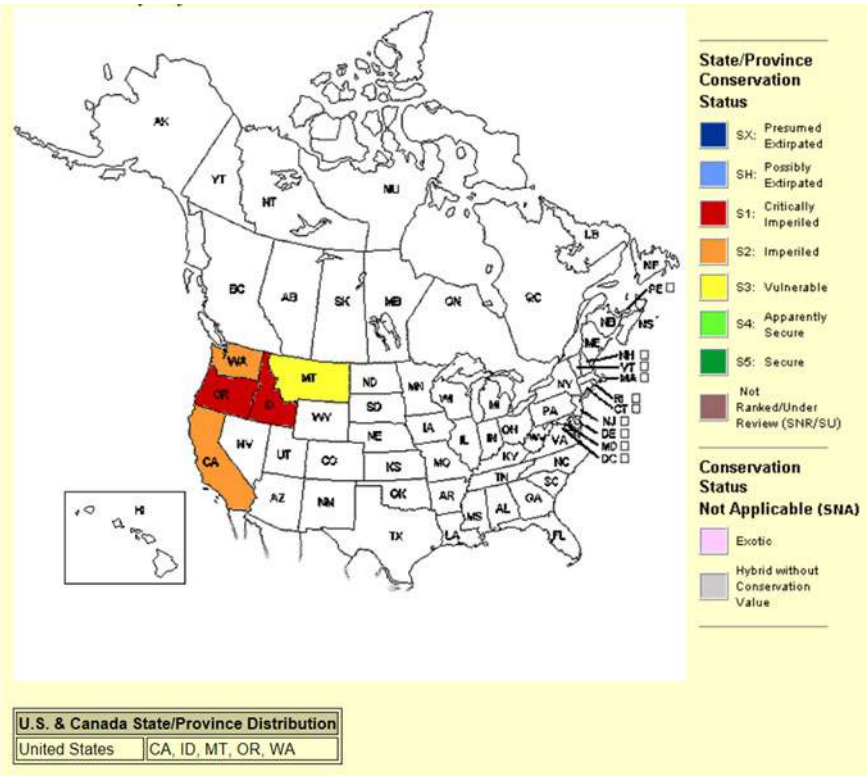

Figure 26. General distribution of water howellia in North America.

xvi. Whitebark Pine

As summarized in USFWS (2016).

Listing History

Whitebark pine was first reviewed as a candidate for listing October 26, 2011, and remains a candidate under review, current as of December 2, 2016.

Life History/Biological requirements

Whitebark pine is a slow-growing, long-lived tree with a life span of up to 500 years and sometimes more than 1,000 years. It is a hardy conifer that tolerates poor soils, steep slopes, and windy exposures and is found at alpine tree line and subalpine elevations throughout its range. It grows typically 16.4-65.6 feet (5 to 20 m) tall with a rounded or irregularly spreading crown shape under a wide range of precipitation amounts, from about 20.1 in (51 cm) to over 100 in (254 cm) per year. Whitebark pine may occur as a climax species, early successional species, or seral (mid-successional stage) co-dominant associated with other tree species. Although it occurs in pure or nearly pure stands at high elevations, it typically occurs in stands of mixed species in a variety of forest community types.

On higher density conifer sites, whitebark pine tends to grow as tall, single-stemmed trees, whereas on open, more exposed sites, it tends to have multiple stems. Above tree line, it grows in a krummholz form, with stunted, shrub-like growth caused by high winds and cold temperatures. This pine species is monoecious (with both male pollen

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and female seed cones on the same tree). Its characteristic dark brown to purple seed cones are 5 to 8 cm long and grow at the outer ends of upper branches.

Whitebark pine is one of five species of stone pine, so-named for their hard, stone-like seeds, and is the only stone pine that occurs in North America. Stone pines are distinguished from other pines by their five needles per cluster, indehiscent seed cones (scales on the cones remain essentially closed at maturity) that stay on the tree, and wingless seeds that remain fixed to the cone and cannot be dislodged by the wind. Because whitebark pine seeds cannot be wind-disseminated, primary seed dispersal occurs almost exclusively by Clark's nutcrackers (*Nucifraga columbiana*), birds in the taxonomic family Corvidae, which includes include ravens, crows, and jays. Consequently, Clark's nutcrackers facilitate whitebark pine regeneration and influence its distribution and population structure through their seed caching activities

Distribution and Critical Habitat

No critical habitat has been designated for this species. The historical distribution of whitebark pine is unknown. Presently, whitebark pine occurs in scattered areas of the warm and dry Great Basin but it typically occurs on cold and windy high-elevation or high-latitude sites in western North America. As a result, many stands are geographically isolated. Its range extends longitudinally between 107 and 128 degrees West and latitudinally between 27 and 55 degrees North. The distribution of whitebark pine includes coastal and Rocky Mountain ranges that are connected by scattered populations in northeastern Washington and southeastern British Columbia (Figure 27).

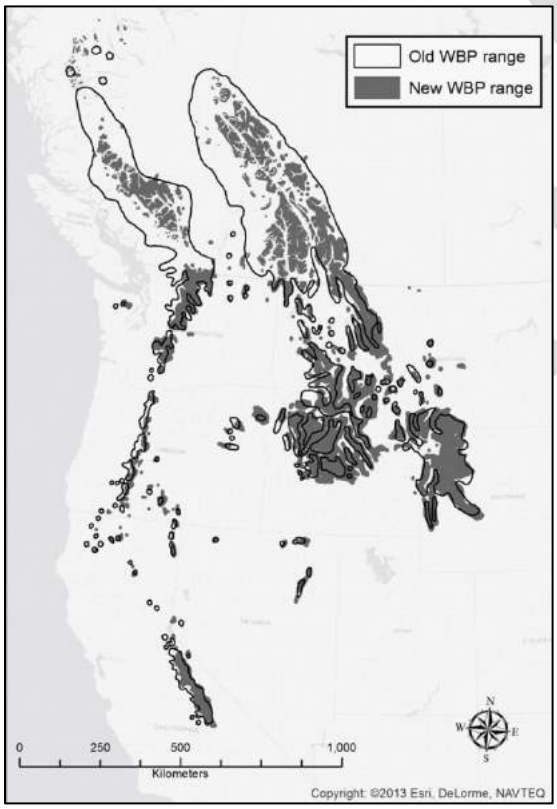

Figure 27. Whitebark pine distribution in North America.

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Threats

1) The primary threat to the species is from disease in the form of the nonnative white pine blister rust and its interaction with other threats. 2) Continuing environmental effects resulting from climate change will result in direct habitat loss for whitebark pine, a high-elevation species occurring only in cool mountaintop habitats. 3) Past and ongoing fire suppression is also negatively impacting populations of whitebark pine through direct habitat loss. Many stands of trees once dominated by whitebark pine are now dense stands of shade-tolerant conifers. This change in forest structure and composition facilitates an increased frequency and intensity of wildfire and an increased susceptibility to predation and disease.

xvii. Yellow-billed Cuckoo

As summarized by USFWS (2018)

Listing History

The western yellow-billed cuckoo was listed as threatened October 3, 2014, while critical habitat was proposed August 15, 2014, but a final designation has not been made. The western DPS includes Arizona, California (Baja California, Baja California Sur, Chihuahua, western Durango, Sinaloa, and Sonora), western Colorado, Idaho, western Montana, western New Mexico, Nevada, Oregon, western Texas, Utah, Washington, western Wyoming, and southwest British Columbia.

Life History/Biological requirements

Yellow-billed cuckoos use wooded habitat with dense cover and water nearby, including woodlands with low, scrubby, vegetation, overgrown orchards, abandoned farmland, and dense thickets along streams and marshes. In the Midwest, look for cuckoos in shrub lands of mixed willow and dogwood, and in dense stands of small trees such as American elm. In the Southwest, yellow-billed cuckoos are rare breeders in riparian woodlands of willows, cottonwoods and dense stands of mesquite to breed.

Yellow-billed cuckoo prey largely on caterpillars. On the east coast, periodic outbreaks of tent caterpillars draw cuckoos to the tent-like webs, where they may eat as many as 100 caterpillars at a sitting. Fall webworms and the larvae of gypsy, brown-tailed, and white-marked tussock moths are also part of the cuckoo's lepidopteran diet, often supplemented with beetles, ants, and spiders. They also take advantage of the annual outbreaks of cicadas, katydids, and crickets, and will hop to the ground to chase frogs and lizards. In summer and fall, cuckoos forage on small wild fruits, including elderberries, blackberries and wild grapes. In winter, fruit and seeds become a larger part of the diet.

Pairs may visit prospective nest sites multiple times before building a nest together. Nest heights can range from 3 feet (0.9 m) to as much as 90 feet (27.5 m) off the ground, with the nest placed on a horizontal branch or in the fork of a tree or large shrub. In the West, nests are often placed in willows along streams and rivers, with nearby cottonwoods serving as foraging sites.

The male and female yellow-billed cuckoo build a loose stick nest together, using twigs collected from the ground or snapped from nearby trees and shrubs. The male

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sometimes continues bringing in nest materials after incubation has begun. Clutch size can range from 1-5 eggs with up to 2 clutches per year.

Distribution and Critical Habitat

Critical habitat is proposed, but not yet designated for yellow-billed cuckoo. The breeding range of the yellow-billed cuckoo formerly included most of North America from southern Canada to the Greater Antilles and northern Mexico. In recent years, the species' distribution in the west has contracted. The northern limit of breeding in the western coastal States is now in Sacramento Valley, California, and the northern limit of breeding in the western interior States is southern Idaho [Hughes, 1999 (Figure 28)]. The species overwinters from Columbia and Venezuela, south to northern Argentina (Ehrlich et al., 1992).

Threats

The greatest threat to the species has been reported to be loss of riparian habitat. It has been estimated that 90% of the cuckoo's stream-side habitat has been lost (USFWS 2018). Habitat loss in the west is attributed to agriculture, dams, and river flow management, overgrazing and competition from exotic plants such as tamarisk.

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Figure 28. Historic and present distribution of western yellow-billed cuckoo.

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4. Environmental Baseline

The environmental baseline is a “snapshot” of a species’ health at a specified point in time. It does not include the effects of the action under review in the consultation. This section presents an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area.

The baseline includes state, tribal, local, and private actions already affecting the species or that will occur contemporaneously with the consultation in progress. Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species or critical habitat.

4.1. Historic Conditions

Pre-English settlement, the proposed action area was largely untouched forest and prairie ecosystems. Natural processes of flood, fire, wind, and wildlife grazing managed the natural ecosystems as they had adapted to over millennia. Rivers ran free and species generally inhabited large ranges, as habitat was un-fragmented and largely suitable.

4.2. Current Conditions

Presently, a variety of human disturbances such as mineral extraction, energy harnessing (wind and water), timber harvest, livestock grazing, recreation, and human development have and will likely continue to significantly alter the habitats of the 12 ESA-listed species considered in this BA. Human development for consumption and profit, suppressed fire regimes, dammed waterways, harvested timber, mined minerals, and overgrazing has necessitated the creation of the ESA in an attempt to eliminate extirpation and extinction of species and habitats beyond the prior irrevocable damage.

4.3. Matrix of Pathway Indicators

The NMFS uses the "Matrix of Pathways and Indicators" (MPI) to summarize important environmental parameters and conditions for aquatic species (Table 5). USFWS adopted a similar strategy in 1997 based on NMFS’ matrix for aquatic species. The MPI is divided into six overall pathways (major rows in the matrix):

- Water Quality
- Channel Condition and Dynamics
- Habitat Access
- Flow/Hydrology
- Habitat Elements
- Watershed Conditions

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Table 5. Checklist for documenting environmental baseline and effects of proposed actions on salmonid habitat indicators.

Pathways Indicators	Environmental Baseline Properly Functioning	At Risk	Not Properly Functioning
Water Quality:			
Temperature			X
Sediment		X	
Chem. Contam./Nut.		X	
Habitat Access:			
Physical			X
Habitat Elements:			
Substrate		X	
Large Woody Debris			X
Pool Frequency			X
Pool Quality		X	
Off-Channel Habitat			X
Refugia		X	
Channel Cond. and Dynamics:			
Width/Depth Ratio			X
Streambank Condition			X
Floodplain Connectivity			X
Flow/Hydrology:			
Peak/Base			X
Drainage Network		X	
Watershed:			
Road Density and Location		X	
Disturbance History			X
Riparian Reserves		X	

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Each represents a significant pathway by which actions can have potential effects on anadromous salmonids and their habitats, and is used herein to analyze habitat for all aquatic species.

It is impossible to conduct an on-site evaluation of current habitat indicators for every proposed site and waterbody for all affected aquatic species; however, applying a higher-level understanding of the current conditions in the northwest can be applied to review of the description of the proposed action and the matrix to determine potential impacts.

While the USFWS has not developed a MPI for ESA-listed terrestrial species, the Corps developed Table 6, which presents the baseline condition for five factors that are critical for most terrestrial species and can be evaluate at a level appropriate for the size of the action area.

Table 6 provides the five critical terrestrial habitat parameters. Explanations are provided below for each relative to their importance and baseline condition.

Table 6. Corps-developed MPI for evaluating the terrestrial species habitat baseline.

Pathways Indicators	Environmental Baseline		
	Properly Functioning	At Risk	Not Properly Functioning
Habitat Connectivity		X	
Migration Corridors		X	
Cover		X	
Reproduction		X	
Food Sources		X	

4.4. Baseline Justification

4.4.1. Aquatic Species

Flowering rush thrives in systems with altered hydrology and the majority of the proposed action sites occur in modified systems, especially impoundments with winter drawdowns and irrigation canals. As such, many of the parameters and indicators are at risk or worse.

Water Quality

The *Temperature* parameter is “not properly functioning”. Water temperature in the action area is at risk due to climate change and habitat disturbance. Additionally, all potential action areas are effected by dams or natural impounding that elevate water temperature.

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The *Sediment* parameter is “at risk”. Human disturbance across the FSA through grazing, timber harvest, and mineral extraction have resulted in increased erosion via precipitation and wind.

The *Chemical Contaminants/Nutrients* parameter is “at risk”. The waterbodies considered in this BA originate and flow through watersheds that range from largely undisturbed, to watersheds that are greatly disturbed. Contaminants and nutrient inputs may be at risk from human development and recreation, and these watersheds are most likely to be at risk.

Habitat Access

The *Physical Barriers* parameter is “not properly functioning”. All action areas considered in this BA are in systems with dams or natural passage and are (at least effectively) blocked to fish passage.

Habitat Elements

The *Substrate* parameter is “at risk”. Sand and silt may deposit anywhere within the watersheds of the action area; however, human disturbance and waterbody alteration increases the likelihood of sediment inputs and deposition.

The *Large Woody Debris* parameter is “not properly functioning”. Large woody debris recruitment may is not properly functioning at the proposed action areas due to stream impoundment, development, and alteration of channel dynamics.

The *Pool Frequency* parameter is “not properly functioning”. Pool frequency is not properly functioning at the proposed action areas due to stream impoundment, development, and alteration of channel dynamics.

The *Pool Quality* parameter is “at risk”. Pool quality may range from good to poor across watersheds in the FSA depending on the watershed disturbance history.

The *Off-Channel Habitat* parameter is “not properly functioning”. Off-channel habitat is not properly functioning at the proposed action areas due to stream impoundment, development, and alteration of channel dynamics.

The *Refugia* parameter is “at risk”. Refugia may range from good to poor across watersheds in in the FSA depending on the watershed disturbance history.

Channel Condition and Dynamics

The *Width to Depth Ratio* parameter is “not properly functioning”. Dams and development have impacted flow and altered width to depth rations at the proposed action areas.

The *Streambank Condition* parameter is “not properly functioning”. Streambank condition habitat is not properly functioning at the proposed action areas due to stream impoundment, development, and alteration of channel dynamics.

The *Floodplain Connectivity* parameter is “not properly functioning”. Floodplain connectivity is not properly functioning at the proposed action areas due to development of the riparian zone and regulation of flows through dams.

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Flow and Hydrology

The *Peak/Base Flows* parameter is “not properly functioning”. The peak/base flow parameter is improperly functioning across the action area due to regulation of flows at dams in the watersheds.

The *Drainage Network Increase* parameter is “at risk”. Drainage network increase may range from good to poor across the action area depending on watershed.

Watershed Conditions

The *Road Density and Location* parameter is “at risk”. The road network within the action area may range from good to poor across the action area depending on proposed treatment site. Road networks have been developed at all proposed action sites and follow the channel in multiple sites.

The *Disturbance History* parameter is “not properly functioning”. Large fires have increased in frequency throughout the FSA. Runoff after a fire can carry increased amounts of sediment. Landslides due to fires and roads also affect the streams within the watersheds.

The *Riparian Reserves* parameter is “at risk”. Riparian reserves may be good to poor quality or non-existent across the action areas.

4.4.2. Terrestrial Species

The *Habitat Connectivity* parameter is “at risk”. Habitat connectivity is critical for species and populations to seek refugia, food sources, and gene flow. Across the action area, many habitats are fragmented significantly, and some to the point that gene flow and reproduction have been impacted. Of course, the smaller the distribution and area of suitable habitat, the greater the risks are for the species or population.

The *Migration Corridors* parameter is “at risk”. Migration corridors are critical for animals like grizzly bear, gray wolf, and Canada lynx, as well as migratory birds. Over time, migration corridors have been encroached upon across the action area by human development in the form of roadways, housing developments, grazing, etc.

The *Cover* parameter is “at risk”. Cover is critical to provide shelter from environmental conditions, support denning or nesting and feeding areas, and largely provide safety from predators across terrestrial species. Cover has been greatly impacted across the action area by human development and actions such as grazing, agriculture, and timber harvest, sometimes to the degree of habitat fragmentation.

The *Reproduction* parameter is “at risk”. Reproductive capability is critical for the persistence of any population. Yellow-billed cuckoo are a prime example of a species with specific reproductive habitat requirements, aside from connectivity and cover. Yellow-billed cuckoo require extensive stands of contiguous vegetation along a riparian border for nesting. Agricultural and developmental practices in the Northwest often restrict riparian zones to 10 to 20 meter strips along a water body. In these circumstances, yellow-billed cuckoo will not nest or breed.

The *Food Sources* parameter is “at risk”. The criticality of food sources goes without saying; however, terrestrial species that rely on specific food sources can be and have been historically displaced or extirpated by habitat disturbance within the action area.

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5. Effects of the Action

This section includes an analysis of general project-related effects of the proposed action, as well as specific effects on the species and physical and biological factors (PBFs) of critical habitat. USFWS species lists were updated for the action area 15 July 2019. Species lists were provided by the Idaho, Montana, and Washington Fish and Wildlife Offices of the USFWS, with Consultation Codes 01EIFW00-2019-SLI-1511, 01EIFW00-2019-SLI-0880, 01EIFW00-2019-SLI-0879, 06E11000-2019-SLI-0208, 06E11000-2019-SLI-0573, 01EWFW00-2019-SLI-0297, 01EWFW00-2019-SLI-0298, 01EWFW00-2019-SLI-0314, 1EWFW00-2019-SLI-0315, 01EWFW00-2019-SLI-0316, 01EWFW00-2019-SLI-1322, and 01EWFW00-2019-SLI-1323.

Factors to be considered in the analysis include proximity of the action, distribution, timing, nature of the effect, duration and disturbance frequency, disturbance intensity, and disturbance severity.

The implementation of flowering rush control will have some minor, unavoidable, short-term adverse effects such as increased stream turbidity and riparian disturbance, in order to gain more permanent habitat improvements. The Corps incorporated standard conservation measures (also known as best management practices or BMPs) into the proposed action to illustrate how the proposed action will accomplish the Corps mission while inherently minimizing the impact of, and reducing the potential for adverse effects. However, short-term effects may not be avoidable and may still be reasonably certain to occur.

The Corps approached its analysis of potential effects through a series of steps.

1. The first step is designed to identify aspects of proposed actions that may have direct and indirect effects on the physical, chemical, and biotic environment of an action area. As part of this step, the spatial extent of these direct and indirect effects, including changes in that spatial extent over time are identified.

2. The second step will determine if there is a concurrence (either spatially, temporally, or both) between ESA-listed species or designated critical habitat and potential stressors that may result from the proposed action. This is based on local distribution information and timing of the proposed action.

3. Once concurrence is determined, then the potential for exposure to potential stressors is analyzed through a series of steps.

4. If it is determined that a given species or critical habitat may be exposed to potential stressors, then an analysis of a potential response must take place. Once we identify which listed resources may be exposed to potential stressors and the nature of that exposure, an examination of the scientific and commercial data available is used to determine whether and how those listed resources are likely to respond to the exposure.

5. The exposure and response analyses are used to assess the likelihood of listed individuals and their habitat to be adversely affected from the stressors of the action.

The Corps anticipates that project-related effects will be similar for all listed fish species that may occur within the action area and will therefore be analyzed collectively.

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The approach to the effects analysis used the following questions (adapted from Johnson, 2009) to determine the extent, if any, of potential effects, and justify the effects determination for each species:

1) Is the proposed action likely to produce potential stressors or subsidies that would reasonably be expected to act directly on individual organisms or to have direct or indirect consequences (positive or negative) on the environment?
   a) An answer of “no” to #1 would result in a “no effect” determination by the Corps.
   b) An answer of “yes” to #1 would result in moving to #2.

2) If the proposed action is likely to produce those potential stressors, are endangered or threatened individuals likely to be exposed to one or more of those potential stressors or subsidies or one or more of the proposed action’s direct or indirect consequences on the environment?
   a) An answer of “no” to #2 would result in a “no effect” determination by the Corps.
   b) An answer of “yes” to #2 would result a “may affect” determination by the Corps, and moving to #3.

3) If listed individuals are likely to be exposed, are those listed individuals likely to respond, positively or negatively, to that exposure?
   a) An answer of “no” to #3 would result in a “not likely to adversely affect” determination by the Corps.
   b) An answer of “yes” to #3 would result in moving to #4.

4) If listed individuals are likely to respond, are those responses likely to be sufficient to reduce their individual performance?
   a) An answer of “no” to #4 would result in a “not likely to adversely affect” determination by the Corps.
   b) An answer of “yes” to #4 would result in a “likely to adversely affect” determination by the Corps. This determination, for any potential effect, and for any given species, would result in a “may affect, likely to adversely affect” determination for that species.

In order to analyze exposure of potential effects of the proposed action, it must be determined if potential stressors could be produced as a result of the action, as proposed.

“Considering that all listed Pacific salmonid ecologically significant units/distinct population segments use watersheds where the use of [chemicals] are authorized, [chemicals] are permitted for use in close proximity to salmonid habitats (0-140 ft), and […] pesticide detections are widespread in freshwater habitats across the U.S., NMFS has expected it is possible all listed Pacific salmonid ESUs/DPSs and their designated critical habitats may be exposed to the stressors of pesticides” (NMFS, 2010).

The Corps is proposing to apply chemical pesticides in the form of herbicides directly to waters that sometimes contain both ESA-listed species and designated critical habitats, thereby making the assumption above applicable and valid. In addition, substrate-disturbing activities (DASH and benthic barriers) are considered potential stressors.

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Therefore, the Corps concludes that there may be potential stressors produced as a result of the proposed action, and ESA-listed species and critical habitats may be exposed to those stressors. Those species that are listed in the counties containing proposed flowering rush treatment locations, but that do not occur within the action area either spatially or temporally, have no potential to be exposed to potential stressors, and, according to 2.a. (above), a “no effect” determination can be made.

Conversely, according to 2.b. (above), a “may affect” determination must be made for those species that occur in spatial and temporal proximity of the proposed action in the action area (Table 7). For species where a “no effect” determination is made in Table 7, the Corps has concluded that individuals of the species would be spatially or temporally removed from the effects of the action and will not be discussed in detail.

If individuals are exposed to potential stressors, then an analysis of the response must take place to gauge the effect on the individual. For example, there could be a range of responses to the exposure, and variability in response, of a pesticide that is toxic to fish, depending on the mode of action of any given pesticide. An individual fish may respond directly or indirectly to exposure to stressors.

Examples of response by species include mortality, behavioral modification, reduced predator avoidance, reduced growth and reproduction, physiological, and habitat alteration. Responses with critical habitat include alteration of spawning gravels, reduction in prey species, water quality, and reduction in riparian vegetation. Responses are a function of the likelihood of exposure, and the extent of that exposure to potential stressors, combined with reductions in that likelihood and extent due to conservation measures. Responses are specific to the type of stressors, and will be identified as such in each potential effect section.

The exposure profile combined with the response profile will determine the effect to the species (and designated critical habitat in later sections). Potential effects will be minimized by the implementation of proposed conservation measures.

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Table 7. Effect determinations based on spatial and temporal proximity of the species to the proposed action.

Species	Species Determination	Critical Habitat Determination
NMFS		
UCR Spring-run Chinook	**May Affect**	**May Affect**
Puget Sound Chinook	**No Effect**	**No Effect**
UCR Steelhead	**May Affect**	**May Affect**
MCR Steelhead	**May Affect**	**May Affect**
Puget Sound Steelhead	**No Effect**	**May Affect**
USFWS		
Bull trout	**May Affect**	**May Affect**
Dolly Varden	**No Effect**	**N/A**
Canada Lynx	**No Effect**	**No Effect**
Golden Paintbrush	**No Effect**	**N/A**
Gray Wolf	**No Effect**	**No Effect**
Grizzly Bear	**May Affect**	**No Effect**
Marbled Murrelet	**No Effect**	**No Effect**
North American Wolverine	**No Effect**	**N/A**
Northern Spotted Owl	**No Effect**	**No Effect**
Oregon Spotted Frog	**No Effect**	**No Effect**
Roy Prairie Pocket Gopher	**No Effect**	**No Effect**
Spalding's Catchfly	**No Effect**	**N/A**
Streak Horned Lark	**No Effect**	**No Effect**
Ute Ladies'-tresses	**No Effect**	**N/A**
Water Howellia	**No Effect**	**N/A**
Whitebark Pine	**No Effect**	**N/A**
Yellow-billed Cuckoo	**May Affect**	**May Affect**

5.1. Effects on Listed Species

5.1.1. Unaffected Species

The proposed action was determined to have no effect on the following species:

i. Puget Sound Chinook salmon, Puget Sound steelhead, and Dolly Varden

The only known occurrences of flowering rush that occur near to locations occupied by Puget Sound Chinook salmon, Puget Sound steelhead, or Dolly Varden are those at Silver Lake in Whatcom County. Silver Lake is located three miles above Maple Falls on Maple Creek a small tributary to the North Fork Nooksack River. Puget Sound Chinook salmon, Puget Sound steelhead, and Dolly Varden utilize the North Fork Nooksack for spawning, rearing, and migration. Maple Falls, however, is a natural passage barrier and neither Chinook salmon, nor Puget Sound steelhead, nor Dolly Varden are present above the falls. Silver Lake itself is warm water habitat and would

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provide neither spawning, nor rearing habitat, even in the absence of a passage barrier. Puget Sound Chinook salmon, Puget Sound steelhead, and Dolly Varden do not occur in the vicinity of the other proposed or potential treatment locations.

Treatment with herbicides in Silver Lake could theoretically affect downstream populations of fish, but this would be extremely unlikely. Prior treatments have injected diquat dibromide into as many as 20 acres of shallow water habitat at a maximum rate of 1.5 ppm; when mixed with the outflow of the rest of the 157.3-acre, 75-feet deep lake diquat levels would be well below effect levels for salmonids. Further, given the rapid adsorption of diquat by sediments and suspended solids, diquat would likely be undetectable in Maple Creek below the falls. These effects would be similar for any of the proposed treatments outlined in this BA, and treatments in Silver Lake would not have measurable effects on fish present in the North Fork Nooksack River. **Therefore, there would be no effect to Puget Sound Chinook salmon, nor Puget Sound steelhead, nor Dolly Varden.**

ii. Canada Lynx

Canada lynx prefer boreal forest with snowy winters and a supply of snowshoe hare as a prey base. In the Northwest, lynx occur at elevations above 4,590 feet (1,400 meters) (Lewis, 2016). Lynx are found to avoid open areas and areas with steep slopes (Koehler, 1990). All proposed action areas occur at elevations below 2,130 feet (650 meters), and are either open at canyon bottoms. These locations could not be described as boreal forest and do not support snowshoe hare. There is no suitable habitat for Canada lynx at the proposed project locations. Terrestrial impacts would be limited to launching boats from establish boat ramps and hiking through riparian zones by personnel carrying backpack sprayers. **Therefore, there would be no effect to Canada lynx**.

iii. Golden Paintbrush

Golden paintbrush is found on open grasslands on glacial outwash prairies and does not tolerate shade from nearby trees, shrubs or even tall nonnative grasses. Flowering rush does not co-occur with golden paintbrush. Conservation Measures require the survey of areas with suitable habitat for special status plants and the coordination of treatment with botanically qualified staff to develop a non-chemical treatment plan that does not affect threatened or endangered plants, including golden paintbrush. This could include restrictions on vehicle access and the number of personnel in the proposed action area. **Therefore, there would be no effect to golden paintbrush.**

iv. Gray Wolf

Within the broad action area, gray wolves occur presently in the in the Northern Cascades and Eastern Washington. While there are several known packs near the proposed action area in the Pend Oreille River, gray wolves are not listed as endangered or threated in Eastern Washington, Idaho, or Montana. There are no known packs and only occasional sightings near the remaining proposed action areas in Washington (Becker et al., 2016; WDFW, 2018). Given the large ranges and mobility of wolves, it is possible that a gray wolf could be present in the approximate vicinity of flowering rush treatment, however these areas do not contain core habitat for the gray wolf, nor do they currently support known populations. Further, the proposed action does not involve disturbance of riparian or upland habitats, as waters will be accessed

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from known and previously developed access points. Terrestrial impacts would be limited to launching boats from establish boat ramps and hiking through riparian zones by personnel carrying backpack sprayers. **Therefore, there would be no effect to gray wolf.**

v. Marbled Murrelet

Marbled murrelets are primarily found in coastal marine areas, but are known to nest inland. In Washington, terrestrial nesting habitat is found in coniferous forests within 55 miles (90 kilometers) of marine waters, with nests documented as far as 36.5 miles (59 kilometers) inland and at elevations up to 4,200 feet (1,280 meters) (Desimone, 2016). One of the proposed action areas is located within 55 miles of salt water, Silver Lake in the state of Washington; however the proposed action would not be likely to generate potential stressors to marbled murrelets.

Silver Lake is located at Silver Lake Park, a Whatcom County regional multi-use park. Improvements include a day lodge, offices, restrooms, concession area, kitchen, overnight lodge, 6 cabins, docks, boat launch, four campground areas with 123 sites in total, restrooms, shower building, picnic areas and open shelters, forestry museum, stables, swimming beach, playground, trails and open activity fields (Whatcom County Parks and Recreation, 2016). Beyond camping and day usage, Silver Lake is a popular sport fishery, stocked with 26,000 trout fingerlings annually.

Proposed activities at Silver Lake in the past have consisted of diquat injection from a workboat, and future actions are likely to be the same or similar. There would be no terrestrial disturbance beyond driving to the facility on established and maintained roads and launching the workboat from the established, concrete boat launch. The workboat would likely be one of many boats at Silver Lake on any given day and would not represent a stressor above baseline activity levels at this busy county park. **Therefore, there would be no effect to marbled murrelet.**

vi. North American Wolverine

North American wolverines require areas that are cold and receive enough winter precipitation to reliably maintain deep persistent snow late into the warm season (Copeland et al., 2010). The requirement of cold, snowy conditions means that, in the southern portion of the species' range where ambient temperatures are warmest, wolverine distribution is restricted to high elevations. In the FSA, wolverines occur in the alpine and subalpine habitats of the Cascades, Blue Mountains, and Rocky Mountains. All proposed action areas occur at elevations below 2,130 feet (650 meters), and none occur in alpine or subalpine habitats, or provide persistent snow through the spring season. There is no suitable habitat for North American wolverine at the proposed project locations. Terrestrial impacts would be limited to launching boats from establish boat ramps and hiking through riparian zones by personnel carrying backpack sprayers. **Therefore, there would be no effect to North American wolverine**.

vii. Northern Spotted Owl

Northern spotted owls live in forests characterized by dense canopy closure of mature and old-growth trees, abundant logs, standing snags, and live trees with broken tops. Flowering rush is not known to exist in these habitats. There are no proposed

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treatments in areas suitable for northern spotted owls. **Therefore, there will be no effect to northern spotted owl.**

viii. Oregon Spotted Frog

Oregon spotted frogs are found in or near perennial bodies of water, such as springs, ponds, lakes, slow streams, canals, or roadside ditches. They prefer fairly large, warm marshes. Known flowering rush locations near Oregon spotted frog habitat are located on Joint Base Lewis-McCord and would be treated under this program. There would be no cost-shared treatments at JBLM. If flowering rush were discovered in Oregon spotted frog habitat outside JBLM, and a cost-share partner requested co-funding, a separate amendment to this BA would be drafted and submitted to the Services prior to sharing costs of the potentially proposed treatment. Oregon spotted frog does not occur at any of the potential treatment sites, and **therefore there would be no effect to Oregon spotted frog.**

ix. Roy Prairie Pocket Gopher

Pocket gophers occupy prairie-like habitat—areas that are relatively open, with short-statured vegetation and few woody plants. Known flowering rush locations near Roy Prairie pocket gopher habitat are located on Joint Base Lewis-McCord and would not be treated under this program. There would be no cost-shared treatments at JBLM. If flowering rush were discovered in pocket gopher outside JBLM, and a cost-share partner requested co-funding a separate amendment to this BA would be drafted and submitted to the Services prior to sharing costs of the potentially proposed treatment. Roy Prairie pocket gopher does not occur at any of the potential treatment sites, and **therefore there would be no effect to Roy Prairie pocket gopher.**

x. Spalding's catchfly

Spalding's catchfly is found on the Palouse Prairie grasslands of eastern Washington, northeastern Oregon, northern Idaho, and western Montana. Flowering rush does not co-occur with Spalding's catchfly. Conservation Measures require the survey of areas with suitable habitat for special status plants and the coordination of treatment with botanically qualified staff to develop a non-chemical treatment plan that does not affect threatened or endangered plants, including golden paintbrush. This could include restrictions on vehicle access and the number of personnel in the proposed action area. **Therefore, there would be no effect to Spalding's catchfly.**

xi. Streak Horned Lark

Streak horned larks inhabit sparsely vegetated grasslands, beaches, and fields. In the proposed action area, it is restricted to a few large open grasslands, sandy islands, and coastal spits on the Southern Washington coast, the lower Columbia River, and South Puget Sound (Stinson, 2016). No proposed action areas are located within these areas, and no suitable habitat for streak horned larks is found at the proposed action areas. **Therefore, there will be no effect to streak horned larks**.

xii. Ute Ladies'-tresses

In the proposed action areas, Ute ladies'-tresses only occur along approximately 60 miles of the Snake River, from the confluence of the Henry's Fork to Palisades Dam in Idaho. The closest proposed action areas are over 50 miles downstream of the most downstream known occurrence of Ute ladies-tresses Ute ladies'-tresses occurs in

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wetland and meadow habitat near perennial water bodies, while flowering rush occurs in waterbodies. The primary risk to Ute ladies'-tresses would be via trampling by men or equipment. Surveys for Ute ladies'-tresses would be performed prior to any cost-shared activities on the Snake River above American Falls Reservoir, and proposed conservation measures would ensure that there are no adverse effects to ESA-listed plants. **Therefore, there would be no effect to Ute ladies'-tresses.**

xiii. Water Howellia

Water howellia occurs in low elevation seasonal wooded wetlands. There is slight range overlap in Montana between proposed flowering rush treatments and possible occurrence of water howellia, although co-occurrence is extremely unlikely. Water howellia requires exposure to air for seed germination in the fall and inundation for growth in the spring. This restricts the species to a seasonally inundated wetlands that dry out in summer or early fall. At the proposed treatment locations in Montana, flowering rush dominates due to early spring dry periods and flooded conditions in summer and fall. Surveys for water howellia would be performed prior to any cost-shared activities in appropriate habitats, and proposed conservation measures would ensure that there are no adverse effects to ESA-listed plants. **Therefore, there would be no effect to water howellia**.

xiv. Whitebark Pine

Whitebark pine is found at alpine tree line and subalpine elevations throughout its range. In the FSA, whitebark pine is found at elevations as low as 5,700 feet (1,740 meters) (Fryer, 2002). All proposed action areas occur at elevations below 2,130 feet (650 meters), and none occur in alpine or subalpine habitats. There would be no whitebark pine at any of the proposed action areas and **therefore, there would be no effect to whitebark pine.**

5.2. Upper Columbia River Spring-run Chinook, Upper Columbia River Steelhead, and Middle Columbia River Steelhead

5.2.1. Beneficial Effects

Invasive species have "been recognized as second only to loss of habitat and landscape fragmentation as a threat to global biodiversity" causing "major environmental damage and economic losses." Many invasives "outcompete and replace native species" (Allendorf and Lundquist, 2003).

In the proposed treatment areas, the Columbia and Yakima Rivers provide foraging and rearing habitat for listed anadromous fish species and bull trout covered in this assessment. "The nearshore shallow water component provides important overwintering habitat, as well as, spring and summer foraging habitat for salmon and steelhead during their outmigration." (NMFS, 2011).

"Healthy riparian habitat provides forage, cover, and, refugia. Riparian vegetation changes can alter a variety of physical processes controlling the development and distribution of nearshore habitats, which in turn affect fish behavior and fish condition" (NMFS 2011). Invasive plant species alter critical habitat to the detriment of native species.

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In Pacific Northwest river reaches, juvenile salmonids seek various substrates from sandy shoals and island shorelines to a mix of hard gravels and cobbles (Quinn, 2018; Trumbo, 2017). With the exception of Hillman et al. (1987), none of the applicable habitat selection studies on juvenile Chinook salmon in the Columbia Basin made any correlation of fish presence to aquatic vegetation. Hillman et al. (1987) found that juvenile spring Chinook overwintering in tributary habitats selected submerged grasses and sedges (i.e. non-emergent, low-growing species) only in the absence of cobble substrate. Similarly, Tiffan et al. (2006) found juvenile Chinook rearing habitat to include sparse, submerged terrestrial grasses and forbs. This suggests that a decline in native aquatic plants and the overtaking of substrates by plants like flowering rush, may have significant negative impacts on critical habitat suitability in the mainstem Columbia and Yakima Rivers.

Effects on long-term fitness from the spread of aquatic invasive species could be dramatic for fishes like juvenile Chinook salmon and steelhead for the following reasons. 1) Denser invasive aquatic vegetation may provide more edge-type habitats suitable for ambush predators like black basses (*Micropterus* spp.), as well as choke out preferred shallow water rearing areas. It can be assumed that juvenile salmonids would seek shelter in dense vegetation if necessary, but are more likely to avoid this habitat given the results of habitat association data. 2) Flowering rush has been documented growing up to 20 feet deep in the mainstem Columbia River. Juvenile Chinook salmon are expected to avoid dense flowering rush, and may be forced into deeper habitat. Therefore, the major risks of no action on invasive aquatic plants are increased predation and reduced fitness due to forcing juveniles into unsuitable habitat with less time spent resting and feeding in optimal shallow water rearing habitats.

Flowering rush control is likely to provide a benefit to aquatic species like juvenile anadromous salmonids by restoring native vegetation, maintaining suitable rearing habitat, and thereby restoring ecosystem and riparian function. In terms of ESA-listed salmon, steelhead, and chars, the restoration of riparian habitat incidental to the proposed action would benefit juveniles by improving shallow water, migration, and rearing habitat, and reducing piscivorous fish habitat. Adult bull trout may benefit from restored riparian habitats through increased prey species that would colonize the improved ecosystem. Consequently, most potential adverse effects are expected to be short-term and offset by benefits to riparian function that would improve the long-term viability of listed species.

Positive changes to the riparian and benthic habitat caused by flowering rush control will benefit fish behaviors and habitats in the action area. Flowering rush treatment is intended to maintain or improve fish and wildlife habitats in the Northwest, and allows the Corps to accomplish required missions including the Environmental Stewardship mission.

Beneficial effects include:

- Improved Habitat
- Reduced Predator Habitat
- Improved Ambient Light
- Maintain fitness of rearing salmonids

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i. Improved Habitat

The Columbia and Yakima Rivers both upstream and downstream of the project area provide foraging, rearing, and migration habitat for ESA-listed species in the action area. Flowering rush is negatively affecting these habitats making them less suitable and increasing risk of predation on juvenile salmonids.

Shallow shoreline habitats, such as those where treatment would be used to reduce flowering rush populations and promote native vegetation, "with low velocities and slopes offer juvenile salmon refugia from predatory fish that may be too large to enter shallow water" (NMFS 2011). These areas are inaccessible in many of the treatment areas because of infestations. Eradication of flowering rush would open these back up for ESA-listed species.

Promotion of native habitats would help reduce the available spawning and rearing habitat for predatory fish, and improve access for foraging, rearing, refugia, and migration. Therefore, exposure to these effects are likely to be ***beneficial***.

ii. Reduced Predatory Habitat

Predatory species in the action area "have an affinity for in-water structure, which can increase the exposure of juvenile salmon to predators by providing predator habitat, reducing refugia, and diverting juveniles into deeper waters" (NMFS 2011). The proposed action reduces dense invasive vegetation and promotes native in-water environments that are preferable to ESA-listed species.

Effects on predatory habitat are expected to be similar in extent to effects on cover. However, proposed treatments should reduce the extent of predatory spawning and hiding habitat in some localized treatment areas. Although the amount is likely immeasurable, it is reasonable to assume the reduced predator habitat may result in a benefit to ESA-listed species in those localized areas. Therefore, exposure to these effects are likely to be ***beneficial***.

iii. Improved Ambient Light

"Reduced ambient light enhances habitat that favors fish preying on young salmon and steelhead. Northern pike-minnow (*Ptychocheilus oregonensis*), smallmouth bass (*Micropterus dolomieu*), and largemouth bass (*Micropterus salmoides*) are also predators that consume juvenile salmon and occupy the river-channel. Predation has been identified as one of the limiting factors for all salmonid species in the Columbia River basin (NMFS 2008). In-river predation is a significant source of mortality for Columbia River and Snake River salmonids and increases in predator populations would affect [the ESA-listed species in the action area]" (NMFS 2011).

"Light levels are a determining factor that can impair fitness and survival in juvenile salmonids by altering certain behaviors, such as migration, feeding success, and predator avoidance." "Ambient light reduction alters fish migration patterns. A variety of studies have shown that salmon fry migrate along the edges of shadows rather than through them" (NMFS 2011).

Flowering rush stands can alter ambient light in treatment areas. Controlling infestations will help avoid and reduce the negative effects of altered ambient light

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regimes from pest species. Changes to the ambient light regime and riparian and benthic habitat resulting from flowering rush control will ***benefit*** fish behaviors.

5.2.2. General Effects

"General effects" described in following sections may result as a part of any of the activities included as part of the proposed action. These general effects are described in detail in the following sections, and a list of each of the general effects will be included as part of the discussion of the activity-specific effects. The general effects include:

- Disturbance
- Turbidity and fine sediment
- Reduced predator habitat
- Elevated turbidity
- Injury
- Direct mortality
- Loss of benthic habitat
- Interference with migration
- Water temperature
- Dissolved oxygen
- Chemical contamination
- Food resources

i. Disturbance

Manual, mechanical, and herbicide treatment activities occurring adjacent to or in occupied river or stream channels have the potential to disturb juvenile and adult listed fish. This disturbance is caused by the physical presence of people traveling immediately adjacent to or in streams or rivers to complete either manual or chemical treatments. DASH includes the use of large in-water gathering equipment that can cause disturbance to a larger extent than other treatments made from shore or on foot.

These effects will cause some juveniles and adults to seek alternative habitat. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates).

The Columbia and Yakima Rivers are used for migration and rearing by anadromous species. These species may be present in Maple Creek during the treatment period, but likely would not be present in the much warmer Silver Lake. Similarly, juvenile anadromous salmonids would likely be present in smaller tributaries in the action area during treatment periods rather than in the lower Yakima River and mainstem Columbia River.

Potential applications may be made between July and October, while anadromous migration is occurring in the Columbia and Yakima Rivers and in Maple Creek. It is reasonable to assume that disturbance may affect migrating anadromous fish species. Although disturbance may result in some delayed migration in smaller streams for up to a few hours, exposure to disturbance effects are not likely to reduce individual performance in NMFS species. Additionally, because of the beneficial effects (above),

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disturbance and avoidance greatly reduce the amount and probability of harassment to below a level expected to disrupt normal behavior patterns. Therefore, the response to the exposure of this stressor is ***discountable, and not likely to adversely affect*** NMFS species.

ii. Turbidity and Fine Sediment

Flowering rush treatments that are extensive, intensive, and immediately adjacent to or in a stream course may cause instream fine sediment delivery, resulting in localized sediment deposition or stream turbidity increases.

Manual removal of flowering rush via DASH treatment, installation of benthic barriers, or injection of aquatic herbicides could result in localized turbidity increases and mobilization of fine sediments. The degree of effect will be in proportion to the extent of the infestation treated, type of substrate in which the plants are rooted, rooting depth, and other factors. Localized turbidity increases are likely to cause some juveniles and adults to seek alternate habitats, which may contain suboptimal cover and juvenile forage. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates) (NMFS, 2008).

However, given baseline conditions, presence in the action area of ESA-listed fish species, and the amount of potential turbidity and fine sediment that could be generated and enter the water, exposure to the stressors produced is not likely to reduce the individual performance in ESA-listed fish that may be present in the treatment area. Therefore, the response to this stressor is ***insignificant, and not likely to adversely affect*** NMFS species.

iii. Injury

Some activities included in the proposed action have the potential to injure ESA-listed fish species that may be present in the treatment area during treatments. These activities are associated with use of equipment that could strike the fish, or inadvertently capture fish during treatment activities. Exposure to these activities is inherently limited, because of disturbance associated with these activities. Timing is also an important factor for treatments, and the windows further reduce the likelihood of fish being present in the treatment areas.

Disturbance and avoidance would likely result in the limited number of individuals escaping the treatment areas during treatments into other suitable nearby areas. Furthermore, juvenile salmonids are likely to avoid target vegetation (Hillman et al. 1987; Tiffan et al. 2006) and would largely be spatially separated from near-shore habitats (Dauble et al., 1989; Gallinat and Ross, 2017; Hillman et al., 1987; Tiffan et al., 2014) making it less likely an individual fish may be injured.

Exposure to the stressor is unlikely, and even less likely to cause responses sufficient to reduce the individual performance in ESA-listed fish that may be present in the treatment area. Therefore, the response to this stressor is ***discountable, and not likely to adversely affect*** NMFS species.

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iv. Direct Mortality

Some activities included in the proposed action have the potential to injure or kill ESA-listed fish species that may be present in the treatment area during treatments. These activities are associated with use of equipment that could strike the fish, or inadvertently capture fish during treatment activities. Exposure to these activities is inherently limited, because of disturbance associated with these activities. Timing is also an important factor for treatments, and the windows further reduce the likelihood of fish being present in the treatment areas.

Disturbance and avoidance would likely result in the limited number of individuals escaping the treatment areas during treatments into other suitable nearby areas. Furthermore, juvenile salmonids are likely to avoid target vegetation (Hillman et al. 1987; Tiffan et al. 2006) and would largely be spatially separated from near-shore habitats (Dauble et al., 1989; Gallinat and Ross, 2017; Hillman et al., 1987; Tiffan et al., 2014) making it less likely an individual fish may be affected.

Exposure to the stressor is unlikely, and even less likely to cause responses sufficient to reduce the individual performance in ESA-listed fish that may be present in the treatment area. Therefore, the response to this stressor is ***discountable, and not likely to adversely affect*** NMFS species.

v. Loss of Benthic Habitat

Smothering, disturbing, or destroying benthic habitat may occur in localized treatment areas within the water. This will be primarily associated with the use of benthic barriers. It is unlikely that small-scale treatments or manual treatments will result in measurable effects on benthic habitat. Furthermore, the removal of dense invasive vegetation will open substrates to a more suitable condition for rearing salmonids.

Given baseline conditions, presence of ESA-listed fish species in the action area during the in-water work window, and the amount of benthic habitat lost when larger equipment may be employed, exposure to the stressors produced is likely. However, the exposure to these stressors is not likely to reach a magnitude to cause responses sufficient to reduce the individual performance in ESA-listed fish that may be present in the treatment area. Therefore, the response to this stressor is ***insignificant, and not likely to adversely affect*** NMFS species.

vi. Food Resources

Flowering rush treatments have the potential to impact food resources for ESA-listed fish species during treatments. The magnitude of this effect to ESA-listed aquatic species is related to the intensity and extent of flowering rush treatment. Manual treatments are likely to have the least significant effects to aquatic food sources.

Listed aquatic species may be indirectly affected if their food source is impacted. Pesticide treatments can be toxic to terrestrial and aquatic insects that are a source of food for listed aquatic species. The magnitude and duration of the potential stressor on riparian insects is related to the sensitivity of the invertebrate to the herbicide, the time the herbicide is in the environment, the extent of the area treated, the toxicity of the herbicide, and the life stages of the invertebrates affected by the herbicide.

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It is unlikely that small-scale treatments or manual treatments will result in measurable effects on benthic habitat. However, when measured against the baseline conditions, these treatments are likely to have immeasurable effects to ESA-listed species. Aquatic macrophytes are a significant producer of macroinvertebrates, but treatments would not target native plant species or remove a proportion of vegetation great enough to adversely affect the overall habitat value. Even though large sections of river are proposed for treatment, due to the specific habitat requirements of flowering rush these reaches contain only isolated patches of the species. Flowering rush requires slow moving water that receives full sunlight (Jacobs, 2011). In riverine habitats like the proposed Pend Oreille and Yakima River sites flowering rush is limited to pools and slow moving river margins without developed riparian canopies. The proposed action includes 131.5 miles of shoreline for spot treatment applications, but treatment would only be at the isolated sites within these reaches where flowering rush has become established.

While most aquatic macrophytes are producers of macroinvertebrates, it is unlikely that the loss of flowering rush from Washington streams would result in a reduction in available food resources. Invasive macrophytes host substantially less diverse invertebrate communities than native vegetation and provide impoverished food resources in comparison to native macrophytes (Kovalenko et al., 2010; Phillips, 2008; Wigginton et al., 2014). Invasive aquatic macrophytes may also disrupt seasonal cycles in nutrient abundance to the detriment of native fishes evolved to site-specific food webs (Blossey et al., 2001; Sanderson et al., 2009). Furthermore, native vegetation is typically able to reestablish quickly in the absence of invasive vegetation and abundance and diversity of macroinvertebrates can rapidly return to pre-invasion patterns (Beltman, 1987; Kovalenko and Dibble, 2011; Poovey et al., 2013; Roerslett and Johansen, 1996).

Given baseline conditions, presence of ESA-listed fish species in the action area, and the relatively small area of food resources impacted from flowering rush treatments, exposure to the stressors produced is unlikely. In addition, the exposure to these stressors is not likely to reach a magnitude to cause responses in ESA-listed fish that may be present in the treatment area. Therefore, the response to this stressor is ***discountable, and not likely to adversely affect*** NMFS species.

vii. Interference with Migration

Manual, mechanical, and herbicide treatment activities occurring adjacent to or in occupied river or stream channels have the potential to interfere with the migration of juvenile and adult listed fish. Interference may result in delayed migration, or avoidance of the treatment area, resulting in altered migration patterns in localized areas. This will primarily occur when larger equipment is employed for DASH treatments, and will be associated with disturbance. However, other treatments resulting in disturbance have the potential to result in interference in migration, albeit on a much smaller scale. Chemical treatments also have the potential to interfere with migration for short periods, as chemical use may cause fish to avoid treatment areas, or may affect olfactory function, resulting in impacted migration.

Herbicide applications may occur between July and October, while anadromous migration is taking place. It is reasonable to assume that disturbance may affect

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migrating anadromous fish species. Although disturbance may result in delayed migration, exposure to disturbance effects are not likely to reduce individual performance in NMFS species. Use of larger equipment and chemicals may result in avoidance of treatment areas, or impacted olfactory function, resulting in delayed or affected migration of individuals in the immediate vicinity of individual treatments. However, given the size of the streams and rivers in the action area, individuals generally have many opportunities to escape treatment areas, and use other, unaffected, portions of streams and rivers for migration. Therefore, the response to this stressor is ***insignificant, and not likely to adversely affect*** NMFS species.

viii. Dissolved Oxygen (DO)

Flowering rush treatment activities have the potential to decrease dissolved oxygen (DO) in the vicinity of the treatment area, which may affect juvenile and adult listed fish.

Large-scale loss of algae or plants can deplete DO. This can be a problem with larger-scale treatments in treatment areas with slow moving water, such as Silver Lake. Decomposition of large masses of vegetation or algae accelerates consumption of oxygen in the water, which can reduce the amount of DO available for fish. This is more probable and problematic during warmer summer months, as DO is already lower at warmer temperatures.

However, in treatment areas within the action area where ESA-listed fish species may occur, there is connectivity with flowing streams or rivers. This connectivity provides for water exchange, and influx of DO.

Given baseline conditions, the presence of ESA-listed fish in the action area, the minimal amount of dissolved oxygen that could be lost as a result of the proposed action, and the exchange of water in treatment areas, exposure to the stressors produced is not likely to cause responses in listed fish sufficient to reduce their individual performance. Therefore, the response to this stressor is ***insignificant, and not likely to adversely affect*** NMFS species.

ix. Chemical Contamination

Operation of equipment, such as ATVs and boats requires the use of petroleum-based fuel and lubricants, which, if spilled into a water body or into the adjacent riparian zone, can injure or kill aquatic organisms. Petroleum-based contaminants contain poly-cyclic aromatic hydrocarbons, which can be acutely toxic to salmonids, but only at high levels of exposure, and can cause lethal and sub-lethal chronic effects to other aquatic organisms (Neff, 1985). Herbicide application equipment will be staged outside of riparian zones, and all equipment will be cleaned and fueled only in these staging areas. Equipment will be inspected and cleaned prior to any application of herbicides within 150 feet of open water. These impact minimization measures will reduce risk of hydrocarbon and other contaminant levels.

The conservation measures stated above will likely reduce the risk of chemical contamination to a level that is not reasonably certain to occur, and is therefore, ***discountable, and not likely to adversely affect*** NMFS species**.**

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5.2.3. Activity Specific Effects

Activity-specific effects of the action are described in the following sections. General effects associated with each activity described in the sections below are identified in each section, but are detailed in the "*General Effects*" section (section 5.2.2).

i. DASH

Diver Assisted Suction Harvesting consists of hand pulling out flowering rush in the water by hand and feeding the gathered material to a suction hose. DASH involves the use of boats and machinery in aquatic and riparian treatment areas to power the suction equipment, and to collect and bag the removed plant matter. Repeated treatments may be needed to see desired results. DASH may cause minor substrate disturbance, and localized turbidity may be associated with these efforts, benthic organisms may be disturbed, and non-target vegetation may be reduced on a small-scale.

General effects resulting from this activity may include:

- • Disturbance
- • Elevated turbidity
- • Injury
- • Direct mortality
- • Interference with migration
- • Water temperature
- • Dissolved oxygen
- • Chemical contamination

Stressors will be produced by this activity, but the Corps has determined that ESA-listed species are not certain to be exposed to or respond to those stressors due to the scale and timing of the activity, and likely avoidance of flowering rush by ESA-listed fishes (Hillman et al. 1987; Tiffan et al. 2006). Because of the low potential for juvenile salmonids to be in the treatment area, minimal acreage that may be treated, and the long-term benefit to critical habitat from the removal of invasive plants, the Corps has determined that potential adverse effects would be ***insignificant***. Therefore, DASH ***may affect, but is not likely to adversely affect*** ESA-listed species and critical habitats.

ii. Benthic Barriers

A bottom screen or benthic barrier covers the sediment like a blanket, compressing aquatic plants while reducing or blocking light to prevent plants from growing into and under the fabric. This fabric covers areas of the stream or river bottom where undesirable vegetation is growing. Because the vegetation exists in these areas, suitable habitat conditions for ESA-listed species are unlikely to occur in the treatment site.

Undesirable aquatic and riparian vegetation is removed in small-scale efforts, minor substrate disturbance and localized turbidity may occur, and benthic organisms may be disturbed on a localized scale.

General effects resulting from this activity may include:

- Disturbance

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- Elevated turbidity
- Loss of benthic habitat

Stressors will be produced by this activity, but at such a scale that the Corps has determined that potential adverse effects from this activity are likely to be immeasurable, and are therefore ***discountable***. Because of the scale and infrequency of this activity, bottom barriers ***may affect, but are not likely to adversely affect*** ESA-listed species and critical habitats. This is reaffirmed by the issuance of NMFS concurrence on treatment of flowering rush in Lake Wallula in 2011.

iii. Chemical Control

As part of the USACE Aquatic Pest Management Plan, a toxicological team was assembled with toxicologists and other experts from NMFS, USFWS, and the Corps, including an U.S. Army Engineer Research and Development Center (ERDC) pesticide specialist, and a volunteer aquatic toxicologist. The team developed an environmental risk assessment (ERA) to assess the potential effects of the proposed aquatic registered chemicals using the best available science. The ERA pulled toxicological data from the ECOTOX and TOXNET (peer reviewed) databases to perform a chemical fate risk exposure analysis. The analysis encompassed calculating the active ingredient concentration based on label rates and parameters. These concentrations were analyzed and compared to data from ECOTOX database by EPA[1] and TOXNET by NLM[2] data pertaining to toxicity, half-life, and other parameters based on data present for the chemicals and species of interest/concern. The following discussion is derived from the ERA.

In developing the ERA, submerged application were agreed among the team to be the greatest concern do to direct application into the water. Meaning ESA species present could have direct contact during these applications. Emergent applications are to the plants floating or arising out of the water allowing direct application to those emergent plants, ultimately minimizing chemical getting to the water.

For submerged application analysis, the worst-case calculations (based on permitted label requirements) were used. This means that minimum dilution rate was used when calculating application rates and considering a static water body instead of the flowing system, which is not typical for the action area. The data presents a worst-case scenario, so if the concentration analyzed is not a concern, then actual applications do no present an issue.

Application of chemicals to or near surface water has the potential to expose salmonids to herbicides, resulting in potential chemical toxicity that could have effects on salmonids and their habitat. The mere presence of an herbicide may not result in effects to aquatic species. Rather, the concentration, duration of exposure, species present, life stage of the listed species, and toxicity of the herbicide and associated compounds determine the potential for effects to aquatic species. Effects from toxicity are a function of exposure to the toxic substance (herbicide), at a concentration, and for duration of exposure, sufficient to cause an effect. This is also dependent upon the

[1] https://cfpub.epa.gov/ecotox/
[2] https://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm

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composition and mode of action of the toxicant. The exposure depends on the application method, and the route of exposure (e.g. direct application, drift, or misapplication).

Sub-lethal effects include changes in behavior that render salmonids susceptible to predation, compromised immune system, and effects to organs. Sublethal effects can also include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could have reproductive, juvenile to adult survival, or other consequences. On the other hand, indirect sublethal effects may be mediated by effects to habitat or food supply.

Four chemicals are proposed for flowering rush control: imazapyr and glyphosate would be applied only to emergent flowering rush, and ammonium salts of imazamox and diquat bromide could be applied to both emergent and submerged flowering rush (Table 8). Chemicals approved for emergent application may also be broadcast at the same application rate over flowering rush growing on exposed substrates during draw down periods at Lake Pend Oreille or Flathead Lake. Additionally, general effects resulting from this activity include:

- Disturbance
- Reduced cover
- Reduced predator habitat
- Elevated turbidity
- Interference with migration
- Water temperature
- Dissolved oxygen
- Chemical contamination

Table 8. Chemicals that may be used to treat flowering rush under the proposed cost-share, 2019-2020.

Chemical	Application Rate Emergent (pt/ac)	Application Rate Submerged (pt/ac-ft)	Application Rate Submerged (ppm)
Imazapyr	6	NA	NA
Imazamox	8	10.9	4.2
Diquat	16	4	1.5
Glyphosate	7	NA	NA

Imazapyr

Based on available data, the United States Environmental Protection Agency (EPA) has determined that the effects of imazapyr on birds, mammals, fish and invertebrates are minimal (Edwards, 2006). Imazapyr is practically non-toxic to freshwater and marine fish with an acute median lethal concentration (the concentration of a toxicant at which point 50 percent of organisms exposed would perish, or “LC50”) of greater than 100 parts per million (ppm). Imazapyr is similarly non-toxic to freshwater and marine

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invertebrates with a half maximal effective concentration (EC50 – the concentration which induces a response halfway between baseline and maximal) of greater than 100 ppm. On a chronic exposure basis, the early life-stage and full life cycle testing in fish showed no significant effects at concentrations up to 120 ppm. Chronic toxicity testing in freshwater invertebrates also showed no significant effects (Edwards, 2006).

Imazapyr would be used for treatment of emergent flowering rush at an application rate of up to 6 pt/ac. Applied with the imazapyr would be an approved aquatic marker dye, at the label specified rate. Isolated patches of flowering rush would be sprayed similar to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, imazapyr could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of 6 pt/ac or less. Treatment of large stands of flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 6 pt/ac or less.

Application rates of imazapyr would be well below that which would cause adverse effects to salmonids. Spot treatments with imazapyr would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazapyr would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 6 pt/ac would result in a concentration of 2.3 ppm once the chemical has diffused through the top one foot of the water column. This is well below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of imazapyr is not likely to reduce the individual performance in ESA-listed fishes that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect ESA-listed salmonids***.

Ammonium salts of Imazamox

Like imazapyr, imazamox is practically non-toxic to animals. Based on available data, the EPA has determined that the effects of imazamox on birds, mammals, fish and invertebrates are minimal (Hamel, 2012). Imazamox is practically non-toxic to freshwater and marine fish with an acute median lethal concentration LC50 of greater than 118 ppm. Imazamox is similarly non-toxic to freshwater and marine invertebrates with an EC50 of greater than 120 ppm. On a chronic exposure basis, the early life-stage and full life cycle testing in fish showed no significant effects at concentrations up to 120 ppm. Chronic toxicity testing in freshwater invertebrates also showed no significant effects (Fisher et al., 2012; Hamel, 2012).

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Imazamox would be used for treatment of emergent flowering rush at an application rate of up to 8 pt/ac and submerged flowering rush at a rate of up to 10.9 pt/ac-ft. Applied with the imazapyr would be an approved aquatic marker dye, at the label specified rate. Individual treatments sites would be sprayed somewhat akin to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, imazamox could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of 8 pt/ac or less. Treatment of large stands of flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 8 pt/ac or less.

Application rates of imazamox would be well below that which would cause adverse effects to salmonids. Spot treatments with imazamox would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazamox would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 8 pt/ac would result in a concentration of 3.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 4.2 ppm. This is well below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of imazamox is not likely to reduce the individual performance in ESA-listed fishes that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect ESA-listed salmonids.***

Diquat dibromide

The Washington State Department of Ecology's (WDOE) *Final Risk Assessment for Diquat dibromide* (Emmett, 2002) reports that diquat can be used safely in the presence of most fish and invertebrates. The Risk Quotient (expected maximum concentration of a pesticide divided by the concentration that will cause mortality in 50% of animals exposed) reported in the assessment for sensitive warm water fish was 0.04, below the level of concern (0.1) for acute exposure. WDOE did not conduct chronic exposure tests due to the lack of acute exposure concerns and the rapid adsorption of diquat in the environment.

Several studies confirm the WDOE assessments. Berry (1984) found that the median 96 hour tolerance concentration for diquat to be 86 ppm, and found no ill effects to goldfish exposed to concentrations less than 32 ppm for up to 96 hours. In Coho salmon, Lorz (1979) found that the acute toxicity threshold for exposure to diquat to be as low as 11 ppm over 10 hours. Lorz did find inhibited outmigration of Coho smolts at

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diquat concentrations as low as 0.5 ppm, though more recent tests with Chinook salmon were unable to replicate these effects (Parametrix, 1997). Due to this uncertainty, WDOE recommends avoiding the use of diquat were juvenile salmonids may be immediately present. There would be little risk of juvenile salmonids being present at mainstem Columbia River and lower Yakima River sites during summer application windows.

Diquat would be used for treatment of emergent flowering rush at an application rate of up to 16 pt/ac and submerged flowering rush at a rate of up to 4 pt/ac-ft. Applied with the diquat would be an approved aquatic marker dye, at the label specified rate. Individual treatments sites would be sprayed similar to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, diquat could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of 16 pt/ac or less. Treatment of large stands of flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 16 pt/ac or less.

Application rates of diquat would be well below that which would cause adverse effects to salmonids. Spot treatments with diquat would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with diquat would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 16 pt/ac would result in a concentration of 6.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 1.5 ppm. This is safely below concentrations demonstrated to be safe for fish.

Treatment with diquat in Silver Lake could theoretically affect downstream populations of fish, but this would be extremely unlikely. Chemical control has historically been injected into up to 20 acres of shallow water habitat at a maximum rate of 1.5 ppm; when mixed with the outflow of the rest of the 157.3-acre, 75-feet deep lake diquat levels would be well below effect levels for salmonids. Further, given the rapid adsorption of diquat by sediments and suspended solids, diquat would be undetectable in Maple Creek below the falls.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of diquat is not likely to reduce the individual performance in ESA-listed fishes that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect ESA-listed salmonids.***

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Glyphosate

Glyphosate is no more than slightly toxic to birds and is practically non-toxic to fish, aquatic invertebrates and honeybees (Folmar et al., 1979; Howe et al., 2004; Mensah et al., 2015; Takacs et al., 2002). Based on available data, the United States Environmental Protection Agency (EPA) has determined that the effects of glyphosate on birds, mammals, fish and invertebrates at common application rates are minimal with an acute LC50 of greater than 86 ppm in rainbow trout (US Environmental Protection Agency, 1993). Glyphosate ranges from slightly toxic to practically non-toxic to freshwater invertebrates with an acute EC50 of greater than 780 ppm for daphnia, but as low as 55 ppm in chironomids (US Environmental Protection Agency, 1993). On a chronic exposure basis, the early life-stage and full life cycle testing in fish showed no significant effects at concentrations of 25.7 ppm (US Environmental Protection Agency, 1993). Chronic toxicity testing in freshwater invertebrates also showed no significant effects (Fisher et al., 2012; Hamel, 2012).

Glyphosate would be used for treatment of emergent flowering rush at an application rate of up to 7 pt/ac. Applied with the glyphosate would be an approved aquatic marker dye, at the label specified rate. Isolated patches of flowering rush would be sprayed similar to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, glyphosate could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the glyphosate to an application rate of 7 pt/ac or less. Treatment of large stands of emergent flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 7 pt/ac or less.

Application rates of glyphosate would be well below that which would cause adverse effects to ESA-listed fishes. Spot treatments with glyphosate would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazapyr would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 7 pt/ac would result in a concentration of 2.7 ppm once the chemical has diffused through the top one foot of the water column. This is well below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of glyphosate is not likely to reduce the individual performance in ESA-listed fishes that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect ESA-listed salmonids***.

5.3. Bull Trout

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5.3.1. Beneficial Effects

Positive changes to the riparian and benthic habitat caused by flowering rush control will benefit fish behaviors and habitats in the action area. Flowering rush treatment is intended to maintain or improve fish and wildlife habitats in the Northwest, and allows the Corps to accomplish required missions including the Environmental Stewardship mission.

Beneficial effects include:

- Improved Habitat
- Reduced Predator Habitat

i. Improved Habitat

Flathead Lake, the Clark Fork, the Flathead River, the Pend Oreille River, the Yakima River, and Lake Pend Oreille, provide foraging, subadult rearing, overwintering, and migration habitat for bull trout. Flowering rush is negatively affecting these habitats making them less suitable for bull trout. Exotic invasive macrophytes, such as flowering rush, are considered “ecosystem engineers” due to their tendency to alter the structure and functions of aquatic environments including changes to current, air-water-sediment exchanges, primary production, and detritus (Strayer, 2010). These impacts can be especially pronounced with flowering rush, as species known to form dense monotypic stands in both previously unvegetated littoral areas and those previously occupied by native littoral species (Boutwell, 1990; Les and Mehrhoff, 1999).

While shallow shoreline habitats in Flathead Lake, Lake Pend Oreille, Flathead River, and the Pend Oreille River between the Lake and Albeni Falls Dam are likely little utilized by bull trout, extensive stands located near the confluence of Lake Pend Oreille and the Clark Fork, Pack River, and Trestle Creek and near the confluence of Flathead River and Flathead Lake indicate that flowering rush could be adversely affecting migration habitat. Infested portions of these areas may be inaccessible to bull trout due to the density of flowering rush colonies. Eradication of flowering rush would open these locations back up for bull trout.

ii. Reduced Predatory Habitat

The *Recovery Plan for the Coterminous United States Population of Bull Trout* states that predation from nonnative fish is a significant and growing threat, and is the most frequently cited primary threat to bull trout in many core areas (USFWS, 2015). While lake trout are considered the primary threat in Lake Pend Oreille, the plan also notes growing threats from structure orientated species such as northern pike, walleye, smallmouth bass, and largemouth bass. The expanding colonies of flowering rush provide habitat for species that are obligate vegetation spawners, such as northern pike, and foraging habitat for a variety of introduced structure orientated predatory species.

Introduced piscivorous species in the action area commonly employ ambush predation strategies. Predators use sheltered areas such a dense vegetation stands to station themselves out of sight of potential prey species and then quickly emerge to capture prey. Prey species including subadult and smaller adult bull trout are captured when they stray too close to the vegetation-open water interface (Savino and Stein, 1989).

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Of particular concern is the potential of flowering rush to mediate the expansion of northern pike throughout the Pend Oreille and Flathead watersheds. Vegetation and plant litter drive northern pike habitat selection and provide key spawning substrates and juvenile rearing habitat (Chapman and Mackay, 1984; Craig, 2013). In the Flathead River system, northern pike spawn on the prior year's senesced flowering rush leaves and are commonly found in shallow areas infested with flowering rush as adults (Rice, 2015). Northern pike grow to considerable size and are capable of capturing even adult bull trout. They display a strong preference for soft-rayed fishes, and the adfluvial migrations of bull trout in Lake Pend Oreille and Flathead Lake may make them especially vulnerable to predation by northern pike, especially when migrating through river deltas heavily infested with flowering rush (Muhlfeld et al., 2008). In the Flathead River System, it has been estimated that northern pike may consume up to 3,500 bull trout annually (Muhlfeld et al., 2008).

Eradication of flowering rush would reduce spawning and rearing habitat for exotic piscivorous fish and reduce and ambush predation upon bull trout, and as such would be beneficial to bull trout.

5.3.2. Exposure to Flowering Rush Treatments

While bull trout in Lake Pend Oreille and Flathead Lake are entirely adfluvial (Corsi et al., 1998), given the variety in migration and emigration timing, sub-adult lake residency, and the potential that adult fish may not spawn every year, we can confidently assume that bull trout are present in both lakes year-round. However, bull trout are unlikely to occur in the vicinity of flowering rush treatments.

Bull trout are found in clean, cold, and complex habitats. Little is documented about habitat associations of bull trout in lakes, but in streams bull trout require coarse substrates, water temperatures below 60° Fahrenheit (F) / 15° Celsius (C), complex cover, and large woody debris (Dunham et al., 2003; Rieman and McIntyre, 1993; Wydoski and Whitney, 2003). Bull trout prefer cold water habitat. 60° F (15° C) is considered the thermal maximum for juvenile bull trout (Dunham et al., 2003; Fraley and Shepard, 1989; Goetz, 1989; McMahon et al., 2007; Rieman and McIntyre, 1995). Wydoski and Whitney (2003) reported that all life history types of bull trout (anadromous, adfluvial, fluvial, and resident) require water temperatures below 60° F. These attributes are largely absent from flowering rush colonization sites, typically soft bottomed nearshore areas. Critically, during treatment times, these sites are typically either dewatered or far too warm for the presence of bull trout.

In the both systems, flowering rush treatments could include chemical spot treatments to emergent flowering rush, broadcast chemical treatments to emergent or submerged flowering rush, broadcast treatments to exposed substrates during draw down periods, and mechanical treatments of emergent, submerged, or exposed flowering rush. Broadcast treatments over emergent or submerged flowering rush are restricted to when water temperatures are above 65° F. It is extremely unlikely that bull trout would be exposed to adverse effects from broadcast treatment.

While specific temperature restrictions have not been placed on spot and foliar treatment of emergent flowering rush, the necessity of a sufficient amount of plant growth above the water means treatments would be unlikely to occur during cold water

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periods in shallow habitats. It is unlikely that bull trout would be exposed to effects from spot and foliar treatment of flowering rush.

Mechanical treatments may occur during any time of the year and may be conducted during times when bull trout are utilizing littoral areas in Lake Pend Oreille or the Pend Oreille River. Of all proposed flowering rush treatments, bull trout are most likely to be exposed to effects from mechanical treatments.

Aquatic vegetation rakes would be utilized only in screened irrigation canals. Bull trout would not be exposed to effects from AVR.

No bull trout would be present near the proposed action areas in eastern Idaho.

In Washington, the Columbia, Yakima, and Pend Oreille Rivers are used for migration and rearing by anadromous species, and for migration by bull trout. It is likely that bull trout will be absent from these potential action areas during application periods, given their life histories, elevated summer water temperatures, and the low densities of bull trout that would be expected to enter the action area (Faler et al., 2008; Gallion et al., 2009). These species may be present in Maple Creek during the treatment period, but likely would not be present in the much warmer Silver Lake.

5.3.3. General Effects

"General effects" described in following sections may result as a part of any of the activities included as part of the proposed action. These general effects are described in detail in the following sections, and a list of each of the general effects will be included as part of the discussion of the activity-specific effects. The general effects include:

- Disturbance
- Turbidity and fine sediment
- Reduced predator habitat
- Elevated turbidity
- Injury
- Direct mortality
- Loss of benthic habitat
- Interference with migration
- Water temperature
- Dissolved oxygen
- Chemical contamination
- Food resources

i. Disturbance

Manual, mechanical, and herbicide treatment activities occurring adjacent to or in occupied river or stream channels have the potential to disturb juvenile and adult bull

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trout. This disturbance is caused by the physical presence of people traveling immediately adjacent to or in streams or rivers to complete either manual or chemical treatments. DASH includes the use of large in-water gathering equipment that can cause disturbance to a larger extent than other treatments made from shore or on foot. These effects will cause some juveniles and adults to seek alternative habitat. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates).

It is likely that bull trout will be absent from the action area during chemical application periods, given their life histories, elevated summer water temperatures in shallow water sites where flowering rush is established, and the low densities of bull trout that would be expected to enter the action area (Faler et al., 2008; Gallion et al., 2009). However, bull trout present in near-shore areas of Lake Pend Oreille would likely be disturbed by any treatment activities and would avoid the action area for the duration of the treatment. Treatments in the shallows of Flathead Lake have so far, only been conducted on exposed substrates during the winter draw down.

Potential chemical applications may be made between July and October, while migration is occurring throughout the watershed. It is reasonable to assume that disturbance may affect migrating adfluvial bull trout. Although disturbance may result in some delayed migration for up to a few hours, exposure to disturbance effects are not likely to reduce individual performance. Additionally, because of the beneficial effects (above), disturbance and avoidance greatly reduce the amount and probability of harassment to below a level expected to disrupt normal behavior patterns. Therefore, the response to the exposure of this stressor is **discountable, and not likely to adversely affect bull trout**.

ii. Turbidity and Fine Sediment

Flowering rush treatments that are extensive, intensive, and immediately adjacent to or in a water body may cause localized sediment deposition or turbidity increases. Manual removal of flowering rush via DASH treatment, installation of benthic barriers, or injection of aquatic herbicides could result in localized turbidity increases and mobilization of fine sediments. The degree of effect will be in proportion to the extent of the infestation treated, type of substrate in which the plants are rooted, rooting depth, and other factors. Localized turbidity increases are likely to cause bull trout to seek alternate habitats, which may contain suboptimal cover and forage, although the treatment areas will themselves occur in suboptimal habitats. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates) (NMFS, 2008).

However, given baseline conditions of locations infested with flowering rush and the amount of potential turbidity and fine sediment that could be mobilized, exposure to the stressors produced is not likely to reduce the individual performance in bull trout that may be present in the treatment area. Therefore, the response to this stressor is ***insignificant, and not likely to adversely affect bull trout***.

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iii. Injury

Some activities included in the proposed action have the potential to injure bull trout that may be present in the treatment area during treatments. These activities are associated with use of equipment that could strike the fish, or inadvertently capture fish during treatment activities. Exposure to these activities is inherently limited, because of disturbance associated with these activities.

Disturbance and avoidance would likely result in the limited number of individuals escaping the treatment areas during treatments into other suitable nearby areas. Furthermore, bull trout are likely to avoid target locations where flowering rush is established and would largely be spatially separated from near-shore habitats during most treatments making it less likely an individual fish may be injured.

Exposure to the stressor is unlikely, and even less likely to cause responses sufficient to reduce the individual performance in bull trout that may be present in the treatment area. Therefore, the response to this stressor is ***discountable, and not likely to adversely affect bull trout.***

iv. Direct Mortality

Some activities included in the proposed action have the potential to injure or kill bull trout that may be present in the treatment area during treatments. These activities are associated with use of equipment that could strike the fish, or inadvertently capture fish during treatment activities. Exposure to these activities is inherently limited, because of disturbance associated with these activities.

Disturbance and avoidance would likely result in the limited number of individuals escaping the treatment areas during treatments into other suitable nearby areas. Furthermore, bull trout are likely to avoid target locations where flowering rush is established and would largely be spatially separated from near-shore habitats during most treatments making it less likely an individual fish may be injured.

Exposure to the stressor is unlikely, and even less likely to cause responses sufficient to reduce the individual performance in bull trout that may be present in the treatment area. ***Therefore, the response to this stressor is discountable, and not likely to adversely affect bull trout.***

v. Loss of Benthic Habitat

Smothering, disturbing, or destroying benthic habitat may occur in localized treatment areas within the water. This will be primarily associated with the use benthic barriers. It is unlikely that small-scale treatments or manual treatments will result in measurable effects on benthic habitat. Furthermore, the removal of dense invasive vegetation will open substrates to a more suitable condition for bull trout.

Given the persistent deployment of benthic barriers, exposure to the stressors produced is likely if bull trout return to a treatment site. However, the exposure to these stressors is not likely to reach a magnitude to cause responses sufficient to reduce the individual performance in bull trout that may be present in the treatment area. Therefore, the response to this stressor is ***insignificant, and not likely to adversely affect bull trout.***

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vi. Food Resources

Flowering rush treatments have the potential to impact food resources for bull trout during treatments. The magnitude of this effect is related to the intensity and extent of flowering rush treatment. Manual treatments are likely to have the least significant effects to aquatic food sources.

Listed aquatic species may be indirectly affected if their food source is impacted. Pesticide treatments can be toxic to terrestrial and aquatic insects that are a source of food for listed aquatic species. The magnitude and duration of the potential stressor on aquatic insects is related to the sensitivity of the invertebrate to the herbicide, the time the herbicide is in the environment, the extent of the area treated, the toxicity of the herbicide, and the life stages of the invertebrates affected by the herbicide.

It is unlikely that small-scale treatments or manual treatments will result in measurable effects on benthic habitat. However, when measured against the baseline conditions, these treatments are likely to have immeasurable effects to ESA-listed species. Aquatic macrophytes are a significant producer of macroinvertebrates, but treatments would not target native plant species or remove a proportion of vegetation great enough to adversely affect the overall habitat value. Even though large sections of systems with flowering rush invasions are proposed for treatment, due to the specific habitat requirements of flowering rush and annual acreage limits for treatment only a small fraction of the overall area of the watershed would be treated. Flowering rush requires slow moving water that receives full sunlight (Jacobs, 2011). In riverine habitats like the proposed river sites flowering rush is limited to pools and slow moving river margins without developed riparian canopies. In Lake Pend Oreille and Flathead Lake, flowering rush is limited to shallow shoreline areas, bays, and deltas.

While most aquatic macrophytes are producers of macroinvertebrates, it is unlikely that the loss of flowering rush would result in a reduction in available food resources. Invasive macrophytes host substantially less diverse invertebrate communities than native vegetation and provide impoverished food resources in comparison to native macrophytes (Kovalenko et al., 2010; Phillips, 2008; Wigginton et al., 2014). Invasive aquatic macrophytes may also disrupt seasonal cycles in nutrient abundance to the detriment of native fishes evolved to site-specific food webs (Blossey et al., 2001; Sanderson et al., 2009). Furthermore, native vegetation is typically able to reestablish quickly in the absence of invasive vegetation and abundance and diversity of macroinvertebrates can rapidly return to pre-invasion patterns (Beltman, 1987; Kovalenko and Dibble, 2011; Poovey et al., 2013; Roerslett and Johansen, 1996).

Given baseline conditions, the limited presence of bull trout in the action area, and the relatively small area of food resources impacted from flowering rush treatments, exposure to the stressors produced is unlikely. In addition, the exposure to these stressors is not likely to reach a magnitude to cause responses in bull trout or potential prey species that may be present in the treatment area. Therefore, the response to this stressor is ***discountable, and not likely to adversely affect bull trout***.

vii. Interference with Migration

Manual, mechanical, and herbicide treatment activities occurring adjacent to or in occupied river or stream channels have the potential to interfere with the migration of

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juvenile and adult bull trout. Interference may result in delayed migration, or avoidance of the treatment area, resulting in altered migration patterns in localized areas. This will primarily occur when larger equipment is employed DASH treatments, and will be associated with disturbance. However, other treatments resulting in disturbance have the potential to result in interference in migration, albeit on a much smaller scale. Chemical treatments also have the potential to interfere with migration for short periods, as chemical use may cause fish to avoid treatment areas, or may affect olfactory function, resulting in impacted migration.

Herbicide applications may occur between July and October, while adfluvial migration is taking place. It is reasonable to assume that disturbance may affect migrating anadromous fish species. Although disturbance may result in delayed migration, exposure to disturbance effects are not likely to reduce individual performance in bull trout. Use of larger equipment and chemicals may result in avoidance of treatment areas, or impacted olfactory function, resulting in delayed or affected migration of individuals in the immediate vicinity of individual treatments. However, given the size the action areas in proportion to the lakes and rivers, individuals generally have many opportunities to escape treatment areas, and use other, unaffected, portions of the lakes and rivers for migration. Therefore***, the response to this stressor is insignificant, and not likely to adversely affect bull trout.***

viii. Dissolved Oxygen (DO)

Flowering rush treatment activities have the potential to decrease dissolved oxygen (DO) in the vicinity of the treatment area, which may affect bull trout.

Large-scale loss of algae or plants can deplete DO. This can be a problem with larger-scale treatments in treatment areas with slow moving water, such as in enclosed bays. Decomposition of large masses of vegetation or algae accelerates consumption of oxygen in the water, which can reduce the amount of DO available for fish. This is more probable and problematic during warmer summer months, as DO is already lower at warmer temperatures. However, in treatment areas within the action area where ESA-listed fish species may occur, there is connectivity with open, unaffected water. This connectivity provides for water exchange, and influx of DO.

Given baseline conditions, the presence of ESA-listed fish in the action area, the minimal amount of dissolved oxygen that could be lost as a result of the proposed action, and the exchange of water in treatment areas, exposure to the stressors produced is not likely to cause responses in listed fish sufficient to reduce their individual performance. Additionally, because of their limited occurrence in the action area, effects on DO are not likely to affect bull trout. Therefore, response to this stressor would be ***discountable, and not likely to adversely affect bull trout.***

ix. Chemical Contamination

Operation of equipment, such as ATVs and boats requires the use of petroleum-based fuel and lubricants, which, if spilled into a water body or into the adjacent riparian zone, can injure or kill aquatic organisms. Petroleum-based contaminants contain poly-cyclic aromatic hydrocarbons, which can be acutely toxic to salmonids, but only at high levels of exposure and can cause lethal and sub-lethal chronic effects to other aquatic organisms (Neff, 1985). Herbicide application equipment will be staged outside of

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riparian zones, and all equipment will be cleaned and fueled only in these staging areas. Equipment will be inspected and cleaned prior to any application of herbicides within 150 feet of open water. These impact minimization measures will reduce risk of hydrocarbon and other contaminant levels.

The conservation measures stated above will likely reduce the risk of chemical contamination to a level that is not reasonably *certain to occur, and is therefore,* ***discountable, and not likely to adversely affect bull trout****.*

5.3.4. Activity Specific Effects

Activity-specific effects of the action are described in the following sections. General effects associated with each activity described in the sections below are identified in each section, but are detailed in the "*General Effects*" section (section 5.1.2).

i. DASH

Diver Assisted Suction Harvesting consists of hand pulling out flowering rush in the water by hand and feeding the gathered material to a suction hose. DASH involves the use of boats and machinery in aquatic and riparian treatment areas to power the suction equipment, and to collect and bag the removed plant matter. Repeated treatments may be needed to see desired results. DASH may cause minor substrate disturbance, and localized turbidity may be associated with these efforts, benthic organisms may be disturbed, and non-target vegetation may be reduced on a small-scale.

General effects resulting from this activity may include:

- Disturbance
- Elevated turbidity
- Injury
- Direct mortality
- Interference with migration
- Water temperature
- Dissolved oxygen
- Chemical contamination

Stressors will be produced by this activity, but the Corps has determined that bull trout are not certain to be exposed to or respond to those stressors due to the scale and timing of the activity, and the low potential for overlap between bull trout occurrences and flowering rush treatments. Because of the low potential for bull trout to be in the treatment area, minimal acreage that may be treated, and the long-term benefit to critical habitat from the removal of invasive plants, the Corps has determined that potential adverse effects would be ***insignificant***. Therefore, DASH ***may affect, but is not likely to adversely affect bull trout***.

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ii. Benthic Barriers

A bottom screen or benthic barrier covers the sediment like a blanket, compressing aquatic plants while reducing or blocking light to prevent plants from growing into and under the fabric. This fabric covers areas of the stream or river bottom where undesirable vegetation is growing. Because flowering rush is most likely to establish in shallow areas with soft substrates and low flows, suitable habitat conditions for bull trout are unlikely to occur in the treatment sites.

As benthic barriers are applied in small-scale efforts, minor substrate disturbance and localized turbidity may occur, and benthic organisms may be disturbed on a localized scale.

General effects resulting from this activity may include:

- Disturbance
- Elevated turbidity
- Loss of benthic habitat

Stressors will be produced by this activity, but at such a scale that the Corps has determined that potential adverse effects from this activity are likely to be immeasurable, and are therefore ***discountable***. Because of the scale and infrequency of this activity, bottom barriers ***may affect, but are not likely to adversely affect bull trout.***

iii. Chemical Control

Application of chemicals to or near surface water has the potential to expose bull trout to herbicides, resulting in potential chemical toxicity that could have effects on bull trout and their habitat. The mere presence of an herbicide may not result in effects to aquatic species. Rather, the concentration, duration of exposure, species present, life stage of the listed species, and toxicity of the herbicide and associated compounds determine the potential for effects to aquatic species. Effects from toxicity are a function of exposure to the toxic substance (herbicide), at a concentration, and for duration of exposure, sufficient to cause an effect. This is also dependent upon the composition and mode of action of the toxicant. The exposure depends on the application method, and the route of exposure (e.g. direct application, drift, or misapplication).

Sub-lethal effects include changes in behavior that render bull trout susceptible to predation, compromised immune system, and effects to organs. Sublethal effects can also include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could have reproductive, juvenile to adult survival, or other consequences. On the other hand, indirect sublethal effects may be mediated by effects to habitat or food supply.

Four chemicals are proposed for flowering rush control: imazapyr and glyphosate would be applied only to emergent flowering rush, and ammonium salts of imazamox and diquat bromide could be applied to both emergent and submerged flowering rush (Table 9). Chemicals approved for emergent application may also be broadcast at the same application rate over flowering rush growing on exposed substrates during draw down

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periods at Flathead Lake and Lake Pend Oreille. Additionally, general effects resulting from this activity include:

- Disturbance
- Reduced cover
- Reduced predator habitat
- Elevated turbidity
- Interference with migration
- Water temperature
- Dissolved oxygen
- Chemical contamination

Table 9. Chemicals that may be used to treat flowering rush in Idaho under the proposed cost-share, 2019-2020.

Chemical	Application Rate Emergent (pt/ac)	Application Rate Submerged (pt/ac-ft)	Application Rate Submerged (ppm)
Imazapyr	6	NA	NA
Imazamox	8	10.9	4.2
Diquat	16	4	1.5
Glyphosate	7	NA	NA

Imazapyr

Based on available data, the United States Environmental Protection Agency (EPA) has determined that the effects of imazapyr on birds, mammals, fish and invertebrates are minimal (Edwards, 2006). Imazapyr is practically non-toxic to freshwater and marine fish with an acute median lethal concentration (the concentration of a toxicant at which point 50 percent of organisms exposed would perish, or “LC50”) of greater than 100 parts per million (ppm). Imazapyr is similarly non-toxic to freshwater and marine invertebrates with a half maximal effective concentration (EC50 – the concentration which induces a response halfway between baseline and maximal) of greater than 100 ppm. On a chronic exposure basis, the early life-stage and full life cycle testing in fish showed no significant effects at concentrations up to 120 ppm. Chronic toxicity testing in freshwater invertebrates also showed no significant effects (Edwards, 2006).

Imazapyr would be used for treatment of emergent flowering rush at an application rate of up to 6 pt/ac. Applied with the imazapyr would be an approved aquatic marker dye, at the label specified rate. Isolated patches of flowering rush would be sprayed somewhat akin to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, imazapyr could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large

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stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of 6 pt/ac or less. Treatment of large stands of flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 6 pt/ac or less.

Application rates of imazapyr would be well below that which would cause adverse effects to bull trout. Spot treatments with imazapyr would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazapyr would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 6 pt/ac would result in a concentration of 2.3 ppm once the chemical has diffused through the top one foot of the water column. This is well below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of imazapyr is not likely to reduce the individual performance in bull trout that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect bull trout***.

Ammonium salts of Imazamox

Like imazapyr, imazamox is practically non-toxic to animals. Based on available data, the EPA has determined that the effects of imazamox on birds, mammals, fish and invertebrates are minimal (Hamel, 2012). Imazamox is practically non-toxic to freshwater and marine fish with an acute median lethal concentration LC50 of greater than 118 ppm. Imazamox is similarly non-toxic to freshwater and marine invertebrates with an EC50 of greater than 120 ppm. On a chronic exposure basis, the early life-stage and full life cycle testing in fish showed no significant effects at concentrations up to 120 ppm. Chronic toxicity testing in freshwater invertebrates also showed no significant effects (Fisher et al., 2012; Hamel, 2012).

Imazamox would be used for treatment of emergent flowering rush at an application rate of up to 8 pt/ac and submerged flowering rush at a rate of up to 10.9 pt/ac-ft. Applied with the imazapyr would be an approved aquatic marker dye, at the label specified rate. Individual treatments sites would be sprayed similar to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, imazamox could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the imazapyr to an application rate of 8 pt/ac or less. Treatment of large stands of flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 8 pt/ac or less.

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Application rates of imazamox would be well below that which would cause adverse effects to bull trout. Spot treatments with imazamox would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazamox would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 8 pt/ac would result in a concentration of 3.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 4.2 ppm. This is well below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of imazamox is not likely to reduce the individual performance in bull trout that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect bull trout.***

Diquat dibromide

The Washington State Department of Ecology's (WDOE) *Final Risk Assessment for Diquat Bromide* (Emmett, 2002) reports that diquat can be used safely in the presence of most fish and invertebrates. The Risk Quotient (expected maximum concentration of a pesticide divided by the concentration that will cause mortality in 50% of animals exposed) reported in the assessment for sensitive warm water fish was 0.04, below the level of concern (0.1) for acute exposure. WDOE did not conduct chronic exposure tests due to the lack of acute exposure concerns and the rapid adsorption of diquat in the environment.

Several studies confirm the WDOE assessments. Berry (1984) found that the median 96 hour tolerance concentration for diquat to be 86 ppm, and found no ill effects to goldfish exposed to concentrations less than 32 ppm for up to 96 hours. In Coho salmon, Lorz (1979) found that the acute toxicity threshold for exposure to diquat to be as low as 11 ppm over 10 hours. Lorz did find inhibited outmigration of Coho smolts at diquat concentrations as low as 0.5 ppm, though more recent tests with Chinook salmon were unable to replicate these effects (Parametrix, 1997). Due to this uncertainty, WDOE recommends avoiding the use of diquat were juvenile salmonids may be immediately present. There would be no risk of juvenile bull trout being present at treatment areas in during approved chemical treatment times.

Diquat would be used for treatment of emergent flowering rush at an application rate of up to 16 pt/ac and submerged flowering rush at a rate of up to 4 pt/ac-ft. Applied with the diquat would be an approved aquatic marker dye, at the label specified rate. Individual treatments sites would be sprayed similar to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, diquat could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed

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substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the diquat to an application rate of 16 pt/ac or less. Treatment of large stands of flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 16 pt/ac or less.

Application rates of diquat would be well below that which would cause adverse effects to bull trout. Spot treatments with diquat would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with diquat would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 16 pt/ac would result in a concentration of 6.1 ppm once the chemical has diffused through the top one foot of the water column. Application rates for submerged flowering rush result in a concentration of 1.5 ppm. This is safely below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of diquat is not likely to reduce the individual performance in bull trout that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect bull trout.***

Glyphosate

Glyphosate is no more than slightly toxic to birds and is practically non-toxic to fish, aquatic in vertebrates and honeybees (Folmar et al., 1979; Howe et al., 2004; Mensah et al., 2015; Takacs et al., 2002). Based on available data, the United States Environmental Protection Agency (EPA) has determined that the effects of glyphosate on birds, mammals, fish and invertebrates at common application rates are minimal with an acute LC50 of greater than 86 ppm in rainbow trout (US Environmental Protection Agency, 1993). Glyphosate ranges from slightly toxic to practically non-toxic to freshwater invertebrates with an acute EC50 of greater than 780 ppm for daphnia, but as low as 55 ppm in chironomids (US Environmental Protection Agency, 1993). On a chronic exposure basis, the early life-stage and full life cycle testing in fish showed no significant effects at concentrations of 25.7 ppm (US Environmental Protection Agency, 1993). Chronic toxicity testing in freshwater invertebrates also showed no significant effects (Fisher et al., 2012; Hamel, 2012).

Glyphosate would be used for treatment of emergent flowering rush at an application rate of up to 7 pt/ac. Applied with the glyphosate, an approved aquatic marker dye, at the label specified rate. Isolated patches of flowering rush would be sprayed similar to spot treatments, where applicators would directly spray small patches of emergent flowering rush with handheld sprayers. Alternately, glyphosate could be wicked or painted onto emergent flowering rush. Larger scale treatments, to large stands of flowering rush located on exposed substrates during drawn down periods, would be performed by ATV using an array of spray nozzles and a water tank to dilute the

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glyphosate to an application rate of 7 pt/ac or less. Treatment of large stands of emergent flowering rush located on submerged substrates in shoreline areas, would be performed by workboat with boom mounted sprayers at an application rate of 7 pt/ac or less.

Application rates of glyphosate would be well below that which would cause adverse effects to bull trout. Spot treatments with glyphosate would be primarily foliar, with the majority of the herbicide remaining on the emergent vegetation and not entering the water column. Larger treatments with imazapyr would likely be conducted during drawn down periods on exposed substrates, with little potential for herbicide to enter the water. In the case of broadcast application over emergent flowering rush, even when assuming that 100 percent of the herbicide would enter the water, application at 7 pt/ac would result in a concentration of 2.7 ppm once the chemical has diffused through the top one foot of the water column. This is well below concentrations demonstrated to be safe for fish.

Considering the established application windows for broadcast applications, the toxicological data, the scale of the proposed action, limited exposure timeframe, low likelihood of exposure, and the beneficial impact of removing invasive aquatic vegetation to enhance native species, application of glyphosate is not likely to reduce the individual performance in bull trout that may be present in the treatment area. ***Therefore, the response to this stressor is insignificant, and not likely to adversely affect bull trout***.

5.4. Grizzly Bear

Grizzly bear do not occur near the proposed action areas in Washington and Idaho. Proposed treatments sites in the Columbia and Yakima Rivers are well outside the known distribution of grizzly bears. Proposed treatment locations in the Pend Oreille River are located near, but removed from the Selkirk Mountains Recovery Zone for grizzly bear. While grizzly bear have large home ranges, there are no known sightings of grizzly bear near the proposed action area near Cusick, Washington (Lewis, 2018). The proposed treatment location in Silver Lake is located within the North Cascades Recovery Zone for grizzly bear, however no grizzly bears are known to exist in the North Cascade Recovery Zone (Lewis, 2018).

Grizzly bears are frequently sighted near the proposed action areas at Flathead Lake in Montana. However, there is no suitable habitat for grizzly bears near the proposed action areas (Merrill et al., 1999) as they are located in areas developed extensively for human use – primarily sections of Flathead Lake near marinas and in agricultural areas of the Flathead Irrigation District. Further, the proposed action does not involve disturbance of riparian or upland habitats, as waters will be accessed from known and previously developed access points. In general, terrestrial impacts would be limited to launching boats from establish boat ramps, treating exposed substrates Flathead Lake during draw down periods, and AVR equipped backhoes from the banks of irrigation canals.

Were grizzly bear to be present in the proposed action areas during treatment of flowering rush, they would likely leave the vicinity, due to the presence of humans and

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equipment used to treat flowering rush. Beyond this, it is not expected that flowering rush control would adversely affect grizzly bears directly nor indirectly, nor their critical habitat. **Therefore, the proposed action may affect, but is not likely to adversely affect grizzly bear**.

5.5. Yellow-Billed Cuckoo

5.5.1. Exposure to Flowering Rush Treatments

Yellow-billed cuckoo was formerly common in willow bottoms along the Willamette and Columbia Rivers in Oregon, and in the Puget Sound lowlands and along the lower Columbia River in Washington. The species was rare east of the Cascade Mountains in these States. It may now be extirpated from Washington (Hughes, 1999). Where they do occur, they primarily nest in large stands (greater than 200 acres / 80 hectares) of contiguous riparian vegetation (McNeil et al., 2013). While yellow-billed cuckoo have rarely been known to nest in stands as small as 50 acres (20 hectares), they do not nest is isolated patches of habitat or 30 to 60 feet-wide (10 to 20 meters) strips of otherwise isolated riparian vegetation (Halterman et al., 2015). In Washington, yellow-billed cuckoo were most recently confirmed breeding in 1923, and only 20 sightings have been confirmed since the 1950s, none of which involved breeding (Wiles and Kalasz, 2017). Yellow-billed cuckoos do not occur at the proposed action areas in Washington, nor do these sites consist of suitable large vegetation stands.

While little is known regarding specific arrival and departure times of yellow-billed cuckoo in Idaho and Montana, historically, populations of yellow-billed cuckoo were present in Washington and Oregon from mid-May until September (Daw, 2014). Currently, they arrive in Rocky Mountain States in late May and have departed entirely by late September (Wiggins, 2005). If flowering rush control was conducted during the summer months in southeastern Idaho or western Montana, it is possible that yellow-billed cuckoo could be present. Any yellow-billed cuckoo present would necessarily be exposed to effects from flowering rush treatment. No yellow-billed cuckoo would be present near the proposed action areas in the Pend Oreille watershed in Idaho, the following discussion will be limited to the potential effects of treatments along the Snake and Blackfoot Rivers in Idaho and near Flathead Lake in Montana.

5.5.2. Direct and Indirect Effects of Proposed Flowering Rush Control Actions

Flowering rush in the proposed action areas in Idaho and Montana occurs in isolated patches along the margins of the Snake River and in larger stands in Flathead Lake and in the irrigation canals of the Flathead Irrigation District. At these locations, treatments would be scale to this level of infestation. Likely treatments would include manual and mechanical control including DASH, manual pulling, and benthic barriers as well as spot chemical treatments applied from backpack sprayers or spray guns manually operated from a workboat. Broadcast and aquatic injection chemical approaches are not anticipated at these sites. Effects to yellow-billed cuckoo from flowering rush treatment may include:

- Disturbance
- Reduced food sources

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- Chemical contamination

i. Disturbance

Noise and human presence associated with flowering rush control could disturb yellow-billed cuckoo. Manual, mechanical, and chemical treatments involve the presence of personnel and equipment that may disturb yellow-billed cuckoos and cause them to evacuate the treatment site. When disturbed, yellow-billed cuckoos may not return to the area until humans are further than 150 feet (50 meters) away (Laymon, 1998). As treatment would only occur outside the nesting season, disturbance would not endanger nests, eggs, or young, and yellow-billed cuckoos would likely temporarily relocate to similar riparian foraging areas away from flowering rush treatment activities. In the Snake River between American Falls Reservoir and Idaho Falls, flowering rush occurs in isolated patches, yellow-billed cuckoos would be able to avoid treatment areas without travelling a great distance. In Flathead Lake and irrigation canals of the Flathead Irrigation District, flowering rush occurs in larger patches, but primarily in the reservoir or in developed agricultural areas where yellow-billed cuckoos are unlikely to nest. All potential treatment areas with potential suitable habitat for yellow-billed cuckoo would be surveyed prior to treatment, but after arrival of breeding birds. If yellow-billed cuckoo were found to be present, flowering rush control would be limited to September 1 through April 30. Effects from disturbance would be insignificant, and **therefore not likely to adversely affect yellow-billed cuckoo.**

ii. Reduced Food Sources

Flowering rush treatments could also both directly and indirectly effect the availability of yellow-billed cuckoo prey. Yellow-billed cuckoo prey includes grasshoppers, crickets, katydids, caterpillars, various bugs and beetles, and occasionally arboreal frogs and lizards (Hamilton et al., 1965; Wiggins, 2005). Manual, mechanical, and chemical flowering rush treatments could directly injure prey species through trampling if treatments are conducted from the shoreline. If prey species use emergent flowering rush as habitat, they may be exposed to chemicals or displaced from the local area when flowering rush is removed via manual or mechanical treatments or withers and dies from chemical treatments. This effect would likely be insignificant as yellow-billed cuckoos have foraging ranges approaching 48 acres (Laymon, 1980), and flowering rush treatments would be small in scale and occur only in localized patches along the riparian zone. It is unlikely that an individual yellow-billed cuckoo would notice an overall change in prey availability. All potential treatment areas with potential suitable habitat for yellow-billed cuckoo would be surveyed prior to treatment, but after arrival of breeding birds. If yellow-billed cuckoo were found to be present, flowering rush control would be limited to September 1 through April 30. Effects from reduced food sources would be insignificant, and **therefore not likely to adversely affect yellow-billed cuckoo.**

iii. Chemical Contamination

Chemical treatments for flowering rush have the potential to occur in suitable or proposed critical habitat for yellow-billed cuckoo. Treatments would consist of spot application to emergent flowering rush using handheld sprayers, or by wicking, wiping, painting, or stem injection. Yellow-billed cuckoos could be exposed to herbicides used for treatment either through dermal contact or through consumption of prey items that

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have been directly sprayed or have themselves come into contact with treated vegetation.

Risk of effect from chemical treatment is linked to the potential toxicity of the herbicide to yellow-billed cuckoos and their prey items. The herbicides proposed for use in flowering rush control in eastern Idaho and Montana are imazapyr, ammonium salt of imazamox, and glyphosate. The use of diquat bromide would not be cost-shared in eastern Idaho or Montana.

Imazapyr: Imazapyr is practically non-toxic to birds. Oral median lethal dose (LD50) values for quail and duck are greater than 2,150 ppm of food ingested (Fisher et al., 2003). There is no published information regarding dermal imazapyr exposure thresholds in birds, but imazapyr is practically non-toxic in dermal applications to mammals with an acute dermal LD50 of greater than 2,000 ppm in Rabbits (Fisher et al., 2003). A wildlife risk assessment conducted by the Washington Department of Transportation for a proposed broadcast treatment at label rates (a much more aggressive application strategy than the spot treatments proposed here) found that the estimated dietary exposure to regional avian species was at least 85-fold lower than the dietary LD50 for quail, and estimated dietary exposure risk to be low to insignificant (Fisher et al., 2003).

Imazamox: Imazamox is practically non-toxic to birds. Oral LD50 values for quail are greater than 2,150 ppm (EFSA, 2016). There is no published information regarding dermal imazamox exposure thresholds in birds, but imazapyr is practically non-toxic in dermal applications to rats (EFSA, 2016). A wildlife risk assessment conducted by US EPA for imazamox to estimate the dietary exposure values from possible ingestion of imazamox or residues from vegetation or prey items found no adverse effects at the highest concentrations and concluded that there were no adverse effects to birds from the labeled use of imazamox (USEPA, 2008).

Glyphosate: Glyphosate is no more than slightly toxic to birds. Oral LD50 values for quail and mallards are greater than 4,460 ppm (Tomlin, 2009). There is no published information regarding dermal glyphosate exposure thresholds in birds, but glyphosate is nonirritating in dermal applications to rabbits (Beste, 1983). The US EPA notes in the draft reregistration review of glyphosate notes that label applications of glyphosate are well below the levels where adverse effects to avian species would be seen (Blankinship and Hetrick, 2015). Additionally, numerous field studies have examine the avian response to the aquatic application of glyphosate. No studies report and adverse effect on birds, with most indicating an increase in avian abundance due to greater open water habitat (Linz et al., 1997, 1996, 1994; Linz and Blixt, 1997; Solberg and Higgins, 1993).

Regardless of the herbicide used, applications would be restricted to isolated patches of flowering rush in the Snake River, or at the vary margins of the riparian zone in the event of extremely low water. Taken in the context of a 48 acre foraging area, and the likelihood that yellow-billed cuckoo would avoid direct exposure by fleeing human activity associated with chemical treatment, effects from chemical contamination would be insignificant, and **therefore, not likely to adversely affect yellow-billed cuckoo.**

5.6. Effects on Critical Habitat

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The effects to designated critical habitat are described below. There is long-term benefit from flowering rush control. Managing flowering rush benefits the long-term potential success of ESA listed species by maintain native species within their evolutionary ecosystem in which they interact with both as habitat and as a food web. By controlling invasive species, you maintain that balance which promotes the greatest success for an ESA species to survive and return to non-ESA status.

Numerous literature from the National Invasive Species Council (NISC), USFWS, NMFS, and academia point to native habitat as a requirement for the success of native species. Literature has shown time and again the impacts of invasive species on native species and ecosystems, and the detriment they have on native species populations, both aquatic and terrestrial. Research has shown that invasive aquatic plants clog streams, estuaries, and access to tributary spawning grounds, resulting in barriers that ESA-listed fish and other native fish species cannot overcome. This leads to reduced fitness that may affect species at the population level. By managing flowering rush, there will be more robust prey species (native), increased potential for native plant species to thrive, recolonize, and begin natural production, leading to overall increase in natural aquatic and riparian plant productivity and function.

5.6.1. Upper Columbia River Spring Chinook, Steelhead, Mid-Columbia River Steelhead, and Snake River Basin Steelhead

i. Freshwater spawning sites

Water quantity: No effect.

Water quality: Effects to water quality are discussed throughout the *General Effects* and *Chemical Control* sections above. The Corps proposes co-funding the application of aquatic-labeled herbicides (glyphosate) directly to emergent flowering rush in areas where critical habitat has been designated. Chemical applications will have negligible short-term effects, and would not reduce the conservation value of critical habitat, rather improve habitat over time. Treatment of flowering rush can result in long-term benefits to water quality in localized treatment areas by moderating DO fluctuations. Turbidity and fine sediment effects will be short-term and localized, and would not reduce the conservation value of critical habitat. However, there is no spawning habitat for Upper Columbia River (UCR) spring Chinook, UCR, or Mid-Columbia River (MCR) steelhead in the action area. Therefore, although the proposed action may affect this PBF, the immediate exposure to the stressors on water quality is *insignificant, and not likely to adversely affect* this PBF.

Substrate: There are no spawning areas within the action area. There will be no effect on spawning habitat from the proposed actions because all spawning areas are upstream from the action area. Turbidity and fine sediment effects will not cause embeddedness in rearing areas, as these effects are insignificant, as described in the section above. Therefore, the exposure to this potential stressor is *discountable, and not likely to adversely affect* this PBF.

ii. Freshwater rearing sites

Water quantity: No effect.

Floodplain connectivity: No effect.

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Water quality: Effects to water quality are discussed throughout the *General Effects* and *Chemical Control* sections above. The Corps co-funding the application of aquatic-labeled herbicides (glyphosate) directly to emergent flowering rush in areas where critical habitat has been designated. Chemical applications will have negligible short-term effects, and would not reduce the conservation value of critical habitat, rather improve habitat over time. Treatment of flowering rush can result in long-term benefits to water quality in localized treatment areas by moderating DO fluctuations. Turbidity and fine sediment effects will be highly localized, short-term, and would not reduce the conservation value of critical habitat. The exposure to the stressors on water quality is *insignificant, and not likely to adversely affect* this PBF.

Forage: Effects to food are described in the *Food Resources* section above. Given baseline conditions and the amount food resources affected from flowering rush treatments, exposure to the stressors produced is likely. However, the exposure to these stressors is not likely to reach a magnitude to reduce the conservation value of critical habitat in the treatment area due to replacement of pelagic and drifting food sources almost immediately post-treatment through water exchange. The response to the exposure of stressors from the general effects and chemical treatments are not likely to reduce the overall availability of food in localized treatment areas, and it is unlikely to reduce the conservation value of critical habitat. Therefore, this stressor is *insignificant, and not likely to adversely affect* this PBF.

Natural cover: No effect.

iii. Freshwater migration corridors

Free passage: No effect.

Water quality: Effects to water quality are discussed throughout the *General Effects* and *Chemical Control* sections above. The Corps co-funding the application of aquatic-labeled herbicides (glyphosate) directly to emergent flowering rush in areas where critical habitat has been designated. It is not anticipated that chemical applications will have long-term or short-term effects, or reduce the conservation value of critical habitat. Treatment of undesirable vegetation can result in long-term benefits to water quality in localized treatment areas by moderating DO fluctuations. Turbidity and fine sediment effects will be highly localized, short-term, and should not reduce the conservation value of critical habitat. The exposure to the stressors on water quality is *insignificant, and not likely to adversely affect* this PBF.

Natural cover: No effect

iv. Conclusions

Based on the purpose of flowering rush treatment, general effects, effects of specific actions, the long-term beneficial effects, the baseline habitat conditions in the submerged treatment sites, the selection of chemicals proposed, and all of the proposed conservation measures, effects to critical habitat are ***insignificant, and not likely to adversely affect*** anadromous species under NMFS jurisdiction. The proposed action is also not likely to reduce the conservation value, or result in the destruction or adverse modification of designated critical habitats.

5.6.2. Bull Trout

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Water quality: Springs, seeps or other groundwater sources contribute a minor amount to the lower Yakima or mainstem Columbia and Pend Oreille Rivers. It is not likely the effect on water quality, quantity, and thermal refugia from these contributions could be measured.

The proposed actions would have no significant short-term or long-term effect on thermal refugia.

Effects to water quality are discussed throughout the *General Effects* and *Chemical Control* sections above. The Corps proposes co-funding the application of aquatic-labeled herbicides to emergent and submerged flowering rush in areas where critical habitat has been designated. It is not anticipated that chemical applications will have long-term and short-term effects, or reduce the conservation value of critical habitat. Treatment of undesirable vegetation can result in long-term benefits to water quality in localized treatment areas by moderating DO fluctuations. Turbidity and fine sediment effects will be short-term and localized, and would not reduce the conservation value of critical habitat. The exposure to the stressors on water quality is ***insignificant, and not likely to adversely affect*** this PBF.

Migration corridors: Effects on migratory corridors are discussed in the *Interference with Migration* section above. Because of their limited occurrence in the action area and the temporal separation between treatment times and bull trout migratory periods, effects are not likely to occur on bull trout or affect the limited migration that occurs in the action area. Therefore, this potential stressor is ***discountable, and not likely to adversely affect*** this PBF.

Food availability: Effects to food are described in the *Food Resources* and *Chemical Control* sections above. Given baseline conditions and the amount food resources affected from flowering rush treatments, exposure to the stressors produced is likely. However, the exposure to these stressors is not likely to reach a magnitude to reduce the conservation value of critical habitat in the treatment area. Aside from migration back to the spawning grounds, bull trout typically use the mainstem rivers for overwintering outside of the proposed work windows. The small proportion of fluvial fish that utilize the mainstem rivers are likely piscivores; hence, their food sources may be mobile as well, replacing what may be affected in treatment areas in hours to days. Furthermore, bull trout are not likely to be foraging in the shallower, warmer water that is likely to be in treatment areas with dense invasive aquatic plants. The response to the exposure of stressors from the general effects and chemical treatments are not likely to reduce the overall availability of food in localized treatment areas, and it is unlikely to reduce the conservation value of critical habitat. Therefore, this stressor **is *insignificant, and not likely to adversely affect*** this PBF.

Instream habitat: Effects to instream habitat are discussed throughout the *General Effects* and *Chemical Control* sections above. Effects on instream habitat are likely to be localized and eventually beneficial in those localized areas. Given the limited reduction in riparian vegetation, there should be no measurable effect as a result of the proposed action. Therefore, the exposure to this potential stressor is ***discountable, and not likely to adversely affect*** critical habitat.

Water temperature: No effect.

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Substrate characteristics: There are no spawning areas within the action area. There will be no effect on spawning habitat from the proposed actions because all spawning areas are several miles upstream from the action area. Turbidity and fine sediment effects will not cause embeddedness in rearing areas, as these effects are insignificant, as described in the *Turbidity and Fine Sediment* section above. Therefore, the exposure to this potential stressor is ***discountable, and not likely to adversely affect*** critical habitat.

Stream flow: No effect.

Water quantity: No effect.

Nonnative species: Beneficial.

Conclusions: Based on the purpose of flowering rush treatment, general effects, effects of specific actions, the long-term beneficial effects, the baseline habitat conditions in the submerged treatment sites, the selection of chemicals proposed, and all of the proposed conservation measures, effects to critical habitat are ***insignificant, and not likely to adversely affect*** bull trout. The proposed action is also not likely to reduce the conservation value, or result in the destruction or adverse modification of designated critical habitats.

5.6.3. Yellow-Bill Cuckoo

Habitat Connectivity: No effect.

Migration Corridors: No effect.

Cover: No effect.

Reproduction: No effect.

Food Sources: Effects to Food Sources are discussed above in Section 5.5.2.2 - *Reduced Food Sources.* Food sources may be affected, but this effect would likely be insignificant as yellow-billed cuckoos have large foraging ranges and flowering rush treatments would be small in scale and occur only in localized patches along the riparian zone. It is unlikely that an individual yellow-billed cuckoo would notice an overall change in prey availability. Therefore, the exposure to this potential stressor is ***discountable, and not likely to adversely affect critical habitat***.

Conclusions: Based on the purpose of flowering rush treatment, general effects, effects of specific actions, the long-term beneficial effects, the baseline habitat conditions in the submerged treatment sites, the selection of chemicals proposed, and all of the proposed conservation measures, effects to critical habitat **are insignificant, and not likely to adversely affect** yellow-billed cuckoo. The proposed action is also not likely to reduce the conservation value, or result in the destruction or adverse modification of designated critical habitats.

5.7. Cumulative Effects

The action area is used for a wide variety of activities year-round. The Columbia and Snake Rivers are used for recreational boating as well as heavy commercial barge traffic. Silver Lake, the Yakima River, and the Pend Oreille River are heavily used for

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year-round recreation activities including fishing, hunting, boating, bird watching, swimming, etc.

The Washington State Department of Ecology's (WDOE) Aquatic Pesticide Permits allow for treatment of a variety of plants, algae, and animal pests in Washington's waters. The Corps proposed action is generally consistent with the WDOE practices and methods. The WDOE permitting process, practices, and methods are likely to continue into the foreseeable future.

The Corps' proposed action is one of many pest management programs in the northwest that utilizes the methods described in this document. This is accomplished through careful project design, review, and adoption of current practices, calculating the hazard of the use of pesticides, and through implementation of conservation measures designed to minimize the impact to the environment.

5.8. Summary of Effects Determinations

Table 10 summarizes the determinations of effects reached in Section 5.

Table 10. Summary of effects to listed species and critical habitats.

Species	Species Determination	Critical Habitat Determination
NMFS		
UCR Spring-run Chinook	**May Affect, Not Likely to Adversely Affect**	**May Affect, Not Likely to Adversely Affect**
Puget Sound Chinook	**No Effect**	**No Effect**
UCR Steelhead	**May Affect, Not Likely to Adversely Affect**	**May Affect, Not Likely to Adversely Affect**
MCR Steelhead	**May Affect, Not Likely to Adversely Affect**	**May Affect, Not Likely to Adversely Affect**
Puget Sound Steelhead	**No Effect**	**No Effect**
USFWS		
Bull trout	**May Affect, Not Likely to Adversely Affect**	**May Affect, Not Likely to Adversely Affect**
Dolly Varden	**No Effect**	**N/A**
Canada Lynx	**No Effect**	**No Effect**
Golden Paintbrush	**No Effect**	**N/A**
Gray Wolf	**No Effect**	**No Effect**
Grizzly Bear	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Marbled Murrelet	**No Effect**	**No Effect**
North American Wolverine	**No Effect**	**N/A**
Northern Spotted Owl	**No Effect**	**No Effect**

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Oregon Spotted Frog	**No Effect**	**No Effect**
Roy Prairie Pocket Gopher	**No Effect**	**No Effect**
Spalding's Catchfly	**No Effect**	**N/A**
Streak Horned Lark	**No Effect**	**No Effect**
Ute Ladies'-tresses	**No Effect**	**N/A**
Water Howellia	**No Effect**	**N/A**
Whitebark Pine	**No Effect**	**N/A**
Yellow-billed Cuckoo	**May Affect, Not Likely to Adversely Affect**	**May Affect, Not Likely to Adversely Affect**

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6. Magnuson-Stevens Fishery Conservation and Management Act of 1976, as Amended

The consultation requirement of section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) directs federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect Essential Fish Habitat (EFH). Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) designated EFH for Chinook salmon, Coho salmon, and Puget Sound pink salmon (Pacific Fishery Management Council, 1999)

The action area includes areas designated as EFH under the MSA for various life-history stages of Chinook and/or Coho salmon (PFMC 1999).

- 17030003 – Lower Yakima is identified as current EFH for Chinook and Coho
- 17020010 – Upper Columbia-Entiat is identified as current EFH for Chinook and currently accessible, but unutilized historic EFH for Coho

6.1. Description of the Proposed Action

The proposed action is described in Chapter 2 of this document.

6.2. Effects of the Proposed Action

Based on information and the analysis of potential adverse effects presented in the ESA portion of this document, the Corps concludes that the effects on Chinook and Coho salmon EFH would be ***insignificant,*** as described in the critical habitat sections above.

6.3. Proposed Conservation Measures

Conservation measures are listed in section 2.1.4 of this document.

6.4. Conclusions for EFH

Based on the description of the proposed action, and the inclusion of conservation measures as an integral part of the proposed action, the Corps believes there will be no long-term adverse effects to EFH, and any short-term adverse effects will be minimized by the proposed conservation measures. Therefore, the Corps has determined that the proposed action will result in ***insignificant*** adverse effects to EFH.

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7. Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) authorizes the USFWS to evaluate the impacts to fish and wildlife species from proposed Federal water resource development projects that could result in the control or modification of a natural stream or body of water that might have effects on the fish and wildlife resources that depend on that body of water or its associated habitats. While the proposed action would affect habitats within and along the Columbia, Yakima, and Pend Oreille Rivers and Silver Lake, the project is not a federally constructed, permitted, or licensed water development project and would not involve impounding, diverting, or controlling of waters. ***Therefore, coordination on the proposed action under the FWCA is not required.***

8. Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712, as amended) prohibits the taking of and commerce in migratory birds (live or dead), any parts of migratory birds, their feathers, or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof. No trees or shrubs that could contain nests would be removed as a result of the proposed action, nor would there be any direct take of any bird. ***Therefore, the proposed action would not result in take of migratory birds.***

9. Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions, primarily for Native American Tribes. Take under the BGEPA includes both direct taking of individuals and take due to disturbance. Disturbance is further defined in 50 CFR 22.3.

Bald eagles are known to nest throughout the action area. While all nest sites have not been documented, locations of some are known. Bald eagles can be found roosting and hunting along the Columbia, Yakima, and Pend Oreille Rivers. In most cases, eagle nests are not located directly on the riverbank, but offset where mature trees provide adequate structure and protection (B. Trumbo, personal communication, 21 March 2018).

Golden eagles are distributed worldwide and occupy habitats from alpine meadows to arid deserts. Washington supports nesting golden eagles east and west of the Cascade Mountains, as well as a winter migratory population from nesting populations in Canada and Alaska. The species has been identified as a state candidate for listing due to declines in the number of nesting pairs at historic nests.

Roosting or foraging eagles may be present in the action area during the proposed work windows; however, flowering rush treatment activities are not expected to adversely affect eagles or disturb forage activities. Eagles that may occupy the area frequently are most likely accustomed to the daily activities and related noise levels generated by hydropower dams, commercial navigation and recreational watercraft, etc. Activity-related noise would be short-term, and work would not impact eagle nesting sites. In

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addition, suitable foraging and roosting habitat is available in adjacent areas. When necessary, the treating agencies would implement the 330/660 foot buffers.

Because the proposed actions would not disturb nesting sites, eagles are likely accustomed to the operation watercraft, and because there are ample alternative roosting or foraging sites in the Project area, the Corps has determined there would be no disturbance or take of eagles as a result of the proposed action.

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Appendix H.
Columbia Basin Flowering Rush Management Plan

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COLUMBIA BASIN COOPERATIVE WEED MANAGEMENT AREA

COLUMBIA BASIN FLOWERING RUSH MANAGEMENT PLAN

A regional strategy to address *Butomus umbellatus* throughout the Columbia Basin

www.columbiabasincwma.org

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Statement of Collaboration:

When possible, the partners of the Columbia Basin Cooperative Weed Management Area will strive to communicate and work collaboratively to develop a unified management effort for flowering rush throughout the Columbia Basin.

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Preface

The Columbia Basin Cooperative Weed Management Area (CBCWMA) is a regional consortium that brings together stakeholders to address noxious weed issues in the Columbia River drainage basin. The CBCWMA provides a unique opportunity for all stakeholders within the Columbia Basin to collaboratively share information, discuss strategies, and make the best use of limited resources to address shared problems. In this instance, this cooperative body has chosen to work across borders and boundaries to address flowering rush; an invasive aquatic plant that is causing numerous and widespread issues in the basin.

Flowering rush has existed in the upper Columbia River watershed for decades and is spreading downstream across state and international boundaries; cooperators saw a need to create a comprehensive strategy to address flowering rush from a basin-wide perspective. This effort has brought together various partners and diverse ideas concerning management of flowering rush. Through implementation of the identified strategic actions, cooperators will be most effective in solving shared problems.

The following individuals have contributed to the completion of this management plan:

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Executive Summary

Invasive species expand beyond jurisdictional boundaries and spread downstream over time when growing within or adjacent to rivers and streams.

The Columbia Basin Cooperative Weed Management Area, created in 2016, provides a unique opportunity for all stakeholders within the Columbia Basin to collaboratively share information, discuss strategy, and make the best use of limited resources to address shared problems. In this instance, this cooperative body has chosen to work across borders and boundaries to address the issue of the invasive species, flowering rush.

Flowering rush, *Butomus umbellatus L.*, is an aggressive freshwater invasive plant that rapidly colonizes wetlands, lakes, slow-moving rivers, canals and irrigation ditches. It is becoming an increasing problem in western North America and with no known effective control methods, is poised to become a substantial problem in many major waterways. It is capable of creating dense stands and with both emergent and submersed growth forms, can dominate from the shoreline to depths of 6 meters (20 feet). Through rhizome fragments and rhizome buds, it can quickly disperse and colonize new areas with the assistance of water movement. Flowering rush is considered an ecosystem engineer for its ability to alter habitats by sediment accretion. It affects irrigation and dam power management and recreational activities such as swimming, fishing and boating. Preliminary data suggests that native aquatic plant communities, and the fish and wildlife that depend on them, are also impacted. Specifically, flowering rush appears to provide excellent habitat for invasive northern pike which predate on native salmonid species.

In the Columbia Basin, flowering rush occurs as several distinct populations. It is extremely difficult to control once established and, with its ability to rapidly disperse, new sites are being found every year. A substantial portion of the basin remains uninfested by flowering rush, however these regions must be surveyed regularly in order to find new infestations and react quickly to eliminate them whenever possible. In regions of the basin where flowering rush is newly invading, early detection-rapid response strategies are employed to prevent its establishment through eradication techniques. In other regions where flowering rush is well-established, the focus is to reduce further spread and manage existing populations. While these efforts have been occurring throughout the basin, there has been no coordinated effort to manage flowering rush across the entire system.

The formation of the Columbia Basin Cooperative Weed Management Area was designed to bring together partners from throughout the basin to develop an integrated weed management plan for controlling flowering rush, thereby increasing the likelihood of success in managing for healthy habitats. The following plan outlines the basin-wide effort to share information and best management practices, as well as a process to identify the strategic short- and long-term actions needed to effectively and efficiently address the challenges provided by this invasive plant. The Columbia Basin Cooperative Weed Management Area intends for this plan to guide future research, policy changes, management activities, and collaboration. Through implementation of the actions identified here, those involved in flowering rush management will be most effective in solving our shared issues. The Columbia Basin Cooperative Weed Management Area thanks you for your interest in this topic and looks forward to collaborating with you to address the important issue of flowering rush.

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Scope and Purpose

Management of the non-native invasive aquatic plant flowering rush (*Butomus umbellatus* L.) in the Columbia Basin requires a collaborative approach. This document highlights the interconnectedness of aquatic systems and the capacity of individuals from different organizations to work together to control and eliminate flowering rush, where possible, and prevent further spread throughout the basin. By bringing multiple states, provinces, tribes and others together, a process to manage aquatic invasive species was created, regardless of jurisdictional boundaries.

The Columbia Basin covers over 673,397 square kilometers (260,000 square miles), from its headwaters in British Columbia, Canada to its mouth at Astoria, Oregon. The basin includes seven states, one Canadian province, and 13 federally recognized Indian reservations and their associated ceded lands (Figure 1). Over 60 major tributaries contribute to the flow and formation of the Columbia River, the primary significant tributaries include the Snake River, Willamette River, Kootenay River, and Pend Oreille River. Other significant tributaries include the Cowlitz, Spokane, Lewis, Deschutes, Yakima, Wenatchee, Okanogan, Kettle, Sand, and John Day Rivers. Through the hydrologic process, over 160 billion cubic meters (130 million acre feet) of runoff flows through the river system annually. The Columbia Basin Flowering Rush Management Plan addresses the geographic area of the Columbia Basin, focused upon the states of Idaho, Montana, Washington, and Oregon, the province British Columbia, and lands of Tribes and First Nations that fall within the Columbia Basin. Although the province of Alberta falls outside the Columbia Basin, Alberta has been highly involved in the process due to concerns over regional flowering rush infestations.

Figure 1. *The Columbia Basin in Western North America*

While collaboration on invasive species is something that has taken place repeatedly throughout the Columbia Basin among various entities (e.g. 100th Meridian Columbia River Basin Team, Lake Roosevelt Forum, Greater Yellowstone Coordinating Committee), the **Columbia Basin Cooperative Weed Management Area**[1] (CBCWMA) was created in 2016 to specifically work across the basin on invasive aquatic plant issues, focusing initially on flowering rush. By working together across boundaries, the CBCWMA hopes to improve regional management of flowering rush. For more information on the mission and background on the CBCWMA, see Appendix E.

The goal of the Columbia Basin Flowering Rush Management Plan (hereafter referred to as the Plan) is to provide a foundation and guide for flowering rush management and research in the Columbia Basin. The document will also provide information to assist policy and funding decisions that guide implementation. Recognizing the diversity of agencies, tribes and other stakeholders, priority areas

[1] Words in bold font are defined in the appendix.

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for management and short- and long-term actions have been identified and organized by geographic regions of the basin. The Plan also recognizes that entities involved in flowering rush management are subject to diverse funding opportunities, jurisdictional and legal authorities, political and cultural realities, and various biological factors.

History of Introduction

Flowering rush was first identified in North America by Marie-Victorin circa 1897 in mudflats of the St. Lawrence River near Montreal, Canada (Countryman 1970). It has since spread or been reintroduced as an escaped garden ornamental and is currently established in parts of the northern US and southern Canada. It was first recorded in the Columbia Basin from the Snake River, Idaho in 1949 (Anderson et al. 1974) and has been a management challenge in irrigation canals in that region for many years (Steve Howser, personal communication). In 1964, it was documented in Flathead Lake, Montana (Consortium of Pacific Northwest Herbaria 2017). Within Flathead Lake, flowering rush has colonized at least 809 hectares (2,000 acres) of the littoral zone and moved downstream through the Clark Fork River into Lake Pend Oreille and the Pend Oreille River in Idaho and Washington (Parkinson et al. 2010, Jenifer Parsons, personal communication). Separate populations were found in the Yakima River in 2008, the Spokane River in 2010, and the Columbia River near Wenatchee in 2015 (Figure 2).

> *The formation of the Columbia Basin Cooperative Weed Management Area was designed to bring together partners from throughout the basin to develop an integrated weed management plan for controlling flowering rush.*

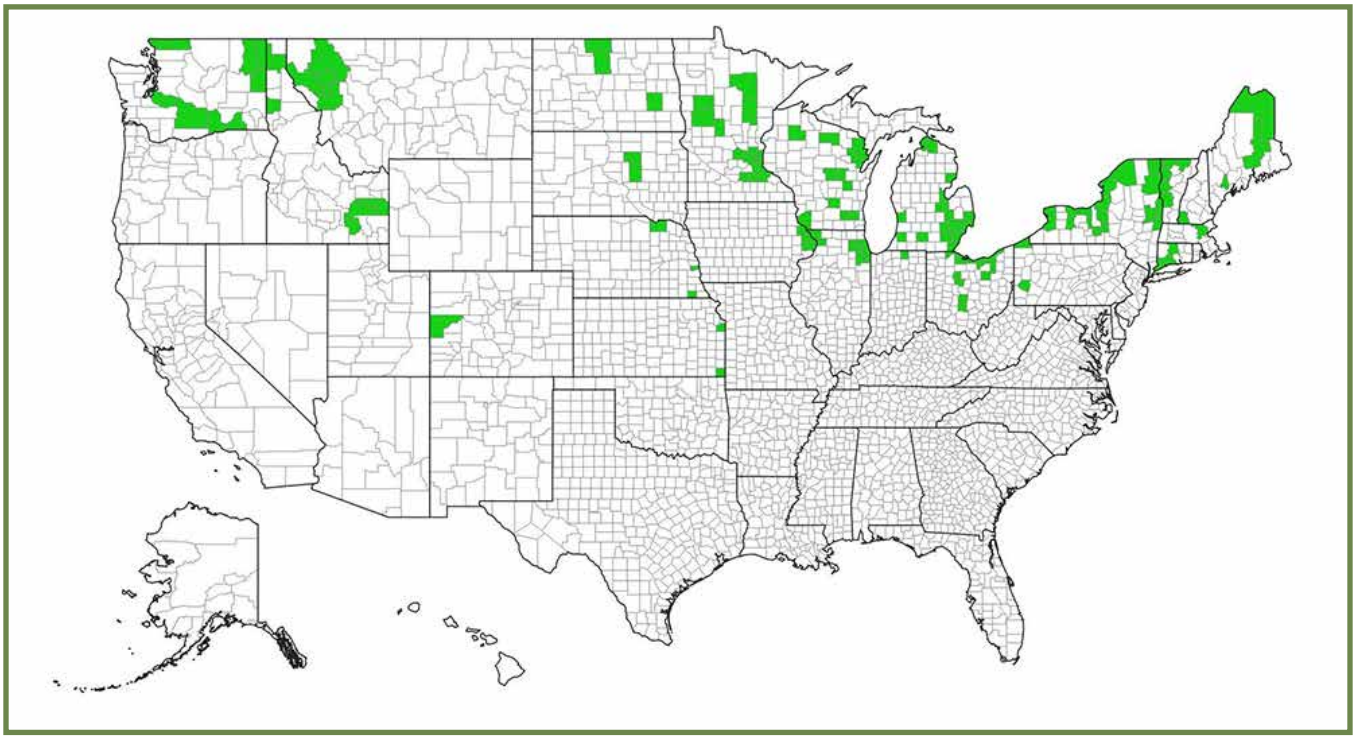

Figure 2. *National distribution of flowering rush. Citation: EDDMapS. 2019. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. Available online at http://www.eddmaps.org/; last accessed July 9, 2019.*

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Identification and Ecology of Flowering Rush

Species Classification

Order: Alismatales
Family: Butomaceae
Genus: *Butomus* L.
Species: *B. umbellatus* L.
Common names: flowering rush, grassy rush, water gladiolus

Flowering rush (*Butomus umbellatus* L.) is an herbaceous, aquatic, perennial monocot and the only species in the family Butomaceae. While it is not closely related to any other plants, it can visually resemble other aquatic and shoreline vegetation, making it hard to distinguish in the field (Figure 3). Flowering rush is indigenous to Europe and Asia, and is found sparingly in those native environments. The following description information is focused on the **triploid cytotype**, which is the dominant type found in Western North America.

Flowering rush has **rhizomes** that form numerous side branches, creating a rhizomatous mat as the plants mature. The rhizomes develop lateral buds, which are connected to the rhizome by a narrow base; thus, they tend to break off easily (Hroudova 1989) (Figure 4). The rhizomes also become brittle with age and develop structurally weak constrictions along their length which spontaneously fragment or break readily following minor disturbance (e.g. from waves, boat wake, feeding waterfowl, human disturbance). Fragments and buds float and disperse easily on water currents to potentially start new populations elsewhere (Parkinson et al. 2010) (Figure 5). Most of the biomass of flowering rush is in the rhizomes (Marko et al. 2015), and rhizome biomass increases substantially from year to year, with an increase of 20 times over a 6-year period in one study (Hroudova 1989). The greatest increase in rhizome biomass occurs late in the growing season (Hroudova et al. 1996); however, some parts of the rhizome may remain dormant (Hroudova 1989).

Figure 3. Distinguishing flowering rush can be challenging, as shown here growing with other shoreline vegetation (Photo credit: A. Halpern).

Figure 4. The rhizomes enable the rapid spread of flowering rush through the Columbia Basin (Photo credit: J. Andreas).

The leaves emerge directly from growing points **(meristems)** along the rhizome. They are triangular in cross-section, especially at the base, tending to flatten toward the tip (Haynes 2000) (Figure 6). They are dark green, sometimes with copper-colored areas especially at the base before sometimes turning white where they join the rhizome. Leaves are typically 1 meter (3 feet)

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Figure 5. A rhizome fragment floating in the waters of Flathead Lake in northwest Montana (Photo credit: P. Rice).

long when growing emerged along shorelines, but can grow up to 3 meters (10 feet) long when fully submersed (Parkinson et al. 2010). Leaves of emergent plants tend to twist (Figure 7).

The flower stalk is produced on emergent plants and is longer than the leaves. Flowers occur in a rounded cluster **(umbel)** of 20 or more light pink flowers with red or purple veins at the end of the flower stalk. The individual flowers are up to 3 centimeters (1 inch) across and have 3 petals, 3 petal-like **sepals,** 9 **stamens** and 6 **pistils** (Haynes 2000) (Figure 8). Occasionally, the **diploid** variety is reported to make bulbils in the flower cluster (Hroudova et al. 1996), which look like tiny bulbs. Triploid variety do not flower consistently from site to site or year to year. Fruits are beaked leathery follicles growing to 1 cm (0.4 inches) long and containing multiple seeds (Haynes 2000). There are up to 6 follicles per flower. The seeds are very small, 1.37 x 0.51 millimeters from diploid plants from Minnesota (Nathan Harms personal communication). Triploid flowering rush produces very little, if any, viable seed (Hroudova 1996, Lui et al. 2005) (Figure 9). However, diploid plants produced an average of 8,800 seeds per **inflorescence** (Lui et al. 2005). A range of seed viability has been reported in the literature, with a long cold stratification required for germination success (Eckert et al. 2000).

Flowering rush grows in a wide variety of water depths. In the Columbia River Basin, it grows as an emergent along shorelines, graduating out to water depths of more than 6 meters (20 feet) where it is completely submersed. It will grow in still water with muddy substrate to flowing water with rocky substrate and everything inbetween. It thrives in areas with fluctuating water levels, but also persists and spreads in stable water conditions (Hroudová 1989, Hroudová et al.

Figure 6. Flowering rush can be identified by its distinct triangular leaves (Photo credit: P. Rice).

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Figure 7. The twisting leaves of an emergent flowering rush (Photo credit: J. Parsons).

1996). It will invade and dominate native plant beds (Madsen et al. 2012) and can colonize habitats previously barren of plant growth (Parkinson et al. 2010). When growing submersed, the leaves are stiff relative to other submersed plants, and thus in flowing water they are present higher in the water column (Gunderson et al. 2016).

Flowering rush exhibits a seasonal growth pattern. It is dormant in winter, and generally the leaves die back to the rhizomes. However, the collapsed dead leaves will occasionally persist through winter, or leaves can also remain upright and green. It begins growing in early spring; in Flathead Lake, Montana it has been recorded to start growing between late February and mid-April (Parkinson et al. 2010). Leaf growth is rapid, peaking in mid-summer (Gunderson et al. 2016), then **senescing**, usually in September to October.

Genetics

Genetic analysis can provide information that helps to manage plant invasions, particularly for species with a variety of **genotypes**. It can pinpoint the origins and population structure of an invasion. This information can be helpful if it is suspected that different genotypes of plants react differently to control efforts. Genetics can also inform how plants are spreading (e.g. from another invasion point or from a source such as a nursery). In addition, understanding the point of origin in the plant's native range can inform biological control agent exploration.

The genotype and ploidy (number of sets of chromosomes in a plant cell) have been studied in-depth for eastern North America populations of flowering rush, but few samples from western North America were included in those studies. The current knowledge of flowering rush genetics suggests the following: there are both diploid (26 chromosomes per cell) and triploid (39 chromosomes per cell) plants that vary in their reproductive strategies (Hroudová et al. 1996) in the North American invasion. The flowering rush in the Columbia Basin is primarily triploid (Poovey et al. 2012), and as such is expected to rarely, if ever, produce viable seed (Hroudová et al. 1996, Lui et al. 2005). Conversely, diploids produce abundant viable seed (Eckert et al. 2003). Diploids produce hundreds of bulbils and triploids usually do not produce bulbils,

Figure 8. Flowering rush's light pink flower (Photo credit: T. Miller).

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Figure 9. *A dried flowering rush flower with seed pod (Photo credit: J. Parsons).*

though they clonally reproduce through rhizome fragmentation and buds (Eckert et al. 2003). Even with these reproductive differences, both diploid and triploid populations tend to contain a single clonal genotype, with rare exceptions. Therefore, reproduction by seed appears to be very uncommon in North America.

The number and diversity of genotypes have been analyzed using either Random Amplification of Polymorphic DNA (RAPDs) or Amplified Polymorphic Length Polymorphisms (AFLPs). Both methods can distinguish closely related individual plants. In Europe, Kliber and Eckert (2005) found 47 RAPD genotypes in 71 populations, and only six genotypes in North America, suggesting significantly lower genetic diversity in the introduction history (i.e. founder effect). They also found that most eastern North America plants are diploid. Seven AFLP genotypes in 72 North American populations have been identified, with most of the western North American plants being the triploid genotype 1, and only two other genotypes found at Bouchie Lake, BC (genotype 2) and Entiat Lake, WA and a pond near the town of Bonanza in Klamath County, OR (genotype 3) (John Gaskin, personal communication). Midwestern and eastern North America contain five different genotypes, with genotype 4 being most common in the St. Lawrence Riverway region (Figure 10).

Exact European origins have not been found for the common triploid genotype 1 that dominates western North America, but Kliber and Eckert (2005) suggest the closest genetic matches are from northern Germany and the Netherlands. The triploid flowering rush populations in North America are represented by four distinct but closely related genotypes; 74% of triploid populations are restricted to just one of these (Kliber and Eckert 2005). All four triploid North American genotypes are closely related to the genotypes in the Netherlands and northern Germany (Kliber and Eckert 2005). The introduction of these triploid genotypes to North America was likely facilitated by their export as horticultural plants from the Netherlands (Kliber and Eckert 2005). In a study of horticultural sources in North America, Eckert et al. (2016) determined that most nurseries sell the dominant triploid genotype. Flowering rush appears to also frequently add or delete chromosomes, resulting in a variety of chromosome numbers reported in the literature (Cahoon 2018). It is unclear if the plants with odd chromosome numbers behave more like triploids or diploids in their reproductive strategies.

Exact European origins have not been found for the common triploid genotype 1 that dominates western North America, but Kliber and Eckert (2005) suggest the closest genetic matches are from northern Germany and the Netherlands.

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Figure 10. *A map of the flowering rush genotypes found across the United States and Canada. Genotypes were derived from Amplified Fragment Length Polymorphism (AFLP) analysis. Seven different AFLP genotypes were identified in North America. Points on the map represent populations of one to 28 individuals, with a total of 574 individual plants genotyped from 78 populations (some populations are geographically close and overlap on the map), and an average of 7 plants per population. Color of marker indicates plant genotypes in a population. Populations contained only one genotype except for the population from Saskatchewan, which contained genotypes 1 and 6. (Photo credit: J Gaskin).*

Ecological Impacts

Flowering rush is a generalist, occupying a wide range of habitats. It has been termed an ecosystem engineer for its ability to alter habitat by sediment accretion (Gunderson et al. 2016). These characteristics, along with rapid population expansion, have raised concerns about the potential impacts on habitat and water delivery if flowering rush becomes established throughout the Columbia Basin.

In Flathead Lake, the most critical environmental impact of flowering rush is the formation of dense stands in previously un-vegetated littoral zones (Figure 11). As unchecked infestations increase in size, the potential impacts increase, including changes in water temperature regimes, nutrient transfers from the hydrosoil to the water column (Van Eeckhout and Quade 1994, James et al. 2003), and altered sediment transport, deposition, and accretion rates.

Flowering rush stands provide ideal habitat for great pond snails *(Lymnaea stagnalis)*, an intermediate host for the trematode parasite (*Trichobilharzia ocellata*) that causes swimmer's itch. In one western Washington lake with dense flowering rush, swimmer's itch prevented swimming and wading until flowering rush

Figure 11. *Taken from a kayak amid a flowering rush infestation at Flathead Lake (Photo credit: P. Rice).*

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was controlled.

There is also potential for other biotic impacts, mainly altered aquatic food webs. Of particular importance for the Pacific Northwest is the potential negative impacts on native resident and anadromous salmonids. Stands of flowering rush provide habitat for introduced fish species that spawn on vegetation, including smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flaven*), and northern pike (*Esox lucius*) (Tabor et al. 1993, Fritts and Pearson 2004, Bonar et al. 2005, Schultz 2006, Cooper et al. 2008). These vegetation-adapted piscivorous species prey upon cutthroat trout (*Oncorhynchus clarkii*), bull trout (*Salvelinus confluentus*), and juvenile anadromous salmonid (*Oncorhynchus*) species. The negative impact of introduced fish on open water native salmonids throughout the Columbia Basin is well documented (Northwest Power and Conservation Council 2008, Sanderson et al. 2009). Northern pike have been confirmed as seriously impacting cutthroat and bull trout in the Flathead Basin of Montana (Muhlfeld et al. 2008). Some of the sloughs on the upper Flathead River, Montana that are being utilized by radio tagged northern pike are heavily infested with flowering rush (Peter Rice and Virgil Dupuis, personal communication). Trapping of juvenile northern pike in a slough on the upper Flathead River has shown that at their critical early life stage, they are associated exclusively with the flowering rush infestations and not present in native vegetation or open water (Rice and Dupuis 2014). It appears that flowering rush litter from the previous year is providing spawning habitat and rearing shelter for the larval and early juvenile stages of northern pike in dam regulated systems that are at low pool in the spring. In addition, the macroinvertebrate community composition is significantly different in flowering rush stands when compared with native aquatic macrophyte stands and open water (Rice and Dupuis 2014). The macroinvertebrate functional groups occupying flowering rush infestations are less favorable prey species for native resident and anadromous salmonids.

Figure 12. *Flowering rush preventing use of a boathouse (Photo credit: P. Rice).*

Economic Impacts

The economic impacts of invasive species in the United States have been estimated at $120 billion annually (Pimental et al. 2005) and at $1.3 billion for Washington State (Community Attributes Inc. 2017). There are no publications to date that outline the economic impacts specific to flowering rush infestations, however inferences may be made from the following examples

Figure 13. *Flowering rush negatively impacts the activities of boaters and other recreationists (Photo credit: P. Rice).*

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that examine other invasive aquatic species.

In some areas where dense infestations grow adjacent to the shoreline and docks (e.g. Flathead Lake, Montana), recreational use (i.e. boating, fishing and swimming) has been impaired (Figures 12 and 13). Property values have been examined where non-native invasive aquatic plants have become established. Several studies suggest that invasive aquatic plants, such as Eurasian watermilfoil (*Myriophyllum spicatum*), can significantly reduce property values and associated property taxes (Zhang and Boyle 2010, Olden and Tamayo 2014, Liao et al. 2015). The economic impact of Eurasian watermilfoil in Washington State was estimated to be $14.8 million annually (Community Attributes Inc. 2017). Presence of invasive non-native aquatic plants can also reduce shoreline development (Goodenberger and Klaiber 2016). The impact due to invasive *Elodea* spp. in Alaska has been examined and suggests that the probable economic loss to commercial fisheries and recreational floatplane pilots may be $97 million per year, with a 5% chance that combined losses exceed $456 million annually (Schwoerer 2017).

In areas of Montana's Flathead Lake where commercial marinas and homeowners have conducted control actions to prevent the growth of flowering rush, costs have ranged between $575/acre to $715/acre to implement small scale repeated chemical application (Virgil Dupuis, personal communication). In southeastern Idaho, mechanical control of flowering rush is conducted annually on nearly 322 km (200 miles) of Aberdeen-Springfield Canal Company irrigation canals near the Snake River (Figure 14). Initial costs to develop the aquatic vegetation rake to control flowering rush were $75,000/season with costs decreasing significantly once flowering rush was reduced to minimal growth (Steve Howser, personal communication).

An anecdotal exploration into potential impacts of flowering rush debris on infrastructure, such as irrigation structures and hydroelectric facilities, has yielded limited information. In some areas where there are significant infestations of flowering rush, debris that is generated from scouring events could accumulate in different areas and impede flow. In the case of irrigation structures, flowering rush debris has been observed accumulated in racks (Peter Rice, personal communication).

Figure 14. *Mechanical control using the aquatic vegetation rake (AVR) on irrigation canals near the Snake River (Photo credit: Aberdeen-Springfield Canal Company)*

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Distribution in the Columbia Basin

Flowering rush occurs as several distinct populations in the Columbia Basin (Figure 15). The known occurrences of flowering rush in the Columbia Basin are currently being recorded and are housed online[2]. The following outlines what is understood to be the distribution at the time of document completion.

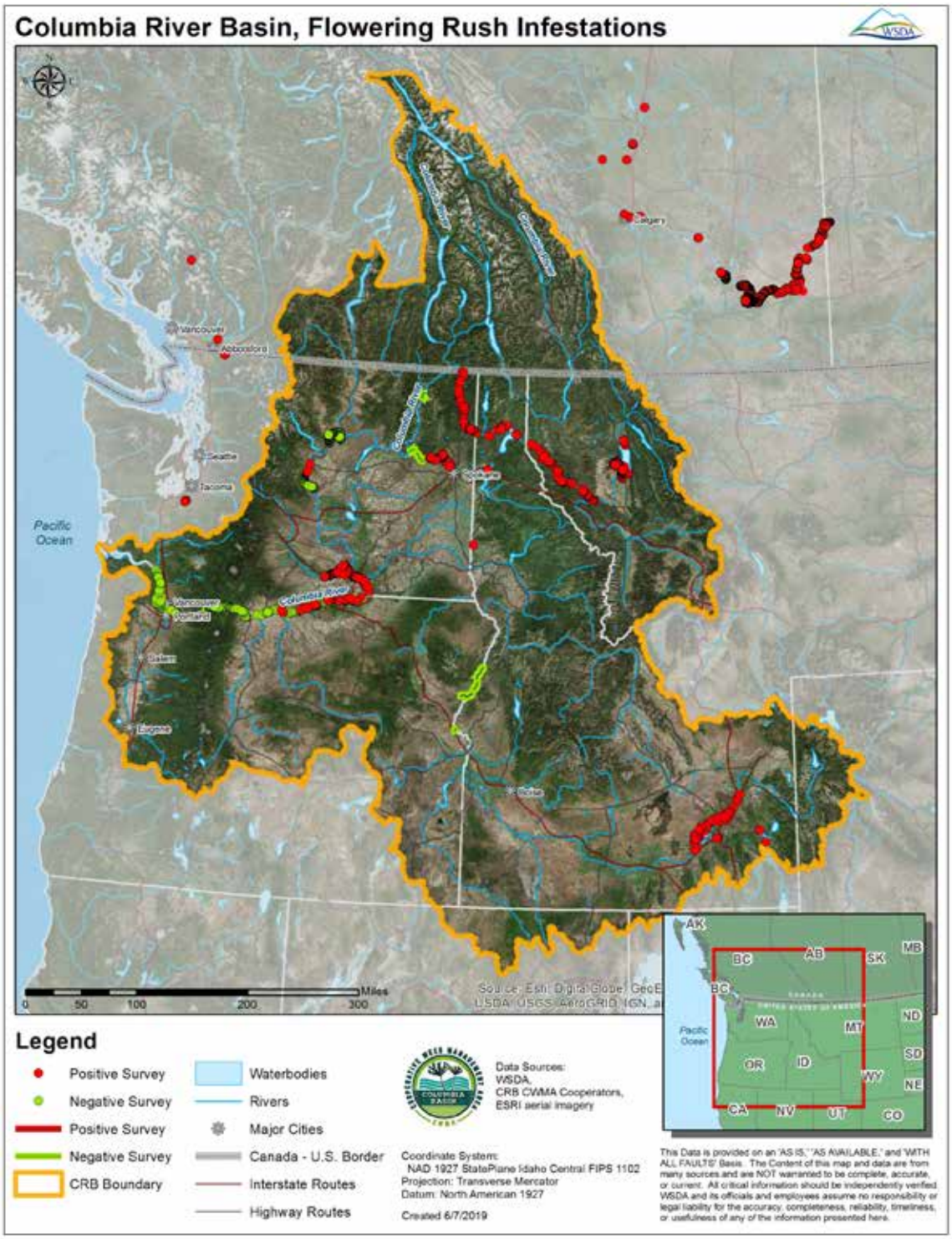

Figure 15. Distribution of flowering rush in the Columbia Basin and surrounding western region.

[2] https://wsda.maps.arcgis.com/apps/webappviewer/index.html?id=9d3b3f18dc3e4b33bb4ca9db923882e3

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Tributaries to the Columbia River

Clark Fork and Pend Oreille Rivers

The upper-most population of flowering rush in the Columbia Basin is in Montana. It was discovered in Flathead Lake in 1964 (Consortium of Pacific Northwest Herbaria 2017), and as of 2008, it had infested over 809 hectares (2,000 acres) of the lake (Rice et al. 2010). It has since dispersed up the main tributary of the Flathead River. Flowering rush has spread downstream into the Clark Fork River, which feeds Lake Pend Oreille, Idaho, where it was first noticed in 2007 (US Geological Survey NAS Database). Idaho State Department of Agriculture surveys of Lake Pend Oreille from 2018 indicate that the distribution is patchy from the Clark Fork River Delta, northwest to the Pend Oreille River, and north to the Albeni Falls Dam where sparse individual plants were recorded in Albeni Cove (3 kilometers [1.8 miles] east of the Washington State - British Columbia border). Dense stands (>75% cover) occurred near Clark Fork (Drift Yard), Sunnyside (Pack River Delta south of train causeway), Culver (Oden Bay), Sandpoint (Dog Beach Park, Sand Creek, Long Bridge), Dover (Dover Bay), Sagle (Swan Shores, Morton Slough, Willow Bay), Laclede (Riley Creek Recreational Area) and Priest River (Priest River Recreation Area). Other dense flowering rush areas not captured during the 2018 survey, include Kootenai Bay and Boyer Slough in Culver (Chase Youngdahl, personal communication). There is continued downstream expansion throughout the Pend Oreille River into Washington and within the waters of the Kalispel Tribe (Figure 16). Where the Pend Oreille River dips into British Columbia, Canada, there are no known populations.

> *It was discovered in Flathead Lake in 1964 (Consortium of Pacific Northwest Herbaria 2017), and as of 2008 it had infested over 809 hectares (2,000 acres) of the lake (Rice et al. 2010).*

Clearwater River

An approximately 0.4 hectare (1 acre) private pond in Idaho County, Idaho has a dense flowering rush population, which covers half of the pond. The infestation was first document in 2018, however the landowner described purchasing "bulbs" from a mail-order vendor about 20 years ago, and is strongly committed to working with the local natural resource management partners to resolve and eradicate the infestation (Connie Jensen-Blyth, personal communication). This isolated flowering rush population lies roughly 5 kilometers (3 miles) from the South Fork of the Clearwater River but with no fluvial connection to nearby waterways.

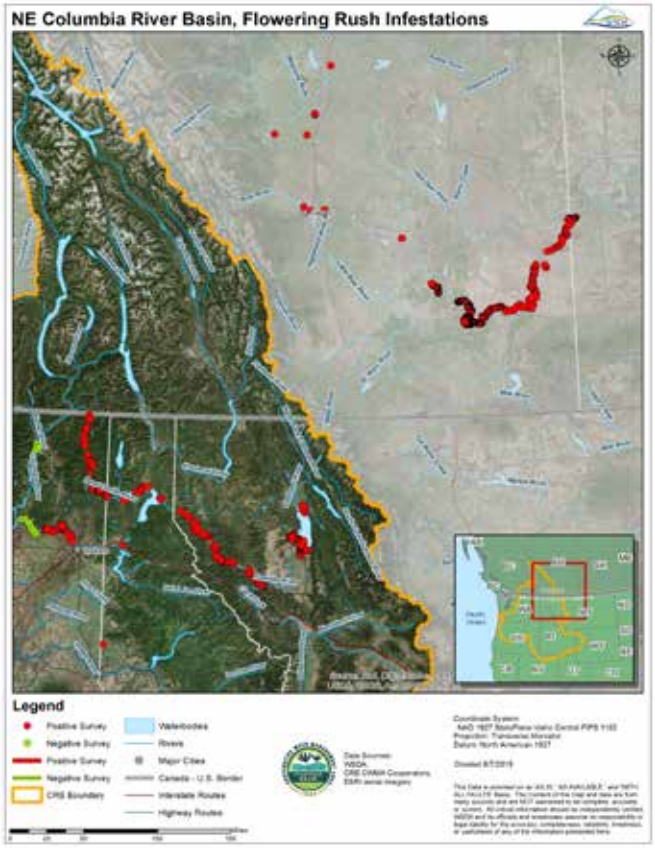

Figure 16. Detailed distribution of flowering rush in northeast portion of the Columbia Basin.

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Figure 17. Detailed distribution of flowering rush in the southeast portion of the Columbia Basin.

Snake River

Flowering rush has been in the upper Snake River in southeast Idaho since at least 1949 (Anderson et al. 1974). The upper Snake River populations are found between Idaho Falls and American Reservoir (also known as the Blackfoot Reservoir) and in the associated canal system of the area (i.e. Aberdeen Springfield Canal) (Figure 17). In southwest Idaho, populations have been documented in Gem Lake Reservoir. An inventory for flowering rush on the Snake River conducted by Oregon Department of Agriculture and Portland State University's Center for Lakes and Reservoirs sampled areas between Farewell Bend and Hells Canyon Dam during 2018 and found no flowering rush.

Spokane River

The Spokane River has flowering rush populations in 9-Mile Reservoir, Lake Spokane (sometimes called Long Lake) and Little Falls Reservoir. These populations occur as scattered individual plants or small patches (Figure 18). The Spokane River flows into Lake Roosevelt after Little Falls Reservoir, and no flowering rush has been found to date in Lake Roosevelt.

Yakima River

There is a population of flowering rush in the Yakima River between the town of Prosser and the confluence with the Columbia River. These are mostly scattered emergent plants, except in the vicinity of two diversion dams where water is deeper and flowering rush grows to approximately 4 meters (12 feet) deep (Figure 19).

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Mainstem of the Columbia River

While there are several known populations of flowering rush in British Columbia, none of those populations are within the Columbia River watershed of British Columbia at the time of document completion. When the Columbia River flows into Washington State from British Columbia, it becomes impounded behind Grand Coulee Dam as Lake Roosevelt. No flowering rush has been found in this reservoir to date. The first known flowering rush location down river of Lake Roosevelt is in Lake Entiat, the impoundment behind Rocky Reach Dam. There the flowering rush restricted to small groups of scattered patches near Lincoln Rock State Park and the Orondo Park boat launch[3].

Figure 19. Detailed distribution of flowering rush in the southwest portion of the Columbia Basin.

Figure 18. Detailed distribution of flowering rush in the northwest portion of the Columbia Basin.

Downstream, the Yakima River population has spread into the Columbia River. Flowering rush is present as mostly submersed patches, some as large as 2 hectares (5 acres), in Lake Wallula behind McNary Dam. Widely scattered patches have also been found in the next lower impoundment of Lake Umatilla behind the John Day Dam (Figure 19). At the time of document completion, no flowering rush had been identified from the Columbia River below John Day Dam.

[3] This population in Lake Entiat is genetically different from the population immediately upstream from it.

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Management Policies Relevant to Flowering Rush

There are various federal, state/provincial and tribal policies that guide the management of flowering rush within the Columbia Basin. The primary legislation or regulations have been identified here.

United States Federal Regulations

Archaeological Resources Protection Act

Actions to manage invasive species require consultation through the Archaeological Resource Protection Act (1979) and with local tribes due to the concern of impact to cultural and historical areas.

Executive Order 13751

"It is the policy of the United States to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. Invasive species pose threats to prosperity, security, and quality of life. They have negative impacts on the environment and natural resources, agriculture and food production systems, water resources, human, animal, and plant health, infrastructure, the economy, energy, cultural resources, and military readiness.

Executive Order 13112 of February 3, 1999 (Invasive Species), called upon executive departments and agencies to take steps to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established. Executive Order 13112 also created a coordinating body -- the Invasive Species Council, also referred to as the National Invasive Species Council -- to oversee implementation of the order, encourage proactive planning and action, develop recommendations for international cooperation, and take other steps to improve the Federal response to invasive species. It also directed Federal agencies to conduct, as appropriate, activities related to invasive species prevention; early detection, rapid response, and control; monitoring; restoration, research; and education. Past efforts at preventing, eradicating, and controlling invasive species demonstrated that collaboration across Federal, State, local, tribal, and territorial government; stakeholders; and the private sector is critical to minimizing the spread of invasive species and that coordinated action is necessary to protect the assets and security of the United States.

This order amends Executive Order 13112 (December 2016) and directs actions to continue coordinated Federal prevention and control efforts related to invasive species. Among other actions, the amendment incorporates considerations of human and environmental health, climate change, technological innovation, and other emerging priorities into federal efforts to address invasive species; and strengthens coordinated, cost-efficient federal action."

Endangered Species Act

The purposes of the Endangered Species Act (ESA) are to provide a means for conserving the ecosystems upon which endangered and threatened species depend and a program for the conservation of such species. The ESA directs all federal agencies to participate in conserving these species. Specifically, section 7 (a)(1) of the ESA charges federal agencies to aid in the conservation of listed species, and section 7 (a)(2) requires the agencies, through consultation with the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), to ensure their activities are not likely to jeopardize the continued existence of listed species or adversely modify designated critical habitats. Section 7(a)(2) requires federal agencies to

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consult on actions they fund, authorize, permit, or otherwise carry out.

In the Columbia Basin aquatic system, the USFWS has primary responsibility for freshwater organisms, including bull trout, while the responsibilities of NMFS are anadromous fish, such as salmon. It is most efficient if federal agencies, applicants, and the appropriate agency engage in early coordination to develop methods of integrating proposed treatment activities with the conservation needs of listed resources before the proposed actions are fully designed.

National Environmental Policy Act (NEPA) 42 U.S.C. §4321 et seq. (1969)

The National Environmental Policy Act (NEPA) of 1969 was created to ensure federal agencies consider the environmental impacts of their actions and decisions. Federal agencies are required to systematically assess the environmental impacts of their proposed actions and consider alternative ways of accomplishing their missions, which are less damaging to and protective of the environment. All federal agencies must use a systematic interdisciplinary approach to environmental planning and evaluation of projects which may have an effect on the environment. Environmental Assessments (EA) and Environmental Impact Statements (EIS), which are assessments of the likelihood of impacts from alternative courses of action, are required from all federal agencies and are the most visible NEPA requirements.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 7 U.S.C. §136 et seq. (1996)

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1996 provides for federal regulation of pesticide distribution, sale, and use. All pesticides distributed or sold in the United States must be registered (licensed) by the Environmental Protection Agency (EPA).

The Federal Noxious Weed Act (FNWA) Section 15 (1974)

Section 15 of the FNWA requires federal land management agencies to develop and establish a management program for control of undesirable plants that are classified under state or federal law as undesirable, noxious, harmful, injurious, or poisonous, on federal lands under the agency's jurisdiction (7 U.S.C. 2814(a)). FNWA also requires the federal land management agencies to enter into cooperative agreements to coordinate the management of undesirable plant species on federal lands where similar programs are being implemented on state and private lands in the same area (7 U.S.C. 2814(c)).

National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (NPDES) permit program, created in 1972 by the Clean Water Act, helps address water pollution by regulating point sources that discharge pollutants to waters of the United States. Under the Clean Water Act, the EPA has authorized the NPDES permit program to the States of WA, OR, and MT; and tribal, and territorial governments, enabling them to perform many of the permitting, administrative, and enforcement aspects of the NPDES program. EPA retains oversight responsibilities in these states.

With respect to NPDES permits, section 511 of the Clean Water Act establishes that only EPA-issued permits to "new sources" (dischargers subject to new source performance standards) are subject to NEPA's environmental review procedures under state law prior to permit issuance. States may have their own versions of NEPA.

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Various federal and state regulations can also apply EPA NPDES Pesticide General Permit (chemical treatments), state fish and wildlife permits and potentially state departments of environmental quality or ecology permits based on locations of action being taken and based on if the state has primacy over the agency/organization taking the action.

National Historic Preservation Act (NHPA), 16 U.S.C. 470 et seq.

Section 106 of NHPA and implementing regulations (36 CFR part 800) require the EPA regional administrator, before issuing a license (permit), to adopt measures when feasible to mitigate potential adverse effects of the licensed activity and properties listed or eligible for listing in the National Register of Historic Places. This Act's requirements are to be implemented in cooperation with state historic preservation officers and upon notice to, and when appropriate, in consultation with the Advisory Council on Historic Preservation.

National Invasive Species Act

The National Invasive Species Act (NISA) was passed in 1996 amending the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The 1990 Act established the Aquatic Nuisance Species (ANS) Task Force to coordinate nationwide ANS activities. The ANS Task Force is co-chaired by the USFWS Assistant Director for Fisheries and Habitat Conservation and the Undersecretary of Commerce/National Oceanic Atmospheric and Administration (NOAA). NISA furthered ANS activities by calling for ballast water regulations, the development of state aquatic invasive species management plans and regional panels to combat the spread of ANS, and additional ANS outreach and research.

United States Federal Agencies

US Bureau of Reclamation

The US Bureau of Reclamation (USBR) owns and operates many water projects within the Columbia Basin, in addition to conducting noxious plant control projects. Any USBR water projects in the Columbia Basin (e.g. Grand Coulee Dam which creates Lake Roosevelt) would be subject to applicable laws and policies to conduct management of flowering rush.

US Fish and Wildlife Service

This management plan includes two regions of the USFWS; Region 6 (Montana) and Region 1 (Idaho, Washington, Oregon, Pacific Islands). Compliance with the Endangered Species Act requires consultation with the USFWS Ecological Services Programs in both Region 1 and Region 6 where management actions could affect salmonids and other native species. Invasive species management is an important component for the USFWS. Management of aquatic invasive species is one of seven core goals identified as priorities in the Strategic Plan for USFWS Fish and Aquatic Conservation Program, 2016-2020 (USFWS 2016). The plan focuses on working with tribes, states, and other partners to prevent introductions; implement an early detection and rapid response framework; prevent the spread; and manage, control, and monitor established populations of invasive species. The Refuge Program within the USFWS manages invasive species through prevention strategies, surveillance, treatment and monitoring on refuge lands. Within Region 1, USFWS has developed a regional invasive species policy to minimize the introduction of invasive species by USFWS activities. This policy also establishes minimum expectations for invasive species prevention guidelines for field activities conducted, funded, reviewed or authorized by Pacific Region employees.

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There are a number of wildlife refuges and waterfowl production areas managed by the USFWS within the Columbia Basin. While many of these areas may have general management guidelines related to noxious weeds, typically none are specific to early detection or rapid response for flowering rush.

National Oceanic Atmospheric Administration

The National Oceanic Atmospheric Administration requires consultation with the NMFS to comply with Endangered Species Act requirements where management actions could affect salmonids and other native species.

National Park Service

The National Park Service's (NPS) Invasive Plant Program (IPP) leads the invasive terrestrial plant issues, as well as some aquatic and wetland plant species. The IPP provides technical assistance and policy guidance to parks and regions on matters related to invasive species prevention, containment, management, and monitoring. The Columbia Basin's Lake Roosevelt is under the management authority of NPS. Any management actions on flowering rush would follow relevant laws and policies of NPS.

US Army Corps of Engineers

The US Army Corps of Engineers (USACE) manages and administers lands and waters, for Federal Civil Works projects, and USACE lands that are utilized for grants and permits. In June 2009, a USACE policy memorandum established a USACE invasive species policy, which complemented the National Invasive Species Act, various executive orders and the National Invasive Species Management Plan, and serves as a blueprint for USACE. This nationwide policy is applied to all Civil Works project operations, planning, regulatory program, and Engineer Research and Development Center (ERDC). Measures to either prevent or reduce establishment of invasive and non-native species will be a component of all USACE Operations and Maintenance (O&M) at project sites, as well as a part of implementation of Civil Works projects.

US Department of Agriculture – Forest Service

The Forest Service works cooperatively with various stakeholders to implement appropriate regulations related to invasive species management, in many situations by working with state entities to implement their statues. Several federal regulations, including the Federal Noxious Weed Act, are applied to Forest Service invasive species management activities.

Canadian Federal Regulations

Pest Control Products Act & Regulations

Pesticides must be registered prior to use in Canada and be used according to the label directions. Pesticides are registered through Health Canada's Pest Management Regulatory Agency (PMRA).

Currently, diquat is the only registered aquatic herbicide for use in Canada. In an emergency, there is the potential to use a non-registered product.

An emergency is generally deemed to exist when both of the following criteria are met:

- An unexpected and unmanageable pest outbreak or pest situation occurs that can cause significant health, environmental, or economic problems; and
- Registered pesticides and cultural control methods or practices are insufficient to address the pest outbreak.

An Emergency Use Registration can be applied for and granted if the following criteria are met:

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- Active ingredients must already be registered in Canada (e.g. a terrestrial product with the same active ingredient is registered).
- An emergency registration cannot be granted for longer than one year and may not be renewed.
- Where the pest infestation is predicted to remain an ongoing issue in future years, the PMRA expects the sponsor and registrant to prioritize the pest issue and pursue full registration of the use through normal regulatory processes as soon as possible.

Federal Fisheries Act & Aquatic Invasive Species Regulations

The aquatic invasive species regulations have designated prescribed persons to authorize the deposit of deleterious substances in the Department of Fisheries and Oceans, Parks Canada, Ontario, Nova Scotia, Manitoba, British Columbia, Saskatchewan, Alberta, and the Yukon. This allows the approval for the deposit of deleterious substances to be issued by the provinces indicated.

Deposit of Deleterious Substance for the Control of Aquatic Invasive Species, subject to section (3), states the deposit of deleterious substance (pesticides) is prohibited in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water unless authorized by the regulations.

Department of Fisheries and Oceans (DFO) Request for Review

Subject to section 35(1) activities that may cause serious harm to fish that are part of a commercial, recreational or aboriginal fishery or to fish that support such a fishery require a DFO Request for Review unless the project meets criteria within the self-assessment. Aquatic invasive species control and/or eradication activities are not listed within the self-assessment at this time.

Species at Risk Act

No permit issued. The Species at Risk Act prohibits the killing, harming, harassment, possession, capturing, or taking of a species listed as extirpated, endangered, or threatened and the damage or destruction of a residence or the destruction of any part of the critical habitat of such a listed species. The DFO self-assessment should be used to determine whether the project should be submitted for a request for review.

Migratory Breeding Birds Convention Act

Migratory Breeding Birds Conventions Act 5.1 (1) *No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.*

Permits are not issued for waterbodies where migratory birds may be present. Environment Canada also does not have the authority to prescribe, recognize, or approve specific best management practices (BMPs). While BMPs do not necessarily guarantee compliance with legislation, it is the provincial government's responsibility to develop and implement appropriate preventive and mitigation measures to reduce the risk of detrimental effects of their activities to help maintain sustainable populations of migratory birds.

Navigation Protection Act

It is prohibited to construct, place, alter, repair, rebuild, remove or decommission a work in, on, over, under, through, or across any navigable water that is listed in the schedule except in accordance with this Act or any

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other federal Act. It is prohibited to dewater any navigable water. If invasive species control activities require the temporary or permanent shut down of a listed navigable waterbody then this Act would require approval from the Federal Minister.

Canada Federal Agencies

Fisheries and Ocean Canada

Fisheries and Oceans Canada and the Canadian Coast Guard manage Canada's fisheries and safeguard its waters. They ensure commercial vessels and recreational boaters can safely navigate our waters and are there to save lives and protect the environment when emergencies arise; sustainably manage fisheries and aquaculture and work with fishers, coastal and Indigenous communities to enable their continued prosperity from fish and seafood; and ensure that Canada's oceans and other aquatic ecosystems are protected from negative impacts. Their work is centered on four core responsibilities: fisheries, aquatic ecosystems, marine navigation and, marine operations and response.

Each responsibility calls for science-based decision-making, engagement with Canada's Indigenous Peoples and reliance on the Canadian Coast Guard fleet as a platform for on-water activities. Aquatic invasive species reports for marine species are led by Fisheries and Oceans Canada, whereas freshwater species have been deferred down to provincial or territorial governments.

Tribal Regulations

Within the Columbia Basin, there are many tribal and First Nations stakeholders which may have a role in management decisions or implementation of actions to address flowering rush. We would like to acknowledge that there are Tribes and First Nations that may not be represented here but that have a stake in management of flowering rush. The information that follows provides examples of tribal authority and response to flowering rush, but it is not a comprehensive archive of tribal and First Nation management in the Columbia Basin.

Coeur d'Alene Tribe (Idaho)

If flowering rush is discovered within the Coeur d'Alene Lake Basin or within the boundaries of the Coeur d'Alene Reservation, then the Tribe would support/implement an appropriate response using existing invasive species programs, management plans, or partnerships. Any efforts would be subject to applicable rules, regulations, or plans governing protection of natural and cultural resources.

Confederated Tribes of the Colville Nation (Washington)

The Colville Tribes follow all state and federal laws pertaining to control of noxious weeds. Flowering rush is listed as a high priority weed species in the 2016 Land Operations Integrated Weed Management Plan. A project proposal for eradication would begin immediately following any findings of flowering rush within the boundaries of the Colville Reservation and the adjacent reaches of the Okanogan and Columbia Rivers. Any management plan would follow the Tribes' project proposal process (3P) prior to applying treatments.

Confederated Salish Kootenai Tribes (Montana)

Ordinance 64a, which deals with work below the high water mark of Flathead Lake, and Ordinance 87a, which protects all other wetlands and streams within the reservation, would be implemented for flowering rush management projects. Empowered by the Environmental Protection Agency, the Confederated Salish Kootenai Tribes work to ensure adherence to the FIFRA.

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Confederated Tribes and Bands of the Yakama Nation (Washington)

The Yakama Tribe adheres to all state and federal laws and regulations to conduct any noxious weed management activity. Additionally, consultation with tribal archaeologists to minimize any potential disturbances from a management action are completed. Flowering rush is listed as a "Watch" species in the 2011 *Integrated Invasive Plant Management Plan for the Yakama Reservation*. If detected within the Yakama Reservation, it would immediately be given an "A" classification and an eradication attempt would be initiated. In addition to authority for weed control within the Reservation, the Yakama Nation has broad interests in resource management within the Yakama Ceded Territories (Appendix D), as well as, a strong management presence for aquatic management throughout the Yakima River Basin. No additional tribal ordinances to address noxious weeds, including flowering rush, have been created.

Confederated Tribes of the Umatilla Indian Reservation (Oregon)

Management of flowering rush is addressed by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in their Integrated Weed Management Plan. Within the riparian areas are priority weed management areas due to the cultural importance of the associated fish habitats for First Foods. Management objectives for riparian areas will be based on the specific invasive weeds present and will follow the species prioritization listed according to the current CTUIR Invasive Weed List. Watch List species are defined as invasive weeds that are not currently known to occur in the Integrated Weed Management Plan (IWMP) management area but have the potential to establish and become invasive. Prevention is the primary management objective for IWMP Watch List species. If any of the Watch List species are detected in the IWMP management area, the species will become a "Priority 1" species for treatment and eradication of the infestation will be attempted. Flowering rush is designated as a watch species.

Kootenai Tribe of Idaho (Idaho)

Prevention of invasive aquatic species is a primary management objective for the Kootenai Tribe of Idaho. Flowering rush is not currently known to be present in the Kootenai drainage, but if detected, the Tribe would work with other management agencies to treat and eradicate it. Flowering rush has a high priority 'Early Detection - Rapid Response' designation in Boundary County, indicating that eradication could be feasible.

> *We would like to acknowledge that there are Tribes and First Nations that may not be represented here but that have a stake in management of flowering rush.*

Kalispel Tribe of Indians (Washington)

The Invasive Aquatic Plant and Invertebrate Prevention and Control Section of the *Kalispel Natural Resources Conservation Plan* outlines appropriate control actions which are guided by the severity of the ecological threat created by the invasive species along with the level of control effort required and ecological harm created by implementation of control actions. The Kalispel Tribe has authority to enforce provisions of the Clean Water Act (CWA) and relevant management actions would be subject to the completion of a Tribal Water Quality Protection Permit and obtaining a CWA section 401 certification.

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Spokane Tribe of Indians (Washington)

The Spokane Tribe of Indians adheres to all state and federal laws and regulations while conducting any noxious weed management activity. The Tribe's management activities will be guided by the Spokane Tribe of Indians Vegetation Management Plan and the Integrated Resource Management Plan for the Spokane Indian Reservation.

State and Provincial Regulations

The state and provincial regulations that may affect flowering rush management actions have been captured here.

Alberta

Prior to 2010, flowering rush was permitted in Alberta. In 2010, the Alberta Weed Control Act, within the jurisdiction of Alberta Agriculture and Forestry, listed flowering rush as a prohibited noxious weed; meaning, where found, it would need to be destroyed. Alberta Agriculture and Forestry jurisdiction lies from the land to the low water mark line. In 2015, the Alberta Fisheries Act, within the jurisdiction of Alberta Environment and Parks, was amended to include a listing of 52 fish, aquatic plants, and invertebrates that are now prohibited to import, sell, transport, or possess in Alberta. This listing includes flowering rush. Alberta Environment and Parks jurisdiction is from the high water mark line to the bed and shore. Due to the overlapping jurisdiction and legislation between Alberta Agriculture and Forestry and Alberta Environment and Parks, both ministries have been involved in control and eradication measures.

British Columbia

Flowering rush has been regulated as a Provincial Noxious Weed under the BC Weed Control Act since 2011 and will be proposed as a provincial Prohibited Noxious Weed in future legislation revisions. Under this legislation, owners or occupiers of land have a duty to control listed noxious weeds on their property and can be instructed to comply by a weed inspector. The weed inspector can detail the level of control required (e.g. preventing seed dissemination to complete eradication). Flowering rush is a candidate for eradication in BC under the Provincial Invasive Species Early Detec-

GEOGRAPHIC AREA	REGULATORY CLASSIFICATION	CLASSIFICATION AGENCY
Alberta	Prohibited Noxious (subject to eradication) /Prohibited	Alberta Agriculture and Forestry Alberta Environment & Parks
British Columbia	Provincially Noxious	BC Inter-Ministry Invasive Species Working Group
Idaho	Containment Class (subject to reduction or elimination)	Idaho State Department of Agriculture
Montana	Priority 2A (subject to eradication or containment)	Montana Department of Agriculture
Oregon	List A (subject to control/eradication) List T (approved for control)	Oregon Department of Agriculture
Washington	Class A (subject to eradication and prevention)	Washington State Noxious Weed Control Board

Table 1. Regulatory classification of flowering rush as per jurisdiction.

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tion Rapid Response Plan. Natural water bodies within the province fall under the jurisdiction of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. The current land management goal for this species is containment with the ultimate goal of eradication. The sale and transport of flowering rush is not currently prohibited in BC; however, future legislation revisions will seek to change this. This species is also listed under the Community Charter - Environment and Wildlife Regulation.

Idaho

Assigned to the 'Containment' category on the Idaho State Noxious Weeds List, flowering rush management mainly consists of reduction or elimination of new and expanding populations. Under Idaho statute, management duties reside with counties, as well as, landowners and citizens with assistance from the Idaho State Department of Agriculture. In addition, cultivation, commerce, and transport of any state-listed noxious weed is prohibited. Certain counties maintain additional noxious weed priority schemes based on local distribution. As a result, flowering rush has a high priority 'Early Detection - Rapid Response' designation in some counties where absent or limited distribution, implying that eradication could be feasible (e.g. Boundary County, Idaho County).

Montana

Flowering rush is currently listed as a 2A noxious weed in Montana. A 2A weed is considered common in isolated areas of Montana. Management criteria will require eradication or containment where less abundant. Management shall be prioritized by local weed districts. Due to overlapping rules and statues, Montana Department of Agriculture, county weed districts and Montana Fish, Wildlife & Parks may work to contain, control, manage and eradicate, where feasible, aquatic invasive plant species including flowering rush. New satellite populations would be targeted for eradication and control, and containment efforts are used for established populations.

Oregon

Flowering rush is an A-rated weed in the state of Oregon. An A-rated weed is a weed of known economic importance which occurs in the state in small enough infestations to make eradication or containment possible; or is not known to occur, but its presence in neighboring states make future occurrence in Oregon seem imminent. The recommended response to an A-rated weed presence is to treat infestations with the intent of eradication or intensive control when and where found. Control of A-rated weeds is mandatory under state law. These weeds are also subject to quarantine and are not allowed to be grown, transported, or brought into the state.

Washington

Flowering rush is a Class A noxious weed on the State Noxious Weed List. Class A weeds are non-native species whose distribution in Washington State is still limited. Eradicating existing infestations and preventing new infestations are the highest priority for the State. Flowering rush is also on the Washington Department of Agriculture's quarantined list of plants. The sale or distribution of flowering rush is prohibited, including importation from other states or countries.

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The strategies used to control other types of aquatic noxious weeds have been explored as tools to manage flowering rush. These include manual, mechanical, cultural, chemical, and biological control methods. Several have been examined in a variety of locations and conditions across the Columbia Basin.

Manual

Manual methods that have been utilized to control flowering rush:

- hand digging de-watered plants
- SCUBA divers using Diver Assisted Suction Harvesting (DASH)
- benthic barriers

These methods have the advantage that no chemical residues are present at a treatment site or in the water that moves downstream. When hand digging de-watered plants, simple materials such as hand tools and buckets are used to completely remove the entire plant. Hand digging can be utilized in areas where populations are exposed aerially to provide ease of access (Figure 20). Raking the leaves to remove plant material is not advised as it would disturb the shallow rhizomes and likely increase spread.

Figure 20. *It is possible to hand dig flowering rush when it is easily accessed. (Photo credit: J. Parsons)*

DASH method utilizes a snorkeler or SCUBA diver depending on depth, current and other site specific parameters. The diver uses a combination of hand-pulling, digging and suction with an underwater vacuum to remove the full plant (Figure 21). The suction is created using a water pump on a boat and hoses to create a "Venturi" effect. Removed plants are suctioned

Figure 21. *ACE diver Todd Manny with DASH suction tube and helmet camera (Photo credit: R. Benoit).*

to a holding tank on the boat and then are disposed of according to state/provincial/tribal regulations for noxious weed disposal (often on land in a dry environment which kills the plant). The application of DASH is best suited to areas with small patchy infestations due to the amount of labor and expense required. Hand digging and DASH must be done with care to remove all rhizomes and rhizome buds. Using netting to contain fragments that might be released while divers are loosening flowering rush rhizomes can be useful especially if there is any current at the site (otherwise suction is enough). Repeated treatments are usually required because it is very difficult to remove all of the rhizome fragments.

Benthic barriers can be used to suppress growth of flowering rush in the areas where they are laid down (Figure 22a and 22b). In locations such as boat slips and marinas, they can be an effective tool with proper placement and maintenance. Because plants can continue to spread and grow once covered, benthic barriers should extend well beyond the edge of the flowering rush patch and be adequately weighted to prevent further growth. Common benthic barriers are constructed of geotextile materials, which exclude light but allow gasses to

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Figure 22a. *Benthic barrier held down by sandbags (Photo credit: US Army Corp of Engineers).*

escape. It is unclear how long a benthic mat should remain in place to kill all rhizome material underneath. One study in Idaho suggests that 16 weeks of cover was not enough to reduce the rhizome biomass (Madsen et al. 2017). In another trial in Idaho, flowering rush was viable after up to 5 years of cover (Tom Woolf, personal communication).

A combination of DASH and covering with benthic barrier has shown promise in controlling small, isolated patches of flowering rush in the Columbia River near McNary Dam. Several sites appeared free of flowering rush two years after the treatment, while other sites with larger initial patches required follow-up with additional benthic barriers to cover new plants near the initial site. Now, three years' post-treatment, some benthic barriers have plants growing around their edges (Mark Porter, personal communication).

Mechanical

Mechanical control methods such as mowing or rototilling are likely to increase the rate of flowering rush spread through root and rhizome disturbance and fragmentation (Marko et al. 2015). However, in areas where flowering rush is dense, mowing repeatedly may reduce the plant's rhizome energy reserves and eventually reduce rhizome abundance, as was demonstrated in an Alberta lake after 20 years of mowing (Cahoon 2018).

Using machines such as back-hoes to dig flowering rush also creates fragments. However, a specially designed bucket, referred to as the Aquatic Vegetation Rake[4] (AVR , see Figure 14), attached to a back-hoe has proven successful at reducing flowering rush biomass and improving water delivery in irrigation canals in southeast Idaho where chemicals cannot be used (Steve Howser, personal communication).

Cultural

Flowering rush rhizomes are not deleteriously affected by freezing, so winter drawdown to promote freezing of sediment does not provide control.

Flowering rush establishment is encouraged by fluctuating water levels (Parkinson et al. 2010). Because exposed bare or sparsely-vegetated substrates are ideal for seed, rhizome, and bulbil sprouting (Hroudová et al. 1996), maintaining stable water levels or increasing levels with flooding events have been explored as a management option. Neither type of water level manipulation has successfully suppressed flowering rush populations once the plant is established (Marko et al. 2015).

Figure 22b. *Benthic barrier before it is laid over infested area (Photo credit: J. Andreas).*

[4] https://maximizedwatermanagement.com

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Chemical

Many herbicides have been tested on flowering rush, yet so far no chemical has been found that will provide complete control with one or a few treatments (Figure 23). In addition, chemical methods can contribute to residuals in the water that may migrate from the treatment site. There are several herbicides that will provide partial to good control, but they vary depending on the plant's growth form and treatment conditions. A summary of known herbicide trial results is presented in Table 2. Reduction of the rhizomes and rhizome buds is the most desirable outcome from any control method, since rhizomes are the key to flowering rush persistence and expansion. However, not all herbicide trials have quantified impacts to the root system. All available methods for containment within the treatment site should be utilized.

Based on the experience of the management plan authors, as well as from results of other published studies, the following recommendations are suggested with the caveat that future work may discover improved outcomes that are not reported here.

Figure 23. Herbicide application at the East Bay of Flathead Lake (Photo credit: P. Rice).

Emergent growth treatments: At least 0.6 meters (2 feet) of exposed leaf should be present above the water to treat. If less than that is above the water, it is better to treat submersed growth with an herbicide approved for that use-mode. A surfactant should be combined with the foliar herbicide to improve leaf absorption. Make sure the surfactant is approved for use in aquatic situations in the region where the treatment is taking place (Figure 24).

Figure 24. Emergent growth treated with herbicide in the Columbia Basin (Photo credit: J. Parsons).

The most promising foliar herbicides, where field trials followed plant growth for at least one-year post-treatment, are imazapyr and glyphosate. However, one-time emergent foliar treatments with imazapyr provided only 35% control one year after treatment, and imazamox provided only 23% control (Rice et al. 2009). Trials with shorter term assessment found additional potential products (Table 2), but due to the ability of flowering rush to recover from initial leaf die-back because of regrowth from the rhizomes, results from studies that follow plants for at least one-year are necessary to inform managers.

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GROWTH FORM	TREATMENT TIMING	HERBICIDE	RESULTS**	SOURCE
EMERGENT*	summer	2,4-D + triclopyr	no control 12 MAT (1 ft leaf exposed and treated)	Rice et al. 2009
		glyphosate	up to 61% control of leaves 12 MAT (2+ ft of leaf exposed)	Miller 2009
		glyphosate + imazapyr	50% control of leaves 12 MAT using higher rates (4% + 0.5% respectively), 1 + ft of leaf exposed	Miller 2011
		imazamox	23% control 12 MAT (1 ft leaf exposed)	Rice et al. 2009
		imazamox + carfentrazone-ethyl	not effective if plants rooted in water > 1 ft deep	Madsen and Miskella 2018
		imazapyr	74% control 12 MAT (2+ ft of leaf exposed); 35% control (1 ft leaf exposed)	Miller 2009; Rice et al. 2009
		triclopyr	56% control 12 MAT (2+ ft of leaf exposed)	Miller 2009
	late season	2,4-D	50% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		2,4-D + triclopyr	95% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		aminopyralid	95% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		glyphosate	80% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		imazamox	95% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		imazamox + glyphosate	95% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		imazapyr	95% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		imazapyr + glyphosate	100% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014
		triclopyr	90% control 6 WAT in mesocosms, 30 - 70 cm of leaf exposed	Wersal et al. 2014

Table 2. A summary of herbicide treatments and herbicide type that have been examined for flowering rush control.
** surfactants approved for aquatic use were combined with the herbicide for trials on emergent growth*
***WAT=weeks after treatment, MAT=months after treatment*

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GROWTH FORM	TREATMENT TIMING	HERBICIDE	RESULTS**	SOURCE
EMERGENT*	fall (Nov in Idaho) treatment of de-watered canals	diuron	not effective	Madsen and Miskella 2018
		flumioxazin	not effective	Madsen and Miskella 2018
YOUNG EMERGENT*	spring, de-watered shore	2,4-D + triclopyr	not effective (6% control 13 MAT)	Rice et al. 2009
		acetic acid	not effective	Madsen et al. 2017
		aminopyralid	not effective	Madsen et al. 2017
		copper	not effective	Turnage et al. 2017
		flumioxazin	not effective	Madsen et al. 2017
		fluridone	reduced above and below ground biomass in mesocosms, but not field trials	Madsen et al. 2017; Madsen et al. 2016
		imazamox	reduced above ground biomass in mesocosms, mixed results from field trials. Madsen et al (2017) saw no reduction, but Rice (2009) had 53% control 13 MAT with 2 qt/acre rate	Madsen et al. 2017; Rice et al. 2009
		imazapyr	reduced above ground biomass in mesocosms, mixed results from field trials. Madsen et al (2017) saw no reduction, but Rice (2009) got 87% control 13 MAT with both 2 & 3 qt/acre application rate. A second treatment the year following resulted in >95% control 1 year after second treatment	Madsen et al. 2017; Rice et al. 2009 & unpublished data
		penoxsulam	reduced above ground biomass in mesocosms	Madsen et al. 2017
		triclopyr	liquid - mixed results in mesocosms, not effective in field trial	Madsen et al. 2017
		triclopyr	granular - reduced above ground biomass in mesocosms	Turnage et al. 2017

Table 2. A summary of herbicide treatments and herbicide type that have been examined for flowering rush control.
** surfactants approved for aquatic use were combined with the herbicide for trials on emergent growth*
***MAT=weeks after treatment, MAT=months after treatment*

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GROWTH FORM	TREATMENT TIMING	HERBICIDE	RESULTS**	SOURCE
SUBMERSED	summer	2,4-D	mixed results in aquaria (ester and amine), mesocosm	Poovey et al. 2013; Wersal et al. 2014
		2,4-D + tricolpyr	reduction in leaf biomass 6 WAT in aquaria, mesocosm	Poovey et al. 2013; Wersal et al. 2014
		bispyribac	not effective in aquaria	Poovey et al. 2013
		copper	not effective, mesocosm trial on young submersed plants	Turnage et al. 2017
		copper + triclopyr	not effective, mesocosm trial on young submersed plants	Turnage et al. 2017
		diquat	repeated treatments reduce above and below ground biomass in field trials > 12 MAT; year of treatment reduction in above ground biomass, mixed year of treatment results on below ground biomass	Poovey et al. 2012; Madsen et al. 2016a; Parsons et al. 2019
		endothall	reduced leaf biomass 4 WAT in aquaria	Poovey et al. 2012; Poovey et al. 2013
		flumioxazin	reduced leaf biomass 4 WAT at highest use rate, aquaria	Poovey et al. 2012; Poovey et al. 2013
		fluridone	mesocosm trial reduced above and below ground biomass 8 WAT; aquaria trial showed no reduction 5 WAT	Poovey et al. 2013; Madsen et al. 2016b
		imazamox	not effective, aquaria and mesocosm	Poovey et al. 2013; Wersal et al. 2014
		triclopyr	mixed results in aquaria, mesocosm	Poovey et al. 2013; Madsen et al. 2016b, Wersal et al. 2014; Turnage et al. 2017
		triclopyr + endothall	reduced leaf biomass 4 WAT in aquaria	Poovey et al. 2013
		triclopyr + flumioxazin	reduced leaf biomass 4 WAT in aquaria	Poovey et al. 2013

Table 2. A summary of herbicide treatments and herbicide type that have been examined for flowering rush control.
** surfactants approved for aquatic use were combined with the herbicide for trials on emergent growth*
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Spring dry substrate treatments: Imazapyr and imazamox have shown high efficacy in situations where water levels are drawn down in spring, exposing the substrate; flowering rush has broken dormancy and started to grow prior to inundation. This application technique has mainly been practiced in Flathead Lake, MT and Lake Pend Oreille, ID. Treating two years in a row provided improved top growth control (Rice et al. 2019). After four and five years of sequential spraying with imazapyr or imazamox, large reductions in rhizome biomass and leaf re-sprouting has been confirmed (Rice et al. 2019).

Fall dry substrate treatments: This application scenario could use more exploration; however, few products are labeled for this use-mode. One trial of two herbicides (diuron and flumioxazin) showed no effectiveness in irrigation canals after water delivery ceased for the season (Madsen and Miskella 2018).

Submersed growth treatments: The best outcomes so far have resulted from repeated treatments with the contact herbicide diquat. Reductions in both leaf and rhizome biomass have occurred when treatments took place for at least two years (Madsen et al. 2016b, Parsons et al. 2019). Trials to determine the lowest rate that will achieve reductions have not taken place to date, so a target concentration of the maximum label rate (37 parts per billion) is recommended at this time.

Biological

A biological control research and development project was initiated for flowering rush in 2012 and the Flowering Rush Biocontrol Consortium was formed in 2013. Flowering rush is an excellent candidate for biocontrol because it is the only species within the Butomaceae family. This lack of closely related species greatly increases the likelihood of finding a host-specific insect or pathogen. Centre for Agriculture and Bioscience International (CABI) - Switzerland has taken the lead on foreign exploration for potential biocontrol agents and funding from various partners has been instrumental in this work.[5] Field surveys have been conducted in northern Germany, Czech and Slovak Republics, Poland, Hungary, Serbia, Georgia, and Kazakhstan. To date, there are no USDA-Animal and Plant Health Inspection Services (APHIS) approved biocontrol agents; however, two insects and one pathogen look very promising and are currently being investigated (Hariet

Figure 25. *Biocontrol research is underway for the leaf- and rhizome-mining beetle,* Bagous nodulosus. *(Photo credit: T. Haye)*

[5] Funding partners in the biocontrol project: US Army Corps of Engineers, Montana Noxious Weed Trust Fund, Montana Department of Natural Resources and Conservation, Washington State Department of Agriculture, Washington State Department of Ecology, Washington State Department of Natural Resources, British Columbia Ministry of Forests, Lands and Natural Resource Operations and Rural Development, Montana Department of Natural Resources and Conservation, Kalispel Tribe, Alberta Environment and Parks, and US Forest Service. Key partners include Jennifer Andreas, Washington State University; Peter Rice, University of Montana; John Gaskin, USDA Agriculture Resource Service Montana.

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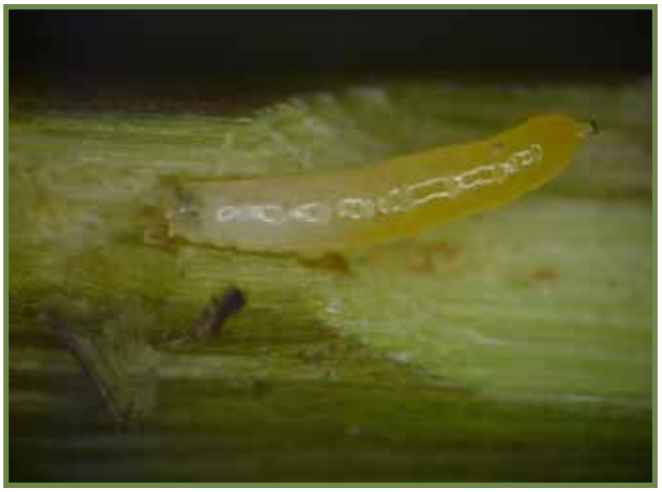

Figure 26. *A stem-mining fly shows promise as a biocontrol agent. (Photo credit: CABI)*

Hinz and Patrick Häfliger, personal communication). The leaf- and rhizome-mining beetle, *Bagous nodulosus*, is currently undergoing host-specificity testing (Figure 25). Sequential no-choice oviposition (adult egg-laying) tests were conducted in 2014-2018 on 45 test plant species to ensure non-target species are not at risk. With only one incidence of an egg being laid on a European species, *Baldellia ranunculoides*, it appears that the beetle is highly host-specific. However, it was recently discovered that *B. nodulosus* larvae can leave plant material and move to nearby plants. Given

> *Flowering rush is an excellent candidate for biocontrol because it is the only species within the Butomaceae family. This lack of closely related species greatly increases the likelihood of finding a host-specific insect or pathogen.*

the mobility of the larval stage, preliminary no-choice larval establishment tests began in 2018 using 18 test plant species. Limited larval feeding was only observed on two species so far; *Hydrocharis morsus-range* (native to Europe) and *Limnobium laevigatum* (native to South America). Studies are underway to assess the weevil's impact on flowering rush. Additional species will be tested in 2019.

A stem-mining agromyzid fly, *Phytoliriomyza ornata*, also looks promising (Figure 26). Flowering rush plants were wilted within weeks during rearing trials. Host-specificity tests and impact studies will be conducted in 2019.

A white smut fungal pathogen, *Doassansia niesslii*, was discovered in northern Germany in 2016. Initial tests indicate that it is highly host-specific and very damaging to flowering rush (Carol Ellison, personal communication) (Figure 27). The strain of rust found in northern Germany was able to kill genotype 2, the

Figure 27. *A white smut fungal pathogen is being tested as a possible biocontrol agent (Photo credit: CABI)*

genotype found in Bouchie Lake, British Columbia but did not attack genotype 1, the genotype most common to western North America. Additional surveys in the natural range of flowering rush will be required to find a match for genotype 1. Continued research on this potential biocontrol agent will take place in 2019, if funding is available.

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Montana

The first report of flowering rush in Montana dated to 1964 in Peaceful Bay in the northwest corner of Flathead Lake (Rice and Dupuis 2009, Consortium of Pacific Northwest Herbaria 2007). Following the 1997 risk assessment, a shoreline survey found dense infestations along the western and southern shores of the lake, including the mouth and delta of Dayton Creek which had been an important spawning stream for adfluvial westslope cutthroat trout (Rice et al. 1997). In addition, Ducharme Fishing Access, a quay built prior to 1990 that extends several hundred yards into East Bay, is now totally obstructed by flowering rush.

In 2001 the Lake County Weed District petitioned the Montana Department of Agriculture to add flowering rush to the State Noxious Weed List. Legal designation as a noxious weed allowed the Montana Noxious Weed Trust Fund to provide some financial support to begin research on the biology, applied ecology, and management of flowering rush. Salish Kootenai College (SKC) and the University of Montana (UM) joined together to take the lead on these efforts in Montana. As SKC and UM gained preliminary knowledge on the flowering rush invasion, they were able to begin to secure numerous larger federal grants for in-depth investigations and development of management methods.

In 2008, Flathead Lake was completely mapped by satellite imagery to determine the full extent of the infestation and develop a spatial model to estimate the potential maximum area of Flathead Lake susceptible to flowering rush domination. At that time 825 hectares (2,039 acres) or 14% of the littoral zone was heavily infested. Based on remote sensing and spectral image analysis, spatial modeling of lakebed substrate exposed at low pool suggested that 4,415 hectares (10,910 acres) of the 0 to 6 meters (0 to 20 feet) littoral zone were susceptible to infestation, meaning 75% of the littoral zone (equivalent to 8.8% of the lake surface area) is at risk (Rice et al. 2010). The upper Flathead River to the north of the lake is also infested and rhizome fragments are continuously passing through Seli'š Ksanka Qlispe' Dam on the southwest corner of the lake into the lower Flathead River and on to Lake Pend Oreille.

Sequential drawdown herbicide treatments with imazapyr and imazamox were started in 2014 in the East Bay of Flathead Lake. After four years of sequential treatments, rhizome mass was reduced up to 89% with imazpyr treatments and 82% with imazamox treatments (Rice, Dupuis and McRyhew 2019).

Annual sequential treatments of flowering rush have been implemented by private landowners at three common use marinas, and by three private landowners for the past four years. SKC and the UM are providing technical assistance in developing a Flathead Lake Flowering Rush Control Project, which will implement annual sequential treatments at drawdown on flowering rush infestations supported by Montana Department of Natural Resources, USACE, and USDA-NIFA Tribal College Extension and Research Programs.

Idaho

Flowering rush was first documented in southeastern Idaho (Snake River, Idaho Falls) in 1949 and northern Idaho (Clark Fork Delta, Lake Pend Oreille) in 2007. The Idaho State Department of Agriculture (ISDA) added the species to the State Noxious Weed List under the Administrative Rule (Noxious Weed, IDAPA 02.06.22) with authority from Idaho Law (Idaho Code, Title 22, Chapter 24).

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In northern Idaho, dry substrate treatments were initially explored during spring 2011 on the Lake Pend Oreille population through a collaboration of county, state and federal natural resource management partners. Treatments consisted of herbicides (i.e. imazapyr, imazamox, fluridone, triclopyr, acetic acid), mechanical removal (hand pulling, digging), and benthic barriers but with no decline in plant biomass four months' post-treatment (Woolf et al. 2011). Other flowering rush management projects include ongoing herbicide trials (imazapyr, imazamox, fluridone, diquat) at Drift Yard led by the US Army Corps of Engineers (2013-present), biannual hand pulling at Sandpoint City Beach and Dog Beach organized by the Lakes Commission (2013-2017), DASH by contractors initiated in 2018, and work by various weed control companies hired by private property owners. Complex ownership boundaries, easements and leases on Pend Oreille Lake and River, including shoreline and littoral areas, warrant extra coordination for aquatic noxious weed management.

Flowering rush was detected in Gem Lake, south of Idaho Falls and Rose Ponds, north of Blackfoot. It was also detected in Blackfoot Reservoir by ISDA. At this same time, a local irrigation company detected flowering rush in their system which originates from Gem Lake. Control trials, using imazamox, carfentrazone-ethyl and combinations of the two products, showed no positive control results. Fall bare ground trials using diuron and flumioxazin have taken place in this system, as well as in a system south of Firth. Trials of diquat and flumioxazin were attempted in Rose Ponds as an emergent control in summer (Madsen and Miskella 2018).

Infestations in Gem Lake were managed with diver dredging in conjunction with Bonneville County Search and Rescue divers. In the first year, the divers spent one day harvesting. In the second year, divers spent just a few hours harvesting, and the past two years no plants have emerged. Bonneville County coordinates with the City of Idaho Falls Power to survey the waterbody each year.

Aberdeen-Springfield Canal Company has spent considerable time and funding to manage infestations in their system since the early 1970s. This system is on the west side of the Snake River, downstream of Blackfoot, and returns into American Falls Reservoir. Surveys below American Falls Reservoir have resulted in minor detections. The early attempts to chain canals seemed to increase the spread of the weed. However, mechanical control with an aquatic vegetation rake have produced good results. The aquatic vegetation rake, developed locally by Maximized Water Management LLC in Chester, is a 5 meter (16 feet) wide tool that removes flowering rush roots and vegetative growth, but not silt. Use of the aquatic vegetation rake suggests flowering rush growth has been reduced and re-treatment is only needed every 5 years (Steve Howser, personal communication).

Fort Hall Tribes have detected flowering rush in many of their irrigation systems as all of their water originates from the Blackfoot River, flowing out of the Blackfoot Reservoir. Flowering rush has not been detected north or upstream of Gem Lake. The county weed departments along the Snake River and ISDA have prioritized monitoring in the region to prevent further spread upstream; however, funding is needed to support survey crews and coordination among county weed programs and irrigation system managers.

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Alberta

Natural Systems

Lake Isle. Flowering rush was reported in 2012 by Parkland County but the full scale of the problem was not realized until 2014 when the north shore was inspected. Following detailed surveying, Lake Isle is considered the worst infestation in Alberta with over 17 linear kilometers (10 linear miles) of infested shoreline. Surveys are conducted annually to determine spread and to ensure flowering rush does not spread to the Sturgeon River and Lac Ste. Anne. Prior to 2016 and currently, mechanical harvesting takes places in Lake Isle to allow for recreational access (e.g. boating, swimming). In 2016, control trials were conducted by a University of Calgary graduate student, which included benthic barriers, mechanical harvesting, hand removal with and without native re-vegetation, and herbicides (diquat and imazapyr). In 2019, eight linear kilometers (5 linear miles) are planned to be treated with diquat.

Buffalo Creek. Flowering rush was reported in 2012 by Mountain View AgFieldmen to Red Deer County AgFieldmen. Efforts to control flowering rush have included seed head cutting in 2012 and steaming in 2013. In 2018, Buffalo Creek underwent the fourth year of herbicide applications (diquat).

Bow and South Saskatchewan Rivers. Reports of flowering rush had been made in these river system in 2015 but its extent was unknown. In 2017, a survey was conducted of both rivers from the City of Calgary to the confluence of the Bow and South Saskatchewan River and of the South Saskatchewan River into Saskatchewan. Survey results indicated extensive distribution and no effective control plan has been developed yet. No control work was conducted in 2018.

Sturgeon River (within City of St. Albert). Flowering rush was reported in 2011 by City of St. Albert. In 2017, a large hand removal project was conducted by the City of St. Albert. Hand removal continued in 2018 in addition to exploring the necessary steps to receive pesticide application approvals for the use of diquat.

Man-made Systems

Edmonton Public Schools Bennett Centre. Reported in 2017, flowering rush was successfully hand removed from two isolated educational ponds. Monitoring continued in 2018 with only one plant found. The facility has agreed to monitor for one more year before replanting with native aquatic species.

Len Thompson Trout Pond (Lacombe). Reported in 2012 by a local citizen. Hand removal took place after the initial report but no further monitoring was conducted. In mid-2018, the site was re-visited and four locations were removed. The location will be monitored for re-growth.

Chestermere Lake & Irrigation Canals. Reported in 2013 by Rocky View County. In 2017, control trials were conducted at Chestermere Lake, which included hand removal, benthic barriers, and diver assisted suction harvesting. Hand digging during draw down was completed in 2018.

Strathcona County. Reported in 2015 by a local pesticide applicator in an urban stormwater management pond. In 2018, the pond underwent its third year of herbicide applications with diquat.

Olds College. Reported in 2012 by Mountain View County. Hand removal was completed in 2018.

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Calgary Zoo. Reported in 2015 by the City of Calgary. Hand removal was completed in 2018.

Sundre Golf Course. Reported in 2017 by a retired plant specialist. No control work was scheduled for 2018.

British Columbia

There are currently three confirmed sites of flowering rush in BC, but none located within the Columbia Basin. However, given the close proximity of flowering rush to the US portion of the Pend Oreille river system, the provincial government has been conducting targeted surveillance for flowering rush on the Canadian portion of the Pend Oreille annually since 2012 with no plants found.

The other three sites include Bouchie Lake in the Cariboo, Hatzic Lake in the Fraser Valley and a golf course pond in Whistler Resort Municipality on the southwest coast.

Bouchie Lake. Consists of numerous relatively small (<5meter^2) [54 feet^2]), discreet sites that have been treated via suction dredge annually since 2016. The population is declining in density and distribution. This site was confirmed by voucher collection in 2013. Site status was confirmed via extent survey in 2014 and contained using permeable weighted curtains in 2015.

Hatzic Lake. This site includes a large, continuous uniform occurrence of flowering rush along almost the entire lake margin and adjacent sloughs. Site status was confirmed via extent survey in 2012. Presence has not been confirmed downstream of the pump station in the Lower Hatzic Slough, where the lake drains into the Fraser River. Herbarium samples were first collected from the Hatzic Lake site in 1973 and periodically after that point. Samples are housed at the Royal BC Museum and the University of British Columbia. Hatzic Lake drains directly into the Fraser River and is about 24 kilometers (15 miles) from Silver Lake, WA where there are known flowering rush infestations. The drainages of Hatzic Lake and Silver Lake are not believed to be connected. Ideally permeable physical barriers would be installed to contain the infestation, in addition to treatment efforts. However, due to the size of the infestation, complexity of the site, and densely populated area, containment and treatment activities have not yet been initiated.

Whistler Pond. This site was first identified in 2006, and confirmed by voucher collection in 2015. An extent survey in 2015 confirmed that the infestation is confined to the man-made pond. Herbicide treatment using diquat was completed in 2016. Treatment was not possible in 2017 due to herbicide product shortage. Herbicide treatment occurred again in 2018.

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Washington

Pend Oreille River. A single patch of flowering rush was discovered in 2010. It was covered and treated with herbicide and eliminated. Since then many additional patches have been found spanning the length of the river, presumably the result of fragments floating down from Lake Pend Oreille. In 2014, comprehensive river and shoreline surveys were initiated, including 1.8 miles (2.9 km) in Idaho below Albeni Dam. Consequently, Boundary Reservoir is on an annual eradication schedule targeting all of the infested areas utilizing herbicide on the shoreline and DASH for in-water treatments. The shoreline infestations in Box Canyon Reservoir are treated annually with herbicide, whereas in-water infestations are treated depending on available funding. The herbicide treatments are done with glyphosate at 6% with surfactant. The Kalispel Tribe has used limited barriers and DASH over the past four years to control stands along the shoreline.

Spokane River. 9-Mile, Lake Spokane and Little Falls Reservoirs – Flowering rush was first found in Lake Spokane and Little Falls Reservoir in 2010, and confirmed in 9-Mile Reservoir in 2012. Since 2011 portions of the populations in 9-Mile and Lake Spokane are hand pulled using divers annually, funded by Avista Utilities to fulfill their Federal Energy Regulatory Commission (FERC) license requirements. No control work has taken place in Little Falls Reservoir to date.

Yakima River. Emergent flowering rush has been treated in those portions of the river accessible by airboat since 2016. Glyphosate with surfactant are being used.

Columbia River at Orondo and Lake Entiat. Divers have hand pulled and covered patches in late summer each year since the presence was confirmed in 2015.

Columbia River at Lake Wallula. Tri-cities area, above McNary Dam – Flowering rush has been found between the Yakima River mouth and about 8 km (5 miles) upriver of the dam have remained untreated except for emergent plants treated near Finley.

Columbia River at Lake Wallula. Near McNary Dam and in Lake Umatilla – Flowering rush in this section of the river, which forms the border with Oregon, has been controlled in cooperation with the Oregon Department of Agriculture and US Army Corps of Engineers (USACE). Flowering rush was first found near McNary Dam on the Washington side, both upstream of the dam and downstream in Lake Umatilla, in 2014. In 2015, additional survey work farther up river located a few additional flowering rush plants. All known patches were controlled using DASH and covered in 2015. The patches were checked and re-controlled in 2016. More recent surveys, conducted by University of Washington botanists in 2017 and 2018 under contract by the USACE, have located additional flowering rush in Lake Umatilla, with isolated patches extending as far down-river as just about 13 km (8 miles) above John Day Dam. Hand pulling had taken place when possible.

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Oregon

Flowering rush was first detected in August 2014 in the Columbia River during surveys conducted by Portland State University with funding provided by an Oregon State Weed Board grant. A total of six sites were discovered above McNary Dam in Umatilla County. The source of the infestation is in the Yakima River and an associated irrigation ditch. USACE and Oregon Department of Agriculture (ODA) staff placed weighted mats over the sites in January 2015 in an attempt to keep them from spreading while permits were in process for DASH treatments.

An extensive survey of McNary Pool occurred in late July of 2015, with a team from ODA, USACE, Washington State Department of Agriculture, Washington Department of Ecology and Morrow County; 24 additional sites were discovered in Oregon – an increase of 68% for the total number of sites in this area from 2014.

Mechanical treatment using DASH was completed on all sites in McNary Pool during the late summer of 2016. Follow up surveys have not been extensive but a few new sites were in close proximity to known sites. All of those sites were covered in 2017. Detailed site histories and maps have been developed to track the results of management and population trajectory between the mouth of the Snake River and the sites in the John Day Pool. No benthic mats or other treatments were done in 2018 in the McNary Pool. Some new sites were found and the initial site remained active. Some initial sites, that had been subject to DASH treatments and covered in 2015, had plants growing out from underneath the benthic barriers.

Surveys by Portland State University over the past two years have discovered multiple sites below McNary Dam, several in Oregon. The Oregon sites, upstream of Arlington, are the farthest west locations to date. These sites were hand pulled and covered in 2017 and 2018. In 2018, all sites that had any visible plants were hand pulled with the exception of the two largest sites (sites were 0.2 acres [0.08 hectares] with 50% cover, and 0.1 acres [0.04 hectares] with 20% cover). No further infestations were found in surveys targeting flowering rush in the Bonneville and Celilo pools down river of these sites.

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Prevention and Education

The prevention of introduction and spread of flowering rush is of great importance to the Columbia Basin area managers and stakeholders. While it is recognized that one strategy may not fit for all individual entities involved in prevention and education, the Columbia Basin CWMA management plan team suggests the following will be instrumental in the effort on flowering rush.

Education on identifying flowering rush, what to do if you find it, and how to prevent its spread are all key components of a management plan for this invasive species. Education programs aim to gain public support while ultimately invoking changes in behavior of targeted user groups. While the relationship between education and behavior change is indirect and complex, education is an essential first step to achieve behavior change. Gaining public support for efforts for managing invasive species will result in a reduction of introductions, better mapping of the species, and maintain healthier ecosystems. The educational strategies below outline key messages and activities[6] to help protect aquatic ecosystems from flowering rush. Aligning messages across jurisdictions, through common campaigns or slogans is beneficial for sharing resources, cost savings, and resonating with the public by hearing it through multiple platforms.

There are multiple resources that have been developed by various partners, (Figure 28) including but not limited to university extension reports, posters, and videos.[7] Many of these resources may be used by others to assist in flowering rush outreach.

Learning Objectives

AWARENESS

- Target audiences are aware that invasive species exist and are a threat to healthy ecosystems.

KNOWLEDGE

- Target audiences understand the impacts of flowering rush on aquatic ecosystems.

ATTITUDE

- Target audiences gain an appreciation and concern for aquatic ecosystems that may be impacted by flowering rush and want to take action to prevent the spread.

SKILLS

- Key target audiences develop the skills required to identify flowering rush, and know who to contact to report the presence of flowering rush.

ACTION

- Key target audiences undertake recommended stewardship actions by preventing the spread of flowering rush, reporting detections to appropriate governing bodies, and actively broadcasting and sharing their knowledge with other people.

Figure 28. An example of flowering rush outreach materials provided to the public (Photo credit: Washington State University Extension)

[6]The strategies follow the approach created by The Campaign for Environmental Literacy http://www.fundee.org/campaigns/
[7]Online resources can be found at www.columbiabasincwma.org. A short educational video, Flowering Rush: Invasion of the Columbia Basin, can be accessed directly at https://www.youtube.com/watch?v=Ii-ZQ8QVpDs

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Key Educational Messages

The following are a variety of potential messages or information that could be shared with the appropriate target audience.

1. Impacts and importance of aquatic invasive species, such as:

- Flowering rush impacts on ecosystems, human health, and the economy
- How flowering rush is spread
- What it means for the public and why they should care

2. Don't Let it Loose Campaign promotes stewardship actions & behavior change, such as:

- Plant native species
- Dispose of aquatic plants in the garbage
- Never release live plants or animals into the environment
- Report any new sightings to the appropriate governing body

3. Key legislation

- Effective legislation passed and enacted
- Enforcement of laws regulating invasive species

> *Education on identifying flowering rush, what to do if you find it, and how to prevent its spread are all key components of a management plan for this invasive species.*

EDUCATIONAL OBJECTIVE GOAL					TARGET AUDIENCE	DESCRIPTION	LEVEL OF IMPACT & INTEREST
AWARENESS	KNOWLEDGE	ATTITUDE	SKILLS	ACTION	Aquaculture Horticulturists	Horticulturists who plant aquatic plants	High
AWARENESS	KNOWLEDGE	ATTITUDE	SKILLS	ACTION	Waterfront Owners	People who own property along water bodies where flowering rush may be growing	High
AWARENESS	KNOWLEDGE	ATTITUDE			Recreationalist	People who utilize waterways for recreation (fishing, boating, swimming, etc.)	High
AWARENESS	KNOWLEDGE	ATTITUDE			Decision Makers	Planners, law makers, decision makers in communities and around water bodies	Medium to High
AWARENESS					Public	All lake and water users	Low

Table 3. Key educational objectives and target audiences in flowering rush outreach are identified. Examples of target audience outcome have been described. The level of impact of each objective is described from high to low.

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Evaluating and Reporting

The prior knowledge of each target audience should be evaluated prior to starting an education plan, unless it can be reasonably assumed that people are not aware of flowering rush or its issues. After three years of implementing the entire education plan, the knowledge, attitudes, and behaviors of the target audience should be re-evaluated. Evaluation techniques include:

- Survey of awareness, attitude and actions: what they know about the issue, how they feel about it and what they have done to help
- Client satisfaction evaluations for the educational products: what are their thoughts about them? Are they meeting their needs while also affecting the general public?
- Scientific data can also help evaluate the strategy as a whole: are there more reports of flowering rush (people are aware of what it looks like, and how to report it)? Are there less introductions or new populations (people stop planting or spreading it)?

POTENTIAL TOOL & ACTIVITIES	AWARENESS	KNOWLEDGE	ATTITUDE	SKILLS	ACTIONS
1. Print	Print resources (Fact sheets, pamphlets, brochures)				
2. Online	Online resources (website, social media)			Training videos	
	Infographics		Social media campaigns	Webinars	
3. Ads	TV, radio, print press releases	TV and radio series			
	Social media ads				
	Press releases, key messages				
4. In-person	Presentations (conferences, meetings)				
	Trade shows				
	Giveaways				
5. On-site	On-site outreach				
	Regulatory signage	Educational signage			
	Posters			Tools to assist, remind of, or prompt, an action	
	Giveaways			Prizes/Incentives for action	
6. Distance		Teaching kits			
	PowerPoint slide deck, Webinars				
7. Community			Citizen science programs		
			Community stewardship initiatives		

Table 4. Potential tools and activities that can be applied in flowering rush education objectives to reach target audiences. Shaded areas in the table indicate the type of tool & activity that will affect a specific educational objective goal.

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In order to address the regional management of flowering rush, strategies from multiple geographic zones (states and provinces) have been determined that identify priority areas[8], and short- and long-term actions designed specific to the issues seen in those geographic zones. For each geographic zone, multiple partners collaborated from state, federal, and tribal entities to develop these priorities and actions.

In 2018, the passage of the US Federal Water Resources Reform Development Act (H.R. 8; WRRDA) included language that addressed invasive species management, specifically for flowering rush. One million dollars was allocated for flowering rush control and projects required a 50% match from state, tribal, or local governments for eligibility. Permitting challenges have delayed allocating this funding source to specific projects. In addition, monitoring, surveillance, and biocontrol development efforts are not eligible projects. Further, the 50% match has been a challenge for state agencies with limited budgets specific to flowering rush management. The following suggestions would help CWMA partner entities accomplish the priorities and actions identified here.

Suggestions include:

- Permit the use of WRRDA funds for early detection monitoring, delimiting surveys, detailed treatment response monitoring, and research
- Reduce match requirements to 25%
- Prioritize state and local funding for flowering rush control projects to maximize opportunities for matching funds
- Restrict use of funds to Columbia Basin states
- Prioritize treatment for infestations on the downstream edge of the invasion
- Allow use of WRRDA funds for projects on federal lands and within federally managed facilities
- Work toward multi-state legislator support for funding and requisite changes to make the funding more useful
- Seek other federal and state sources of funding that might be less restrictive or more appropriate

> *One million dollars was allocated for flowering rush control and projects required a 50% match from state, tribal or local governments for eligibility.*

Montana State Flowering Rush Priority Areas, Short-term and Long-term Actions

Developed by Tom Woolf (Montana Fish, Wildlife & Parks) and Craig McLane (Montana Fish, Wildlife & Parks).

Montana Priority Areas

1. Clark Fork River
2. Flathead Lake
3. Flathead River
4. Noxon Reservoir
5. Cabinet Gorge Reservoir
6. Thompson Falls Reservoir

MT Short-term Actions

- Evaluate listing aquatic invasive plants under Montana Fish, Wildlife & Parks Invasive Species List instead of Montana Department of Agriculture's Noxious Weed List.
- Continue early detection monitoring efforts west of the Continental Divide.

[8]In many cases the priority areas that have been identified for specific geographic areas will encompass US Fish and Wildlife Service managed refuges and waterfowl production areas.

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- Respond to infestations in new waterbodies to prevent new satellite populations.
- Maintain public access at infested waters.

MT Long-term Actions

- Encourage regional efforts for research into long-term control options.
- Support the development of biocontrol options.
- Develop a biocontrol implementation plan prior to this control option becoming available.

Idaho State Flowering Rush Priority Areas, Short-term and Long-term Actions

Developed by Jeremey Varley (Idaho State Department of Agriculture).

Idaho Priority Areas

1. Lake Pend Oreille (North Idaho)
2. Blackfoot Reservoir (East Idaho)
3. Gem Lake Reservoir (East Idaho)
4. Aberdeen Springfield Canal near American Falls Reservoir (East Idaho)

ID Short-term Actions

- Survey known populations to determine a rate of spread.
- Control "leading edge" populations by diver harvesting to slow the rate of spread.
- Target large dense populations of flowering rush to receive treatments based on best management practices with efforts targeted at control, keeping the plant below detrimental thresholds.

ID Long-term Actions

- Continue the study started with Dr. John Madsen (USDA ARS/UC Davis) to determine the best treatment efficacy.
- Continue treatments to prevent spread further downstream into the Columbia River Basin.

Alberta Flowering Rush Priority Areas, Short-term and Long-term Actions

Prepared by Nicole Kimmel (Alberta Agriculture & Forestry) and Tanya Rushcall (Alberta Environment and Parks).

Alberta Priority Areas

1. Flowering rush has not been found in the Canadian portion of the Columbia River Basin

2. Lake Isle (>17 kilometer [11 miles] of shoreline)

Background: Largest infestation with width up to 10 meters (33 feet). Flowering rush is continuous in the west basin of the lake. Isolated control efforts through research have been attempted to date. Plans for 2019 include diquat application on 8 km (4.9 miles) of shoreline. Diquat is currently the only registered aquatic herbicide in Canada. Imazapyr is under review for registration.

3. Buffalo Creek (2.5 kilometers [1.5 miles])

Background: Found in isolated patches. Management complicated by bed and shore ownership by landowner through old Hudson Bay claim. Completed three years of diquat, bi-annual applications with slight biomass reductions so far. Currently exploring the potential to use imazapyr.

4. Sturgeon River (4 kilometers [2.5 miles] surveyed, more likely downstream)

Background: First documented escape for Alberta reported in 1990, with no action until 2017. The City of St. Albert hand removed plants in 2017 and expanded efforts to dig entire river infestation in 2018.

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5. Bow River

a. Natural Watercourse (88 km [55 miles] of river, isolated patches to solid patches)

Background: Confirmed a few locations but extent was not fully realized until survey in 2017. Any control work approvals cannot be sought without exact knowledge of locations. Control options are limited by drinking and irrigation users.

b. Western Irrigation District Diversion (20 km [12 miles] of irrigation canal)

Background: Canal dredged mechanically starting 2015 but for silt removal, did not touch riprap sides where rush was established. Suction harvesting was attempted in 2016 on a small test section. Diver Assisted Suction Harvesting was explored in 2017.

c. Chestermere Lake, (10 km [6.2 miles] shoreline)

Background: Research trials on non-chemical control treatments occurred in 2016 and 2017. Control efforts complicated by drinking use and irrigation use. Reservoir drained from Oct-April. Flowering rush has moved past lake to areas of drainage. Hand pulling was implemented in 2018 along all shores to prevent flowering rush from gaining a major presence.

6. South Saskatchewan River

(450 km [280 miles])

Background: Infestation is very prevalent in this river. Extensively used for drinking and irrigation use makes control efforts daunting. Extent was only discovered in 2017. No plan outside of awareness for municipalities has started yet.

7. Sherwood Park storm water pond

Background: Infestation is somewhat isolated. Entering the third year of diquat application.

8. Various other storm water pond/pond/golf course water hazards/dugout locations

Background: Infestations are mostly isolated. Waiting for effective control efforts before prescribing control work in these areas. Hand removal is occurring in smaller populations (Edmonton, Calgary, Lacombe, Olds, Sundre and Taber).

Alberta Short-term Actions

Potential shovel-ready projects:

- Control activities on Lake Isle (small portion for diquat application)
  - Hand digging to continue with lake residents
  - Cutting and mechanical harvesting to continue for lake access
- Control activities at Buffalo Creek
  - Herbicide application - 4th year of diquat
- Control activities at Sturgeon River
  - Hand digging in city limit section
- Control activities in Chestermere Lake
  - Hand digging in drawdown
- Monitoring
  - Determine downstream extent of population on Sturgeon River.
- Education and promotion of citizen science
- Improve provincial approval response time and clarify process
- Clarify effective treatments for controlling flowering rush available to Alberta

Alberta Long-term Actions

- Explore extending herbicides available for aquatic use in Canada as well as extending labels for currently/pending products.
  - Currently diquat is the only registered aquatic herbicide in Canada.

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  - Imazapyr is currently under review with the Pest Management Regulatory Agency for registration. Label does state it is not to be used on waters with irrigation, which is a significant portion of Alberta waters.
- Determine economic impact of flowering rush to Alberta.

British Columbia Flowering Rush Priority Areas, Short-term and Long-term Actions

Provided by Val Miller and Becky Brown (British Columbia - Ministry of Forests, Lands, Natural Resource Operations and Rural Development).

BC Priority Areas

1. Pend Oreille River: Flowering rush has not been confirmed in the Canadian portion of the Columbia Basin.

2. Flowering rush populations outside the Columbia Basin occur in:

a. Bouchie Lake (Cariboo) – flows into the Fraser River Watershed

b. Hatzic Lake (Fraser Valley) – flows into the Fraser River Watershed

c. Whistler Pond (golf course) – flows into the Lillooet River via Green Lake and Green River

BC Short-term Actions

- Continue conducting annual detection surveys in the Pend Oreille River with the expectation that it will eventually show up from the Washington State upriver population.
- Physically contain confirmed populations using permeable barriers.
- Conduct treatments (via suction dredge and diquat herbicide) to reduce population density and distribution, with the ultimate goal of eradication.
- Educate the public in affected areas to identify flowering rush and prevent new introductions to new locations.
- Encourage nursery retailers to not sell flowering rush (sales are not a common occurrence at this time).
- Enforce the Weed Control Act to eradicate new occurrence as required.

BC Long-term Actions

- Canadian portion of Pend Oreille River is completely influenced by two dams downstream. The regular draw down may help with access and selection of treatment options in the future if/when flowering rush is discovered.
- Develop long-term strategy with Washington State.
- Revise provincial legislation to prevent the sale and transport of flowering rush and elevate species to Prohibited Noxious Weed.
- Eradicate confirmed populations.
- Support the registration of new aquatic herbicide products in Canada and label expansions to existing/pending products.
  - Diquat is the only registered aquatic herbicide for plants in Canada
  - Imazapyr is currently under review with the Pest Management Regulatory Agency for full registration

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Washington State Flowering Rush Priority Areas, Short-term and Long-term Actions

Developed by Jenifer Parsons (Washington State Department of Ecology), Justin Bush (Washington Invasive Species Council), Greg Haubrich (Washington State Department of Agriculture), and Jennifer Andreas (Washington State University Extension)

Washington Priority Areas

1.Pend Oreille River (includes entire length of river in Washington State)

Background: High priority control area. Flowering rush is patchy throughout river in WA. Control has occurred since 2010.

2. Spokane River

Background: Found in three reservoirs (9-Mile, Lake Spokane, Little Falls). Past management varies by landowner. Avista Utilities funds some diver pulling and covering but not enough to control the populations. No control work has been done to date in Little Falls Reservoir; which has no public boat access.

3.Yakima River

Background: Infestation extends from Prosser to the confluence with the Columbia River. The population consists mostly of emergent plants. Past control work has been done from airboats, includes spraying, surveying and mapping. Two sections have not been controlled because it is too shallow and rocky for airboats. Nearby irrigation canals have bank populations that are not being controlled, and there is a large population in a seasonally-flooded wetland off the main river that was treated with imazapyr in 2018.

4. Mainstem Columbia River

a. Orondo (0.40 km [0.25 miles] of shoreline just downriver of the Orondo Park boat launch and near Lincoln Rock State Park in Lake Entiat above Rocky Reach Dam)

Background: Small infestations have been controlled over last 2-3 years with good results. The reservoirs upstream (Lake Pateros) and downstream (Rock Island Pool) have been surveyed with no additional plants found. This population is genetically distinct, genotype 3, from other Washington populations, which are genotype 1.

b. Mouth of the Yakima River to near Arlington, OR.

i. The mouth of the Yakima River to the mouth of the Snake River (a control and contain area)

ii. The confluence of the Snake to John Day Dam (early detection - rapid response area)

Background: Work in this section has been in partnership with Oregon Department of Agriculture (ODA), USACE Walla Walla and Portland Districts, and USFWS Mid-Columbia National Wildlife Refuge. Some flowering rush patches are fairly large (2 hectares [5 acres]) with smaller scattered patches. The flowering rush plants are mostly submerged. Control work has consisted of mostly DASH, pulling and covering. Partnership with ODA, USACE Portland District, and USFWS have supported surveys and control work conducted yearly on lower sections of the river.

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Washington Short-term Actions

Potential shovel-ready projects:

- Control activities on Pend Oreille River
- Control activities Prosser to Columbia River
- Control at Little Falls area, increase control on Lake Spokane, 9-Mile reservoirs
- Control in Columbia between Arlington and Yakima River
- Control in Columbia River patches in Lake Entiat (near Orondo)
- Invite Spokane Tribe of Indians and Avista Utilities to join the CWMA
- Determine upstream extent of population on Spokane River (above 7-mile bridge)
- Develop control plan for Little Falls population
- Develop control plan for irrigation canal edges
- Coordinate site visits for stakeholders to view upstream issue
- Create economic impact analysis for impacts in Washington State
- Analyze/estimate control costs for Washington State projects. Develop a range (lowest to highest) of control costs per acre—manual, mechanical, biological, chemical
- Identify stakeholder groups that can help educate decision makers on this issue
- Create a Washington State Flowering Rush Management Plan using the regional plan as foundation

WA Long-term Actions

- Clarify management responsibilities in reservoirs
- Develop control plan for Benton County private duck pond population
- Develop monitoring strategy for Snake River in Washington
- Develop biocontrol implementation plan for flowering rush ~1-2 years before agent availability
- Convene a work group tasked with developing model FERC comments related to monitoring and treatment of Class A, B designate noxious weeds
- Ensure nursery inspectors are trained in flowering rush identification to better enforce the quarantine laws

Oregon State Flowering Rush Priority Areas, Short-term and Long-term Actions

Developed by Mark Porter (Oregon State Department of Agriculture), Mark Sytsma (Portland State University), and Tim Butler (Oregon State Department of Agriculture).

Oregon Priority Areas

1. **Main-stem Columbia River** (no other known infestations in the Columbia River Basin)

    a. Stateline to near Arlington, OR

    Background: All patches are very small but scattered between Wallula Gap and Arlington. Plants are mostly submerged. Mostly DASH, pulling and covering used for control. EDRR is ongoing. Managed by USACE Walla Walla and Portland Districts and the USFWS Mid-Columbia National Wildlife Refuge with help from the Lower Columbia Flowering Rush Working Group. This partnership is facilitated by ODA/WDOE and WSDA and includes over 70 members from multiple stakeholder groups. Partnership with ODA and USACE Portland District have supported surveys conducted yearly on lower sections. No known sites below Arlington, though surveys have been completed in likely habitats below dam.

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Oregon Short-term Actions

Shovel-ready projects:

- Control in Columbia between Stateline and John Day Dam
  - EDRR inventory in likely sites of infestation. Physically mark and treat as found (DASH and cover)
  - Manual control on all new sites. Use DASH (versus pulling) where possible and cover
  - Monitor all known sites and immediate areas for any growth. Use DASH (versus pulling) where possible and cover
- John Day Pool
  - EDRR inventory in likely sites of infestation
  - Manual control on all new sites. Use DASH (versus pulling) where possible and cover
  - Monitor all know sites and immediate areas for any growth. Use DASH (versus pulling) where possible and cover
- Bonneville Pool downstream to the mouth of the Columbia
  - Continue EDRR surveys in likely areas for new sites
  - Physically mark and treat as found (DASH and cover).
  - Survey at-risk irrigation reservoirs, wildlife areas and ditches in the area (i.e. Cold Springs)
- Implement monitoring for flowering rush propagules at dam gate wells, John Day Dam and other overflows
- Facilitate ongoing coordination and implementation
- Support inventory and control work with Oregon State Weed Board Grants
- Continue to co-coordinate the Lower Columbia River Flowering Rush Working Group with WDOE,WSDA and other partners to ensure:
  - Coordinated and regional treatments are in enacted
  - All entities are apprised of best management practices
  - Proper permissions are understood and received and in place (i.e. NEPA and Consultation, Archeological clearance)
  - Support for ongoing biological control research as a long-term solution to regional infestations

Oregon Long-term Actions

- Help explore and support herbicide options or any other new methods of control (e.g. time release herbicide) and implement if effective and as approved (USACE NEPA & consultation as needed).
- Educate public and landowners on the identification, risk and control of flowering rush through:
  - Brochures and on-line information
  - Meetings and presentations with local weed control entities
  - Keep irrigation districts apprised and involved in project work
- Ensure flowering rush is not spread through recreational or other activities:
  - Support Clean, Drain, Dry messaging to incoming and outgoing recreationalists
  - Support outreach to boating community by providing education and outreach info to ODFW's boat inspection staff and stations
  - Monitor aquatic plant sales when found
- Update Oregon State Flowering Rush Management Plan to complement the regional plan
- Develop monitoring strategy for Snake River in Oregon
- Develop biocontrol implementation plan for flowering rush ~1-2 years before agent availability

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- Coordinate early detection surveys with other ongoing aquatic invasive species surveys, e.g. quagga and zebra mussel surveys

Columbia Basin CWMA Actions

Short-term Regional Actions

- Define or document survey and monitoring protocols being used regionally
- Create data sharing agreement and frequency for basin states and provinces
- Increase support for biocontrol development funding
- Increase research focus on ecological impact to fisheries and salmon recovery, especially with non-native piscivorous fish in the lower Columbia River
- Initiate conversations with fisheries managers about preventing and/or monitoring northern pike movements in the Columbia River
- Develop long-term monitoring strategy and information sharing for Snake River in Oregon, Idaho, and Washington
- Develop long-term monitoring strategy and information sharing for lower Columbia Basin in both Oregon and Washington
- Reduce down-river movement of propagules

Long-term Regional Actions

- Create economic impact analysis for impacts across Columbia Basin
- Develop regional biocontrol implementation strategy

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Identified Research Needs

Despite the long presence of flowering rush in North America, there is much to be learned about its biology and ecology. Better understanding of the phenology, reproduction and dispersal, impacts, and management options would facilitate control of the plant in the Columbia Basin. Flowering rush research questions were solicited at the Flowering Rush Summit in Spokane in February 2018. Additional discussion via email occurred following the meeting. Research questions that were suggested are listed below without any attempt to prioritize.

1. Flowering rush in the Columbia Basin perennates and disperses primarily via vegetative propagules (rhizomes and rhizome buds).
   a. Do rhizome buds exhibit dormancy?
   b. What is the most effective method to manage the rhizome bud bank in the sediments?
   c. How does temperature and photoperiod influence the timing of sprouting of rhizome buds?
   d. How long can rhizomes and rhizome buds survive out of water?
   e. Does size of rhizome bud relate to establishment success in flowering rush in the Columbia Basin?
   f. How does the buoyancy of root buds and rhizomes affect dispersal?
   g. How and when do the root buds that are in the sediment detach from the rhizome and get to the surface to spread?
   h. Do plants sprouted from root buds, bulbils, or rhizomes differ in ability to establish in deep water?
2. Flowering rush competes with, and can displace, native aquatic plant communities.
   a. Does disturbance (e.g. ice scouring, wave action, boating activities, wildlife trampling and browsing, management of Eurasian watermilfoil) of submersed plant communities facilitate invasion and establishment of flowering rush?
   b. Does allelopathy, consumptive competition, or resource preemption facilitate the invasion of flowering rush and displacement of other submersed plants?
3. Additional treatment options are desperately needed.
   a. Can liquid or granular, low-rate treatments with triclopyr control flowering rush?
   b. Can non-chemical treatment with UV-light effectively control the submersed growth form of flowering rush?
   c. How does the interaction of phenological stage and treatment timing influence efficacy of treatment, and is it the same for submersed and emergent growth forms?
   d. How does contact/exposure time influence efficacy of untested aquatic herbicides on flowering rush (e.g. penoxsulam, topramezone, bispyribac-sodium, florpyrauxifen-benzyl)?
   e. What unregistered aquatic herbicides, adjuvants, and delivery methods can increase efficacy of flowering rush control?
   f. Lack of efficacy below the waterline with emergent foliar herbicide application has been commonly reported. Why is this occurring and how can herbicide translocation to roots be enhanced in these treatment situations?
   g. How would these treatments impact other organisms in the sites where flowering rush would be treated?
   h. Explore deployment of vertical barriers around treatment sites in flowing systems to reduce dilution of herbicides and prevent downstream dispersion for maximum effectiveness.

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4. Documentation of impacts of flowering rush is needed to understand the consequences of the invasion, spur interest in management, and increase potential funding for resource managers.
   a. How does flowering rush affect pH, temperature, and dissolved oxygen in water?
   b. How does flowering rush, which has a simple submersed growth form, influence invertebrate populations, epiphyte productivity, fish habitat quality, and food web dynamics?
   c. Does flowering rush invasion cause reduction in recreation and property values?
   d. What additional economic costs does flowering rush incur for irrigation districts?
   e. How do the economic impacts of flowering rush compare to impacts of other invasive aquatic plants?
   f. Does flowering rush establishment increase incidence of pond snails and presence of swimmer's itch parasites?
   g. What are the relationships and impacts on northern pike spawning and salmonid predation?
   h. Do flowering rush populations reduce water flows, displace water carrying capacity, and water quality in irrigation corridors? How does this economically affect production agriculture?
5. The genetic structure of adventive flowering rush populations in the Columbia Basin can influence management success.
   a. How do the genetic characteristics of flowering rush available in the nursery trade compare with established populations in the Columbia Basin, North America, and the native range?
   b. Does genotype affect palatability to herbivores, growth rate, and susceptibility to control techniques?
6. An effective and safe biocontrol agent is critical to long-term management of large, established populations of flowering rush in the Columbia Basin. Ongoing biocontrol research has identified some promising potential agents and should continue.
   a. How deep do root weevils travel in the water column and what depth do they prefer?
   b. Can potential biocontrol agents survive drawdown exposure in the winter?
7. Early detection and rapid response are crucial to management of the spread of flowering rush in the basin.
   a. Can outreach to the public, natural resource and irrigation district managers facilitate early detection and rapid response?
   b. How should resources be allocated to treatment of core and downstream/leading edge populations for most efficient control of flowering rush in the Columbia Basin?

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Next Steps

The completion of this plan marks the beginning of an effort to regionally address flowering rush and other invasive species. By working together across the basin, the Columbia Basin CWMA hopes to improve the management and coordination to address flowering rush. Successful control of flowering rush in the Columbia Basin will require a long-term commitment to a coordinated strategy with adequate funding to protect the valuable natural and economic resources of the basin.

Key next steps include:

- Coordination among management entities in the basin through regular flowering rush updates and management plan implementation meetings and conferences.
- Working with state and federal legislators to implement this plan.
- Coordinating with other aquatic invasive species early detection and management programs in the basin to develop synergies.
- Advocating for support to address research needed to better control flowering rush.
- Widely distribute this plan through electronic distribution and presentations at relevant conferences (Pacific Northwest Economic Region Meeting, Western Regional Panel on ANS Annual Meeting, International Conference on Aquatic Invasive Species, etc.).
- Updating this plan as needed to maintain its viability and responsiveness to changing circumstances and incorporate the best available scientific information.

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Acronyms

CRTFIC – Columbia River Intertribal Fisheries Commission

CWMA – Cooperative Weed Management Area

DASH – Diver Assisted Suction Harvest

CBCWMA – Columbia Basin Cooperative Weed Management Area

EDRR – Early Detection Rapid Response

FERC – Federal Energy Regulatory Commission

IDAPA – Idaho Administrative Procedures Act

ISDA – Idaho Department of Agriculture

MFWP – Montana Fish, Wildlife & Parks

WISC – Washington Invasive Species Council

WSDA – Washington State Department of Agriculture

WDOE – Washington Department of Ecology

ODA – Oregon Department of Agriculture

USACE – US Army Corps of Engineers

USFWS – US Fish and Wildlife Service

USFS – US Forest Service

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Definitions

Adventitious roots – plant roots that form from non-root tissue

Bulbils – small bulb-like vegetative reproductive structure

Columbia Basin – the entire region, including watersheds in Canada, which drains into the Columbia River

Cooperative Weed Management Area - a partnership of federal, state, provincial, and local government agencies, Native American and First Nation Tribes, non-governmental organizations, individuals, and various interested groups that manage invasive species (or weeds) within a defined area

Cytotype – refers to ploidy level

Diploid – containing two homologous sets of chromosomes; the fertile type of flowering rush

Genotype – the entire set of genes in a cell, an organism or an individual

Impoundment – a body of water confined within an enclosure, as a reservoir

Inflorescence – in a flowering plant, a cluster of flowers on a branch or a system of branches

Rhizome – a continuously growing horizontal underground stem that puts out lateral shoots and adventitious roots

Meristem – plant tissue primarily found at the growing tips of roots and shoots consisting of actively dividing cells forming new tissue

Perennates – to survive from one growing season to the next, often with a period of reduced or arrested growth between seasons

Pistil – the ovule producing part of a flower

Ploidy – the number of sets of chromosomes in a cell, or in cells of an organism

Sepal – outer parts of the flower, often green and leaf-like

Senescence – the process by which cells irreversibly stop dividing and enter a state of permanent growth arrest without undergoing cell death

Stamen – the pollen producing part of a flower

Triploid – containing three homologous sets of chromosomes; the sterile type of flowering rush

Umbel – an inflorescence that consists of a number of short flower stalks which spread from a common point

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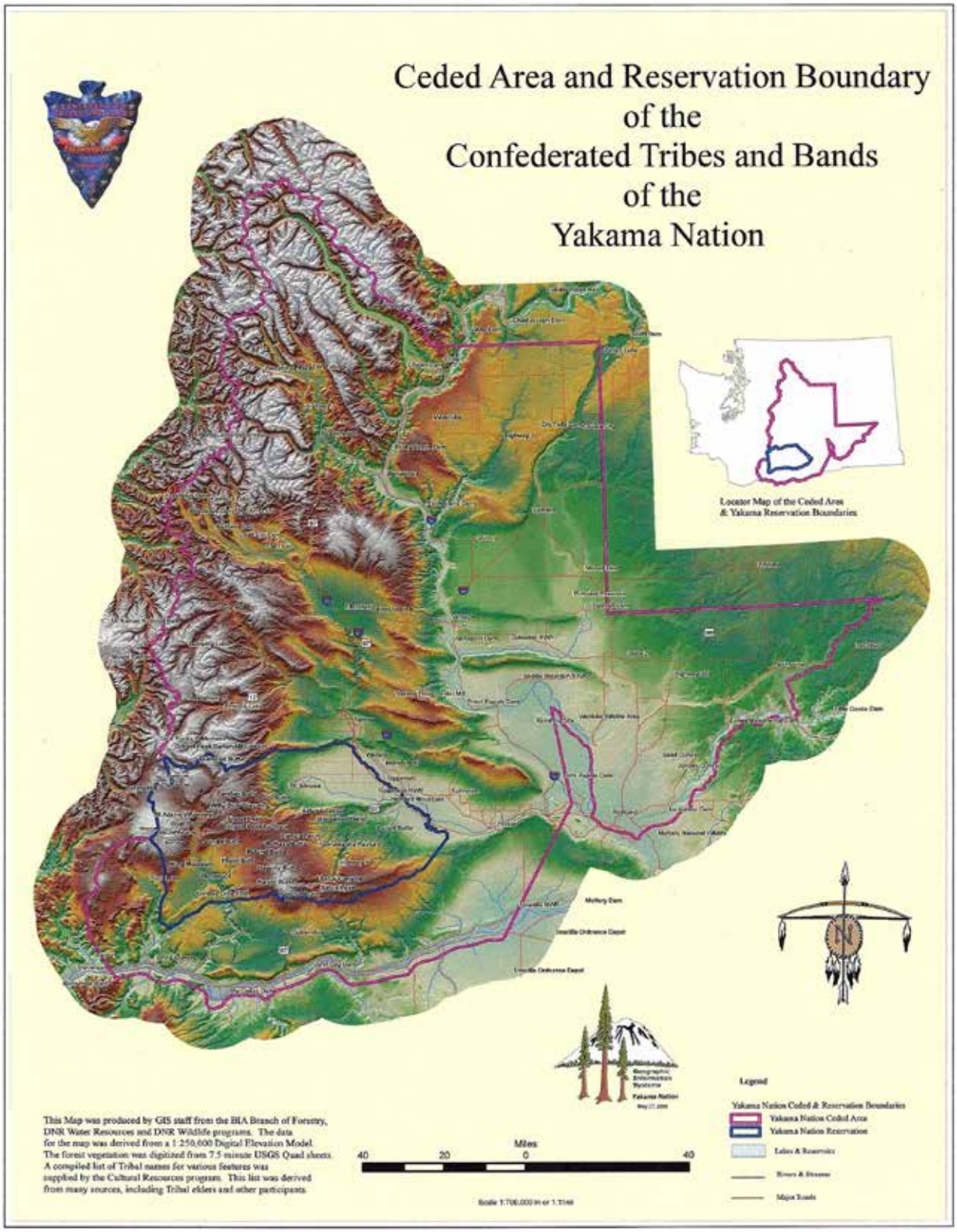
Yakama Ceded Territories



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Background on Columbia Basin Cooperative Weed Management Area

The creation of the Columbia Basin CWMA and primary actions.

Organizations across the Columbia Basin have engaged various actions to address flowering rush since first detected in 1964 in Flathead Lake. In 2014 the Northern Rockies Invasive Plant Council hosted a flowering rush regional meeting in Spokane, Washington to share information and raise awareness of the issue. In subsequent years, the issue has been reported on at various regional events, such as the 100th Meridian Initiative[9] Columbia River Basin Team meetings.

At the March 2016 Washington Invasive Species Council[10] regular meeting, the Council received a presentation on the status of flowering rush in Washington State and the Pacific Northwest region. The Washington Invasive Species Council directed staff to form an interagency work group to discuss options for responding to this issue within Washington State. Following interagency meetings between state agencies, the participants reached consensus that the issue would be best addressed at a watershed-wide level.

Following Washington Invasive Species Council research into funding opportunities for regional collaborative groups, they identified the National Fish and Wildlife Foundation, Pulling Together Initiative[11] (PTI) grant opportunity. The Pulling Together Initiative is a nationally competitive funding opportunity that is one of the only public-private partnerships to address invasive weeds nationally. PTI grants are intended to help support the creation of public-private partnerships to bring together landowners, citizen groups, and experts to develop and implement strategies for managing weed infestations on public lands, natural areas, and private working lands.

The Washington Invasive Species Council convened multiple meetings with key stakeholders from across the basin over the course of fall and winter 2016 to develop a proposal in response to the 2016 Pulling Together Initiative Request for Proposals. The National Fish and Wildlife Foundation awarded the Washington Recreation and Conservation Office $65,000 to implement the proposal submitted on behalf of the Columbia Basin stakeholders.

Following execution of an agreement between the National Fish and Wildlife Foundation and Washington Recreation and Conservation Office on January 2, 2017, staff of the Washington Invasive Species Council issued a Request for Quotations[12] on February 15, 2017 for an organization to implement the tasks of the agreement. The Invasive Species Action Network[13] (ISAN) was selected as the successful contractor by the Washington Recreation and Conservation Office who then began implementation of contracted tasks following contract execution on April 4, 2017. One of the first tasks completed by ISAN was the formation of a CWMA Steering Committee.

The Columbia Basin CWMA Steering Committee was formed in 2017 to provide long-term leadership for the CWMA in addressing flowering rush and advance the mission of the Columbia Basin CWMA. The mission of the CWMA is as follows:

[9] http://www.westernais.org/100th-meridian
[10] https://invasivespecies.wa.gov/
[11] http://www.nfwf.org/pti/Pages/home.aspx
[12] https://invasivespecies.wa.gov/documents/RFQQ-RCO1701-WISC-CRB-States-CWMA.pdf
[13] http://stopais.org/

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The organization is assembled for the purposes of collaboration and cooperation on cross-jurisdictional and cross-border management of invasive species that threaten a significant portion of the Columbia Basin watershed. The initial focus of the organization shall be on the invasive aquatic plant flowering rush *(Butomus umbellatus)*, but the focus may expand based on regional need and consensus among the organization leadership.

CWMA Membership

Individuals who are interested in the management of flowering rush are invited to join the CWMA. Membership or participation in the CWMA does not preclude membership in other CWMA organizations that have a different scope or geographic footprint. The Columbia Basin CWMA includes participation from state, provincial, federal, and tribal governments, as well as regional government (i.e. county), non-profit organizations, industry and other stakeholders.

CWMA Information Sharing

The Columbia Basin CWMA hosts a website that provides general information and related products completed by the CWMA (http://www.columbiabasincwma.org). Those with an interest in the Columbia Basin CWMA may join the list serv (columbiabasincwma@lists.wsu.edu) to post or learn from information shared on this platform.

COLUMBIA BASIN CWMA STEERING COMMITTEE 2019

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COOPERATIVE WEED MANAGEMENT AREA

COLUMBIA BASIN

CWMA

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Appendix I. Public Comments and Responses, BIA Comments and Responses, CSKT Responses: Water Quality, Water Resources, Office of Pesticides, Fisheries, Wildlife, Tribal Historic Preservation Office

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Appendix I. Public and Agency Scoping meeting comments

December 10, 2019, Polson Indian Senior Citizens Center

Can lake levels be managed to facilitate flowering rush treatments?

Response: To be addressed in planning for a long term Flowering Rush Controls Program development

What will happen with native vegetation in treatment areas?

Response: There will be native plant losses at treatment locations where flowering rush and native plants grow in common. Flowering rush generally grows alone in most treatment sites. See in environmental consequences section of the Flathead Lake Flowering Rush Environmental Assessment.

What is nature of infestation on north end of the lake?

Response: West shore, north shore, and upper Flathead River have populations of flowering rush.

What is the home range of flowering rush?

Response: Middle East

How far is it distributed?

Respone: North eastern US to the middle Columbia River region.

How does it spread?

Response: Rhizomes

What entities are engaged in flowering rush investigations?

Response: CSKT, SKC, University of Montana, University of Mississippi, University of Lethbridge

What type of soils does it favor?

Response: Muck, peat, sandy soils

Include north end of lake in landowner notification and mapping flowering rush?

Response: Working with MT FWP on north end of lake inventory.

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December 11, 2019, NRD

What is half-life of chemical

Response: See herbicide safety fact sheets (Appendix B. Imazapyr has a half-life of three to five days. Imazamox has a half-life of 17 days

Flowering Rush comments from the Bureau of Indian Affairs Provided is the status of the proposed project for draft Environmental Assessment (EA): Flathead Lake Flowering Rush Controls:

1. Environmental Assessment content, format, page limit & adding requested information in the EA document (NEPA process as a whole).

A. I have attached an outline of the format, page limit, heading and requirements in EA.

Response: We have reviewed the proposal and feel it complies with the BIA Indian Affairs National Environmental Policy Act (NEPA) Guidebook 59 IAM 3-H (2012)
Section 6 Environmental Assessments (EA, 6.4)

2. Threatened & Endangered Species Act (ESA-Section 7) (1 part of NEPA process): Coordination with Tribal Wildlife needs to be completed or provided documents, if already completed.

A. Affected Environment (baseline) information needed:
A description and map of eagle and known swan nests around the action area.

Response: Maps of eagle and swan nests are in CSKT Wildlife Department comments attached. Annual consultation will occur with the Wildlife Department on the status of active and non-active nests.

A description and map of bull trout habitat and the action area.

Response: Bull trout critical habitat map is included in the environmental assessment and comments from the CSKT Fisheries Department attached.

A description of grizzly bear activity in the action area.

Response: Provided in CSKT Wildlife comments attached.

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A list in the Appendix of T&E species and other fish and wildlife species, specifically those that could be impacted like a list of amphibians, birds, fish.
Maps, maps, and more maps

Response: Five threatened and endangered species are listed with anticipated no effects for species and habitat impacts attached.

B. Environmental Consequences (impacts) additional information needed:
The effects of the proposed herbicide on forage fish prey species (for eagles and grizzly etc.), and on amphibians, invertebrates (water quality) etc. Literature/references cited.

Response: Herbicide fact sheets are included in Appendix B. The proposed herbicides are classified as practically non-toxic by the US EPA to fish, mammals, birds, and invertebrates. These chemicals do not bioaccumulate in fish, birds, or mammals. The use of methylated seed oil surfactant is labeled for aquatic use.

The effects on water quality, bull trout habitat and habitat conditions.

Response: The CSKT water quality program comments do not identify water quality concerns from implementation of herbicide controls attached. The CSKT Fisheries program supports the reduction of flowering rush and they find flowering rush degrades habitat for bull trout and westslope cutthroat trout attached. The CSKT and US ACE both determine bulltrout May be Affected, Not likely to be Adversely Affect by herbicide use attached.

C. Mitigation Required:
"A 660 buffer will be applied to activities around all eagle nests when the activity (including application from a boat) is visible from the nest; and a 330-foot buffer around swan, and for eagle nests if the activity isn't visible."

Response: CSKT Wildlife comments establish a ¼ mile buffer from active bald eagle and swan nests. Annual consultation will review proposed treatments and determine nesting activity attached.

Grizzly bear conservation measures were mentioned.

Respone: No special grizzly bear measures were identified by CSKT Wildlife attached.

Bull trout mitigation, if needed.

Respone: No special bull trout measures were identified by CSKT Fisheries attached.

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Posting/signs at the application sites stating what and why the aquatic herbicide, and any precautions.

Response: Application sites will be posted with information about the herbicide used. There is a one day re-entry period and no restrictions for recreational use. The adjacent landowners have been contacted and they have provided their agreement to participate in the project.

D. All Application permits in the Appendix. Maps.

Response: A Pesticide General Use Permit is under application to the US EPA. Shoreline Protection Office will issue permits directly to participant adjacent landowners.

This is a must: Regional Biologist will require a letter/email/documentation from the CSKT Hydrology, Fish, and Wildlife programs to be included in the Appendix for the final draft.

Letters from CSKT Fisheries, Wildlife, Water Quality, and Hydrology are included in this appendix.

3. Cultural Resources (Section 106) (2nd part of NEPA process):

Regional Archaeologist is out, however provided is his requirement for analysis. I did not see any Tribal Archaeologist of THPO letter and/or memo in the draft EA. **Analysis for Impact:** This step is conducted by Archaeologists, this can be at the Tribe if the Tribe has qualified staff on-board. To assist in projects moving forward quickly having the tribal archaeologist or THPO indicate if surveys have been done in the area and if any potential impact is noted under 36 CFR 800. For Tribes with no THPO, if an impact (to historic resources, this does not include other types of impacts) is expected the CEER moves to an EA and requires consultation with the SHPO. If no impact is expected and can clearly be shown, then the CEER moves forward. This step requires the applicant and/or submitter to actually discuss with the archaeologist the proposed project and its scope and then submitting the archaeologists letter/report/memo about potential impacts or avoidance. If this step is not completed prior to submission, the Regional Archaeologist will halt the review and contact the Tribal Archaeologist and/or THPO to discuss the proposed project and its potential impacts.

Response: The CSKT Cultural Preservation Office has an application to review the proposed treatment sites and will submit a letter to the regional archaeologist.

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January 30, 2020

Mr. Virgil Dupuis – SKC Extension
Director
PO Box 70
Pablo, MT 59855

Dear Mr. Dupuis,

This letter is in response to the Salish Kootenai College and BIA draft Environmental Assessment to assess impacts from the proposed Flathead Lake Flowering Rush Controls Project. The proposed action is to implement annual herbicide treatments on flowering rush to the bed of Flathead Lake and the Flathead River.

The Water Quality Program appreciates the efforts of the Salish Kootenai College faculty and staff to include the CSKT Natural Resources Department staff in the preparation of this project.

At this time, the Water Quality Program does not have objections to the project. Please keep the program informed of any changes that may affect water quality within the scope of the project.

Respectfully,

Chauncey Means,
CSKT Acting Water Quality Program Manager

cc: Willie Keenan, CSKT Environmental Protection Division Manager

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THE CONFEDERATED SALISH & KOOTENAI TRIBES

WATER RESOURCES PROGRAM

MEMORANDUM

To:	Virgil Dupuis, SKC Extension Director
From:	Casey Ryan, CSKT Natural Resources Department
Date:	January 29, 2020
Re:	Flathead Lake Flowering Rush Controls Project

Background

Salish Kootenai College and BIA are preparing a draft Environmental Assessment to assess impacts from the proposed Flathead Lake Flowering Rush Controls Project. The proposed action is to implement sequential annual herbicide treatments to flowering rush infestations during spring lake drawdown to reduce top growth and rhizome growth to reduce the spread around Flathead Lake and down the Flathead, Clark Fork, and Columbia River system

Summary of Findings

Impacts to Tribal surface water resources will be minimal to non-existent. The proposed applications would not occur within ½ mile of active potable drinking water sources. All herbicide applications will comply with EPA and manufacturer guidelines. The proposed action would not result in a consumptive use of Tribal water resources.

Impacts to Tribal groundwater resources will be minimal to non-existent. The described application levels are not sufficient to cause impacts to groundwater quality. Consumptive withdrawals from groundwater sources for use in this project are *de minimis*.

Impacts to irrigation water flow are minimal to non-existent. Irrigation water delivery will not be affected, and irrigation water quality impacts are considered *de minimis.*

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Flowering rush is shown to reduce irrigation canal water flow, thus reduction of flowering rush from the immediate area is considered beneficial.

Flowering rush reduces desirable habitat for native fish species. Removal of flowering rush is considered a benefit to aquatic habitat for native species.

Recommendations

Contractors and applicators must be qualified to use and familiar with all herbicide application best management practices and guidelines.

Contractors and applicators must take all necessary precautions to prevent herbicide spills or uncontrolled releases. Any uncontrolled releases or spills must be immediately reported to the SKC Project Manager.

Any boats used must be inspected for aquatic invasive species prior to launching on any water body.

All mechanical equipment must be cleaned prior to and after use in any waterbody.

It is the opinion of the CSKT Water Resources Program that if these recommendations are adhered to, there will be no significant negative impact to Tribal water resources as a result of this project.

Thank you for the opportunity to provide comment on this matter.

Yours respectfully,

Casey E Ryan

Casey E. Ryan, Hydrologist
Confederated Salish & Kootenai Tribes
Natural Resources Program

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January 9, 2020

Mr. Virgil Dupuis – SKC Extension Director
PO Box 70
Pablo, MT 59855

Dear Mr. Dupuis,

The Confederated Salish and Kootenai Tribes Pesticide Program has reviewed your proposal to implement annual herbicide treatments on flowering rush to the bed of Flathead lake and River. We are very excited and grateful that you and your team are working hard on this growing threat and support this project. We do not have any questions or concerns about the proposed program, but we would like to have our program included in the project pertaining to the following considerations:

- Notification of who is contracted to perform herbicide applications.
- Including the CSKT Pesticide Program on the call list for reporting pesticide spills, exposures, and emergencies.
- Notification of sites selected for treatment.
- Including the CSKT Pesticide Program on any further news and updates to the project/program.

Please feel free to contact me if you have any questions.

Sincerely,

Ryan Evans
Pesticide Specialist I, CSKT

cc: Jasmine Brown
Pesticide Program Manager, CSKT

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Confederated Salish and Kootenai
TRIBAL FISHERIES PROGRAM

MEMORANDUM

Date: February 3, 2020
To: Virgil Dupuis, Director, SKC Extension
From: Barry Hansen, Fisheries Biologist
Subject: Draft EA on Flathead Lake Flowering Rush Controls Project

The Tribal Fisheries Program is concerned about the expanding invasion of flowering rush in Flathead Lake and its likely detrimental effects on native fish species. Accordingly, the Program supports efforts to address this growing problem provided that treatments are closely monitored and communicated to stakeholders. The Draft EA and process provide assurance that our concerns will be met, and therefore we support proceeding with future treatments.

Bull trout (*Salvelinus confluentus*) currently listed as threatened, and Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) a species of special concern, both occur year-round in Flathead Lake. In addition, the preferred habitat for both species is the shallow, nearshore portions of the lake. Therefore there is clear potential for these species to come in contact with the herbicide used to treat flowering rush.

Flowering rush is likely detrimental to native fish species in Flathead Lake because it is either radically modifying or completely replacing the structurally and species diverse plant community that was present historically. We are concerned that dense infestations may even impede access to some spawning tributaries. Dense stands also likely favor certain non-native fishes for a wide range of needs from spawning to foraging.

We assume that negative effects on native fishes will be undetectable based on published reports of extremely low toxicity and rapid breakdown rates for imazamox and imazapyr. Additionally, while fish may have slight exposure to the treatment chemicals, they also have free movement to uncontaminated waters away from shore.

While fish mortality is very unlikely, we request that workers be observant of the possibility of any associated fish-kills or abnormal behavior and report such events.

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MEMORANDUM

Date: February 3, 2020

To: Virgil Dupuis, Flathead Indian Reservation Extension

From: Dale Becker, Tribal Wildlife Program Manager

Subject: Flowering Rush Treatment Plan EA Comments

I have reviewed the documents related to this project and have also discussed potential wildlife and/or wildlife habitat impact issues with you related to this proposed project. After reviewing the materials, maps of locations of potential treatment sites and other related wildlife data, I am sending this memorandum to address questions raised in either our discussions or in the comments from U. S. Bureau of Indian Affairs personnel. These comments primarily address federally-listed Endangered, Threatened and Candidate Species of Terrestrial wildlife documented either on or adjacent to potential flowering rush treatment sites, bald eagle nests, and trumpeter swan nesting areas.

According to the U. S. Fish and Wildlife Service's Website addressing federally-listed species, the following species are included for the project area, which is located at several sites along the shoreline of the south half for Flathead Lake, located in Lake County, Montana.

Grizzly Bear (Threatened Species)
Canada Lynx (Threatened Species)
Yellow-billed Cuckoo (Threatened Species)
Wolverine (Proposed Threatened Species)

Grizzly bears inhabit the entire extent of the Mission Range to the east of Flathead Lake (see attached U. S. Fish and Wildlife Service Species Profile, including range map). While grizzly bears occasionally are observed near the eastern shore of the lake, their presence there is sporadic and incidental, and it is not considered as part of the species' core habitat or as management Situation 1 or 2 habitat. Given the nature, timing, duration and methodology of the proposed flowering rush treatment project, I do not anticipate any adverse impacts upon either grizzly bears or their habitat in the area. The Tribal Wildlife Management program will provide information to project planning and treatment personnel to minimize the potential for encounters with grizzly bear, precautions for on-site activities and reporting procedures in case grizzly bears or grizzly bear activity is observed. Copies of standard public information on these procedures is included as an attachment to this memorandum.

Canada lynx inhabit portions of the Mission Range along the east side of Flathead Lake, generally at elevations above 4,000 feet above sea level (see attached U. S. Fish and Wildlife Service Species Profile, including range map). There have been no verified observations of Canada lynx occupying any of the proposed project treatment areas, and any occurrence at those sites would be deemed as incidental. I do not anticipate any adverse impacts upon Canada lynx or the habitat of this species resulting from any activities associated with this project, given the location and habitats involved with it.

Yellow-billed Cuckoo may or may not inhabit areas on the Flathead Indian Reservation, even though the U. S. Fish and Wildlife Service Species Profile (attached) includes mention of western Montana as

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potential habitat. During the Tribal Wildlife Management Program's breeding bird and other avian surveys on the Flathead Indian Reservation no observations of the species have been noted. In addition, the habitats proposed for flowering rush treatment in the current proposal are not habitats in which the presence of yellow-billed cuckoos would not be anticipated. I do not anticipate any adverse impacts upon yellow-billed cuckoos or the habitat of this species resulting from any activities associated with this project, given the location and habitats involved with it.

Wolverines inhabit portions of the Mission Range to the east of Flathead Lake, generally at higher elevations (see attached U. S. Fish and Wildlife Service Species Profile, including range map). Only one potential observation of a wolverine is known at lower elevation near the lakeshore, but not on or immediately adjacent to any of the potential flowering rush treatment sites. Habitats proposed for treatments are not habitats in which the presence of wolverines would be anticipated. I do not anticipate any adverse impacts upon wolverines or the habitat of this species resulting from any activities associated with this proposed project, given the location and habitats involved with it.

In addition to a review of potential impacts upon federally-listed species, I also considered potential impacts of the proposed flowering rush treatment proposals upon nesting bald eagles and trumpeter swans. Neither of these species are listed as Endangered, Threatened or Proposed by the U. S. fish and Wildlife Service; however, both are species show status is closely monitored annually be the Tribal Wildlife Management Program.

Bald eagles were de-listed as a Threatened Species several years ago. Since the late 1980s, the Tribal Wildlife Management Program has monitored bald eagle nesting activity and wintering eagles each year. The Tribal Wildlife Management Program maintains a data bae of these data and updates them annually. In evaluating the potential for negative impacts upon nesting bald eagles from flowering rush treatment, I noted that six bald eagle nesting locations are in close proximity to potential treatment sites. Some of those sites may not be active during proposed treatment periods in April, 2020. The Tribal Wildlife Management Program utilizes guidelines included in the Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group, 1994), of which the Confederated Salish and Kootenai Tribes are a signatory entity. The general guideline for restriction of mechanized activity such as timber harvest, building construction, road construction is implementation of a no activity buffer of ¼ mile around the nest location. The recommended primary seasonal restriction for activities within the buffer zone around an active nest is from approximately February 1st through August 15th. However, the proposed flowering rush treatment sites may not occur within that buffer zone. If they are outside that distance from active nests, no restriction related to conducting the treatment would be required. If potential treatment were planned for sites within the ¼ mile around an active bald eagle nest, the Tribal Wildlife Management Program would oppose treatment at those sites within the time-period mentioned above. Evaluation of such conflict sites would be conducted annually to determine status of nesting bald eagles at those sites annually prior to any potential treatments. That said, I would not expect the same potential for nest abandonment due to treatment activities as I might for other habitat-altering activities, such as those mentioned above.

Trumpeter swans were apparently common as a local breeding bird prior to 1900; however, the species was nearly exterminated in the 1880s and early 1900s due to market hunting for skins, feathers and meat, as well as impacts due to wetland habitat destruction and degradation. The Tribal Wildlife management Program commenced reintroduction of Trumpeter Swans in 1997, and the project has been quite successful in restoration of the species as a local breeding bird. In evaluating the potential flowering rush treatment sites, I reviewed locations of known trumpeter swan nests on Flathead Lake.

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The only nesting territory is located west of Ducharme Point Fishing Access in wetland vegetation (including flowering rush). Although there is no guarantee that this pair of nesting swans will utilize the same general location or this specific site in subsequent years, the Tribal Wildlife Management Program recommends that no treatment occur within ¼ mile of this nest site. In addition, treatment of this area should be coordinated to avoid undue disturbance of nesting trumpeter swans.

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Field Checklist for Birds & Wildlife of the Flathead Indian Reservation

WILDLIFE MANAGEMENT PROGRAM
CONFEDERATED SALISH AND KOOTENAI TRIBES
Box 278 • Pablo, MT 59855
Ph. (406) 675-2700 email: wildlife@cskt.org

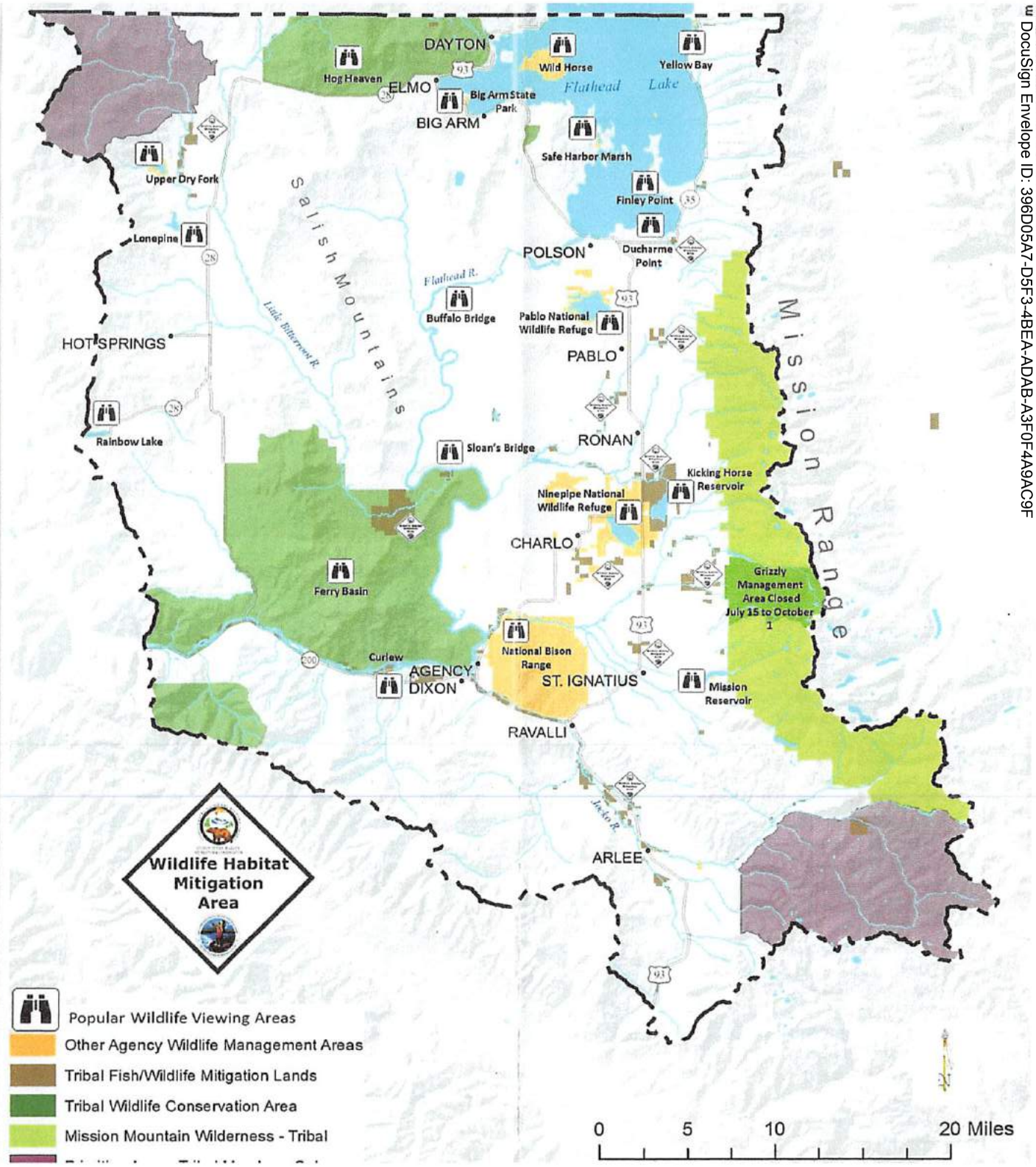
THE TRIBAL WILDLIFE MANAGEMENT PROGRAM

The responsibility of the Confederated Salish & Kootenai Tribal Wildlife Management Program is to protect, enhance, and manage wildlife resources and habitats to provide for viable populations of all wildlife species present on the Flathead Indian Reservation (FIR). A few major objectives of the wildlife program include • the monitoring of big game; waterfowl; upland gamebird; endangered and threatened species; sensitive and nongame species and furbearer populations, • achieving hydroelectric mitigation at Kerr; Libby; and Hungry Horse Dams, • development and implementation of regulations necessary to insure stable wildlife populations, • providing input in forest and range management; habitat inventory; natural resources planning; and environmental assessments related to projects administered or regulated by other Tribal programs.

The Tribes of the FIR are closely tied to their natural environment and believe that everything in nature is embodied with a spirit. These spirits are woven tightly together to form a sacred whole (the Earth). Changes, even subtle changes, affecting one part of this web affect other parts, making it essential for the Tribal Wildlife Program to protect these cultural resources if the Tribes are to sustain Tribal values and cultures. In the elders' stories of birds, we can hear something of their deeply felt connection to these animals as well as learn the tribal way of careful, close observation of animals. The Tribal people's souls and spiritual values stem from the landscape and its wildlife. We see an ancient relationship with birds that is rooted in the very creation of the world and the coming of Tribal peoples to this land. While enjoying the beauty of our Reservation through various outdoor recreational activities, please help us preserve the wildlife and our culture by leaving an area as pristine as possible.

Contemporary wildlife management activities occurred in the 1930's with the passage of several Tribal Council Resolutions. In 1936, the Tribal Council established and sold the first Tribal hunting and fishing permits and established fish and game regulations. Tribal Game Wardens were first hired in 1943 and the first Biologist was employed during the early 1940's.

Collectively, the Fisheries and Wildlife programs manage roughly 18,000 acres of Tribal Wildlife Mitigation Lands throughout the Flathead Indian Reservation. These lands were purchased through funding from hydroelectric, mining, and highway mitigation settlements and are managed to restore habitat and maintain movement corridors. These fisheries and wildlife habitat mitigation properties, designated in brown on the map, offer great wildlife viewing opportunities, and are marked by white signs such as the one shown on the map. Other great areas to view wildlife are the Bison Range, Ninepipe National Wildlife Refuge, Kicking Horse Reservoir, Pablo National Wildlife Refuge, Ferry Basin, Safe Harbor Marsh, and Wild Horse Island. Walk-in access at these sights is available to both members and non-members.



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	B	R
LOONS		
_Common Loon (S)	Y	P
GREBES		
_Pied-billed Grebe	Y	P
_Horned Grebe	Y	P
_Red-necked Grebe	Y	P
_Eared Grebe	Y	P
_Western Grebe	Y	P
_Clark's Grebe	N	SM
PELICANS		
_American White Pelican	N	SM
CORMORANTS		
_Double-crested Cormorant	Y	P
BITTERNS AND HERONS		
_American Bittern (S)	Y	SM
_Great Blue Heron	Y	P
_Great Egret	N	SM
IBISES		
_White-faced Ibis (S)	N	SM
SWANS, GEESE, & DUCKS		
_Tundra Swan	N	SP/F
_Trumpeter Swan (S)	Y	P
_Snow Goose	N	SP/F
_Ross' Goose	N	SP/F
_Canada Goose	Y	P
_Wood Duck	Y	SM
_Green-winged Teal	Y	P
_Mallard	Y	P
_Northern Pintail	Y	P
_Blue-winged Teal	Y	P
_Cinnamon Teal	Y	SM
_Northern Shoveler	Y	P
_Gadwall	Y	P
_American Wigeon	Y	P
_Canvasback	Y	SM
_Redhead	Y	P
_Ring-necked Duck	Y	P
_Greater Scaup	N	SP/F,WM
_Lesser Scaup	Y	P
_Harlequin Duck (S)	Y	SM
_Common Goldeneye	Y	P
_Barrow's Goldeneye	Y	P
_Bufflehead	Y	P
_Hooded Merganser	Y	P
_Common Merganser	Y	P
_Red-breasted Merganser	N	SP/F
_Ruddy Duck	Y	P
VULTURES		
_TurkeyVulture	Y	P
OSPREYS, EAGLES, & HAWKS		
_Osprey	Y	SM
_Bald Eagle (T)	Y	P

	B	R
_Stilt Sandpiper	N	SM
_Long-billed Dowitcher	N	SM
_Wilson's Snipe	Y	P
_Wilson's Phalarope	Y	SM
_Red-necked Phalarope	N	SM
GULLS AND TERNS		
_Franklin's Gull	N	SM
_Bonaparte's Gull	N	SM
_Ring-billed Gull	Y	P
_California Gull	Y	P
_Herring Gull	N	WM
_Caspian Tern	Y	P
_Common Tern	Y	SM
_Forster's Tern	Y	SM
_Black Tern	Y	SM
PIGEONS AND DOVES		
_Band-tailed Pigeon	N	SM
_Rock Dove	Y	P
_Mourning Dove	Y	P
_Eurasian Collared Dove	-	P
OWLS		
_Barn Owl	Y	P
_Western Screech Owl	Y	P
_Great Horned Owl	Y	P
_Snowy Owl	N	WM
_Northern Pygmy Owl (S)	Y	P
_Norther Saw-whet Owl (S)	Y	P
_Burrowing Owl (S)	Y	SM
_Barred Owl	Y	P
_Great Gray Owl (S)	Y	P
_Long-eared Owl	Y	P
_Short-eared Owl	Y	P
_Boreal Owl (S)	Y	P
GOATSUCKERS		
_Common Nighthawk	Y	SM
_Common Poorwill	N	SM
SWIFTS		
_Black Swift	Y	SM
_Vaux's Swift	Y	SM
_White-throated Swift	N	SM
HUMMINGBIRDS		
_Black-chinned Hummingbird	Y	SM
_Calliope Hummingbird	Y	SM
_Rufous Hummingbird	Y	SM
KINGFISHERS		
_Belted Kingfisher	Y	P
WOODPECKERS		
_Lewis' Woodpecker	Y	P
_Red-naped Sapsucker	Y	SM
_Williamson's Sapsucker	Y	SM
_Downy Woodpecker	Y	P
_Hairy Woodpecker	Y	P

	B	R
_Western Bluebird	N	P
_Mountain Bluebird	Y	P
_Townsend's Solitaire	Y	P
_Veery	Y	SM
_Swainson's Thrush	Y	SM
_Hermit Thrush	N	SM
_American Robin	Y	SM
_Varied Thrush	Y	P
MIMIC THRUSHES		
_Gray Catbird	Y	SM
PIPITS		
_Water Pipit	N	P
WAXWINGS		
_Bohemian Waxwing	N	WM
_Cedar Waxwing	Y	SM
SHRIKES		
_Northern Shrike	N	WM
_Loggerhead Shrike	N	SM
STARLINGS		
_European Starling	Y	P
VIREOS		
_Cassin's Vireo	Y	SM
_Warbling Vireo	Y	SM
_Red-eyed Vireo	Y	SM
WOOD WARBLERS		
_Tennessee Warbler	Y	SM
_Orange-crowned Warbler	Y	SM
_Nashville Warbler	Y	SM
_Yellow Warbler	Y	SM
_Yellow Rumped Warbler	Y	P
_Townsend's Warbler	Y	SM
_American Redstart	Y	SM
_Northern Waterthrush	Y	SM
_MacGillivrays' Warbler	Y	SM
_Common Yellowthroat	Y	SM
_Wilson's Warbler	Y	SM
_Yellow-brested Chat	Y	SM
TANAGERS		
_Western Tanager	Y	SM
GROSBEAKS & THEIR ALLIES		
_Black-headed Grosbeak	Y	SM
_Lazuli Bunting	Y	SM
SPARROWS & THEIR ALLIES		
_Spotted Towhee	Y	P
_American Tree Sparrow	N	SM
_Chipping Sparrow	Y	SM
_Clay-colored Sparrow	Y	SM
_Brewer's Sparrow	Y	SM
_Vesper Sparrow	Y	SM
_Lark Sparrow	Y	SM
_Savannah Sparrow	Y	SM
_Grasshoopper Sparrow	Y	SM

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	B	R
_Northern Harrier	Y	P
_Sharp-shinned Hawk	Y	P
_Cooper's Hawk	Y	P
_Northern Goshawk (S)	Y	P
_Swainson's Hawk	Y	SM
_Red-tailed Hawk	Y	P
_Ferruginous Hawk	N	SM
_Rough-legged Hawk	N	WM
_Golden Eagle	Y	P
FALCONS		
_American Kestrel	Y	P
_Merlin	Y	P
_Peregrine Falcon	Y	P
_Gyrfalcon	N	WM
_Prairie Falcon	Y	P
PARTRIDGE AND GROUSE		
_Gray Partridge	Y	P
_Ring-necked Pheasant	Y	P
_Spruce Grouse	Y	P
_Blue Grouse	Y	P
_White-tailed Ptarmigan	Y	P
_Ruffed Grouse	Y	P
_Wild Turkey	Y	P
RAILS AND COOTS		
_Virginia Rail	Y	SM
_Sora	Y	SM
_American Coot	Y	P
CRANES		
_Sandhill Crane	Y	SM
PLOVERS		
_Black-bellied Plover	N	SM
_Lesser Golden Plover	N	SM
_Semipalmated Plover	N	SM
_Killdeer	Y	P
STILTS AND AVOCETS		
_Black-necked Stilt (S)	Y	SM
_American Avocet	Y	SM
SANDPIPERS AND PHALAROPES		
_Greater Yellowlegs	N	SM
_Lesser Yellowlegs	N	SM
_Solitary Sandpiper	N	SM
_Willet	N	SM
_Spotted Sandpiper	Y	SM
_Long-billed Curlew	Y	SM
_Marbled Godwit	N	SM
_Sanderling	N	SM
_Semi-palmated Sandpiper	N	SM
_Western Sandpiper	N	SM
_Least Sandpiper	N	SM
_Baird's Sandpiper	N	SM
_Pectoral Sandpiper	N	SM
_Dunlin	N	SM

	B	R
_Three-toed Woodpecker	Y	P
_Black-backed Woodpecker (S)	N	P
_Northern (Red Shafted) Flicker	Y	P
_Pileated Woodpecker (S)	Y	P
FLYCATCHERS		
_Olive-sided Flycatcher	Y	SM
_Western Wood-Pewee	Y	SM
_Willow Flycatcher	Y	SM
_Least Flycatcher	N	SM
_Hammond's Flycatcher	Y	SM
_Dusky Flycatcher	Y	SM
_Western Flycatcher	N	SM
_Say's Phoebe	Y	SM
_Western Kingbird	Y	SM
_Eastern Kingbird	Y	SM
LARKS		
_Horned Lark	Y	P
SWALLOWS		
_Tree Swallow	Y	SM
_Violet-green Swallow	Y	SM
_N. Rough-winged Swallow	Y	SM
_Bank Swallow	Y	SM
_Cliff Swallow	Y	SM
_Barn Swallow	Y	SM
JAYS, MAGPIES, & CROWS		
_Gray Jay	Y	P
_Steller's Jay	Y	P
_Blue Jay	N	P
_Clark's Nutcracker	Y	P
_Black-billed Magpie	Y	P
_American Crow	Y	P
_Common Raven	Y	P
CHICKADEES		
_Black-capped Chickadee	Y	P
_Mountain Chickadee	Y	P
_Chestnut-backed Chickadee	Y	P
NUTHATCHES		
_Red-breasted Nuthatch	Y	P
_White-breasted Nuthatch	Y	P
_Pygmy Nuthatch	Y	P
CREEPERS		
_Brown Creeper	Y	P
WRENS		
_Rock Wren	Y	SM
_Canyon Wren	Y	P
_House Wren	Y	P
_Marsh Wren	Y	P
DIPPERS		
_American Dipper	Y	P
KINGLETS AND THRUSHES		
_Golden-crowned Kinglet	Y	P
_Ruby-crowned Kinglet	Y	P

	B	R
_Fox Sparrow	Y	SM
_Song Sparrow	Y	P
_Lincoln's Sparrow	N	SM
_Swamp Sparrow	N	P
_White-throated Sparrow	N	WM
_White-crowned Sparrow	Y	P
_Harris' Sparrow	N	WM
Dark-eyed Junco	Y	-
_Oregon Junco	Y	P
_Lapland Longspur	N	WM
_Snow Bunting	N	WM
BLACKBIRDS & ORIOLES		
_Bobolink	Y	SM
_Red-winged Blackbird	Y	P
_Western Meadowlark	Y	P
_Yellow-headed Blackbird	Y	SM
_Brewer's Blackbird	Y	P
_Common Grackle	Y	SM
_Brown-headed Cowbird	Y	SM
_Bullock's Oriole	Y	SM
FINCHES		
_Rosy Finch	Y	P
_Pine Grosbeak	Y	P
_Purple Finch	N	WM
_Cassin's Finch	Y	P
_House Wren	Y	P
_Red Crossbill	Y	P
_White-winged Crossbill	Y	P
_Common Redpoll	N	WM
_Hoary Redpoll	N	WM
_Pine Siskin	Y	P
_American Goldfinch	Y	P
_Evening Grosbeak	Y	P
OLD WORLD SPARROWS		
_House Sparrow	Y	P

Remember to view wildlife at a respectful distance!

It is important to remember that the wildlife you encounter are wild, unpredictable and potentially a dangerous species. By getting too close you can unknowingly disturb a nesting or denning site which may cause territorial behavior. We ask that you do not approach them too closely, no matter how tame they appear. Remember, if you are close enough to change their natural behavior... You're too close! Please be respectful and view wildlife from a safe distance.

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ACCIDENTAL / RARE BIRDS	
_Least Bittern	
_Snowy Egret	
_Green-backed Heron	
_Mute Swan	
_Brant	
_Eurasian Wigeon	
_Oldsquaw	
_Surf Scoter	
_White-winged Scoter	
_Sharp-tailed Grouse (S)	
_Common Moorhen	
_Snowy Plover	
_Whimbrel	
_Ruddy Turnstone	
_Buff-breasted Sandpiper	
_Short-billed Dowitcher	
_American Woodcock	
_Red Phalarope	
_Long-tailed Jaeger	
_Glaucous Gull	
_Mew Gull	
_Glaucous-winged Gull	
_Black-legged Kittiwake	
_Sabine's Gull	
_Ancient Murrelet	
_Marbled Murrelet	
_Black-billed Cuckoo	
_Flammulated Owl (S)	
_Anna's Hummingbird	
_Broad-tailed Hummingbird	
_Red-headed Woodpecker	
_Boreal Chickadee	
_Northern Mockingbird	
_Brown Thrasher	
_Sprague's Pipit	
_Philadelphia Vireo	
_Northern Parula	
_Chestnut-sided Warbler	
_Blackpoll Warbler	
_Black-and-White Warbler	
_Rose-breasted Grosbeak	
_Indigo Bunting	
_Dickcissel	
_Black-throated Sparrow	
_Sage Sparrow	
_Baird's Sparrow	
_LeConte's Sparrow	
_Golden-crowned Sparrow	
_Rusty Blackbird	
_Brambling	
_Black-crowned Night-heron	
_Upland Sandpiper	
_Black Rail	

MAMMALS	A
SHREWS	
_Pygmy Shrew	U
_Masked Shrew	C
_Northern Water Shrew	U
_Vagrant Shrew	C
_Montane (Dusky) Shrew	-
BATS	
_Hoary Bat	U
_Silver-haired Bat	C
_Townsend's Big-eared Bat (S)	U
_Big Brown Myotis	U
_Long-eared Myotis	U
_Long-legged Myotis	U
_(Western) Small-footed Myotis	U
_Yuma Myotis	R
_Little Brown Myotis	C
_Fringed Myotis	R
_California Myotis	R
PIKAS, RABBITS, & HARES	
_Pika	U
_Snowshow Hare	C
_Mountain (Nuttall's) Cottontail	C
RODENTS	
_Porcupine	U
_Beaver	C
_Northern Pocket Gopher	C
_Yellow-bellied Marmot	C
_Hoary Marmot	R
_Yellow Pine Chipmunk	-
_Red-tailed Chipmunk	-
_Golden-mantled Ground Squirrel	U
_Columbian Ground Squirrel	C
_Northern Flying Squirrel	R
_Red Squirrel	C
_Western Jumping Mouse	-
_House Mouse	C
_Bushy-tailed Wood Rat	U
_Deer Mouse	C
_Muskrat	C
_Southern Red-backed Vole	C
_Heather Vole	-
_Water Vole	-
_Long-tailed Vole	-
_Meadow Vole	C
_Montane Vole	U
CARNIVORES	
_Mountain Lion	U
_Lynx (T)	-
_Bobcat	C
_Grizzly Bear (T)	C
_Black Bear	C
_Raccoon	C
_Red Fox	C
_Gray Wolf	U

	A
_Coyote	C
_River Otter	U
_Striped Skunk	C
_Badger	U
_Wolverine (S)	R
_American Marten	U
_Fisher (S)	-
_Mink	C
_Short-tailed Weasel	C
_Long-tailed Weasel	C
UNGULATES	
_Moose	U
_Elk	C
_White-tailed Deer	C
_Mule Deer	C
_Bison (Bison Range or Captive)	-
_Mountain Goat	U
_Bighorn Sheep	U
_Pronghorn (Bison Range)	-
REPTILES	
_Western Skink	R
_Northern Alligator Lizard	R
_Western Painted Turtle	C
_Bull Snake (Gophersnake)	U
_Eastern Racer	U
_Rubber Boa	U
_Western Rattlesnake	U
_Terrestrial (Western) Garter Snake	C
_Common Garter Snake	C
_Western Fence Lizard	U
AMPHIBIANS	
_Western (Boreal) Toad	U
_Rocky Mountain Tailed Frog	U
_Northern Leopard Frog	-
_Columbia Spotted Frog	C
_American Bullfrog	U
_Pacific Tree Frog	C
_Long-toed Salamander	C

Key to Checklist Symbols

B = breeding status
- Y -- recorded breeding
- N -- no breeding record

R = residency status
- P -- permanent
- WM -- winter migrant
- SM -- summer migrant
- SP/F -- Seen during spring and fall migrations

A = Abundance
- C -- Common, seen at least half the time
- U -- Uncommon, occurring in small numbers
- R -- rarely encountered, should be reported to CSKT Wildlife
- (S) -- listed as species of special concern
- (T) -- listed as threatened species
- (E) --listed as endangered species
- - absent or unknown data, if observed report to CSKT Wildlife

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IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

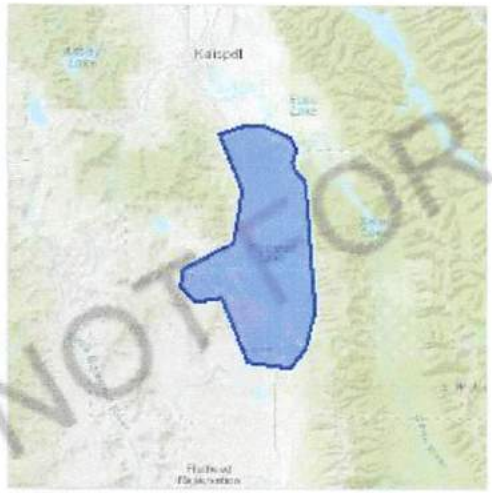
This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

Location

Flathead and Lake counties, Montana



Local office

Montana Ecological Services Field Office

(406) 449-5225
(406) 449-5339

585 Shephard Way, Suite 1
Helena, MT 59601-6287

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Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

NOT FOR CONSULTATION

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Mammals

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intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

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Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

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Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
Benton Lake National Wildlife Refuge	5,790.25 acres

(406) 727-7400
(406) 727-7432

922 Bootlegger Trail
Great Falls, MT 59404-6133

https://www.fws.gov/refuges/profiles/index.cfm?id=61510

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Canada Lynx Lynx canadensis — Threatened
There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/3652

Grizzly Bear Ursus arctos horribilis — Threatened
There is **proposed** critical habitat for this species. The location of the critical habitat is not available.
https://ecos.fws.gov/ecp/species/7642

North American Wolverine Gulo gulo luscus — Proposed Threatened
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5123

Birds

NAME	STATUS
Yellow-billed Cuckoo Coccyzus americanus There is **proposed** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3911	Threatened

Fishes

NAME	STATUS
Bull Trout Salvelinus confluentus There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8212	Threatened

Flowering Plants

NAME	STATUS
Spalding's Catchfly Silene spaldingii There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3681	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE

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Bull Trout Salvelinus confluentus Final
https://ecos.fws.gov/ecp/species/8212#crithab

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

MIGRATORY BIRD INFORMATION IS NOT AVAILABLE AT THIS TIME

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project

NOT FOR CONSULTATION

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U.S. Fish & Wildlife Service

ECOS

ECOS / Species Profile

Grizzly bear (Ursus arctos horribilis)

Range Information |Candidate Info |Federal Register |Recovery |Critical Habitat |SSA |Conservation Plans |Petitions |Biological Opinions |Life History

Taxonomy: View taxonomy in ITIS

Listing Status: Threatened and others listed below

General Information

Grizzly Bears reach weights of 180-680 kg (400-1,500 lb); the male is on average 1.8 times as heavy as the female, an example of sexual dimorphism. Their coloring ranges widely across geographic areas, from blond to deep brown or black. These differences, once attributed to subspeciation, are now thought to be primarily due to the different environments these bears inhabit, particularly with regard to diet and temperature. The Grizzly has a large hump over the shoulders which is a muscle mass used to power the forelimbs in digging. The head is large and round with a concave facial profile. In spite of their massive size, these bears can run at speeds of up to 55 km/h (35 mph).

The species historical range included Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming. See below for information about where the species is known or believed to occur.

Population detail

The following populations are being monitored: Grizzly bear

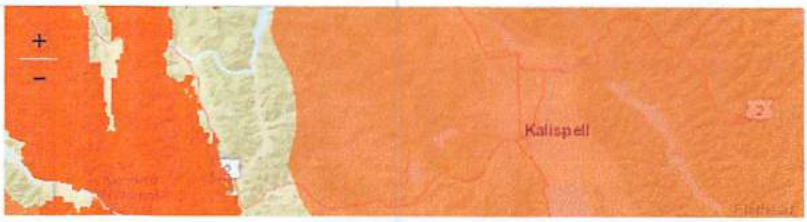
Current Listing Status Summary

Status	Date Listed	Lead Region	Where Listed
Threatened	07-28-1975	Mountain Prairie Region (Region 6)	U.S.A., conterminous (lower 48) States, except where listed as an experimental population Additional species information
Experimental Population, Non-Essential	11-17-2000	Mountain Prairie Region (Region 6)	Bitterroot Grizzly Bear Nonessential Experimental Population Area Additional species information
Under Review		Mountain Prairie Region (Region 6)	North Cascades Ecosystem Recovery Zone Additional species information
Under Review	07-28-1975	Mountain Prairie Region (Region 6)	Cabinet-Yaak Recovery Zone Population Additional species information
Under Review	07-28-1975	Mountain Prairie Region (Region 6)	Greater Yellowstone Ecosystem Distinct Population Segment Additional species information

» Range Information

Current Range

U.S.A., conterminous (lower 48) States, except where listed as an experimental population



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Bitterroot Grizzly Bear Nonessential Experimental Population Area

- ☑ *North Cascades Ecosystem Recovery Zone*
- ☑ *Cabinet-Yaak Recovery Zone Population*
- ☑ *Greater Yellowstone Ecosystem Distinct Population Segment*

Zoom in! Some species' locations may be small and hard to see from a wide perspective. To narrow-in on locations, check the state and county lists (below) and then use the zoom tool.

Want the FWS's current range for all species? Click here to download a zip file containing all individual shapefiles and metadata for all species.
* For consultation needs do not use only this current range map, please use IPaC.

- **U.S.A., conterminous (lower 48) States, except where listed as an experimental population**

  Listing status: Threatened

  - **States/US Territories** in which this population is known to or is believed to occur: Idaho, Montana, Washington, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur: Benton Lake Wetland Management District, Little Pend Oreille National Wildlife Refuge, Lost Trail National Wildlife Refuge ...Show All Refuges

- **Bitterroot Grizzly Bear Nonessential Experimental Population Area**

  Listing status: Experimental Population, Non-Essential

  - **States/US Territories** in which this population is known to or is believed to occur: Idaho
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

- **North Cascades Ecosystem Recovery Zone**

  Listing status: Under Review

  - **States/US Territories** in which this population is known to or is believed to occur: Washington
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

- **Cabinet-Yaak Recovery Zone Population**

  Listing status: Under Review

  - **States/US Territories** in which this population is known to or is believed to occur: Idaho, Montana
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

- **Greater Yellowstone Ecosystem Distinct Population Segment**

  Listing status: Under Review

  - **States/US Territories** in which this population is known to or is believed to occur: Idaho, Montana, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

» Candidate Information

No Candidate information available for this species.

No Candidate Assessments available for this species.

Candidate Notice of Review Documents

Show 10 entries

Date	Citation Page	Title

DocuSign Envelope ID: 396D05A7-D5F3-4BEA-ADAB-A3F0F4A9AC9F

Bitterroot Grizzly Bear Nonessential Experimental Population Area

- *North Cascades Ecosystem Recovery Zone*
- *Cabinet-Yaak Recovery Zone Population*
- *Greater Yellowstone Ecosystem Distinct Population Segment*

Zoom in! Some species' locations may be small and hard to see from a wide perspective. To narrow-in on locations, check the state and county lists (below) and then use the zoom tool.

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* For consultation needs do not use only this current range map, please use IPaC.

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  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur: Benton Lake Wetland Management District, Little Pend Oreille National Wildlife Refuge, Lost Trail National Wildlife Refuge ...Show All Refuges

- **Bitterroot Grizzly Bear Nonessential Experimental Population Area**

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  - **States/US Territories** in which this population is known to or is believed to occur: Idaho
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

- **North Cascades Ecosystem Recovery Zone**

  Listing status: Under Review

  - **States/US Territories** in which this population is known to or is believed to occur: Washington
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

- **Cabinet-Yaak Recovery Zone Population**

  Listing status: Under Review

  - **States/US Territories** in which this population is known to or is believed to occur: Idaho, Montana
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

- **Greater Yellowstone Ecosystem Distinct Population Segment**

  Listing status: Under Review

  - **States/US Territories** in which this population is known to or is believed to occur: Idaho, Montana, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

» Candidate Information

No Candidate information available for this species.

No Candidate Assessments available for this species.

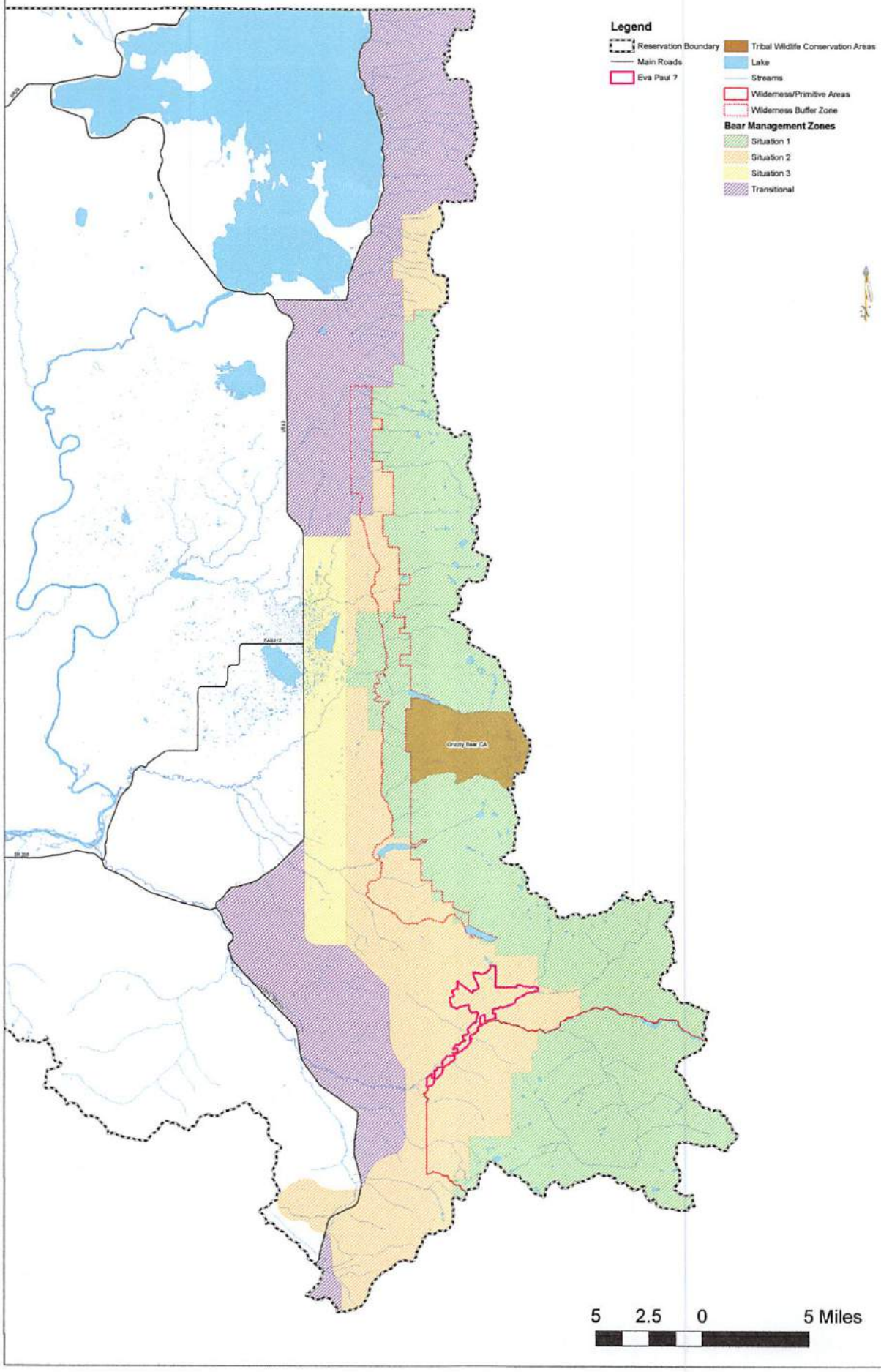
Candidate Notice of Review Documents

Show 10 entries

Date	Citation Page	Title

DocuSign Envelope ID: 396D05A7-D5F3-4BEA-ADAB-A3F0F4A9AC9F

Bear Management



Document Path: Y:\NRD\FWRC\wildlife\Bear_MGMT.mxd

U.S. Fish & Wildlife Service

ECOS

ECOS / Species Profile

Canada Lynx (Lynx canadensis)

Range Information |Candidate Info |Federal Register |Recovery |Critical Habitat |SSA |Conservation Plans |Petitions |Biological Opinions |Life History

Taxonomy: View taxonomy in ITIS

Listing Status: Threatened

Where Listed: WHEREVER FOUND

General Information

The lynx is a medium-sized cat with long legs, large, well-furred paws, long tufts on the ears, and a short, black-tipped tail. The winter pelage of the lynx is dense and has a grizzled appearance with grayish-brown mixed with buff or pale brown fur on the back, and grayish-white or buff-white fur on the belly, legs and feet. Summer pelage of the lynx is more reddish to gray-brown. Adult males average 10 kilograms (22 pounds) in weight and 85 centimeters (33.5 inches) in length (head to tail), and females average 8.5 kilograms (19 pounds) and 82 centimeters (32 inches). The lynx□s long legs and large feet make it highly adapted for hunting in deep snow. The distribution of lynx in North America is closely associated with the distribution of North American boreal forest. In Canada and Alaska, lynx inhabit the classic boreal forest ecosystem known as the taiga. The range of lynx populations extends south from the classic boreal forest zone into the subalpine forest of the western United States, and the boreal/hardwood forest ecotone in the eastern United States. Forests with boreal features extend south into the contiguous United States along the North Cascade and Rocky Mountain Ranges in the west, the western Great Lakes Region, and northern Maine. Within these general forest types, lynx are most likely to persist in areas that receive deep snow and have high-density populations of snowshoe hares, the principal prey of lynx.

The species historical range included Alaska, Colorado, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, Oregon, Utah, Vermont, Washington, Wisconsin, Wyoming. See below for information about where the species is known or believed to occur.

Current Listing Status Summary

Status	Date Listed	Lead Region	Where Listed
Threatened	03-24-2000	Mountain Prairie Region (Region 6)	Wherever Found in Contiguous U.S. Additional species information

» Range Information

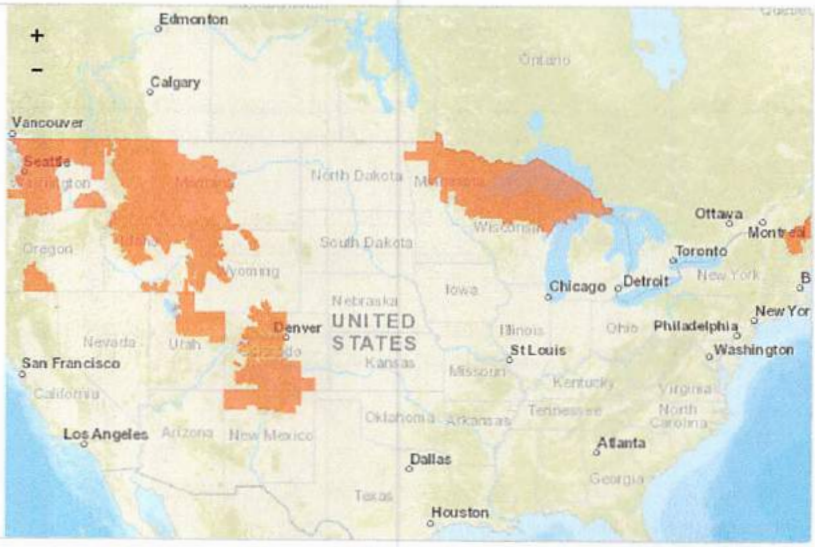
Current Range

Wherever Found in Contiguous U.S.

Zoom in! Some species' locations may be small and hard to see from a wide perspective. To narrow-in on locations, check the state and county lists (below) and then use the zoom tool.

Want the FWS's current range for all species? Click here to download a zip file containing all individual shapefiles and metadata for all species.

* For consultation needs do not use only this current range map, please use IPaC.



- **Wherever Found in Contiguous U.S.**

  Listing status: Threatened

  - **States/US Territories** in which this population is known to or is believed to occur: Colorado, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New Mexico, Oregon, Utah, Vermont, Washington, Wisconsin, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All

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- **USFWS Refuges** in which this population is known to occur: Aroostook National Wildlife Refuge, Benton Lake Wetland Management District, Little Pend Oreille National Wildlife Refuge ...Show All Refuges

» Candidate Information

No Candidate Information available for this species.

No Candidate Assessments available for this species.

Candidate Notice of Review Documents

Show 10 entries

Date	Citation Page	Title
10/30/2001	66 FR 54808 54832	ETWP; Review of Plant and Animal Species That Are Candidates or Proposed for Listing as Endangered o Threatened,Annual Notice of Findings on Recycled Petitions, and Annual Description of Progress on Listin Actions; Proposed Rule
10/25/1999	64 FR 57535 57547	Review of Plant and Animal Taxa That Are Candidates or Proposed for Listing as Endangered or Threaten Annual Notice of Findings on Recycled Petitions; Annual Description of Progress on Listing Actions
09/19/1997	62 FR 49398 49397	Review of Plant and Animal Taxa

Showing 1 to 4 of 4 entries

< Previous 1 Next >

No Uplisting Documents currently available for this species.

» Federal Register Documents

Federal Register Documents

Show 10 entries

Date	Citation Page	Title	Supportin Document
09/12/2014	79 FR 54781 54846	Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary; Final Rule	• Critic Habi Shar
06/20/2014	79 FR 35303 35309	Revised Designation of Critical Habitat for the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary	
09/26/2013	78 FR 59429 59474	Revised Designation of Critical Habitat for the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary; Proposed Rule	
10/01/2010	75 FR 60735 60736	Proposed Issuance of Incidental Take Permits to the Washington Department of Fish and Wildlife for State of Washington Wildlife Areas	
12/17/2009	74 FR 66937 66950	12-month Finding on a Petition To Change the Final Listing of the Distinct Population Segment of the Canada Lynx To Include New Mexico	

Showing 1 to 10 of 49 entries

< Previous 1 2 3 4 5 Next >

» Species Status Assessments (SSAs)

Species Status Assessments (SSAs)

No Species Status Assessments (SSA's) are currently available for this species.

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- **USFWS Refuges in which this population is known to occur:** Aroostook National Wildlife Refuge, Benton Lake Wetland Management District, Little Pend Oreille National Wildlife Refuge ...Show All Refuges

» Candidate Information

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Candidate Notice of Review Documents

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‹ Previous 1 Next ›

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» Federal Register Documents

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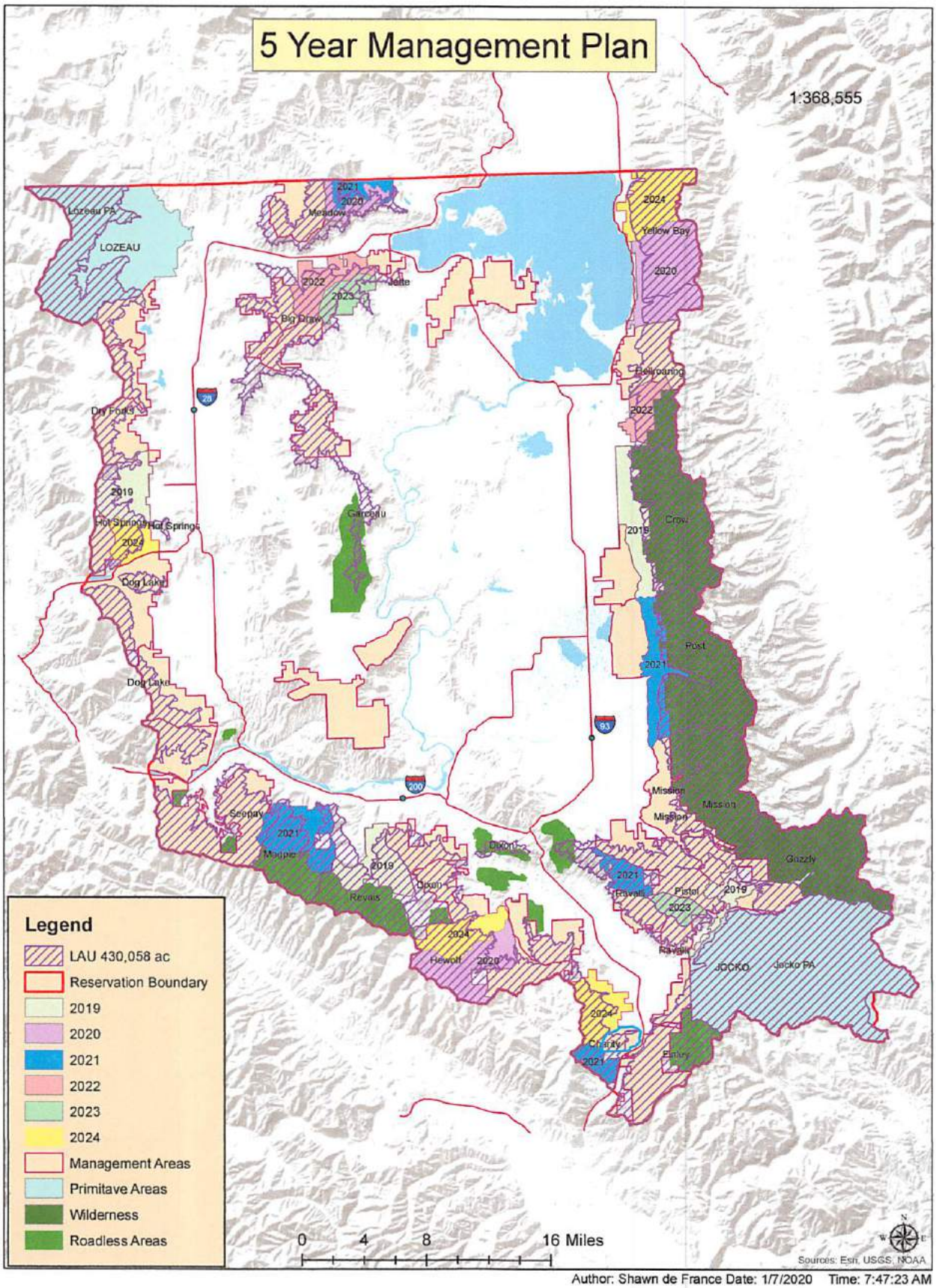


Author: Shawn de France Date: 1/7/2020 Time: 7:47:23 AM

U.S. Fish & Wildlife Service

ECOS

ECOS / Species Profile

Yellow-billed Cuckoo (Coccyzus americanus)

Range Information |Candidate Info |Federal Register |Recovery |Critical Habitat |SSA |Conservation Plans |Petitions |Biological Opinions |Life History

Taxonomy: View taxonomy in ITIS

Listing Status: Threatened

General Information

Yellow-billed Cuckoos are fairly large, long, and slim birds. The mostly yellow bill is almost as long as the head, thick and slightly downcurved. They have a flat head, thin body, and very long tail. Wings appear pointed and swept back in flight. Yellow-billed Cuckoos are warm brown above and clean whitish below. Their blackish face mask is accompanied by a yellow eyering. In flight, the outer part of the wings flash rufous. From below, the tail has wide white bands and narrower black ones.

References cited in Species Profile

- Cornell Lab of Ornithology. 2015. Yellow-billed Cuckoo. All About Birds. http://www.allaboutbirds.org/guide/Yellow-billed_Cuckoo/id
- Hughes, Janice M. 2015. Yellow-billed Cuckoo (Coccyzus americanus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/418
- Laymon, S. A. 1998. Yellow-billed Cuckoo (Coccycus americanus). In The Riparian Bird Conservation Plan:a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/riparian_v-2.html
- Partners in Flight. 2012. Species assessment database. http://rmbo.org/pifassessment/Database.aspx
- USGS Patuxent Wildlife Research Center. 2012. North American Breeding Bird Survey 1966-2010 analysis. http://www.mbr-pwrc.usgs.gov/bbs/specl10.html

The species historical range included Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, Wyoming. See below for information about where the species is known or believed to occur.

Current Listing Status Summary

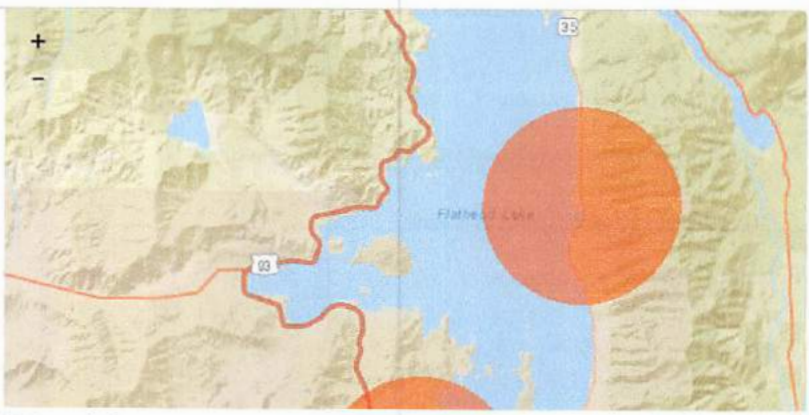
Status	Date Listed	Lead Region	Where Listed
Threatened	11-03-2014	Southwest Region (Region 2)	Western DPS: U.S.A. (AZ, CA, CO (western), ID, MT (western), NM (western), NV, OR, TX (western), UT, WA, WY (western)); Canada (British Columbia (southwestern); Mexico (Baja California, Baja California Sur, Chihuahua, Durango (western), Sinaloa, Sonora) Additional species information

» Range Information

Current Range

Western DPS: U.S.A. (AZ, CA, CO (western), ID, MT (western), NM (western), NV, OR, TX (western), UT, WA, WY (western)); Canada (British Columbia (southwestern); Mexico (Baja California, Baja California Sur, Chihuahua, Durango (western), Sinaloa, Sonora)

Zoom in! Some species' locations may be small and hard to see from a wide perspective. To narrow-in on locations, check the state and county lists (below) and then use the zoom tool.



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- **Western DPS: U.S.A. (AZ, CA, CO (western), ID, MT (western), NM (western), NV, OR, TX (western), UT, WA, WY (western)); Canada (British Columbia (southwestern); Mexico (Baja California, Baja California Sur, Chihuahua, Durango (western), Sinaloa, Sonora)**

  Listing status: Threatened

  - **States/US Territories** in which this population is known to or is believed to occur: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur: Bill Williams River National Wildlife Refuge, Bosque del Apache National Wildlife Refuge, Browns Park National Wildlife Refuge ...Show All Refuges
  - **Countries** in which this population is known to occur: Canada,Mexico,United States

» Candidate Information

No Candidate information available for this species.

No Candidate Assessments available for this species.

Candidate Notice of Review Documents

Show 10 entries

Date	Citation Page	Title
11/21/2012	77 FR 69993 70060	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions
10/26/2011	76 FR 66370 66439	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions
11/10/2010	75 FR 69222 69294	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Propose
11/09/2009	74 FR 57804 57878	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions
12/10/2008	73 FR 75176 75244	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Propose
12/06/2007	72 FR 69034 69106	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Propose
09/12/2006	71 FR 53756 53835	Review of Native Species That Are Candidates or Proposed for Listing as Endangered or Thre Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions
05/11/2005	70 FR 24870 24934	Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidat Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; An

Showing 1 to 10 of 16 entries

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No Uplisting Documents currently available for this species.

» Federal Register Documents

Federal Register Documents

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- **Western DPS: U.S.A. (AZ, CA, CO (western), ID, MT (western), NM (western), NV, OR, TX (western), UT, WA, WY (western)); Canada (British Columbia (southwestern); Mexico (Baja California, Baja California Sur, Chihuahua, Durango (western), Sinaloa, Sonora)**

  Listing status: Threatened

  - **States/US Territories** in which this population is known to or is believed to occur: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur: Bill Williams River National Wildlife Refuge, Bosque del Apache National Wildlife Refuge, Browns Park National Wildlife Refuge ...Show All Refuges
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10/26/2011	76 FR 66370 66439	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions
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11/09/2009	74 FR 57804 57878	Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annu Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions
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Showing 1 to 10 of 16 entries ‹ Previous 1 2 Next ›

No Uplisting Documents currently available for this species.

» Federal Register Documents

Federal Register Documents

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Annual Work Plan Tribal Historic Preservation Office Requirements

The project proponent will develop an Annual Work Plan that will include maps of the proposed actions identified as the Area of Potential Effect (APE) and attached descriptions of the proposed activities within the APE. These work plans should include sufficient details to understand any and all hand, mechanical or chemical applications to invasive species within the APE and clearly identify any staging areas. Maps will include the following information: scale, title, author, north arrow and date. The attached Confederated Salish and Kootenai Tribes Cultural Clearance Form will be attached to the Annual Work Plan and maps for the Tribal Historic Preservation Office (THPO) to review no later than January 15th of each year with the proposed actions for the year. The THPO will have (30) days to respond to the project proponent as per 36 CFR 800.3(c)(1)(4), at which point if no response is received the project proponent may proceed. If the THPO reinitiates consultation after this time the process is assumed to have been reinitiated and the consultation should proceed prior to further project implementation. It is the responsibility of the project proponent to provide meaningful and proactive attempts to ensure that the consultation takes place.

Impacts to historic and/or cultural resources will be identified by the Confederated Salish and Kootenai THPO and appropriate avoidance and minimization efforts identified to avoid adverse effects to resources on the reservation. If resource impacts cannot be avoided the appropriate mitigation measures will be identified in consultation between the project proponent and THPO, the BIA may participate if requested by both parties. The mitigation measures should be agreed upon with a Memorandum of Agreement and opportunities provided to the appropriate parties to participate as per 36 CFR 800.6.

Information regarding archaeological and historic sites is exempt from public disclosure under the National Historic Preservation Act (16 U.S.C. Section 470w-3) and the Archaeological Resources Protection Act of 1979 (16 U.S.C. Section 470hh). Any information provided by the THPO to the project proponent are considered confidential and should be kept with need to know staff and not distributed widely, and kept secure when not in use.

It is the responsibility of the project proponent to meaningful consult with the CSKT's THPO to ensure compliance with the CSKT's Cultural Resource Protection Ordinance in addition to the above mentioned Annual Work Plan Requirements.

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Confederated Salish and Kootenai Tribes
Cultural Clearance Form

Date _____

Cultural Clearance # _____ Project Name: _____

Applicant Name: _____ Phone #: _____

Agency Name: _____

The Tribal Preservation Office requires the following conditions:

☐ *There are **NO KNOWN** cultural or historical site locations present. Project may commence as described in Cultural Clearance application.*

☐ *This undertaking will have **NO ADVERSE EFFECT** to cultural and /or historical site(s). Project may commence as described in Cultural Clearance application.*

☐ *This undertaking will have an **ADVERSE EFFECT** to cultural and /or historical site(s). Special conditions are required to be in compliance with CSKT's Cultural Resource Protection Ordinance. See comments and/or attached document(s).*

This project qualifies as a NEPA Categorical Exclusion? Yes ☐ No ☐

COMMENTS:

****All areas** within the exterior boundaries of the Flathead Indian Reservation have the potential to contain cultural and historical resources. If any such resources or site locations are located during the project, cease activity in the vicinity of the cultural and/or historical resource and contact the Tribal Preservation Office (TPO) immediately.****

_____ Compliance Technician

_____ Approving Official

IMPORTANT STIPULATIONS: This Cultural Clearance permit is only valid for the activity described within the original application for one year. Any alterations to project plans invalidate this permit. All conditions established by the TPO must be adhered to or this permit is invalid. The applicant/agency are subject to penalties as defined in CSKT's Cultural Resource Protection Ordinance.