Columbia River Basin Team, 100th Meridian Initiative

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Columbia River Basin

Interagency Invasive Species Response Plan: Dreissenid spp.

Updated August 2018

Columbia River Basin
Interagency Invasive Species Response Plan: Dreissenid Species

Prepared for the 100th Meridian Initiative Columbia River Basin Team

This plan was prepared with funding support from the U. S. Fish and Wildlife Service, Pacific States Marine Fisheries Commission, National Oceanic and Atmospheric Administration, and the Bonneville Power Administration. The Columbia River Basin Team of the 100th Meridian Initiative includes representatives from federal, state, tribal, industry, and non-governmental organizations. Special appreciation is given to those members who directly participated in development and review of this Plan. Incident Solutions, LLC was instrumental in development of the coordination structure (Incident Command System) portions of the document. Additional document preparation assistance was provided by Dynamic Solutions Group LLP. This document was originally prepared in 2008 by Paul Heimowitz, U. S. Fish and Wildlife Service, Pacific Region and Stephen Phillips, Pacific States Marine Fisheries Commission. It has been updated on a regular basis by Creative Resource Strategies, LLC.

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An electronic version of this Plan and information about the100th Meridian Initiative Columbia Basin Team is available at https://www.westernais.org/rr-plans-exercises-groups.

Note: Some of the information contained in this, the last (2018) version of the *Columbia River Basin Interagency Invasive Species Response Plan: Dreissenid Species* is outdated. We have moved relevant rapid response information to **https://www.westernais.org/rapid-response** and **Columbia River Basin Dreissenid Incident Response Toolkit** (**http://www.crbdirt.com/**).

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USDOI Fish and Wildlife Service (Date)
October 3, 2008

Columbia River Inter-Tribal Fish Commission (Date)
October 3, 2008

Province of British Columbia (Date)
October 9, 2009

As signatories, the above parties agree to implement this plan as appropriate consistent with each signatory's laws, policies, and authorities should dreissenid species be detected in Columbia River Basin waters.

Plan Amendments

Original document produced September 2008.

Amendment #	New Amended Date of Plan	Amendment Description	Approval Date
1	9 September 2011	Updates of Figures 1 and 2, Modification of Rapid Response Objective 10, update of ESA provisions in Appendix E, update of Appendix C contacts	25 August 2011
2	3 February 2014	Updates to Figures 1 and 2, Additional background on Congarea, Mytilopsis, and Lymnoperna. Changes to Verification language, Addition of Waterbody definitions	31October 2013
3	3 November 2016	Update of Appendix C. Notification List	3 November 2016
4	27 January 2017	Updated notification list, Updated figures 1 and 2, updated Appendix C, D, and E, and F	27 January 2017
5	8 March 2017	Added Appendix J – Dreissenid Mussel Laboratories	8 March 2017
6	30 July 2018*	Updated entire document	

Introduction

The Columbia River Basin (CRB) Team was established as part of the 100th Meridian Initiative to address the special needs of the CRB. The CRB Team includes state, federal, tribal, and university ANS managers and researchers. This dreissenid mussel Interagency Response Plan for the CRB reflects strategies, models, and activities gleaned from a variety of other plans and documents, and more importantly, from a variety of initiatives, such as *Building Consensus in the West* and *Safeguarding America's Lands and Waters from Invasive Species*.

Although this Interagency Response Plan is dreissenid-specific, the response framework could be applied to other invasive species that pose a threat to the region.

I. Hazard Analysis

The family *Dreissenidae* consists of three genera of mussels: *Congarea*, *Mytilopsis*, and *Dreissena*. Collectively, these are known as dreissenids.

This plan is focused on two members of the genus *Dreissena*; the zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena rostriformis bugensis*). Although there are differences in the biology of these two species, they share many similar life history traits and cause similar adverse environmental and economic impacts. Both species have European origins and were introduced to the United States in the 1980s as the result of ballast water discharge. Both zebra and quagga mussels attach to a broad range of surfaces, including pilings, pipes, rock, cement, steel, rope, crayfish, other bivalves, aquatic plants, and each other, forming dense colonies. Zebra and quagga mussels seem to have divergent spatial distributions; zebra mussels are primarily warm, eutrophic, shallow water inhabitants whereas quagga mussels prefer shallow, warm water to deep, oligotrophic, cold-water (MacIsaac 1994). Although this Plan includes some references specific to zebra mussels (reflecting a larger national focus on the spread of this species), its objectives and tactics also apply to quagga mussels and other dreissenids.

Conrad's false mussel (*Mytilopsis leucophaeta*), also known as the false dark mussel, is another invasive member of the family *Dreissenidae*, and occasionally is found on boats entering the Pacific Northwest. This mussel represents a threat to brackish waters. Conrad's false mussel has a planktotrophic life-stage and may be difficult to differentiate from *Dreissena* species using visual identification techniques. However, as an obligate estuarine species, it is not named as a species of concern in this Plan.

The golden mussel (*Limnoperna fortunei*), an invasive freshwater mussel in the family *Mytilidae* that shares many characteristics with zebra mussels, including planktonic larvae and byssus threads, is also a potential species of concern. However, for ease of comprehension, this Plan will refer to "zebra mussels and other dreissenids" with the understanding that golden mussels may be included in this designation, although they are not members of the family *Dreissenidae*.

From 2012–2017, the states of Washington, Oregon, Idaho, and Montana intercepted a total of 313 dreissenid-fouled watercraft that originated from throughout North America. In 2016, invasive mussel larvae were discovered in Tiber and Canyon Ferry Reservoirs in Montana.

A. Zebra Mussels

The zebra mussel is a small bivalve mollusk with two matching half shells. Its name is derived from the striped pattern on its shell. Since its introduction, the zebra mussel has spread to 32 states and three Canadian provinces (Figure 1). It rapidly dispersed throughout the Great Lakes and much of the Mississippi River because of its tremendous reproductive capability and the

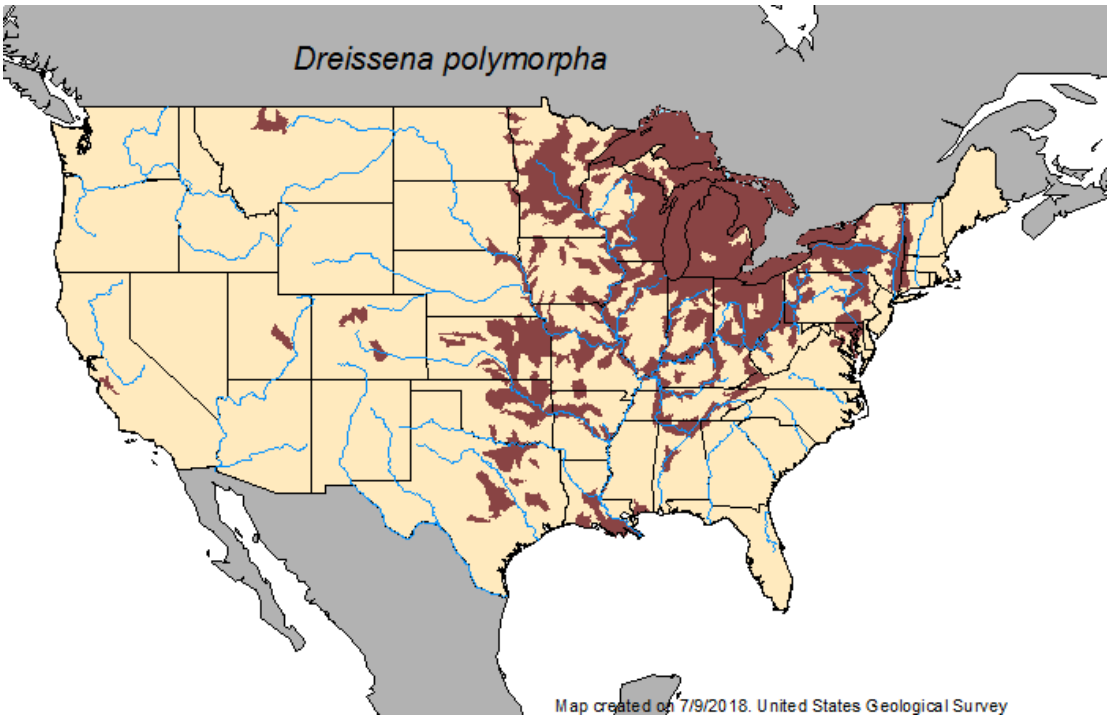

Figure 1. Distribution of zebra mussels (*Dreissena polymorpha*) in the United States effective 9 July 2018. Source: US Geological survey (http://nas.er.usgs.go/queries/speciesmap.aspx?SpeciesID=5).

ability of larvae to a) establish colonies downstream of spawning locations and b) attach to boats navigating from infested waters. Although Drake and Bossenbroek (2004) identify the Columbia River as being at high risk for a zebra mussel invasion, Whittier et al. (2008) classify western portions of the Pacific Northwest as being at "very low risk" or "low risk" for *Dreissena* species invasion. Annual monitoring in the Columbia River and throughout the CRB (http://psmfc.maps.arcgis.com/apps/MapSeries/index.html?appid=d317e395e88c48de8302a5753cf8789c) is contributing to a robust dataset of information that is documenting water quality characteristics, such as calcium and pH. Zebra mussels have been detected on recreational watercraft entering the CRB, and were discovered in Lake Winnipeg, Manitoba in 2013. The western states and provinces have collaborated to develop a network of watercraft inspection stations to protect the perimeter of the CRB. (Figure 2).

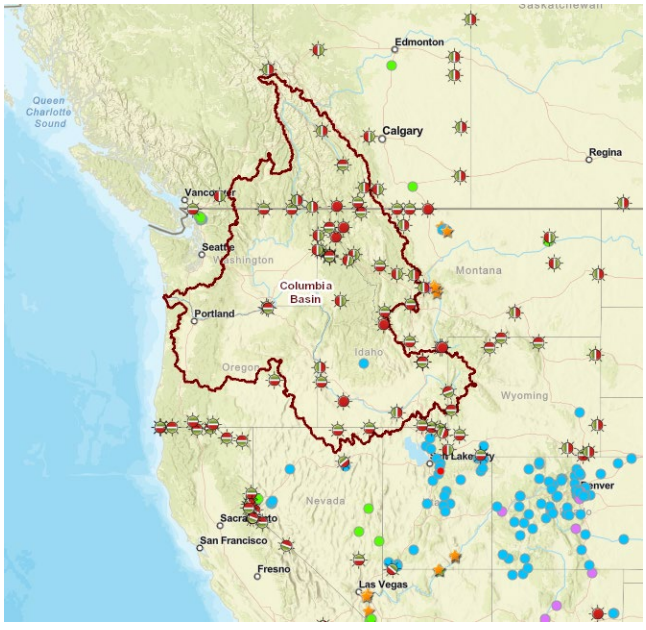

Figure 2. Watercraft inspection stations in and around the CRB, 2018. Source: PSMFC.

B. Quagga Mussels

The quagga mussel (*Dreissena rostriformis bugensis*) resembles the zebra mussel, but is rounder, and has a shell that seems asymmetrical when viewed from the front, or ventral side. In January 2007, live quagga mussels were found living in Lake Mead. Since then, quagga mussels have been detected in other waters of the Colorado River Basin as well as California, Nevada, Utah, and Arizona (Figure 3). The documented invasion history represents tremendous movement across the country and presents a more imminent threat that a *Dreissena* species will be introduced into CRB waters.

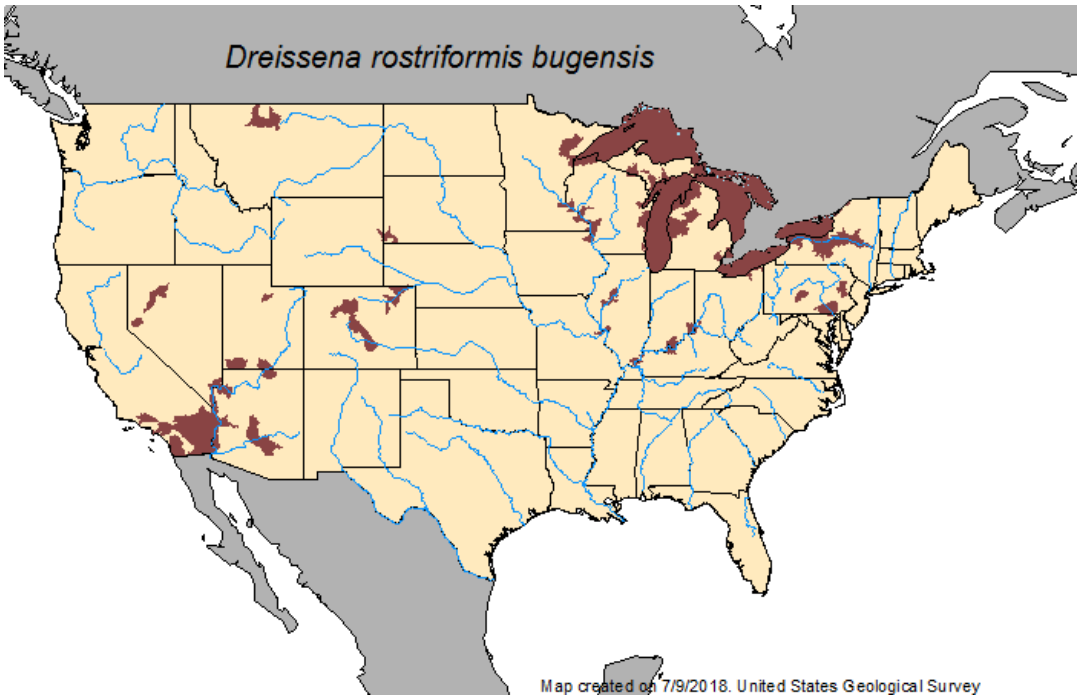

Figure 3. Distribution of quagga mussels (*Dreissena rostriformis bugensis*) in the United States effective 9 July 2018. Source: US Geological survey (https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=95).

C. Golden Mussels

Despite its yellowy/olive coloration, the golden mussel (*Limnoperna fortunei*), an epifaunal freshwater mussel in the family *Mytilidae*, closely resembles zebra mussels. The golden mussel is similar in length to the zebra mussel, attaches to hard substrates with byssal threads, can form dense druses, has a high reproductive capacity, occurs in a planktonic larval state, and due to its capacity for filter feeding, is a known invader with documented ecological and economic impacts. Although likely restricted to waters with minimum temperatures above 5 °C, the golden mussel displays a higher tolerance for waters with lower calcium levels (≥3 mg/l) than zebra or quagga mussels, and generally has a broad salinity tolerance (0–12 psu). Native to mainland China and southeastern Asia, the golden mussel has been introduced into estuaries, lakes, and

rivers in Hong Kong, Japan, Taiwan, and, more recently, in South America, where it has spread throughout Argentina, Brazil, Paraguay, and Uruguay. It has not yet been detected in North America. Given the current distribution of golden mussels, ballast water is the most likely introduction vector into the CRB. The movement of in-water equipment, boats, and other watercraft are the likely primary means of spread throughout the basin once introduced. Although no formal assessment of risk of the golden mussel in the CRB has been performed, the golden mussel has been included in this rapid response plan as a precaution based on similar life-history traits to dreissenid mussels and its broad environmental tolerances.

Additional information about dreissenids can be found in Appendix A, Biology of Dreissenids.

D. Environmental and Economic Implications

Environmental

The environmental impacts of zebra and quagga mussels to lakes and rivers is profound. Both species compete effectively with many native species and may completely replace native mussels, causing a collapse of the native food chain. The introduction of zebra and quagga mussels into the CRB, which drains 258,500 square miles in seven western states and Canada, has the potential to threaten native species, particularly salmon and trout, as well as industrial, agricultural, recreational, navigation, and subsistence use of waters.

Once established, dreissenid mussels can dramatically alter the ecology of a water body and associated fish and wildlife populations. As filter feeders, they remove phytoplankton and other particles from the water column, shifting production from the pelagic to the benthic portion (Sousa et al. 2009). In Lake Michigan, dreissenid invasions have caused significant phytoplankton community structure shifts, including dominance in cyanobacteria (DeStasio et al. 2014). In Lake Simcoe, Ontario, Canada, there were significant and sustained declines in phytoplankton biovolumes and chlorophyll *a* concentrations during the 12 years following invasion by dreissenids (Baranowska et al. 2013).

Native mussels are significantly threatened by the presence of invasive mussels. By attaching themselves to the surfaces of other bivalves, dreissenid mussels can starve freshwater mussels and drive indigenous populations to local extinction (Montgomery and Wells 2010). Dreissenid mussels can also affect dissolved oxygen through respiration, and dissolved calcium carbonate concentrations through shell building (Strayer 2009). The filtering capabilities of dreissenids increase water transparency, decrease chlorophyll concentrations, and increase the amount of pseudofeces (Claxton et al. 1998). Increases in pseudofeces reduce oxygen levels, which makes water pH more acidic and toxic. Increased water clarity increases light penetration and causes growth in aquatic plants. Dreissenids also bioaccumulate pollutants, which can be passed up the food chain, increasing wildlife exposure to organic pollutants (Snyder et al. 1997).

Polychlorinated biphenyl (PCB) concentrations in mussel tissue are correlated to sediment PCB levels, indicating mussels may provide an entry point for PCBs into nearshore benthic food webs (Macksasitorn et al. 2015).

Economic

The economic costs associated with these invaders are also significant. The economic impact of zebra and quagga mussels to the hydropower system on the Columbia and Snake Rivers is of particular concern. If introduced into the CRB, the mussels could affect all submerged components and conduits of this system, including fish passage facilities, navigation locks, raw water distribution systems for turbine cooling, fire suppression and irrigation, trash racks, diffuser gratings, and drains (see Appendix F).

The following studies have documented and estimated the costs of a dreissenid introduction:

- *Advancing a Regional Defense Against Dreissenids in the Pacific Northwest* estimated the annual cost of dreissenids becoming established in the CRB was $500,000,000 (Creative Resource Strategies 2015).

- The direct economic impacts (impacts to dams, removal from boat launches, direct impacts to fishing) of invasive mussels to the State of Washington is estimated to be $43,112,000. Total economic activity at risk is 500 lost jobs and $27.8 million in labor income (Community Attributes, Inc. 2017).

- Annual welfare losses (i.e., costs or loss of benefits) of a dreissenid invasion in the CRB is estimated at $64 million, although that estimate did not include losses related to fish and wildlife resources (Warziniack et al. 2011).

- Idaho estimated an infestation of zebra mussels would cost the state $94,474,000 to hydropower facilities, other dams, drinking water systems, golf courses, boat facilities and maintenance, hatcheries and aquaculture industries, loss of angler days, and irrigation (Idaho Aquatic Nuisance Species Task Force 2009).

- Total annual costs to Alberta from invasive mussels is estimated at $75.5 million (AEP 2015).

- Dreissenids have cost North American entities about $5 billion between 1993 and 1999 because of clogging water intake pipes (Roefer et al. 2009).

- The infestation of zebra mussels in the Great Lakes has cost the power industry $3.1 billion between 1998–1999, including a total economic impact of more than $5 billion (Western Regional Panel on Aquatic Nuisance Species 2009). The power generation industry in the Great Lakes experiences $1.2 million annually per power plant to monitor and control zebra mussels, and $1.7 million annually to research better zebra control methods. Water treatment plants pay $480,000–$540,000 annually to control zebra

mussels, and municipal water treatment facilities pay $353,000 annually to control zebra mussels (Colautti et al. 2006).

II. Scope and Purpose

The purpose of this Plan is to coordinate a rapid, effective, and efficient interagency response to delineate, contain, and when feasible, eradicate zebra, quagga, and other dreissenid mussel populations if they are introduced to CRB waters. Recognizing that dreissenid mussels typically establish in a watershed prior to detection, this Plan assumes that a detected population has not dispersed widely or reproduced (i.e., eradication is still reasonable to consider) until further analysis reveals otherwise.

A. Planning Assumptions

Prevention is the highest priority for addressing the risk of dreissenids in the CRB, including preventing contaminated watercraft from entering uncontaminated water bodies. This Plan is not intended to guide interception of contaminated watercraft prior to launching.

The provisions of this Plan are intended to enhance interagency coordination beginning with the discovery of dreissenid mussels through containment and initial control efforts. Long-term monitoring and control of a permanent infestation will require a separate management plan developed and implemented by the individuals or organizations with authority and responsibility for managing the infested site(s).

This Plan focuses on actions that would **follow** a reported dreissenid introduction. It does not address strategic actions needed to enhance preparedness prior to a detection.

B. Responsibilities

The specific agencies and entities required to respond to the discovery of dreissenid species depends on where the detection occurs. However, regardless of location, implementation of this Plan depends upon the cooperation of a broad variety of public and private sector organizations, including, but not limited to, the agencies that are signatories to this Plan, and those included in Table 1.

Table 1. Agencies and Organizations with Invasive Species Management/Coordination Responsibilities in the CRB.

State entities

- Idaho Department of Agriculture
- Idaho Department of Environmental Quality
- Idaho Department of Fish and Game
- Montana Department of Fish, Wildlife, and Parks
- Oregon Department of Environmental Quality
- Oregon Department of Fish and Wildlife
- Oregon State Police
- Oregon State Marine Board
- Washington Department of Ecology
- Washington Department of Fish and Wildlife
- State and Local Emergency Management Offices
- State aquatic/general invasive species committees and councils

Provincial entities

- Department of Fisheries and Oceans, Canada
- Provinces of British Columbia and Alberta

Universities

- Portland State University, Center for Lakes and Reservoirs

Federal agencies

- Bonneville Power Administration
- Bureau of Land Management
- NOAA Fisheries
- U. S. Army Corps of Engineers
- U. S. Bureau of Reclamation
- U. S. Department of Agriculture
- U. S. Environmental Protection Agency
- U. S. Fish and Wildlife Service
- U. S. Fish and Wildlife Service
- U. S. Forest Service
- U. S. Geological Survey
- U. S. National Park Service

Tribal entities

- Columbia River Inter-Tribal Fish Commission

Other

- 100th Meridian Initiative CRB Team
- City and County Governments
- Mid-Columbia River Public Utility Districts
- Pacific States Marine Fisheries Commission
- Port authorities
- Western Regional Panel on Aquatic Nuisance Species
- Mid-Columbia River Public Utility Districts
- Western Regional Panel on Aquatic Nuisance Species
- Pacific Northwest Economic Region

The 100th Meridian Initiative's CRB Team is responsible for:

- Developing, reviewing, and maintaining this Plan. Review of the Plan shall occur annually.
- Posting the current Plan on the 100th Meridian Initiative CRB Team website. (https://www.westernais.org/regional).
- Facilitating training, conferences, meetings, and exercises, as necessary, to ensure all participants are aware of roles, procedures, and changes to the Plan.
- Encouraging member organizations to maintain appropriate staffing and resource levels for the organizational and implementation elements identified in this Plan.

Each member organization is responsible for:

- Participating in meetings, conferences, and working groups necessary to develop, test, and maintain the Plan;
- Participating in the development and review of this Plan and associated documents and procedures;
- Identifying staff to participate in the organizational elements of this Plan, and ensuring staff are familiar with the Plan and trained in their duties and responsibilities;
- Ensuring that relevant individuals have access to the Plan;
- Establishing and maintaining inventories of resources available upon Plan activation;
- Implementing the Plan according to internal authorities and guidelines, and the provisions of this plan; and
- Participating in evaluations of exercises and activations of the Plan.

This Plan relates to a set of interagency response documents that in some cases are more general (e.g., State and local Emergency Operations plans), and in other cases are more specific (e.g., individual agency ANS response plans, the Bonneville Hydroelectric Project addressed in Appendix F). In addition, state-level rapid response plans—Oregon, Washington, Idaho, and Montana—have been developed that tier from this plan and provide more specifics associated with in-state organizations and resources, authorities, permitting requirements, risk assessment, notification and communication, and coordination.

III. Notification of Introduction

States and agencies within the CRB will be responsible for activating and implementing management structures necessary to respond to and support efforts to contain and control a dresissenid infestation.

State invasive species coordinators, or federal employees, will initiate the steps described in Figure 4 to notify the USGS (https://nas.er.usgs.gov/SightingReport.aspx) and the CRB Notification Coordinator, which is staffed by the USFWS (Pacific Regional Office). The Notification Coordinator has the authority and responsibility to convene the MAC Coordination and Support Staff, the MAC Group Chair, and the standing members of the CRB MAC Group, and to ensure all organizations on the Priority 1 and 2 notification lists (see Appendix C) have been notified.

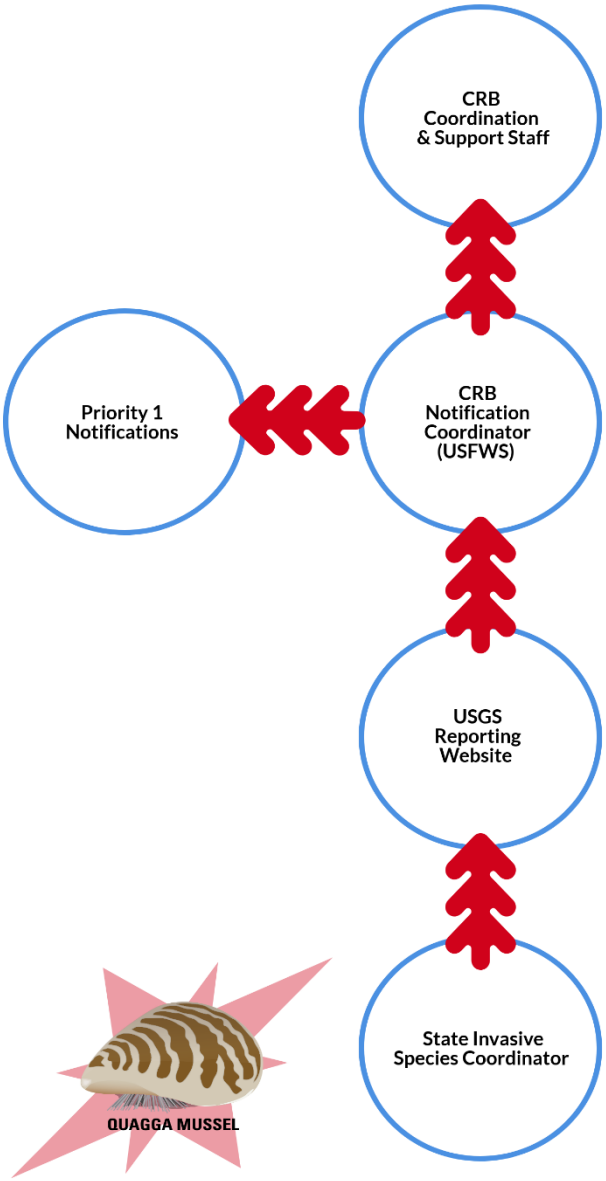

Figure 4. Diagram showing dissemination of a dreissenid report from initial call into state agency to CRB Notification coordinator to CRB MAC Group, Priority 1 contacts, and support staff.

A. Coordination Structure

The coordination structure (Figure 5) described in this Plan is designed to comply with the requirements of the National Incident Management System (NIMS). This structure focuses on interagency communication rather than on-the-ground tactics.

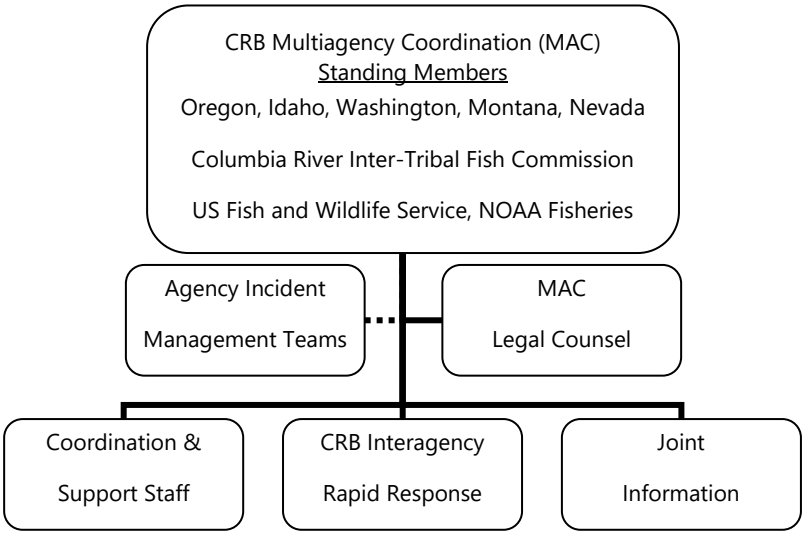

Figure 5. Multi-agency Coordination (MAC) structure and organizational elements.

The coordination structure includes four organizational elements with the following general responsibilities (also see Appendix B for checklists):

- **Columbia River Basin (CRB) Multiagency Coordination (MAC) Group**: Policy recommendations, including review of management plans, potential assistance with resources, and interagency media coordination.

The MAC Group includes "standing," or permanent members, who are representatives of CRB Team member agencies that are expected to participate in the activation of this Plan. Standing members, who are included because they have authorities and responsibilities not limited by geography within the CRB, include the US Fish and Wildlife Service, NOAA Fisheries, the Columbia River Inter-Tribal Fish Commission, and the states within the CRB. The second tier of MAC Group Members includes agencies or organizations that may participate depending upon their responsibilities associated with the location of a detection (such as U. S. Forest Service, specific tribes, or local governments).

It is the responsibility of the standing members of the CRB MAC Group to identify, notify, and include representatives of other organizations that should join the MAC Group depending on the location of the detection.

The CRB MAC Group may be supported by Legal Counsel. The CRB MAC Group will annually select one of its members to serve as the CRB MAC Group Chair.

- **Columbia River Basin (CRB) Coordination and Support Staff**: This group provides technical, scientific, and logistical support to the CRB MAC Group, the Interagency Rapid Response Team (IRRT), and local affected agencies/entities, including positive confirmation of extent and scope of the detection. They assist in identifying appropriate containment, control, and eradication efforts. The CRB Coordination and Support Staff is comprised of subject matter experts activated in response to the specific needs of the reported detection. Subject matter experts may be employees of any or all entities participating in this Plan, or from organizations outside the CRB Team.

- **CRB Joint Information Center (JIC)**: As part of its external communications system, the CRB MAC Group may activate a Joint Information Center (JIC) to support its efforts to develop and implement effective interagency development and dissemination of information to the public and other interest groups.

CRB Interagency Rapid Response Team (IRRT): This team includes interagency personnel that may be assigned to provide on-scene technical support, or incident management support, at the request of the impacted jurisdiction/entity and the approval of the CRB MAC Group. The IRRT also assists in confirming the presence and determining the scope of the detection, as well as identifying and implementing appropriate containment, control, and eradication efforts. Team members will be selected based on the technical and management needs of the specific detection.

B. Management Structure

The management structure described in this Plan is designed to comply with the requirements of the National Incident Management System (NIMS). This structure focuses on tactical implementation.

- **Agency Incident Management Teams**: ICS-based organizations responsible for the on-scene implementation of agency and CRB MAC Group management decisions. The Incident Management Team reports to the Agency Administrator(s) of the responsible entity or entities. *Note:* The CRB IRRT may be deployed as an Incident Management Team. In such assignments, the IRRT will operate in the place of the Agency Incident Management Team, under a written delegation of authority from the Agency Administrator.

IV. Interagency Response Procedures

A. Response Objectives

Eleven response objectives support the Plan's goal to delineate and control zebra, quagga, and other dreissenid mussel populations if detected in CRB waters. **Note that tasks associated with these objectives are not necessarily sequential, and may be implemented simultaneously**.

Table 2 lists the 11 objectives and designates the appropriate part of the Plan that addresses the objective. Table 2 also indicates which element of the CRB Coordination organization is responsible.

Table 2. Response objectives that support the plan's goal to delineate and control zebra, quagga, and other dreissenid mussel populations if they are detected in CRB waters.

Rapid Response Objective	Plan Location	Responsible Coordination Element
1. Make Initial Notifications	**Section IV-A Pages 19–20;** **Appendix C**	**State invasive species coordinators**
2. Activate appropriate organizational elements of the CRB Interagency Response Plan	**Section IV-A pages 21**	**CRB Notification Coordinator; MAC Group Chair**
3. Verify Reported Introduction	**Section IV-A, page 22**	**Responsible Agency/State ANS Coordinator**
4. Define Extent of Colonization	**Section IV-A page 23** **Appendix B Field Operations Page B-50–51**	**Responsible Agency or CRB Coordination and Support Staff and IRRT/IMT**
5. Establish External Communications System	**Section III, pages 15–17; Section IV-A pages 23–24** **Appendix B Joint Information Center. Page B-39–41**	**CRB MAC Group**

Rapid Response Objective	Plan Location	Responsible Coordination Element
6. Initiate Environmental Compliance Steps, Including Section 7 Consultation (when warranted)	**Appendix B Field Operations, Page B-50–54** **Section IV-A, page 24**	**Responsible Agency**
7. Obtain and Organize Resources	**Section IV-A, page 24**	**CRB MAC Group & CRB Coordination & Support Staff**
8. Prevent Further Spread Via Quarantine and Pathway Management	**Section IV-A, page 24** **Appendix B Field Operations, page B-50–54**	**Responsible Agency or CRB IRRT/IMT**
9. Initiate Available/Relevant Control Actions	**Section IV-A, page 24** **Appendix B Field Operations Page B 50–54** **Appendix D Control Options**	**Responsible Agency or CRB IRRT/IMT**
10. Institute Long-Term Monitoring	**Section IV-A, pages 24–25** **Appendix B** **Field Operations Page B-50–54**	**Responsible Agency**
11. Stand Down Incident, and Evaluate the Response and the Plan	**Section IV-A, page 25**	**CRB MAC Group** **CRB Team/all responding elements.**

Objective 1: Make Initial Notifications.

***Purpose*:** Ensure that all parties that have jurisdiction in response decisions, or can provide technical support, and are quickly engaged. Rapidly inform all other interested parties.

***Lead entity*:** The agency that initially receives confirmation of dreissenid detection, State ANS coordination contacts, federal agency representatives, or tribal representatives.

Notification of a possible detection of dreissenid species may come from any source. All states within the CRB have established reporting procedures for invasive species. This Plan assumes that reports of *Dreissena* will follow those established processes.

1. The first participating agency to detect, or receive a report of, a detection will notify the appropriate state invasive species contact (see Appendix C). The initial recipient should collect as much of the following information as possible:

- Date and time of the report.
- Date and time of the sighting(s).
- Name, agency, and contact information for the person making the report.
- Name, agency/entity, and contact information of identifying biologist (if positive identification has been made).
- Details of the location of the detection, such as name of the affected water body, landmarks, highway mile, and other (GPS if possible) information where the suspect mussels were found or detected.
- An estimate of the number, density, and extent of the mussel colonies found or introduced.
- A digital or other photograph (with scale indicator), if possible.
- A sample of the mussels, if possible (in compliance with relevant state/federal regulations regarding movement of live prohibited species).
- Other relevant conditions (access limitations, etc.)

2. After confirming the report as credible, the state invasive species coordinators will notify the US Geological Survey website to report a sighting of a nonindigenous aquatic species: https://nas.er.usgs.gov/SightingReport.aspx.

3. The state invasive species coordinators will also notify all affected local agencies and organizations.

4. The state invasive species coordinators will notify the CRB Notification Coordinator.

5. The following statement can be used as a template for disseminating initial alerts (see text box below) during the verification progress:

"A preliminary report suggests that dreissenid mussels have been found in [*insert name of water body or other location*]. We are investigating the veracity of this report and will communicate updates via [*insert name of listserv, website, etc.*]. Until then, we encourage other jurisdictions to treat this

SHARING PRELIMINARY REPORTS

Given the potential for regional spread, agencies handling preliminary reports of dreissenid introductions need to consider the importance of alerting all vulnerable jurisdictions – including those outside of the CRB (e.g., other western states). Disseminating inaccurate information rapidly and broadly can compromise response effectiveness. Unless unique law enforcement or other conditions warrant extreme caution, this plan recommends that the above initial alert message be communicated via email (and phone if possible) as soon as possible to all state invasive species coordinators in the West, even if positive identification is pending.

location as an elevated risk. To expedite the local response, we also request that you keep this information internal and wait for us to release further information to interested parties."

Objective 2: Activate Appropriate Organizational Elements of the Interagency Response Plan.

***Purpose*:** Activate a response management system that expedites interagency decision making, promotes information sharing, ensures efficient resource management, and supports on-scene management of the detection.

***Lead entity*: CRB Notification Coordinator and CRB MAC Group.**

Activation of this Plan can begin several ways, but generally will occur when a state's governor declares a state of emergency and announces the formation of an incident command structure. These activities trigger initiation notification to the CRB Notification Coordinator. The coordinator will discuss the situation with the state and the CRB MAC Group, including any additional prevention measures neighboring states may wish to take upon announcement of the introduction. The level of activation is flexible, depending on the size, location, and life cycle of the infestation as well as the support requests of the responsible agency.

The CRB Notification Coordinator will notify the members of the Columbia River MAC Group identified in the Priority 1 table of Appendix C. The MAC Group Chair may elect to request a preliminary meeting of the CRB MAC Group in person, or via conference call, in advance of positive identification (see Objective 3 below), or wait until positive identification has been confirmed, depending on the nature and credibility of the report.

The CRB Notification Coordinator will notify the members of the Columbia River Coordination and Support Staff identified in the Priority 1 table of Appendix C. The members will report at the time and location indicated by the Notification Coordinator.

Following notification of Priority 1 contacts, the CRB Notification Coordinator, with assistance from the Coordination and Support Staff, will notify Priority 2 contacts. All primary contacts listed in Appendix C will be responsible for further notifications internal to their agency/entity or jurisdiction. Additional contacts may be required depending on the location of the infestation and the affected jurisdictions.

Objective 3: Verify Reported Introduction and Determine Status of Waterbody

Purpose: Confirm suspect/positive/infested identification of the mussels as *Dreissena polymorpha*, *D. rostriformis bugensis*; and/or *Limnoperna fortunei*.

Confirmation may include one or both of the following methods[1]:

- Visual identification at the infested site by one or more qualified subject matter experts (Appendix C).

- Visual and genetic[2] identification of a sample sent to a qualified subject matter expert (and handled based on directions given by that qualified subject matter expert in compliance with relevant state/federal regulations regarding movement of live prohibited species) (Appendix J).

Until further analysis reveals otherwise, the CRB response organization will assume that the reported mussels are dreissenid mussels of concern and that the detected population has not dispersed widely or reproduced (i.e., eradication is still reasonable to consider).

The appropriate CRB response organization(s) will oversee the verification process using the Water Body Definitions listed below as guidance, and will determine the status of the water body of concern.

Lead entity: The agency that receives and accepts responsibility for handling the initial report in coordination with subject matter experts.

Water body definitions: **The definitions below are intended as guidance. Definitions are based on the analysis of plankton samples and may differ if adult mussels are found.**

Status Unknown – **Waters that have not been monitored.**

Undetected/Negative – **Sampling/testing is ongoing and nothing has been detected, or nothing has been detected within the time frames for de-listing.**

Inconclusive (temporary status) – **Water body has not met the minimum criteria for detection*.**

Suspect – **Water body that has met the minimum criteria for detection.**

Positive – **Multiple (2 or more) subsequent sampling events that meet the minimum criteria for detection.**

Infested – **A water body that has an established (recruiting or reproducing) population of AIS.**

**Minimum to verify detection: 2 independent results from the same sample, using scientifically accepted identification techniques.*

[1] *Mytilopsis leucophaeata*, a member of the Dreissenidae family and an invasive species of concern, also has a planktotrophic life stage and may be difficult to differentiate from the above-named mussel species using XPLM. However, as an obligate estuarine species, it is not specifically named as a species of concern in this Plan.
[2] Minimum to verify detection: Two independent results from the same sample, using scientifically accepted techniques. Participating entities may have their own requirements relative to required visual and/or genetic techniques.

Appendix D-4 highlights methods for verifying the mortality of dead mussels. These include:

- Visual
    - Valve gaping with no response of exposed mantle tissue to external stimuli.
    - Failure of plantigrade mussel to respond to the touch of a probe (for mussels with gaping shells).
    - Absence of ciliary beating and adductor muscle activity when inserting probe between the values of the mussel (for mussels with closed shells).

Objective 4: Define Extent of Colonization.

***Purpose*:** Establish physical range of infestation and identify mussel life-cycle phase to inform policy and tactical response to the infestation.

***Lead entity*:** The responsible agency where the initial sighting(s) of mussels occurs in partnership with other CRB agencies and organizations.

Additional procedures are described in Appendix B, Field Operations.

Objective 5: Establish External Communications System

***Purpose*:** Activate and staff the CRB Joint Information Center to ensure consistent and effective communication to interested external stakeholders, including the media and public.

***Lead Entity*:** CRB MAC Group.

Additional procedures are described in Appendix B - Joint Information Center.

Objective 6: Initiate Environmental Compliance Steps, Including Section 7 Consultation (when warranted)

***Purpose*:** Determine steps needed to ensure environmental compliance, including all permits and other approvals associated with a potential action.

***Lead entity*:** CRB MAC Group and Coordination and Support Staff with resource support from CRB agencies and organizations.

Additional procedures are defined in the ESA Manual.

Objective 7: Obtain and Organize Resources

***Purpose*:** Provide sufficient resources to implement response objectives.

***Lead Entity*:** CRB MAC Group and Coordination and Support Staff with resource support from CRB agencies and organizations.

Additional procedures are described in Appendix B.

Objective 8: Prevent Further Spread via Quarantine and Pathway Management.

***Purpose*:** Minimize vectors that could contribute to further spread.

***Lead Entity*:** Agency with jurisdiction with technical assistance from CRB agencies and organizations.

Additional procedures are described in Appendix B - Field Operations.

Objective 9: Initiate Available/Relevant Control Measures.

***Purpose*:** Evaluate management options, and then proceed with either eradication efforts, or containment/mitigation activities.

***Lead Entity*:** Agency with jurisdiction with technical assistance from CRB agencies and organizations.

Additional procedures are described in Appendix B - Field Operations.

Objective 10: Institute Long-Term Monitoring.

***Purpose*:** Provide data for adaptive management and long-term evaluation efforts.

***Lead Entity*:** Agency with jurisdiction.
Additional procedures are described in Appendix B - Field Operations.

Objective 11: Stand Down Incident, and Evaluate the Response and the Plan.

***Purpose*:** De-activate groups and operations and demobilize associated personnel and equipment. Capture and implement lessons learned during exercises and activations of the Interagency Response Plan to enhance preparedness and response.

***Lead Entity*:** CRB MAC Group; 100th Meridian Initiative Columbia Basin Team.
Additional procedures are described in Appendix B.

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Appendix A. Dreissenid Biology

Dreissenid Life History

Zebra and quagga mussels are closely related filter-feeding freshwater mussels (Table 1), capable of filtering about one liter of water per day while feeding on algae (Benson et al. 2018). These bivalves produce free-swimming planktonic larvae that eventually settle out of the water column and attach to hard surfaces using byssal threads. Zebra mussels tend to prefer hard surfaces, whereas quagga mussels can inhabit both hard and soft substrates up to depths of 130 meters (Benson et al. 2018). Although quagga mussels can colonize more surfaces in a lake, zebra mussels are more likely to successfully invade river systems (but will not settle in currents greater than 2m/sec) because zebra mussels have stronger byssal threads and a distinctive flat edge that may increase their stability and grip on hard surfaces (Oregon Sea Grant 2008).

Dreissenids are highly invasive because they are dioecious (fertilization occurs in the water column), and they have a high reproductive capacity (they can produce millions of eggs in one spawning season) (Oregon Sea Grant 2008). Males and females release their eggs and sperm simultaneously into the water, where they are fertilized and develop into microscopic planktonic larvae, called veligers. The veligers settle, attach to a substrate using byssal threads, and develop into adult mussels in the first or second year of life. The threads can be broken, enabling the mussels to translocate to new areas (Ackerman et al. 1994).

Under laboratory conditions, the zebra mussel can tolerate 30 °C (86 °F) for extended periods and higher temperatures (<39 °C (102 °F)) for a period of hours depending on the acclimation temperature and the rate of temperature change (Spidle et al. 1995). The upper thermal limit of the quagga mussel may be as low as 25 °C (77 °F). Mussels of both species acclimated to 5 °C (41 °F) were less able to survive at high temperatures (30–39 °C (86 °F–102 °F)) than mussels acclimated to 15 °C (59 °F) or 20 °C (68 °F). The temperature preference for zebra and quagga mussels is 17 °C (64 °F) and 16 °C (61 °F), respectively (US Fish and Wildlife Service 2007). Neither species can survive salinity tolerances greater than 5 parts per thousand (Spidle et al. 1995).

Bacteria are the main food for the larval stage of dreissenids. Adult quagga and zebra mussels filter feed on phytoplankton and zooplankton from the water column; one mussel can filter one liter of water per day (Oregon Sea Grant 2010).

Table 1. Zebra and quagga mussel traits.

Trait	Zebra Mussels	Quagga Mussels
Shell	Triangular shape, underside flat. Obvious ridge between side and bottom. When placed on its ventral side, it will remain upright.	Rounder sides, convex underside. No ridge. When placed on its underside, the quagga mussel will topple.
Color	Variable colors and patterns, usually dark.	Pale near hinge, dark concentric rings on the shell.
Underside	Large groove in middle of flat side; allows tight hold on rocks.	Small ventral groove near the hinge.
Habitat occupied	Lakes, waterways, ponds, and rivers with current less than 2m/sec	Lakes, waterways, and ponds
Substrate colonized	Hard only	Hard and soft

Density and Food Availability

Zebra mussel densities within the CRB could vary widely depending on physical and environmental characteristics, food availability, and breeding population. After initial introduction, zebra mussel populations can rapidly increase by orders of magnitude, and then similarly decrease. Eurasian zebra mussel population densities range up to 40,000 mussels per square meter (Neumann et al. 1993). Under ideal conditions in the Laurentian Great Lakes, zebra mussel densities reach 700,000–800,000 per square meter (Kovalak et al. 1993). In the lower Mississippi River, densities of 400,000 per square meter have been reported (Kraft 1995). The Mississippi River has an ideal environment for zebra mussels, in part because food resources are abundant (Kraft 1995). The Columbia River's lower plankton densities, in comparison to the Mississippi River or Great Lakes, may limit zebra mussel population densities, though this has yet to be quantified.

Water Temperatures

Dreissenids can tolerate a wide range of water temperatures from roughly 32 ^{0}F–86 ^{0}F (0 ^{0}F to 30 ^{0}C) (Ohio Sea Grant 1997). North American zebra mussel spawning (release of gametes into the water column) will not generally occur at temperatures below about 12 °C (Claudi and Mackie 1994). There is evidence, however, that quagga mussels in deep waters of the Great Lakes are capable of spawning at temperatures near 5 °C (Roe and MacIsaac 1997) and 9 °C (Claxton and Mackie 1998).

Calcium Requirements

Numerous studies have been conducted on the calcium requirements of zebra and quagga mussels. In the early 1990s, it was documented that North American zebra mussel populations require 10 mg Ca^{2+}/l to initiate shell growth and 25 mg Ca^{2+}/l to maintain moderate shell growth (Claudi and Mackie 1993). One key study from the 1990s documented that larval development is inhibited at a pH of 7.4, higher rates of adult survival occur at a pH of 7.0–7.5, and populations have been found in the hypolimnetic zone of lakes with a pH of 6.6–8.0, and in

the epilimnetic zone with a pH of 7.7–8.5 (McMahon 1996). Optimal larval survival occurs at a pH of 8.4, and optimal adult growth occurs at a pH 7.4–8.0. (Benson and Raikow 2007).

However, since these earlier studies, the ability to estimate survival, growth, and reproductive potential of dreissenids has been questioned. Davis et al. (2015) determined that quagga mussels have higher risk of establishment in low calcium lakes if habitats exist that have slightly elevated calcium, emphasizing that a waterbody in the 12 to 15 ppm calcium range could potentially be at risk of establishing sustainable quagga mussel populations. This particular study emphasized the uncertainty of using a single parameter in assigning establishment risk given the complexity of variables in specific water-bodies that influence life history performance of introduced species. Claudi and Prescott (2011) documented that marginal concentrations of calcium (12mg/L–15 mg/L), the survival of adult dreissenids may be aided by a pH above 8.0.

History of Control Efforts

As of July 2018, no practical methods exist for large-scale eradication of invasive dreissenid mussel populations once they become widely established in a reservoir, lake, or river (i.e., open water). Control agents, including potash (potassium chloride), copper compounds, and bacterial strains specifically pathogenic to dreissenid mussels, have been tested in open-water situations with limited success. Because of the limited success, control efforts generally focus on containment and prevention.

Although an attempt to eradicate a dreissenid mussel infestation presents significant challenges, there is at least one documented success story in a closed system. In 2002, the first introduction of zebra mussels in Virginia was confirmed in Millbrook Quarry. Over a three-week period in early 2006, the water body was treated with 174,000 gallons of potassium chloride solution over a 3-week period from January 31 to February 17, 2006. Potassium concentrations were measured weekly throughout the quarry and in adjacent surface waters to ensure a target concentration of 100 milligrams of potassium per liter of water.

Monitoring results demonstrated that potassium concentrations lethal for dreissenids were achieved at various depths. Several weeks after treatment ended, four independent methods were used to confirm zebra mussel eradication:

a) More than 1,000 mussels were sampled from rocks at numerous sites around the quarry; none were alive.

b) Divers visually inspected the quarry and could not find live zebra mussels.

c) An extensive video survey was conducted using a robotic camera system, documenting dead zebra mussels.

d) A total of 80 sets of live zebra mussels (100 per set) were placed at various locations and depths within the quarry. After one month of exposure to the treated quarry water,

mortality of these test mussels was 100% (compared to zero mortality of a control set placed in untreated water).

Other aquatic life in the quarry (including turtles, fish, and aquatic insects) seemed to be thriving after the treatment. This case involved infestation in a small, contained, or "closed," water body. Since 2002, numerous locations throughout North America have undergone attempted eradication projects using a variety of approaches and treatments. Examples of those projects are documented at https://www.westernais.org/qz-eradication-projects. As of this CRB Plan update (July 2018), there exists no practical methods for large-scale eradication of invasive dreissenids in open water systems. As a result, the Bureau of Reclamation sought "innovative solutions" in 2018 to eradicate zebra and quagga mussels from large reservoirs, lakes, and rivers in a cost-effective and environmentally sound manner, using a three-phase challenge approach to include laboratory-scale and field-scale demonstrations.[3]

References for Appendix A are incorporated in the main document.

[3] https://www.usbr.gov/research/challenges/mussels.html

Appendix B. Rapid Response Checklists

This appendix includes a review of rapid response objectives and the CRB Plan organizational structure followed by detailed position descriptions and rapid response checklists for coordination and field operations.

Note: The nature and scope of the invasive species threat in the CRB as well as the deliberate flexibility of the NIMS organizational structure make it impossible to develop definitive position descriptions and checklists. Some incidents will not require activation of all elements, or completion of all tasks. Others may require that all elements of the organization be activated, and that additional tasks developed on a case-by-case basis. The organizational structure and information in this annex should be used as a guide to establish the response framework appropriate to the specific infestation.

CRB Multi-Agency Coordination Structure	Position Description

Position:

MAC Group Chair

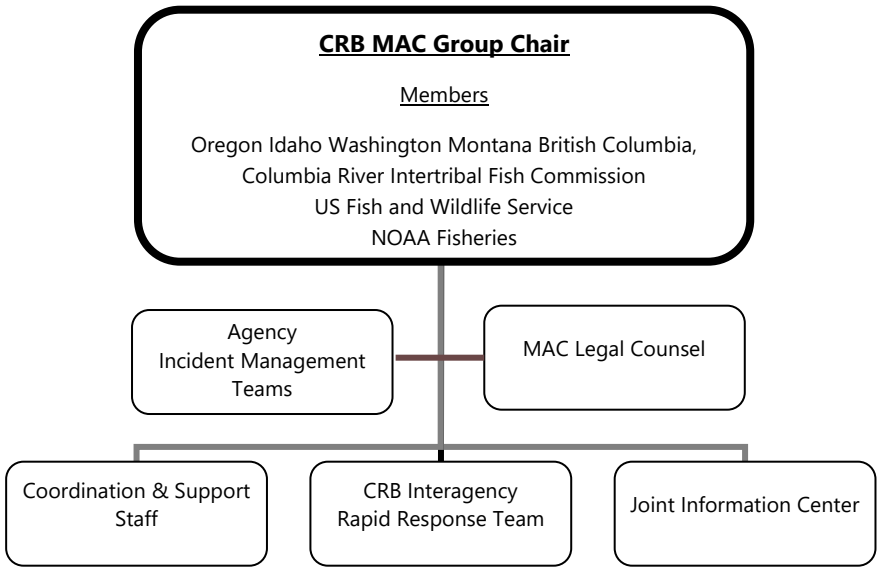
Reporting Relationships:

Reports to: Elected Officials

Reports to this Position:

- CRB Coordination and Support Staff Manager
- CRB MAC Group Legal Counsel
- Interagency Rapid Response Team (IRRT) Leader
- CRB Joint Information Center Manager

Location in Organization:



General Responsibilities:

The MAC Group Chair is selected by the standing members for a term of one year, and has responsibilities in all phases of the CRB Invasive Species Planning Process:

- Mitigation: Ensure that Plan signatories pursue a coordinated and consistent approach to invasive species mitigation.
- Preparedness: Ensure that the CRB Rapid Response Plan is reviewed, exercised and revised to ensure currency.
- Response: Serve as the facilitator for the MAC Group, and the liaison to the Coordination and Support Staff, MAC Legal Counsel, Joint Information Center and IRRT.
- Recovery: Ensure that response activities are evaluated for lessons learned, and that these are incorporated into the CRB Plan as appropriate.

CRB MAC Chair Response Checklist (page 1 of 3)

This checklist is a guideline. Plan users should feel free to augment the list as necessary. Some actions are one-time actions; others are ongoing or repetitive for the duration of the infestation.

____ Activate appropriate members of the CRB MAC Group.

____ Obtain initial briefing from CRB Notification Coordinator.

____ Assess infestation situation.

- Review the current situation status. Ensure that all County, State and Federal agencies impacted by the infestation are notified.
- Determine probable scope and impact of infestation.
- Determine the need for/status of disaster declarations.
- Determine impact on commercial and recreational activities.
- Determine current priorities

____ Review current status of CRB Coordination and Support Staff. Ensure appropriate staffing.

____ Brief CRB MAC Group and Coordination and Support Staff

- Identify priorities, strategic considerations, and fiscal and policy directives for the management of the infestation.
- Determine the time and location of first CRB MAC Group meeting.
- Define what agency contacts will be delegated to the CRB Coordination and Support Staff and which will be retained by the CRB MAC Group (for example, routine updates may be assigned to the Coordination and Support Staff, but policy-level communication may be retained by the MAC Group).

____ Establish External Communications System:

- Notify impacted County Commissioners and other elected officials of infestation, and keep them informed as to incident status and activities. Include in MAC Group meetings as appropriate.
- Authorize release of information to the media. Activate Joint Information Center as required.

____ Direct the call back of off-duty personnel as needed (keep in mind the possible need to staff additional shifts). Assess staffing needs for:

- IRRT
- CRB Joint Information Center
- Establish what resources will be procured, managed and allocated through the CRB MAC Group.

____ Determine information needs and inform staff of requirements.

CRB MAC Chair Response Checklist (page 2 of 3)

___ Prioritize incidents daily, when new incidents occur, or if there is a major change in existing incidents. The following rankings may be used to prioritize incidents:

- 1st Priority-Infestations which can be contained and eradicated.
- 2nd Priority-Infestations which present a threat to essential infrastructure.
- 3rd Priority-Infestations which present a threat to commercial or subsistence activity.
- 4th Priority-Infestations which present a threat to recreational activity.
- 5th Priority-Infestations that present a threat to imperiled species or another significant ecological value.

___ Obtain and organize resources.

- Allocate scarce/limited resource to incidents based on priorities.
- Establish parameters for resource requests and releases.
  - Review requests for critical resources.
  - Approve assignment of IRRT upon request from impacted jurisdiction.
  - Confirm who has ordering authority within the organization and in impacted jurisdictions.
  - Define those orders which require CRB MAC Group authorization.

___ Establish level of planning to be accomplished.

- Contingency Planning
- Formal CRB MAC Group Meetings

___ Establish parameters for tactical response.

- Define those management plans which require CRB MAC Group authorization. Coordinate authorization with responsible agency administrator and on-scene IMT(s).
- Review and approve proposed management plan(s).
- Authorize implementation of approved management plan(s).

___ Ensure CRB MAC Group and CRB Coordination and Support Staff coordination.

- Periodically check progress on assigned tasks of MAC and Coordination and Support Staff personnel.
- Approve necessary changes to strategic goals and action plans.

___ Ensure Inter-jurisdictional coordination.

- Ensure that all press releases are coordinated with other impacted jurisdictions and agencies.

CRB MAC Chair Response Checklist (page 3 of 3)

- Ensure that agency Incident Management Teams are sharing information and coordinating activities as appropriate.
- Ensure that situation status is being shared with cooperating and assisting agencies.
- Ensure that logistical support requests are being handled efficiently.

____ Request emergency declaration as necessary. Ensure declaration is forwarded to impacted County Emergency Manager(s) (Counties must process request for disaster declaration from the Governor of the impacted State). Provide courtesy call to Governor's Office and Office of Emergency Management in affected State(s).

____ Review and approve disaster assessment statements from CRB Coordination and Support Staff prior to forwarding to County (ies) and State(s).

____ Facilitate meetings. Ensure documentation of decisions and actions taken.

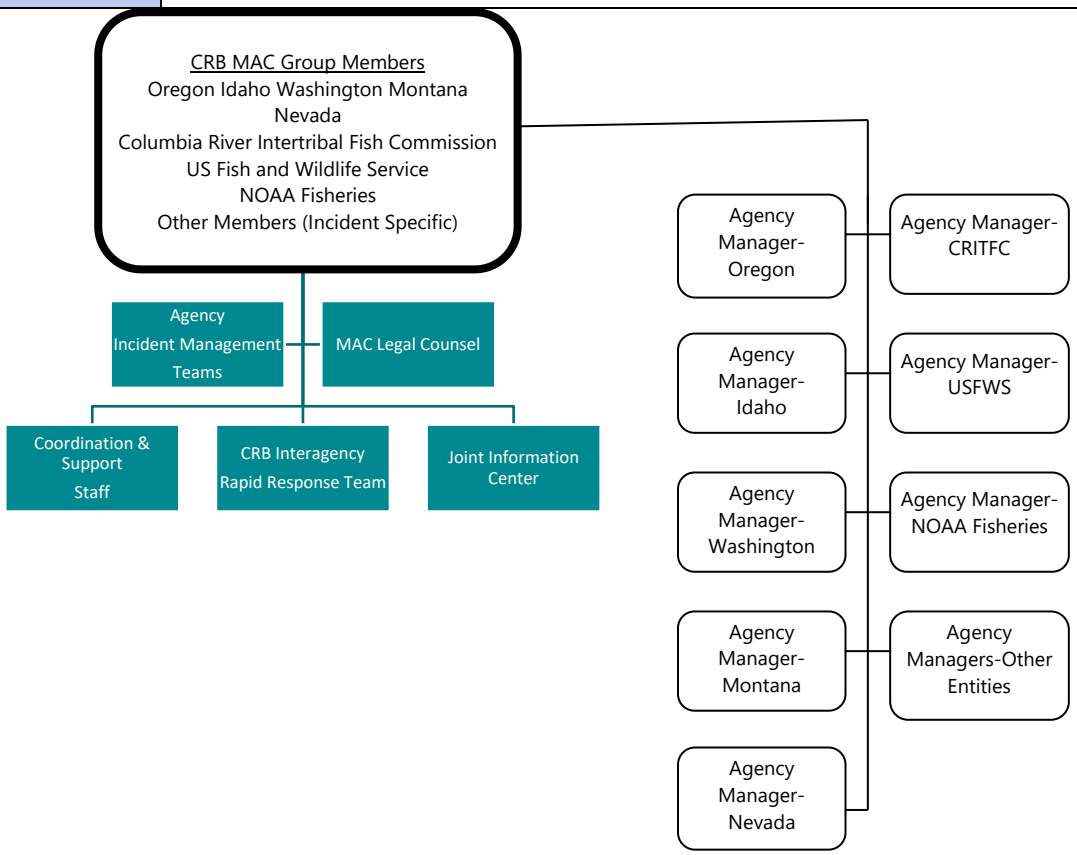
____ Ensure post action review is conducted, and lessons learned are captured and incorporated into training and Plan revisions and updates.

- Conduct a follow-up evaluation of response organizations and other interest groups to identify opportunities for improving rapid response capacity. Disseminate "lessons learned" to other interested organizations (e.g., regional ANS panels).
- Revise the Rapid Response Plan and associated documents/guidelines based on evaluation and long-term monitoring results.
- As resources allow, develop and implement a research plan that evaluates the associated ecological and economic impacts of the invasion, the effectiveness of management interventions, and negative consequences of management interventions (beyond that required by permits).
- Determine the need for long-term funding for the current management effort and seek this funding as warranted.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **MAC Group Members**	**Reporting Relationships**: Reports to: Elected Officials Reports to this Position: Agency/Entity Managers

Location in Organization:



General Responsibilities:

CRB MAC Group members are responsible for assisting the CRB MAC Chair in prioritizing infestations, allocating scarce resources, and establishing policy for management of the incident. **CRB MAC Group members must have the authority to commit their agencies/entities to the decisions developed by the CRB MAC Group.** CRB MAC Group members are responsible for:

- Assessing the impact of the infestation on their agencies or entities.
- Adjusting personnel, financial, and other resources to meet the needs of the incident/continue service delivery.
- Approving appropriate control options and incident priorities.
- Ensuring that the priorities and policies formulated by the CRB MAC Group are implemented by their agencies/entities.

CRB MAC Group Members Response Checklist (page 1 of 2)

This checklist is a guideline. Plan users should feel free to augment the list as necessary. Some actions are one-time actions; others are ongoing or repetitive for the duration of the infestation.

____ Confirm identification and appointment of MAC Chair (this may be done annually).

____ Obtain initial briefing from CRB MAC Chair, CRB Coordination and Support Staff Manager and impacted jurisdictions.

- Identify priorities, strategic considerations, and fiscal and policy directives for the management of the emergency.
- Determine the time and location of first CRB MAC Group meeting.
- Determine which agency contacts will be yours to establish and maintain.

____ Assess infestation.

- Determine probable scope and impact of infestation.
- Determine the need for/status of disaster declarations.
- Determine impact on services
- Project impact on budget allocations
- Determine current resource priorities
- Assess adequacy of current resources
- Identify available resources
- Identify needed resources
- Assign resources as requested

____ Assist the CRB MAC Chair in identifying additional agencies/entities that should be included in the CRB MAC Group.

____ Inform CRB MAC Chair if emergency will impact the agency's ability to meet current work assignments, or will exceed budget allocations.

____ Review current policies, procedures and agreements for resource sharing. Determine status of implementation. Implement or suspend as appropriate.

____ Anticipate future resource needs.

____ Direct the call back of off duty personnel as needed (keep in mind the possible need to staff additional shifts). Assess staffing needs for CRB Coordination and Support Staff, CRB Joint Information Center, and IRRT.

____ Approve the assignment of the IRRT as requested by the responsible jurisdiction.

____ Determine information needs and inform staff of requirements.

CRB MAC Group Members Response Checklist (page 2 of 2)

____ Ensure that agency personnel observe protocols for resource requests and releases.

____ Participate in CRB MAC Group Meetings as scheduled by the CRB MAC Chair:

____ With assistance from on-scene representative(s), identify impact of the infestation on your agency/entity. Assist CRB MAC Group Chair in establishing incident priorities.

____ With assistance from on-scene representative, identity resource shortages. Assist CRB MAC Group Chair in allocating scarce resources according to incident priorities.

____ Identify policies and procedures to facilitate management of the infestation. Assist the CRB MAC Chair and CRB MAC Legal Counsel in determining appropriate changes.

____ Ensure interagency/inter-jurisdictional coordination.

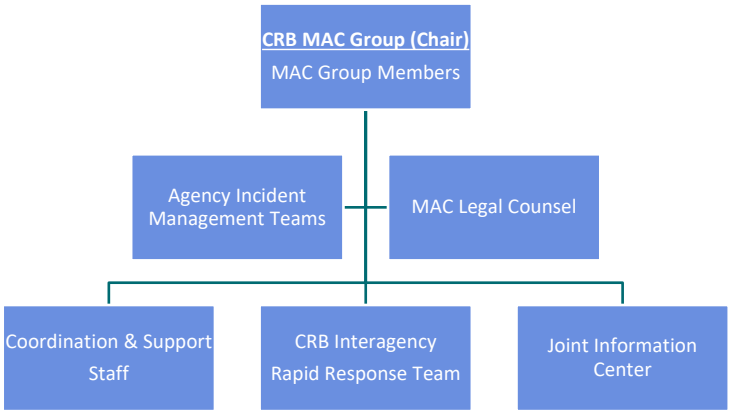
- Make periodic contact with assigned agencies and jurisdictions.
- Ensure that all agency/entity press releases are coordinated with the CRB MAC Public Information Officer and/or the Joint Information Center.
- Ensure that situation status is being shared with cooperating and assisting agencies.
- Ensure that logistical support requests are being handled efficiently.

____ Direct agency/entity managers to implement decisions of the CRB MAC Group. Monitor outcomes.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **MAC Group Legal Counsel**	**Reporting Relationships**: Reports to: MAC Group Chair

Location in Organization:



General Responsibilities:

The CRB MAC Group Legal Counsel serves as the CRB MAC Legal Counsel, a member of the CRB MAC Group Support staff, and is responsible for:

- Advising the CRB MAC Group in matters of legal authority and responsibility.
- Assisting in the drafting of interagency and private-sector agreements necessary to manage the infestation.
- Advising the CRB MAC Group on issues of regulatory compliance.
- Coordinating legal issues with outside legal counsel.
- Assisting in the formulation of policies and procedures to manage the infestation.

CRB MAC Group Legal Counsel Response Checklist (page 1 of 1)

This checklist is a guideline. Plan users should feel free to augment the list as necessary. Some actions are one-time actions; others are ongoing or repetitive for the duration of the infestation.

____ Obtain briefing from CRB MAC Chair. Determine:

- What emergency codes, authorities, or provisions have been implemented or anticipated.
- Regulatory and environmental compliance issues.
- Status of disaster declarations.
- What interagency agreements have been implemented.
- What interagency or private-sector agreements are needed.
- Any known or anticipated legal ramifications of the infestation or proposed management activities.

____ Confirm the assignment of the Coordination and Support Staff Compliance Technical Specialist. Assist as necessary with processing required regulatory compliance applications.

____ Research legal issues associated with management of the infestation. Prepare and present legal opinions to CRB MAC Group.

____ Assist in the formulation of policies and procedures as appropriate.

____ Coordinate with legal counsels from cooperating and assisting agencies, and other impacted agencies and jurisdictions as necessary to develop a consistent legal approach to management of the infestation.

____ Attend CRB MAC Group Planning Meetings.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description

Position:

Coordination and Support Staff Manager

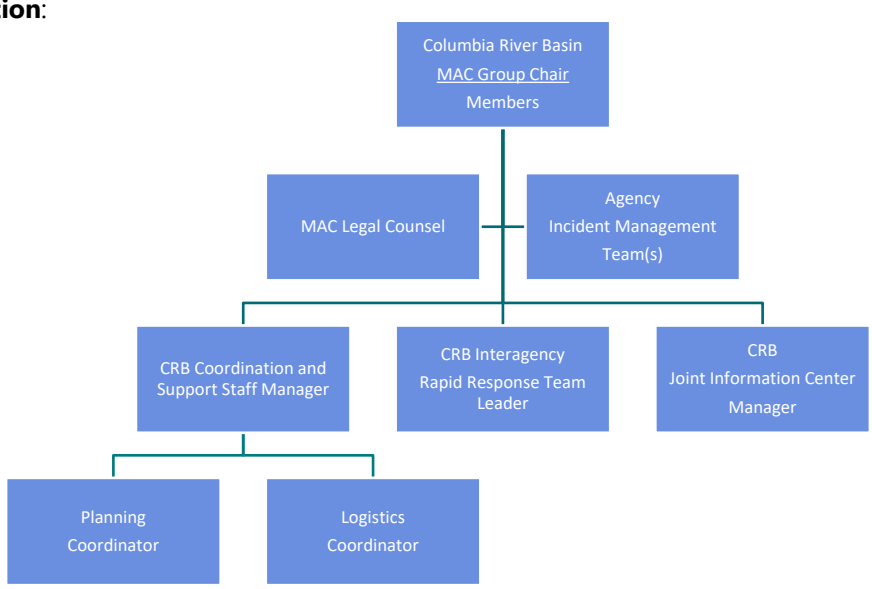
Reporting Relationships:

Reports to: MAC Group Chair

Reports to this Position:

- Planning Coordinator
- Logistics Coordinator

Location in Organization:



General Responsibilities:

The CRB Coordination and Support Staff Manager ensures that accurate and timely situation and resource status is provided to the CRB MAC Group so that policy can be made, incidents prioritized, and resources allocated. The Manager also assists in ensuring that the organization has the resources it needs to respond to the infestation.

This responsibility has been divided into two general areas—Planning and Logistics:

- Planning requires the activation and management of subject matter experts whose skills and knowledge confirm the presence of dreissenids, the extent of the infestation, and the most appropriate control actions.
- Logistics requires providing the communications, facilities, and other support required by the MAC Group, as well as assisting in the identification, procurement, and delivery of resources that may be required to manage the infestation.

The Coordination and Support Staff Manager is responsible for activating and supervising staff assigned to Planning and Logistics.

The individual filling the position of CRB MAC Group Chair may also fill the CRB Coordination and Support Staff Manager position. In long term or very complex infestation management efforts, it may be necessary to fill both positions.

CRB Coordination and Support Staff Manager Response Checklist (page 1 of 1)

This checklist is a guideline. Plan users should feel free to augment the list as necessary. Some actions are one-time actions; others are ongoing or repetitive for the duration of the emergency.

____ Obtain briefing from CRB Notification Coordinator, Incident Commanders, and/or MAC Group Chair.

____ Staff Planning and Logistics Coordinators as appropriate.

____ Confirm that Priority 1 notifications have been completed.

____ Confirm that positive identification of dreissenid species has occurred.

____ Complete or obtain completed ICS form 201 Incident Briefing, ICS Form 232 Resources at Risk and ICS Form 209 Incident Status Summary (see Appendix H for blank forms).

____ Ensure that CRB MAC Group room is set up, including resource/situation status displays.

____ Notify and convene appropriate subject matter experts to assist in confirming the presence of dreissenids, extent of infestation, and control and management options. Ensure that resource and situation status information is accurate, current, and complete.

____ Develop situation and resource status reports.

____ Brief CRB MAC Group.

____ Advise the CRB MAC Group on general emergency management issues and procedures.

____ Assist in obtaining and organizing resources. Identify scarce resources. Research location and availability of additional resources. With approval of the CRB MAC Group, procure and assign additional resources.

____ Determine CRB MAC Group Schedule. Ensure CRB Coordination and Support Staff provide required information to meet time lines.

____ Document actions taken by the CRB Coordination and Support Staff. Provide copies to Planning Coordinator.

____ Brief CRB Coordination and Support Staff on decisions made by the CRB MAC Group. Ensure decisions are implemented.

____ Attend CRB MAC Group Planning Meetings.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description

Position:

Coordination and Support Staff Planning Coordinator

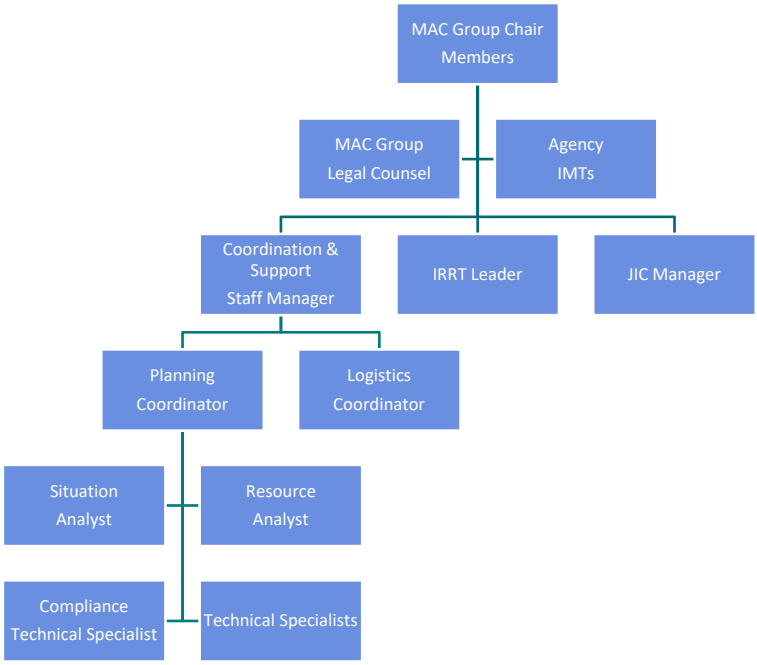
Reporting Relationships:

Reports to: Coordination and Support Staff Manager

Reports to this Position:

- Situation, Resource Analysts,
- Compliance Technical Specialist
- Technical Specialists

Location in Organization:



General Responsibilities:

The Planning Coordinator is responsible for the collection, evaluation, dissemination, and use of information about the development of the infestation and status of resources. Information is needed to: 1) understand the scope and implications of the infestation, 2) predict probable course of the infestation, and 3) prepare alternative strategies and control operations for the infestation.

The Planning Coordinator activates, assigns, and supervises Analysts and Technical Specialists who are subject matter experts in their areas of expertise. The Technical Specialists required will vary depending on the nature and location of the infestation, but may include biologists, experts in environmental compliance, hydrologists, and meteorologists.

The Planning Coordinator is responsible for completing a variety of situation status forms to document analysis, management plans, and resource status. These include, but are not limited to, the ICS form 201 Incident Briefing, ICS Form 232 Resources at Risk and ICS Form 209 Incident Status Summary (see Appendix H for blank forms). The Planning Coordinator is also responsible for developing and/or procuring maps, situation and resource status displays, etc., for the use of the Coordination and Support Staff and the MAC Group.

Planning Coordinator Response Checklist (page 1 of 3)

This checklist is a guideline. Plan users should feel free to augment the list as necessary. Some actions are one-time actions; others are ongoing or repetitive for the duration of the infestation.

____ Obtain briefing from the CRB Coordination and Support Staff Coordinator.

- Determine current resource status
- Determine current situation status
- Determine current strategic goals and tactical objectives
- Determine time and location of first CRB MAC Group Planning Meeting.
- Determine desired contingency plans.

____ Activate Situation and Resource Analysts and Technical Specialists as necessary.

____ Assist in obtaining and organizing resources:

- Establish and maintain resource tracking system.
- Identify scarce resources. Identify need for specialized resources; discuss need with CRB Coordination and Support Staff Manager; assist in identifying sources and availability of additional resources. Facilitate resource requests with Logistics.
- Form, deploy, and supervise technical specialist teams.

____ Develop situation and resource reports for the CRB MAC Group according to the schedule set by the CRB MAC Group Chair & CRB Coordination and Support Staff Manager.

____ Advise CRB Coordination and Support Staff Manager of significant changes in incident status.

____ Compile and display infestation status summary information.

- Forward infestation status summary reports to Priority 1 agencies/entities according to schedule established by the CRB Coordination and Support Staff Manager.
- Provide copy to JIC and local entity Public Information Officer(s).

____ Obtain/develop infestation maps.

____ Establish information requirements and reporting schedules for CRB Coordination and Support Staff and impacted entity/agencies.

____ Ensure sampling and monitoring plan has been developed and implemented (long-term monitoring is the responsibility of the responsible agency/lead entity).

____ Prepare contingency plans and containment/control recommendations.

- Review current and projected infestation and resource status.
- Develop alternative strategies.

Planning Coordinator Response Checklist (page 2 of 3)

- Identify resources required to implement contingency plan.
- Document alternatives for presentation to CRB MAC Group.

____ Identify and establish communications points with agencies responsible for compliance issues.

____ Notify Planning Coordinator of Compliance staff activated, including names and location of assigned personnel.

____ Prior to CRB MAC Group meetings, meet with CRB Coordination and Support Staff Manager and CRB MAC Group Chair to discuss proposed strategy and tactics and diagram infestation organization and resource locations.

____ Attend CRB MAC Group Meeting.

____ Participate in preparation of MAC Group Management Plan.

- Provide input on regulatory and environmental compliance issues, including approval status, estimated timelines, etc.
- Prepare the compliance assignments for the next operational period based on the contingency plans approved at the CRB MAC Group meeting.
- Identify future operational strategies, so as to anticipate compliance requirements

____ Prepare and submit compliance documents in a timely fashion. Coordinate review with CRB MAC Legal Counsel as needed.

____ Supervise preparation and distribution of the written MAC Group Management Plan, if indicated. Minimum distribution is to all CRB MAC Group Members, the IRRT, and local IMTs.

- Establish information requirements and reporting schedules for use in preparing the IAP.
- Ensure that detailed contingency plan information is available for consideration by the IRRT and local IMTs.
- Verify that all support and resource needs are coordinated with Logistics Section prior to release of plan.
- Coordinate changes with CRB Coordination and Support Staff, IRRT, and local IMTs. Obtain approval from CRB MAC Group Chair. Distribute written changes as appropriate

____ Coordinate preparation of the MAC Communications Plan with CRB Logistics Coordinator.

____ Provide periodic predictions on infestation potential.

____ Establish a weather data collection system when necessary.

Planning Coordinator Response Checklist (page 3 of 3)

____ Ensure Section has adequate coverage and relief.

____ Hold Section meetings as necessary to ensure communication and coordination among Planning staff.

____ Ensure preparation of demobilization plan (if appropriate).

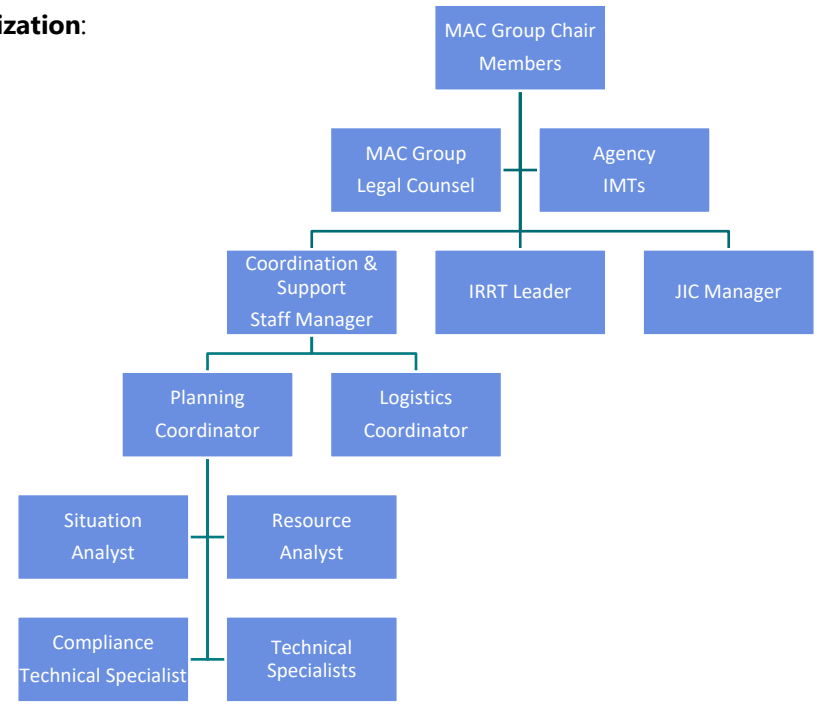
____ Ensure preparation of final incident package. Route to US Fish and Wildlife Service for archiving or follow-up.

____ Provide briefing to relief on current and unusual situations.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Situation Analyst**	**Reporting Relationships**: Reports to: Planning Coordinator Reports to this Position: Technical Specialists

Location in Organization:



General Responsibilities:

The Situation Analyst is responsible for the collection and evaluation of information about the infestation. The Situation Analyst assigns and supervises Technical Specialists who are subject matter experts in their areas of expertise. Responsibilities will vary depending on the nature and location of the infestation, but may include:

- Determining the scope of the infestation.
- Confirming the presence and positively identifying the invasive species.
- Identifying the source of the infestation.
- Identifying and quantifying resources at risk.
- Researching likelihood of success and possible effects of proposed control options.
- Developing and recommending most appropriate control plan.

The Situation Analyst is responsible for completing a variety of situation status forms to document analysis and management plans. These include, but are not limited to, the ICS form 201 Incident Briefing, ICS Form 232 Resources at Risk and ICS Form 209 Incident Status Summary (see Appendix H for blank forms).

The Situation Analyst is also responsible for developing and/or procuring maps, and situation status displays, etc. for the use of the Coordination and Support Staff and the MAC Group.

Situation Analyst Response Checklist (page 1 of 2)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from Planning Coordinator.

- Review current incident status
- Determine current strategy, assess effectiveness
- Determine necessary reports and plans
- Identify reporting requirements and schedules-both internal and external to the incident.

____ Organize and staff unit as appropriate.

- Form, assign, and supervise Technical Specialists groups as necessary.
- Establish reporting requirements, including schedule and format.
- Request additional Technical Specialists as needed.

____ Supervise Technical Specialists as assigned.

- Brief Technical Specialists on current incident status.
- Assign analysis tasks.
- Notify staff of time lines and format requirements
- Monitor progress

____ Compile, maintain, and display incident status information for MAC Group and Coordination and Support Staff.

- Sort data into required categories of information (i.e., geographic area, environmental values at risk, location of operations, etc.)
- Determine appropriate map displays
- Review all data for completeness, accuracy, and relevancy prior to posting.
- Plot infestation boundaries, location of perimeters, facilities, access routes, etc. on display maps.
- Develop additional displays (weather reports, incident status summaries, etc.) as necessary.
- Ensure displays and maps are kept up to date.

____ Provide photographic services and maps.

- Provide timely photo processing.
- Develop specialized maps.

Situation Analyst Response Checklist (page 2 of 2)

____ Provide situation evaluation, prediction and analysis for the MAC Group prepare information on alternative strategies.

- Review current and projected infestation and resource status.
- Develop alternative strategies.
- Identify resources required to implement management plan.
- Document alternatives for presentation to MAC Group.

____ Interview operations personnel to determine effectiveness of strategy and tactics, work accomplished and left to be accomplished.

____ Request weather forecasts as necessary. Spot weather forecasts may be requested directly from the National Weather Service.

____ Prepare incident status summary form (ICS209L) and other status reports as assigned prior to each MAC Group Planning Meeting. Provide copies to Coordination and Support Staff and MAC Group. Forward to other entities as directed.

____ Participate in MAC Group planning meetings as required.

____ Prepare predictions at periodic intervals, or upon request of the Planning Coordinator. Notify Planning Coordinator if unforeseen changes occur.

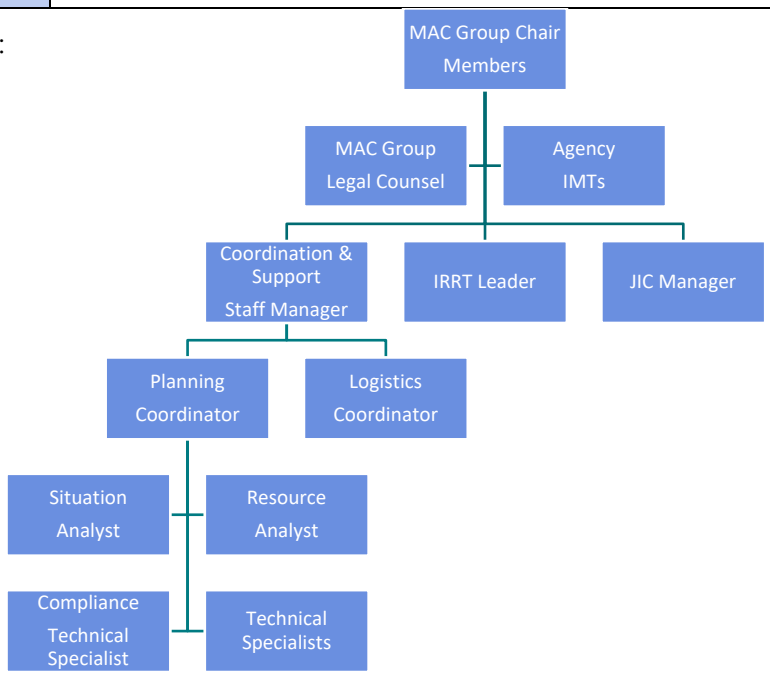
____ Provide briefing to relief on current and unusual situations.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description

Position: **Resource Analyst**	**Reporting Relationships**: Reports to: Planning Coordinator Reports to this Position: Technical Specialists

Location in Organization:



General Responsibilities:

The Resource Analyst is responsible for the collection and display of critical/scarce resource status, and for assisting in researching and locating additional resources required to manage the infestation.

Resource Analyst Response Checklist (page 1 of 1)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from the Planning Coordinator. Determine what resources are considered scarce/critical.

____ Organize, staff, and supervise unit as appropriate. Provide for adequate relief.

____ Establish contact with incident information sources to determine what scarce/critical resources have been assigned to the incident, their status, and location.

____ Compile, maintain and display scarce/critical resource status information.

____ Participate in MAC Group planning meetings as assigned.

____ Brief relief on current and unusual situations.

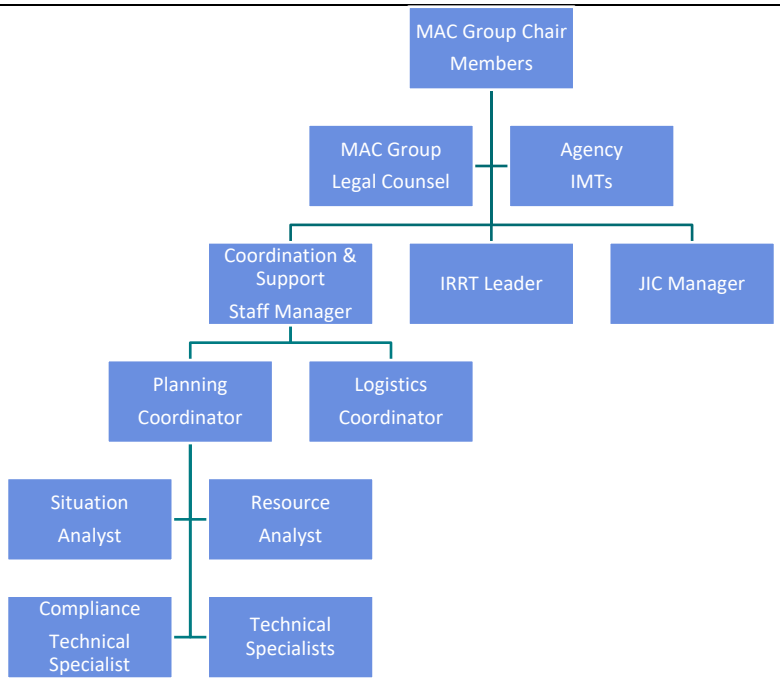
____ Assist in identification of additional and special resources

- Other disciplines
- Technical specialists
- Resources needed to implement proposed management plans

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Compliance Technical Specialist**	**Reporting Relationships**: Reports to: Planning Coordinator

Location in Organization:



General Responsibilities:

The Compliance Technical Specialist assists in identification and compliance with applicable regulatory issues, applications, and other authorizations. Tasks may include:

- Analyzing proposed management plans for regulatory implications.
- Preparing necessary applications, justification for waivers, etc. that may be necessary before the proposed management plan can be implemented.
- Coordinating applications, justifications, etc. with the MAC Group Legal Counsel as necessary.
- Advising the Planning Coordinator and the MAC Group on regulatory and compliance issues.

Compliance Technical Specialist Response Checklist (page 1 of 1)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from Planning Coordinator.

____ Obtain copies of proposed management plans.

____ Identify regulatory issues related to the proposed management plan(s).

____ Complete applications, requests for waivers, etc. according to required format and timelines.

____ Advise Planning Coordinator of timelines for review and approval. Timelines may affect choice of management plan.

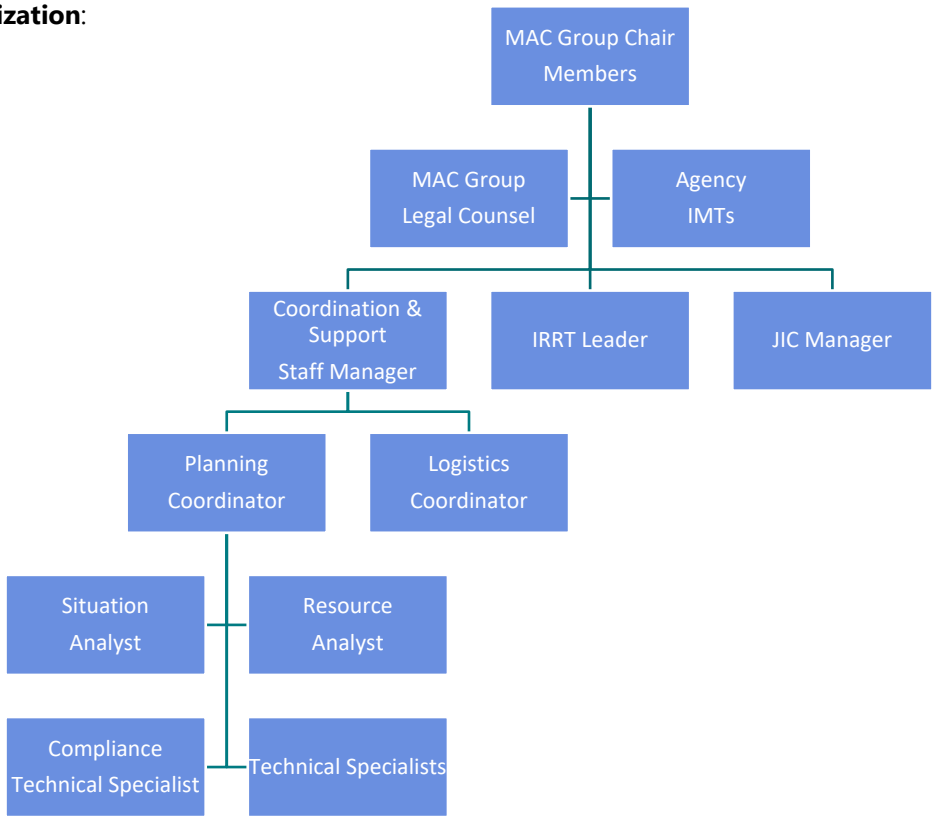
____ Participate in MAC Group planning meetings as requested.

____ Provide technical expertise to supervisor in organization according to established format, timelines, etc.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Technical Specialist**	**Reporting Relationships**: Reports to: Planning Coordinator, Situation Analyst or other positions as assigned.

Location in Organization:



General Responsibilities:
Technical Specialists are advisors with special skills needed to support incident operations. Technical Specialists may report to the Planning Coordinator or Situation Analyst, or to other parts of the organization such as the on-scene Incident Management Team, or to the IRRT.

Technical Specialist Response Checklist (page 1 of 1)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from Planning Coordinator.

- Identify supervisor in organization.
- Determine nature and scope of assignment.
- Identify work location, resources available, expectations of Incident organization concerning time-lines, report format, participation in planning meetings, etc.

____ Obtain copies of management plans or Incident Action Plan (if available).

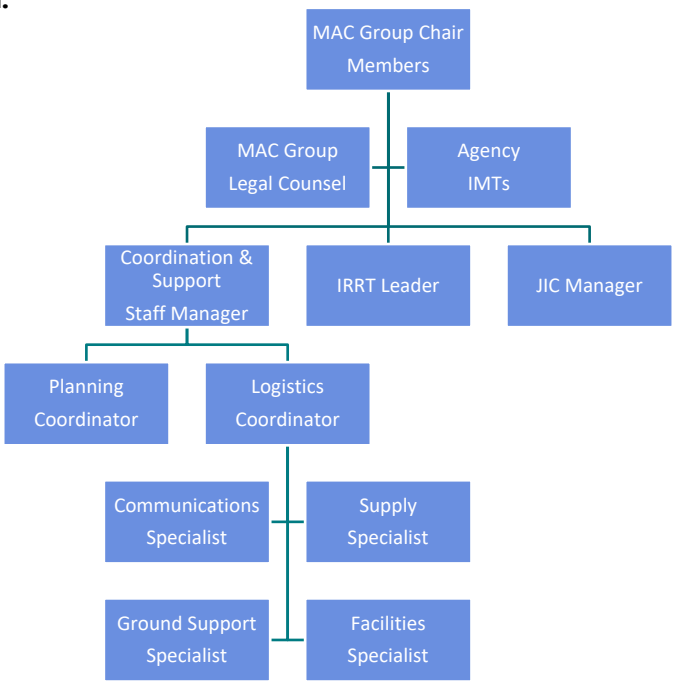
____ Participate in planning meetings as requested.

____ Provide technical expertise to supervisor in organization according to established format, timelines, etc.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Coordination and Support Staff Logistics Coordinator**	**Reporting Relationships:** Reports to: Coordination and Support Staff Manager Reports to this Position: Supply Specialist, Facilities Specialist, Ground Support Specialist, Communications Specialist

Location in Organization:



General Responsibilities: The Logistics Coordinator, a member of the CRB Coordination and Support Staff, is responsible for providing facilities, services, and materials (except tactical aircraft) in support of the MAC Group and the on-scene operations managing response to the infestation. Tasks associated with these responsibilities may include, but are not limited to:

- Identifying and procuring facilities for the MAC Group, Coordination and Support Staff, and on-scene incident management team.
- Arranging for hotel rooms and food for the MAC Group, Coordination and Support Staff, and on-scene incident management team.
- Designing, procuring, and implementing communications systems and equipment in support of the MAC Group, Coordination and Support Staff, and on-scene incident management team.
- Assisting in the identification and procurement of resources needed to manage the infestation.
- Providing transportation for personnel and materials to the scene of the infestation.

Coordination and Support Staff Logistics Coordinator Response Checklist (page 1 of 2)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the infestation.

____ Obtain briefing from the CRB Coordination and Support Staff Manager.

- Review Situation and Resource status for number of personnel assigned to incident.
- Review current MAC Group organization

____ With approval from the CRB Coordination and Support Staff Manager, determine system for request and release of additional resources.

____ Assess adequacy of current MAC communications plan.

____ Organize and staff Logistics staff as appropriate. Consider the need for facility security, Communications, and Supply Specialists.

____ Assemble, brief, and assign work locations and preliminary work tasks to Logistics personnel.

- Provide summary of infestation situation
- Provide summary of the kind and extent of support the CRB Coordination and Support Staff Logistics organization may be asked to provide.

____ Notify Planning Coordinator of Logistics staff activated, including names and location of assigned personnel.

____ Attend CRB MAC Group Meeting.

____ Participate in preparation of MAC Group Management Plan.

- Provide input on resource availability, support needs, identified shortages, and response time-lines for key resources.
- Prepare the Logistics assignments for the next operational period based on the operational objectives generated at the CRB MAC Group planning meeting.
- Identify future operational needs (both current and contingency), so as to anticipate logistical requirements
- Ensure MAC Communications Plan is prepared.

____ Establish contact with adjoining and mutual aid cooperators.

____ Review Incident Action Plan and estimate section needs for next operational period; order relief personnel if necessary.

Coordination and Support Staff Logistics Coordinator Response Checklist (page 2 of 2)

____ Assist in obtaining and organizing resources.

- Research availability of additional resources.
- Process requests for scarce resources.
- Provide resource identification information and arrival times with on-scene Logistics Section Chief.

____ Hold Logistics staff meetings as necessary to ensure communication and coordination among Logistics staff.

____ Ensure coordination between Logistics and CRB staff.

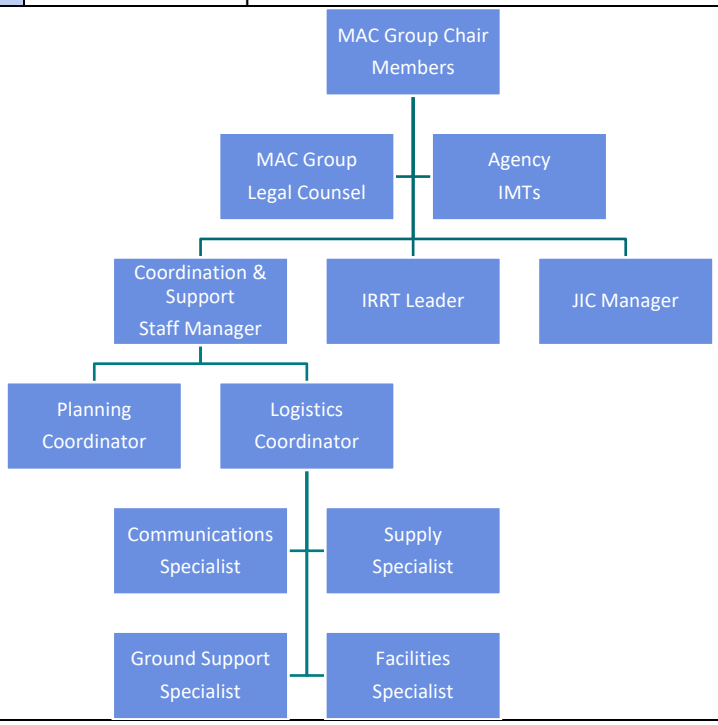
____ Ensure general welfare and safety of section personnel.

____ Provide briefing to relief on current activities and unusual situations.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Communications Specialist**	**Reporting Relationships:** Reports to: Logistics Coordinator Reports to this Position: Communications Technicians Communications providers

Location in Organization:



General Responsibilities:

The Communications Specialist is responsible for designing and implementing communications plans to support the CRB MAC Group and the on-scene operations. Tasks may include:

- Identifying communications modes already in use.
- Determining additional communications support that may be required.
- Identifying and activating sources of communication support.
- Developing a communications plan to ensure effective communication between the MAC Group, its constituent agencies/entities, and the on-scene Incident Management Team.

Communications Specialist Response Checklist (page 1 of 2)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from the Logistics Coordinator.

____ Organize and staff unit as appropriate.

- Ensure adequate staff is assigned to answer phones and email and attend fax machines.

____ Assess communications systems in use; determine communications capabilities/limitations.

____ Develop and implement effective communications procedures (flow) internal and external to the Coordination and Support Staff.

____ Assess phone load. Activate additional lines as needed.

____ Prepare and implement MAC Communications Plan.

- Obtain current organizational chart
- Identify email addresses, cellular and land-line telephone numbers, or radio links for the following:
  - MAC Group Chair
  - Coordination and Support Staff (including Technical Specialists assigned to the field).
  - MAC Group Members
  - Constituent agencies/entities
  - JIC
  - Local/national press
  - Incident Management Team
  - MAC Group Legal Counsel
  - IRRT Leader

____ Determine need and research availability of additional nets and systems. Order through Supply Specialist after approval by Logistics Coordinator.

____ Document malfunctioning communications equipment and facilitate repair.

____ Establish and maintain communications equipment accountability system.

Communications Specialist Response Checklist (page 1 of 2)

____ Provide technical information, as required, on:

- Adequacy of communications system currently in use.
- Geographic limitation on communications equipment.
- Equipment capabilities.
- Amount and types of equipment available.
- Anticipated problems in the use of communications equipment.

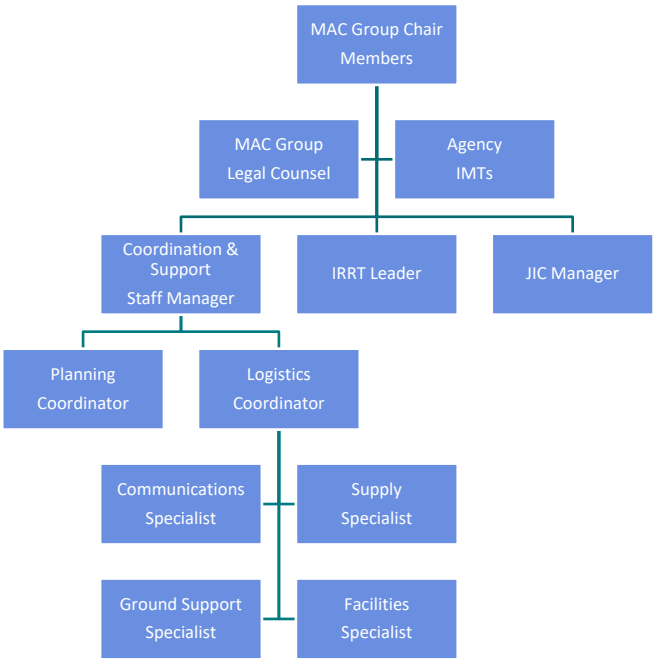
____ Estimate unit needs for expected operations; order relief personnel.

____ Provide briefing to relief on current activities and unusual situations.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Supply Specialist**	**Reporting Relationships:** Reports to: Logistics Coordinator Reports to this Position: Ordering staff Technical Specialists-Resources

Location in Organization:



General Responsibilities:

The Supply Specialist is responsible for ordering, receiving, and storing all resources needed to support MAC Group Operations. Tasks may include:

- Identifying and purchasing general office supplies and other resources.
- Activating additional staff upon request from other MAC Group staff.
- Maintaining accountability for resources purchased.
- Identifying and ordering scarce/critical resources.

Supply Specialist Response Checklist (page 1 of 2)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from Logistics Coordinator

- Determine charge code or purchasing process for incident.
- Confirm ordering process
- Determine scope of supply process (on scene and MAC Group)

____ Organize and staff unit as appropriate.

- Consider need for "lead agency" representation in ordering process
- Consider dividing ordering responsibilities either by discipline or by type (equipment, personnel, supplies)

____ Determine ordering parameters, authorities and restrictions. Ensure that ordering staff observe ordering system and chain of command for ordering.

____ Contact Resource Analyst to determine what resources are scarce/critical.

____ Receive resource orders from authorized staff. Document:

- Qualifying specifications (size, extra equipment, personnel protective equipment, qualifications, etc.).
- Desired delivery time and location, person ordering, and person to whom the resource should report or be delivered.
- Obtain estimated price for resources which expect reimbursement.
- Ensure rented equipment is inspected before use.

____ Order, receive, distribute, and store supplies and equipment.

- Obtain resource name, number, identifiers, etc., along with ETA's.
- Relay this information to appropriate staff.

____ Advise affected personnel of changes in arrival times of requested resources. Advise immediately if order cannot be filled.

____ Alert Logistics Coordinator to changes in resource availability which may affect incident operations.

Supply Specialist Response Checklist (page 2 of 2)

____ Maintain inventory of supplies and equipment.

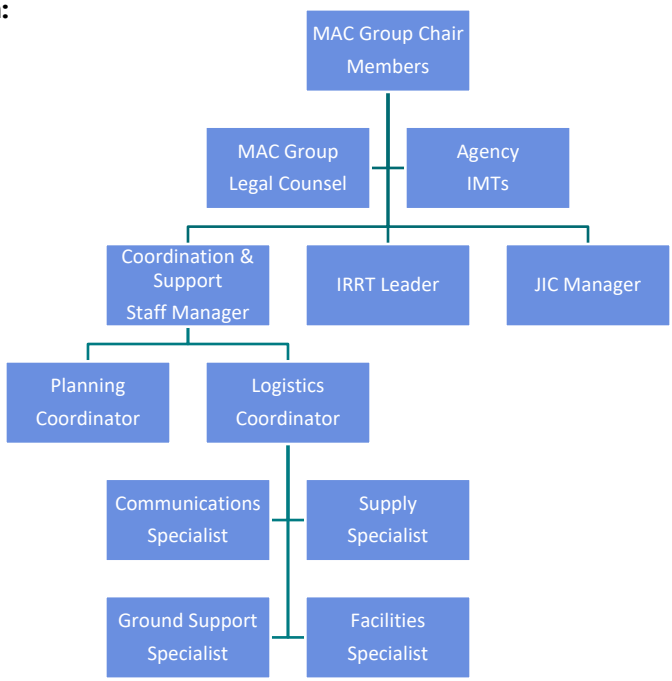
____ Keep and submit copies of all orders and related documentation to the Planning Coordinator.

____ Brief relief on status of outstanding orders, current activities, and unusual situations.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Facilities Specialist**	**Reporting Relationships**: Reports to: Logistics Coordinator

Location in Organization:



General Responsibilities:

The Facilities Specialist is responsible for the layout and activation of facilities required to support the MAC Group, including office space, meeting rooms, and the JIC. The Facilities Specialist also ensures that staff have sleeping accommodations, and identifies and arranges for food to be delivered to staff who are unable to leave their work assignments to eat. Tasks may include:

- Identifying appropriate office/workspace for the MAC Group and its support elements.
- Negotiating use agreements for workspace.
- Making reservations for hotel/motel rooms.
- Identifying easily accessible restaurants.
- Arranging for food and coffee service as necessary.

Facilities Specialist Response Checklist (page 1 of 1)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from the Logistics Coordinator.

- Expected duration and scope of the incident.
- Anticipated facility needs.

____ Assess need for additional workspace.

____ Determine requirements for each facility to be established.

- Workspace
- Meeting rooms
- Sanitation
- Supply area
- Communications needs (including computers)
- Security needs
- Break areas
- Parking

____ Plan facility layouts in accordance with above requirements.

____ Coordinate negotiation for rental office or storage space:

____ Video or photograph rental office or storage space prior to taking occupancy.

____ Make hotel reservations for staff as necessary.

____ Order food and coffee service as necessary.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description

Position:

Ground Support Specialist

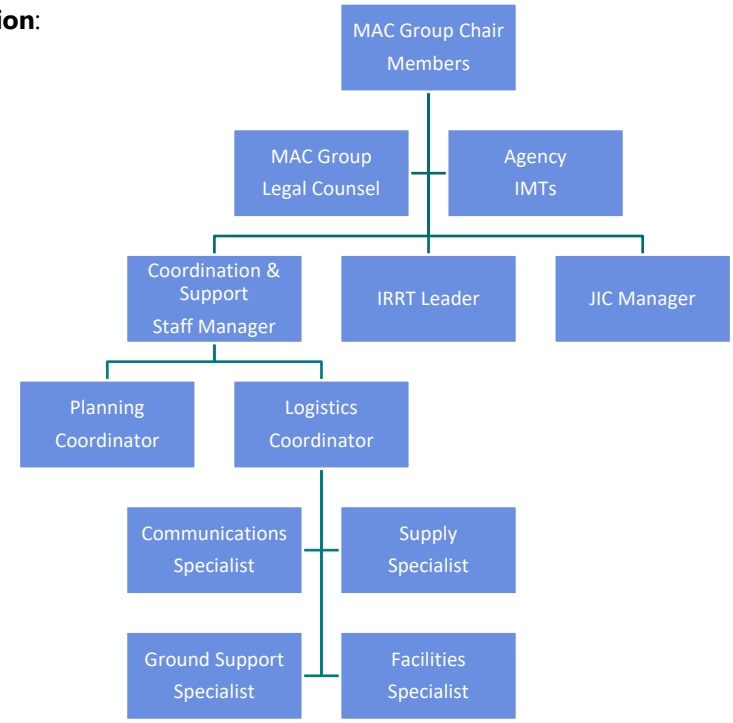
Reporting Relationships:

Reports to: Logistics Coordinator

Reports to this Position:

- Drivers
- Transportation providers

Location in Organization:



General Responsibilities:

The Ground Support Specialist is responsible for transportation of personnel, supplies, food, and equipment to and from the MAC Group and support staff, and to the scene of the infestation. Depending on the complexity of the operation, and funding agreements, tasks could include:

- Requesting, assigning and tracking agency or rental vehicles.
- Negotiating delivery of resources to the MAC Group or to the scene of the infestation.
- Arranging commercial transportation for personnel responding to or returning home from assignment to the MAC Group or scene of the infestation.
- Ensuring that rental vehicles and other equipment are inspected before use.

Ground Support Specialist Response Checklist (page 1 of 1)

The following checklist is a guideline. Users of this manual should feel free to augment the list as necessary. Note that some of the activities are one-time actions, others are ongoing or repetitive for the duration of the incident.

____ Obtain briefing from Logistics Coordinator.

- Transportation needed for MAC Group and on-scene Staff.
- Location of Supply Specialist receiving and distribution point(s)

____ Staff Unit as indicated by the above considerations.

____ Consider the need to use agency/entity pool vehicles or rental vehicles to augment transportation resources.

____ Maintain inventory of support and transportation vehicles.

____ Provide transportation services.

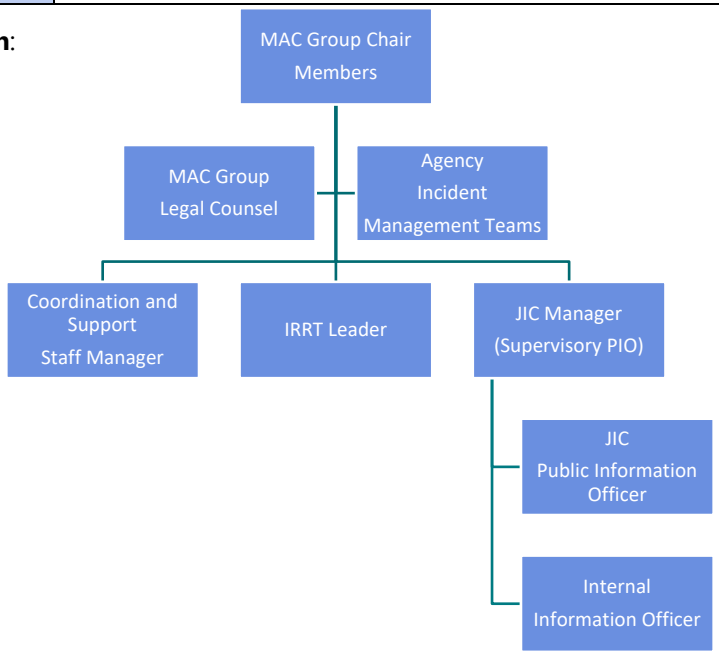
- Review management plans for transportation requirements.
- Review inventory for needed resources.
- Request additional resources through Supply Unit. Give type, time needed, and reporting location.
- Schedule use of support vehicles.
- Document mileage, fuel consumption, and other costs.

____ Ensure that the condition of rental equipment is documented prior to use.

____ Maintain Unit Log (ICS 214). Provide all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **Joint Information Center Manager/Supervisory PIO**	**Reporting Relationships**: Reports to: MAC Group Chair Reports to this Position: ▪ Public Information Officers ▪ Internal Information Officer

Location in Organization:



General Responsibilities:

The CRB Joint Information Center (JIC) Manager/Supervisory PIO is responsible for the coordinated formulation and release of information about the infestation to the news media, the public, agency/entity employees, and other agencies and organizations. Tasks may include:

- Developing press releases.
- Conducting press conferences.
- Developing talking points and other public information documents.
- Responding to rumors and incorrect information.
- Supervising JIC staff.
- Advising the MAC Group in matters pertaining to public information and media relations.

JIC Manager Response Checklist (page 1 of 2)

The following checklist is a guideline for the use of the CRB JIC Manager/Supervisory PIO. Users of this Plan should feel free to augment the list as necessary. Note that some of the activities are one-time actions; others are ongoing or repetitive for the duration of the emergency.

____ Obtain briefing from the CRB MAC Chair.

- Determine current status of infestation
- Identify current organization
- Determine point of contact for media (scene or JIC)
- Determine current media presence and interest

____ Contact Public Information Officers from impacted agencies and jurisdictions. Determine:

- Status of press contacts.
- Method for coordinating press releases and briefings.
- Need for a CRB Joint Information Center (it may be possible to issue a joint press release or hold a joint press conference rather than set up a formal JIC).
- Ensure that information provided to the public is consistent across jurisdictional boundaries when appropriate.

____ Assess need for special alert and warning efforts, including industries especially at risk, or which may need advance notice to shut down processes.

____ **The initial release of information about the infestation is the responsibility of the affected jurisdiction.** Prepare initial information summary as soon as possible after activation. If no other information is available, consider the use of the following general statement:

> *We are currently investigating reports of (name of invasive species) in the vicinity of (general location). Experts from the Columbia River Basin Interagency Response Team and local agencies are responding, and we will have additional information available as we are able to confirm it. We will hold a briefing at (location), and will notify the press at least ½ hour prior to the briefing. At this time, this briefing is the only place where officials authorized to speak about the incident and confirmed information will be available. Thank you for your assistance.*

____ Ensure adequate work space, materials, telephones, and staff. Consider activating:

- JIC Public Information Officers
- Internal Information Officers

____ Establish contact with Field (IMT) Public Information Officers. Assist in the development of a coordinated, interagency approach to public information.

JIC Manager Response Checklist (page 2 of 2)

____ Establish contact with local and national media representatives as appropriate.

____ Establish location of Information Center for media and public, away from MAC Group and Coordination Group work areas.

____ Establish schedule for news briefings.

____ Coordinate with Logistics the activation and staffing of message center "rumor control" lines to receive requests and answer questions from the public and impacted entities. Provide statement to operators.

____ Obtain current incident status reports from Planning Section; coordinate updates schedule.

____ Observe constraints on the release of information imposed by the CRB MAC Group and impacted jurisdiction Incident Commanders.

____ Obtain approval for information release from CRB MAC Chair.

- Confirm details to ensure no conflicting information is released.
- Identify site and time for press briefings, and confirm participation by other CRB MAC Group members, and representatives from impacted jurisdictions.
- Confirm who can authorize information releases in absence of CRB MAC Chair.

____ Release news to media, and post information in Coordination and MAC Group work areas and other appropriate locations.

____ Record all interviews and copy all news releases. Contact media to correct erroneous or misleading information being provided to the public via the media. Coordinate this activity with PIOs from impacted jurisdictions.

____ Update affected agencies/entities on a regular basis. Electronic mail may be used for updates. Provide standard statement for general requests for information.

____ Attend CRB MAC Group planning meetings.

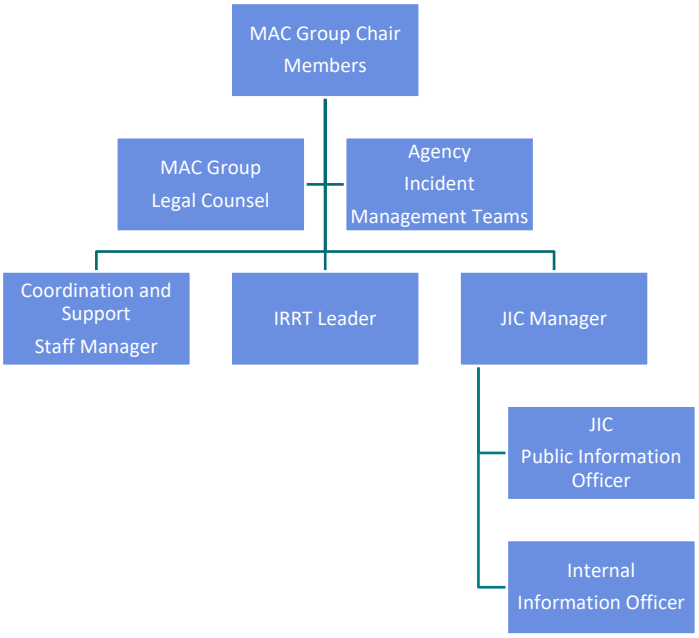
____ Respond to special requests for information.

____ Provide all news releases, bulletins, and summaries to Coordination Group Planning Coordinator to be included in the final incident package.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **JIC Public Information Officer**	**Reporting Relationships**: Reports to: JIC Manager/Supervisory PIO

Location in Organization:



General Responsibilities:

Public Information Officers assigned to the JIC are responsible for developing a coordinated approach to public information related to the infestation. Tasks may include

- Developing press releases, talking points, and information summaries for dissemination to the press, agency employees, and outside agencies/entities.
- Coordinating document development with agency and Field Public Information Officers.
- Conducting briefings for the press and other interested groups.
- Identifying trends in press and public opinion and bringing these to the attention of the JIC Manager.

JIC Public Information Officer Response Checklist (page 1 of 1)

The following checklist is a guideline. Users of this Plan should feel free to augment the list as necessary. Note that some of the activities are one-time actions; others are ongoing or repetitive for the duration of the emergency.

____ Receive briefing from Supervisory Public Information Officer.

____ Determine location and participants in Joint Information Center (JIC).

____ Assist in the development of public information documents such as press releases, internal employee briefings, etc.

____ Determine constraints on information to be provided by the JIC.

____ Observe constraints established on information release. Provide copies of JIC releases to home unit and Field Public Information Officers. Request that errors or misleading/confusing information be identified.

____ Be proactive in requesting updates on information from home unit.

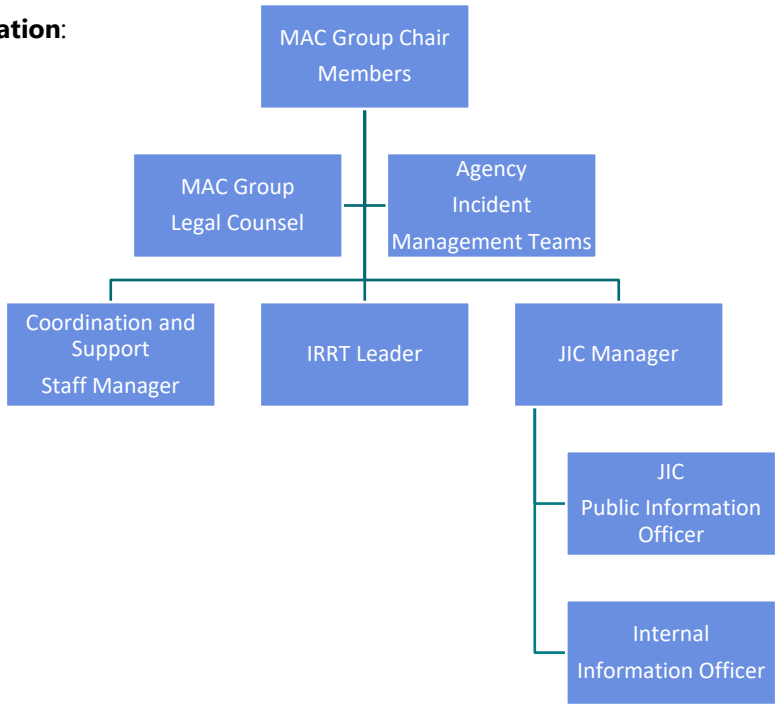
____ Keep home unit Public Information Officer apprised of activities of JIC.

____ Maintain copies of releases; provide to Supervisory Public Information Officer for inclusion in Final Incident Package.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **JIC Internal Information Officer**	**Reporting Relationships**: Reports to: JIC Manager/Supervisory PIO

Location in Organization:



General Responsibilities:

The Internal Information Officer assigned to the JIC is responsible for ensuring that employees of agencies and entities responding to the infestation are kept informed on response activities. Tasks may include:

- Developing summaries for dissemination to agency employees and communications points.
- Coordinating document development with agency/entity Public Information Officers.
- Conducting briefings for agency/entity employees.
- Identifying and addressing rumors, discrepancies in information, etc.

Internal Information Officer (page 1 of 1)

The following checklist is a guideline. Users of this Plan should feel free to augment the list as necessary. Note that some of the activities are one-time actions; others are ongoing or repetitive for the duration of the emergency.

____ Obtain briefing from JIC Manager/Supervisory Public Information Officer.

____ Develop standard statement to be provided to communications points.

- Department secretaries and switchboard operators
- 911 Centers (if necessary)
- Other communications points which may receive calls about the infestation

____ Obtain approval for statements from JIC Manager/Supervisory Public Information Officer.

____ Determine communications methods available. E-mail may be used to update affected entities simultaneously.

____ Determine what phone line has been established for internal updates, make sure affected entities are appraised of the number.

____ Provide copies of statements to Logistics Coordinator for use by rumor control operators.

____ Be proactive in requesting information updates from JIC Manager/Supervisory Public Information Officer and other JIC staff.

- Planning Coordinator for Incident updates
- Logistics Section for information on resource use.

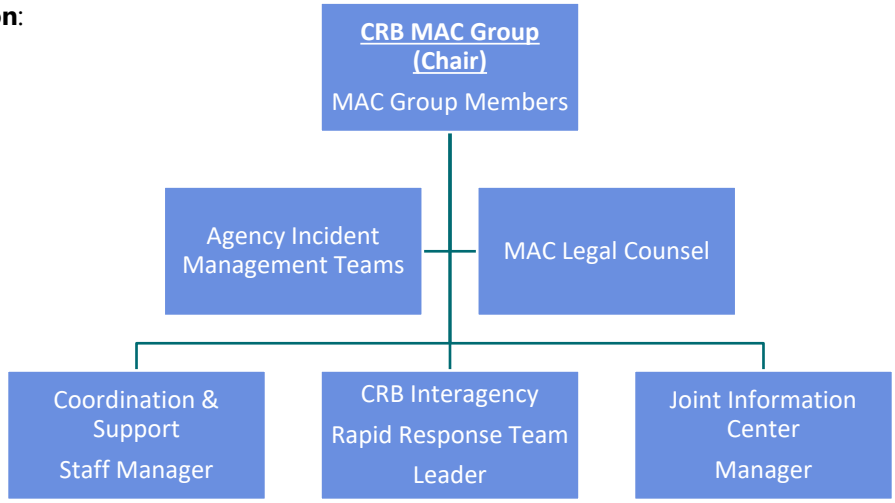
____ Update communications points on a regular schedule.

____ Maintain copies of statements given; provide to JIC Manager/Supervisory Public Information Officer for inclusion in Final Incident Package.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

CRB Multi-Agency Coordination Structure	Position Description
Position: **IRRT Leader**	**Reporting Relationships**: Reports to: MAC Group Chair, Agency Administrators (when responding as an Incident Management Team) Reports to this Position: Individual Team Members, Subject Matter Experts

Location in Organization:



General Responsibilities:

The Interagency Rapid Response Team consists of ICS-trained subject matter experts that can be deployed to the scene in three ways:

- As a Unified Command incident management team providing on-scene response, management, and control of the infestation,
- As individual ICS Command/General Staff Filling vacancies within the local Incident Management Team's Command and General Staff or
- As Technical Specialists providing technical expertise to the local Incident Management Team, or serving as Field Observers or Technical Specialists to the MAC Coordination and Support Staff's Planning function.
- Depending upon the management needs of the agency suffering from the infestation.

IRR Team Leader Response Checklist (page 1 of 3)

The following checklist is a guideline designed for use by the IRRT Leader/IC. Users of this Plan should feel free to augment the list as necessary. Note that some of the activities are one-time actions; others are ongoing or repetitive for the duration of the emergency.

____ Receive assignment from CRB MAC Group. Determine:

- Configuration (IMT or Technical Specialists).
- Status of Delegation of Authority (IMT)
- Team members assigned and en route

____ Name and location of local Incident Commander (Technical Specialist assignment)

____ Conduct assignments according to established agency SOPs.

The remaining elements of the checklist are for use by the IRRT Leader when responding as Incident Commander. Checklists for Command and General Staff can be found in the NIMS Field Operations Guide. Checklists for Rapid Response Objectives assigned to the field operations elements of the responsible agency or to the IRRT Incident Management Team can be found in *Field Operations* beginning on page B-27.

The Incident Commander is responsible for the overall management of the infestation, the development and implementation of strategic goals and objectives (in coordination with the CRB MAC Group), and for approving the ordering and release of resources. IRRT Command will be Unified, with Command personnel from USFWS, the impacted state Fish and Wildlife Agency, and tribal or other agencies or jurisdictions who share authority for the incident. **Any functions not assigned by the Incident Commander remain the responsibility of the Incident Commander.**

The following checklist is a guideline. Users of this Plan should feel free to augment the list as necessary. Note that some of the activities are one-time actions; others are ongoing or repetitive for the duration of the incident.

____ Supervise Command and General Staff; ensure welfare and safety of incident personnel.

____ Obtain initial briefing.

____ Assess infestation situation.

- Review the current situation status and initial strategic objectives. Ensure that all County, State and Federal agencies impacted by the incident are notified.

IRRT Leader Response Checklist (page 2 of 3)

____ Conduct Unified Command Meeting. The Command Meeting is usually attended only by the Incident Commanders, and the following topics should be discussed as appropriate:

- Jurisdiction or agency priorities
- Jurisdiction or agency limitations, concerns, restrictions
- Develop a collective set of incident objectives (coordinate with CRB MAC Group)
- Establish and agree on acceptable priorities
- Adopt an overall strategy or strategies to achieve objectives
- Agree on basic organizational structure.
- Designate the best qualified and acceptable Operations Section Chief.
- Agree on General Staff personnel designations and planning, logistical, and financial arrangements and procedures.
- Confirm the resource ordering process to be followed (with CRB Coordination and Support Staff).
- Agree on cost-sharing procedures.
- Agree on informational matters (with CRB JIC if activated).
- Designate one IC to act as the Unified Command spokesperson.

____ Activate appropriate Command and General Staff positions.

- Confirm dispatch and arrival times of activated resources.
- Confirm work assignments.

____ Determine what management plans and activities require MAC Group approval.

____ Brief staff

- Identify strategic goals and any policy directives for the management of the infestation.
- Provide a summary of current organization.
- Provide a review of current activities.
- Determine the time and location of first planning meeting.

____ Determine information needs and inform staff of requirements.

____ Ensure interagency coordination.

- Ensure that affected elected officials have been informed of infestation, and keep them informed as to status and activities. Include elected officials in planning meetings as appropriate.
- Determine status of Disaster Declarations and Delegation of Authority.
- Ensure that the Liaison Officer is making systematic contact with elected officials and cooperating and assisting agency/entity managers.

IRR Team Leader Response Checklist (page 3 of 3)

____ Establish parameters for resource requests and releases.

- Review requests for critical resources.
- Confirm who has ordering authority within the organization.
- Confirm those orders which require Command authorization.
- Establish contact and coordination procedures with CRB Coordination and Support Staff Logistics Coordinator.

____ Authorize release of information to the media.

- If operating within a Unified Command, ensure all ICs approve release.
- Coordinate release of information with CRB JIC (if activated)

____ Establish level of planning to be accomplished.

- Written Incident Action Plan (in coordination with the CRB MAC Group)
- Contingency Planning
- Formal planning meeting

____ Ensure planning meetings are conducted according to schedule.

____ Approve and authorize implementation of the Incident Action Plan.

- Review IAP for completeness and accuracy
- Verify that objectives are incorporated and prioritized.
- Sign ICS202

____ Ensure Command and General Staff coordination.

- Periodically check progress on assigned tasks of Command and General Staff personnel.
- Approve necessary changes to strategic goals and action plan.
- Ensure that Liaison Officer is making periodic contact with participating agencies.

____ Request emergency declaration as necessary (in coordination with CRB MAC Group). Ensure declaration is forwarded to affected local or tribal agency Office of Emergency Management, and to the affected State Office of Emergency Management.

____ Review and approve disaster assessment statements from Planning staff prior to forwarding to State.

____ Document all significant actions, information on Unit Log (ICS214). Forward copies of all documentation to the Planning Coordinator.

IV. Field Operations Response Checklists

The following checklists provide additional guidance for field operations. Field operations may be conducted by the responsible agency or by the IRRT Incident Management Team.

Rapid Response Objective 4 - Define Extent of Colonization

Site Surveys

***Purpose*:** Establish physical range of infestation, and identify life-cycle phase of mussels to inform policy and tactical response to the infestation. Determine geographic extent and demography of infestation, (including upstream and downstream areas and connected water bodies) to guide subsequent management decisions, including survey design. Because veligers may only be in the water for a short period of time, plankton sampling and identification must have a quick turnaround time (no more than a week) so that further sampling can occur swiftly and in a coordinated fashion that ensures proper geographic coverage.

***Lead entity*:** The agency where the initial sighting(s) of mussels occurs. In the event the agency does not have the incident management capability, or the technical expertise to conduct the site survey, it may formally delegate that responsibility to the CRB IRRT.

***Tasks*:**

1. Survey nearby water bodies with vulnerability to the same vectors (using information from boater surveys where available to determine high traffic areas). Potential methodologies include:
    - Sampling fixed and temporary hard substrates
    - Shoreline surveys
    - SCUBA and snorkel surveys (use diver-based survey protocols established by the US Geological Survey)[4], including:
        i. Dive Practices—Advanced preparation, dive planning, communication with divers, and the buddy system.
        ii. Identifying Mussels Under Water—What divers are and are not searching for.
        iii. Defining the Search Area.
        iv. Methods for Searching—General considerations, arc search method, circle search method, jackstay search method, and dock search method.
        v. Collecting Information about the Search Area.
        vi. Assessing the Probability of Detecting Mussels.
        vii. Collecting Mussel Samples; and
        viii. Decontamination of Equipment.

[4] US Geological Survey. 2010. Procedures for conducting underwater searches for invasive mussels (Dreissena spp). Open-File Report 2010–1308. 44pp.

- Plankton sampling. Plankton sampling may be analyzed microscopically or via Polymerase Chain Reaction (PCR) genetic analysis (see Appendix C for associated analytical resources). Plankton samples should involve sufficient water volume to detect low veliger concentrations via either of those methods. These efforts should follow existing regional or national protocols.

2. Assess maturity and spawning condition of mussels at the infestation site(s).
3. Determine likely water flow dispersal of mussel veligers. Potential methodologies include:
   - dye studies
   - other hydrographic research techniques
   - interviewing field personnel
4. Identify facilities (e.g., hydropower, fish hatcheries, irrigation systems, etc.) that could be affected. See Appendix F-Contingency Plans.
5. Ensure that surveys are completed and that results are reported to the CRB Coordination Group via the 100th Meridian Initiative website (http://www.westernais.org).

Rapid Response Objective 6: Initiate Environmental Compliance Steps, Including Section 7 Consultation (when warranted)

Follow steps described in ESA Manual (2018).

Rapid Response Objective 8: Prevent Further Spread via Quarantine and Pathway Management

***Purpose*:** Minimize all vectors that might further spread the original infestation.

***Lead entity*:** The agency where the infestation of mussels is found. In the event the agency does not have the incident management capability or the technical expertise to conduct quarantine and pathway management tasks, it may formally delegate that responsibility to the CRB IRRT.

Tasks:

1. Identify dispersal vectors (including movement by humans, fish and wildlife, water traffic, water flow, and other processes). Assume measures are needed to prevent release of veligers as well as movement of adult mussels.
   - Assess the likely movement of boats that recently used the infested water body to identify inspection needs in other water bodies.
2. Establish public outreach efforts, including:
   - Ensure that zebra/quagga mussel "alert" signs are adequately deployed.

- Alert prior users of these waters of the risks their boats and equipment create for other water bodies.
- Design and implement educational outreach programs using print, electronic media and other avenues, with an emphasis on raw water users.

3. Restrict dispersal pathways, where feasible, including:
   - If feasible, identify and eliminate the likely source of mussel inoculation (e.g., infested boat).
   - Quarantine any hatcheries or aquaculture operations that are likely to spread mussels or their larvae via transfers outside the affected watershed(s).
   - Quarantine infested water bodies as needed to prevent spread by watercraft.
   - Consider and implement any needed prevention of overland veliger or adult mussel transport to other water bodies.
   - Develop and implement Hazard Analysis and Critical Control Point (HACCP) plans to ensure that response personnel do not further spread the original infestation.
   - Stop or slow water release to potentially uninfested sites.
   - Draw water from below thermocline.
   - Install physical barriers.
   - Consider special management measures for operations of locks and commercial vessel traffic
4. Establish wash and inspection requirements on boats and equipment, and provide for associated logistical support (e.g., disinfection kits).
   - Begin a post haul-out inspection of boats and equipment in the areas where mussels were found.
   - Begin a pre-launch inspection program for all boats and equipment in places where boats and equipment from a contaminated area are likely to be launched next.

Rapid Response Objective 9: Initiate Available/Relevant Control Measures

***Purpose*:** Evaluate management options, and then proceed with either eradication efforts or containment/mitigation activities.

***Lead entity*:** The responsible agency where the infestation of mussels is found. In the event the agency does not have the incident management capability or the technical expertise to conduct control measures, it may formally delegate that responsibility to the CRB IRRT.

***Tasks*:**

1. Decide if eradication is possible based on rapid analysis of population dynamics and pathways of spread. Consider the following:

- Cost vs. benefit of treatment options.
- Type of water body – contained lake, mainstem reservoir, tributary reservoir, small stream, large river, estuary, or water diversion facility.
- Type of substrate – e.g., rocks that allow mussel attachment on their undersides where chemicals may not reach them.
- Extent of population distribution – isolated vs. widespread coupled with *a priori* assumptions about the spread of mussels before detection.
- Life stage(s) present (default assumption is both veligers and adults).
- Time of year in relation to spawning season.
- Is spawning occurring now or at least possible based on current water temperature (e.g., 12 °C or greater)?
- When is the likely spawning season based on predicted temperature conditions?
- How do mean monthly temperature patterns for the water body relate to mussel spawning requirements?
- Amount of water in reservoir or waterway.
- Does the reservoir need to be drawn down before treatment?
- How far can the reservoir be drawn down?
- Is river flow low enough for effective treatment?
- Circulation patterns in water body.
- Spreading pattern of population within the water body.
- Inflow rates and sources.
- If drawdown needs to occur, what is the feasibility given input source(s)?
- Rate of outflow and distance of veliger dispersal.
- Do flow patterns help or hinder eradication options?
- Presence of state or federally listed threatened or endangered species.
- Special status of water body, including:
    - Water use designation (e.g., drinking water).
    - 'Wild and scenic' designation.
    - Wilderness area.
    - Potential impact to cultural resources.
    - Department of Defense or other restricted access areas
    - Tribal lands
    - Endangered Species Act critical habitat

- Presence of marine mammals covered by Marine Mammal Protection Act
- Clean Water Act 303(d) listing
- Beneficial Uses of water bodies

2. If eradication is attempted, select appropriate method(s) - see D-2.
3. If eradication is not possible, develop control objectives and select/design appropriate control measures - see D-2.
4. Obtain relevant permits and regulatory agency concurrence (see Appendix E-Regulatory Requirements).
5. Implement eradication or control strategies

Rapid Response Objective 10: Institute Long-Term Monitoring

***Purpose*:** Provide for data for adaptive management and long-term evaluation efforts.

***Lead entity*:** The responsible agency where the infestation of mussels is found.

***Tasks*:**

1. Design a monitoring program to evaluate the status of the zebra/quagga mussel populations, emphasizing veliger sampling. Monitoring activities should be carried out in coordination with other field operations, such as environmental monitoring to meet permit and other regulatory compliance requirements (e.g., National Pollutant Elimination Discharge System [NPDES]).
2. Disseminate findings through an easily-accessible, consolidated, coordinated real-time database and list serve (e.g., via 100th Meridian Initiative website).

Appendix C. Notification Lists and Procedures

Note: Priority 1 contacts will be notified when a report is received of live *Dreissenids* within the Columbia River Basin. These contacts represent standing members of the CRB MAC Group and the Coordination and Support Staff. The listed contacts for each agency are responsible for internal notification within their agency. This chart was last updated 15 July 2018.

Priority 1 Notification List								
Organization	**Name/position**	**Office Phone**	**Cell phone**	**Fax**	**Email**	**Notes**	**Assignment MAC C&S**	
Oregon Department of Fish and Wildlife	Kevin Blakely, Deputy Division Administrator	(503) 947-6311	(503) 400-1926		Kevin.l.blakely@state.or.us		x	
Oregon Department of Fish and Wildlife	Rick Boatner, AIS Coordinator	(503) 947-6308	(503) 302-5294		Rick.j.boatner@state.or.us	Will coordinate with PSU for OR notification		X
Washington Department of Fish and Wildlife	Bill Tweit, Special Assistant to Director	(360) 902-2723	(360) 489-2644		william.tweit@dfw.wa.gov		x	
Washington Department of Fish and Wildlife	Allen Pleus, AIS Coordinator	(360) 902-2724	(360) 918-3868		allen.pleus@dfw.wa.gov			X
Washington Department of Fish and Wildlife	Captain Eric Anderson, WDFW AIS Enforcement Coordinator	(360) 902-2200 then select option #2 to be transferred to dispatch	(360) 640-0493		Eric.Anderson@dfw.wa.gov			X
Idaho Department of Agriculture	Lloyd Knight, Administrator	(208) 332-8664	(308) 859-4173		lloyd.knight@isda.idaho.gov		x	
Idaho Department of Agriculture	Nic Zurfluh, Invasive Species Section Manager	(208) 334-3791			nicholas.zurfluh@isda.idaho.gov		X	
Idaho Department of Fish and Game	Paul Kline, Sport Fishing Program Coordinator	(208) 287-2788	(208) 539-3937		Paul.kline@idfg.idaho.gov			X

Priority 1 Notification List								
Organization	**Name/position**	**Office Phone**	**Cell phone**	**Fax**	**Email**	**Notes**	**Assignment MAC C&S**	
Montana Fish, Wildlife, and Parks	Eileen Ryce, Fisheries Division	(406) 444-2448			eryce@mt.gov		x	
Montana Fish, Wildlife, and Parks	Thomas Woolf, Aquatic Invasive Species Bureau Chief	(406) 444-1230			Thomas.woolf@mt.gov			x
Nevada Department of Wildlife	Laura Megill, AIS Coordinator	(775) 688-1532			lmegill@ndow.org			x
Oregon Marine Board	Larry Warren, Director	(503)378-2617			larry.warren@oregon.gov		x	
Oregon Marine Board	Glenn Dolphin, AIS Prevention Program Coordinator	(503) 378-2625			Glenn.dolphin@oregon.gov			x
U. S. Fish and Wildlife Service	Johnna Roy, Fisheries Supervisor	(503) 231-2387	(503) 913-8986		Johnna_roy@fws.gov		x	
U. S. Fish and Wildlife Service	VACANT							x
U. S. Fish and Wildlife Service	Patrick DeHaan, >	360-753-9090			<patrick_dehaan@fws.gov			x
U. S. Fish and Wildlife Service	Bob Kibler, AIS Coordinator, Idaho F&W Office	(208) 378-5255		(208) 378-5264	bob_kibler@fws.gov			x
U. S. Fish and Wildlife Service	Joanne Grady, Region 6 AIS Coordinator	(303) 236-4519	(303) 842-5268	(303) 236-8163	joanne_grady@fws.gov			x
U. S. Fish and Wildlife Service	Louanne McMartin Region 8 AIS Coordinator	209-946-6400 (x342)			louanne_mcmartin@fws.gov			
National Oceanic and Atmospheric Administration	Ritchie Graves, Supervisory Fisheries Biologist	(503) 231-6891	(503) 730-5148		ritchie.graves@noaa.gov		x	
National Oceanic and Atmospheric Administration	Nancy Munn ESA Section 7 Coordinator	(503) 231-6269			Nancy.munn@noaa.gov			x

Priority 1 Notification List								
Organization	**Name/position**	**Office Phone**	**Cell phone**	**Fax**	**Email**	**Notes**	**Assignment MAC**	**C&S**
Columbia River Inter-Tribal Fish Commission	Jaime Pinkham, Executive Director	(503) 238-0667			director@critfc.org		x	
Columbia River Intertribal Fish Commission	Blaine Parker, AIS Coordinator	(503) 731-1268	(503) 314-8238	(503) 235-4228	parb@critfc.org	Notify CRITFC member tribes		x
Columbia River Inter-Tribal Fish Commission	Mike Matylewich, Fisheries Management Director	(503) 731-1251	(503) 756-3329	(503) 235-4228	matm@critfc.org			x
Bonneville Power Administration	Wayne Todd, Generating Assets Manager	(503) 230-3470			watodd@bpa.gov			
Bonneville Power Administration	Kim Johnson, Environmental Strategist – Generating Assets	(503) 230-3902			kojohnson@bpa.gov			
Province of British Columbia, Ministry of the Environment	Martina Beck, Invasive Fauna Unit Head	(778) 698-4364			Martina.Beck@gov.bc.ca			x
Fisheries and Oceans, Canada	Thomas Therriault	(250) 756-7394	(250) 713-5484		Thomas.Therriault@dfo-mpo.gc.ca			
Province of Alberta	Nicole Kimmel, AIS Specialist/program coordinator	780-427-7791	780-975-3793		Nicole.Kimmel@gov.ab.ca			
Fisheries and Oceans, Canada	Renny Talbot	(250) 756-7180	(778) 884-3447		Renny.talbot@dfo-mpo.gc.ca			
Montana Invasive Species Advisory Council	Stephanie Hester, Council Coordinator	(406) 444-0547			shester@mt.gov			
Oregon Invasive Species Council	Jalene Littlejohn, Coordinator	(971) 998-0573			coordinator@oregoninvasivespeciescouncil.org			

Priority 1 Notification List								
Organization	**Name/position**	**Office Phone**	**Cell phone**	**Fax**	**Email**	**Notes**	**Assignment MAC C&S**	
Washington Invasive Species Council	Justin Bush, Executive Coordinator	(360) 902-3088	(360) 704-0973	(360) 902-3026	invasivespecies@rco.wa.gov			

Note: Priority 2 contacts will be notified when a report is received of live Dreissenids within the Columbia River Basin. These contacts may be incorporated into the CRB MAC Group and the Coordination and Support Staff depending on the nature of the incident. The listed contacts for each agency are responsible for internal notification within their agency.

Priority 2 Notification List						
Organization	**Name/position**	**Office Phone**	**Cell Phone**	**Fax**	**Email**	**Notes**
U. S. Forest Service	Jim Capurso, Regional Fisheries Biologist	(503) 808-2847			jcapurso@fs.fed.us	Oregon and Washington
U. S. Forest Service and BLM	Cynthia Tait, Regional Aquatic Ecologist	(801) 625-5358			ctait@fs.fed.us	Idaho
U. S. Bureau of Reclamation	Bryan Horsburgh, Regional Resource Services Manager	(208) 378-5356	(208) 240-0038		bhorsburgh@usbr.gov	Notify all other USBR contacts
U. S. Environmental Protection Agency	David Allnutt, Office of Environmental Review and Assessment	(206) 553-2581			Allnutt.david@Epamail.epa.gov	
U. S. Army Corps of Engineers	Mike LangeslayANS Lead,Portland District	(503) 808-4060			mike.j.langeslay@usace.army.mil	
U. S. Army Corps of Engineers	Damian Walter, Walla Walla District	(509) 527-7136			Damian.j.Walter@usace.army.mil	
U. S. Army Corps of Engineers	Madelyn Martinez, Environmental Stewardship Program Manager Seattle District	(206) 764-6940			Madelyn.T.Martinez@usace.army.mil	
Shoshone-Paiute Tribes	Jinwon Seo, Director of Fish, Wildlife, and Parks Dept.	(208) 759-3246			Seo.jinwon@shopai.org	

Priority 2 Notification List						
Portland State University, Center for Lakes and Reservoirs	Mark Sytsma, Director/AIS Coordinator	(503) 725-3833		(503) 725-3834	sytsmam@pdx.edu	Notify all other State of Oregon contacts in coordination with ODFW
Pacific States Marine Fisheries Commission	Stephen Phillips, AIS Coordinator	(503) 595-3100		(503) 595-3232	sphillips@psmfc.org	Notify all other PSMFC contacts
U. S. Geological Survey	Stephen M. Waste, PhD, Western Fisheries Research Center	(509) 538-2299, ext. 2936	(503) 505-1755		swaste@usgs.gov	Notify all other USGS contacts
U. S. Geological Survey	Tim Counihan, Western Fisheries Research Center	(509) 538-2981	(541) 645-0923	(509) 538-2843	tcounihan@usgs.gov	
National Park Service	John Wullschleger, Fish Program Lead	(970) 225-3572			john_wullschleger@nps.gov	

Recognized Experts To Confirm Zebra Mussel Identification

Name and/or Position	Affiliation	Expertise	Phone	Email
AIS Coordinator	Portland State University, Center for Lakes and Reservoirs	Veligers, Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	Washington Dept. Fish and Wildlife	Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	Idaho Department of Fish and Game	Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	Montana Fish, Wildlife, & Parks	Veligers, Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	U. S. Fish and Wildlife Service, Pacific Region	Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	U. S. Fish and Wildlife Service, Western Washington Field Office	Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	U. S. Fish and Wildlife Service, Mountain-Prairie Region	Adults	See Prior Notification List	See Prior Notification List
AIS Coordinator	U. S. Geological Survey, Western Fisheries Research Center	Adults	See Prior Notification List	See Prior Notification List
Zebra Mussel Information System Coordinator	U. S. Army Corps of Engineers Research and Development Center	Veligers, Adults		
Blaine Parker, AIS Coordinator	Columbia River Intertribal Fish Commission	Adults	See Prior Notification List	See Prior Notification List
Stephen Phillips, AIS Coordinator	Pacific States Marine Fisheries Commission	Adults	See Prior Notification List	See Prior Notification List
Sam Chan, AIS Educator	Oregon Sea Grant	Adults	503-679-4828	samuel.chan@oregonstate.edu
Robert McMahon, Director	Center for Biological Macrofouling Research, University of Texas-Arlington	Veligers, Adults, Histology	(817) 272-2412	r.mcmahon@uta.edu

Appendix D.

D1. Control Options

Thermal Shock

Hot water treatment can kill zebra mussels. Temperatures of 37 °C and above are lethal to zebra mussels. Depending upon acclimation temperature, zebra mussels will die in about one hour. At winter acclimation temperatures (5 to 10 °C), temperatures of 33 °C and above will kill zebra mussels within 13 hours.

Freezing

Adult zebra mussels die when aerially exposed to freezing temperatures. In winter, populations can be controlled by dewatering and exposing zebra mussels to freezing air temperatures. Zebra mussels die in 2 days at 0 °C and at minus 1. 5 °C, in 5 to 7 hours at minus 3 °C, and in under 2 hours at minus 10 °C. Duration to mortality is less for single mussels than for clustered mussels. (Payne 1992).

Oxygen Starvation

Oxygen starvation can be achieved by cycling ambient water through oxygen-starving pumps. The developer of the technology, Wilson J. Browning of Amark Corp, Norfolk County, VA, claims the equipment can cycle 200 million gallons of water. Another method of removing oxygen is to add oxygen scavenging chemicals, such as sodium-meta-bisulfite and hydrogen sulfide gas. Zebra mussels can tolerate oxygen deprivation for up to two weeks, provided ambient temperatures are low enough (USACE-ZMIS).

Desiccation

Desiccation is a viable option for eradicating zebra mussels from areas that can be dewatered for several days. Alternatively, desiccation can also act as a population control method in areas that cannot be completely dewatered. For example, reservoir levels can be lowered to expose zebra mussels inhabiting shallow water. Most of the zebra mussel population inhabits shallow water within 2 to 7 meters below the surface, with moderate to low densities up to 50 meters. Colonization is dependent upon water temperature, oxygen content, and food availability. They tend to colonize above the thermocline.

Temperature is positively related, and humidity is negatively related to adult zebra mussel mortality. As humidity increases and temperature decreases, survival increases. Aerial exposure of zebra mussels to temperatures exceeding 25 °C will result in 100% mortality in a minimum of three days (Kappel 2012). Temperatures over 32 °C are lethal within 5 hours. Instantaneous mortality occurs at 36 °C. At temperatures below 30 °C, time to mortality is dependent upon relative humidity.

Table 1. Number of days to 100% mortality of adult zebra mussels aerially exposed to different levels of relative humidity and air temperature (McMahon et al. 1993).

	Days to 100% Mortality at Air Temperature, Degrees Celcius		
Relative Humidity, %	**5**	**15**	**25**
95	26.6	11.7	5.2
50	16.9	7.5	3.3
5	10.8	4.8	2.1

In general, zebra and quagga mussels can survive longer out of water if local conditions are cold and humid than if conditions are hot and dry. Although the dry time estimator is used to recommended quarantine times for watercraft based on average humidity and temperature zones in the 48 contiguous United States, it is useful when considering dessication times for dreissenids.

Recommendations are only guidelines for average conditions and are based on evidence from laboratory experiments where other factors are held constant. Thus, recommended quarantine times may not produce 100% mortality under real-world conditions where unidentified, yet contributing factors are free to vary. This tool will provide a minimum quarantine time that you may need to adjust upward if your situation includes additional contributing factors that may be important.

Table 2. Dry Time Estimator

Maximum Daily Temperature (°F)	Minimum Days Out of Water
<30	
30-40	28 (4 weeks)
40-60	21 (3 weeks)
60-80	14 (2 weeks)
80-100	7 (1 week)
>100	

Note: Add 7 days for temperatures ranging from 32 °F to 95 °F if relative humidity exceeds 50% (McMahon, pers. comm. 2009).

[1] Equation used to create the Drying Time Estimator: http://www.westernais.org/technical-information is from U.S. Army Corps of Engineers Contract Report EL-93-1, June 1993, "Use of Emersion as a Zebra Mussel Control Method" by Robert F. McMahon, Thomas A. Ussery, and Michael Clarke, The University of Texas at Arlington.

Depriving mussels of oxygen by applying tarps, or benthic mats/barriers, is a benign control tactic that ranks relatively low on the Integrated Pest Management list of dreissenid control options.

Benthic Mats

Bottom benthic mats, or barriers, involve installing tarps on top of pest populations (generally on the bottom of a water body), and weighing or anchoring the tarps with sandbags, or rebar. Tarps can also be installed around large rocks, pylons, docks, and other infrastructure. Oxygen depletion kills attached juvenile and adult mussel stages. In some cases, chemicals, or biocides, are applied underneath the tarps to accelerate mortality. This technique can be used with other techniques that target larval stages.

This tactic is used in discrete sites, often in hard-to-reach locations (crevices) to kill mussels (Culver et al. 2013). The remaining shells from deceased mussels usually remain in the water body, which creates substrate for new mussel infestations and problems for swimmers and boaters (Culver et al. 2013).

Laboratory bioassays carried out in aquaria demonstrated that benthic mat covering of zebra mussels for two weeks resulted in mortality rates of 14.9–100%, whereas mortality rates were 2% or lower for control aquaria without mats. In laboratory studies in which mussels were covered for four weeks, mortality rates of 20–100% occurred, and did not vary significantly with duration of covering, or size class. Measurements of several water chemistry parameters beneath mats, including dissolved oxygen, ammonia, calcium, magnesium, and pH, indicated that dissolved oxygen concentration was the only parameter to exhibit both significant change and a consistent trend during the study, declining from nearly 100% saturation to a mean of 16.5% saturation, and remaining at this level for the duration of the experiment (Sandra Nierzwicki-Bauer, personal communication, 2008).

In field studies carried out in New York's Saratoga Lake, divers created treatment and control zebra mussel colonies at 2m depths on a rocky substrate by placing rocks with attached mussels on fiberglass screens placed on prepared gravel beds. During a field trial where two treatment colonies, composed of approximately 30,000 mussels each, were covered with $4m^2$ mats, mortality rates exceeded 99% after nine weeks of covering. As observed in the laboratory tests, dissolved oxygen concentrations declined significantly under the mats, correlating strongly with increased mortality (Sandra Nierzwicki-Bauer, personal communication. 2008).

Manual Removal

When found in relatively small numbers, manual removal may be an effective way to reduce dreissenid populations and potentially even eradicate them if reproduction has not yet occurred. Manual removal can take place via hand extraction or via mechanical scraping and suction, typically using divers. In Lake George, New York an effort involving hand harvesting by divers appears to have significantly reduced an introduced population. Divers removed 267 mussels in 1999, followed by a peak of nearly 20,000 in 2000. Since then, ongoing removal efforts have yielded fewer than 2,000 mussels per year (Sandra Nierzwicki-Bauer, personal communication, 2008). The apparent eradication of the nonnative sabellid polychaete worm (*Terebrasabella heterouncinata*) in California provides analogous evidence to the role of hand removal as a control technique. After this marine pest was found at an intertidal site outside of an infected

abalone culture facility, over 1. 6 million native black turban snails (*Tegula funebralis*) - the preferred native host - were extracted by hand, along with other infested material. This effort reduced the transmission of the pest species to the point that it no longer was detectable in follow-up surveys (Culver and Kuris 2000).

Predation

The relatively soft shells of zebra mussels and their exposure (on substrates as opposed to buried in sediment) make them vulnerable to predation. Possible predators of adult mussels are some species of carp, catfish, bullhead, sucker, sunfish, sturgeon, crayfish, and muskrats. A possible predator of veligers is the American shad. However, there is no evidence of predation control in the Great Lakes, Ohio River, and Poland. There is some evidence of population reduction in the Hudson River. Despite the lack of clear evidence of population control through predation, it is recommended that harvest of predatory species in infested waterbodies be stopped.

Acoustic Deterrents

It should be noted that the impacts and effectiveness of the following acoustic deterrents are not fully proven, especially in high-flow areas. However, they are relatively low maintenance technologies that have a low likelihood of harming non-target organisms, are environmentally friendly, and have few related safety issues. Acoustic methods are only suitable for certain kinds of structures and are limited to areas where power is available.

- Cavitation is a form of acoustic energy that initiates the formation and collapse of microbubbles. At frequencies between 10 and 380 kHz, this type of energy has demonstrated mortalities of veliger, juvenile, and adult zebra mussels. Exposure times are ranges of seconds for veligers, minutes for juveniles, and hours for adults. (Nalepa and Schloesser 1993).

- Sound treatment using low frequency energy has prevented the settlement of zebra mussels and could be a valid option for reducing the spread of the organisms. Sound waves in the 20 Hz to 20 kHz range have been used to cause veligers to detach and sink. Ultrasound waves in the 39 to 41 kHz range have fragmented veligers in a few seconds and killed adults in 19 to 24 hours. (Sonalysts, and Aquatic Sciences 1991).

- Vibration is the use of solid-borne acoustic energy in mechanical structures. This treatment will only work on structures that can be subjected to vibration and not suffer structural deterioration. Vibrational energy is effective in killing zebra mussel veligers and juveniles at just below 200 Hz and between 10 and 100 kHz. (Nalepa and Schloesser 1993).

Electrical Deterrents

- Continuous low-voltage electrical fields can control adult zebra mussel settlement. However, veligers and juveniles seem to remain relatively unaffected. Adult settlement can be completely prevented with an eight-volt A-C current. This technology has been successfully applied using electrodes attached to the hull of a vessel to prevent mussel attachment (Smythe and Miller 2003).
- Plasma pulse technology (Sparktec Environmental, Inc.) has proven effective in controlling zebra mussels in intake pipes. The system works by releasing stored energy that subsequently causes an intensive shockwave, a steam bubble, and ultraviolet light. (Mackie et al. 2000).
- Pulse power devices can be us to create an electrical field between two electrodes. When the field spans the entire width of the area to be protected, it has been effective in stunning and killing juveniles as they pass through the electrical field. Although not very effective against veligers because of their small body mass, pulse power has also been used successfully to prevent mussel settlement (Smythe and Miller 2003). There is a strong correlation between adult zebra mussel mortality and peak dose, or applied power, at water temperatures of 15 and 22 degrees Celcius (Luoma et al. 2017). Exposure to 39.4 kWh of 20% duty cycle square-wave PDC per 0.07 m^2 at a water depth of 20cm and at water temperatures $\geq$ 15 degrees Celcius would result in $\geq$ 80% mortality of adult zebra mussels (Luoma et al. 2017). At a cost of $0.04/kWh, a 1-hectare application was estimated to cost $0.225 million, which would make this technique cost-prohibitive for large-scale dreissenid control, but potentially feasible for small-scale, or industrial, settings, particularly in locations in which the application of chemicals is not feasible (Louma et al. 2017).

Ultraviolet (UV) Radiation

UV radiation is an effective method for controlling zebra mussels in all life stages, although veligers are more sensitive than adults. Complete veliger mortality can be obtained within four hours of exposure to UV-B radiation, and adult mortalities can also be obtained if constant radiation is applied. UV radiation can be harmful to other aquatic species, and its effectiveness may be decreased by turbidity and high suspended solids loads (Wright et al. 1995). Doses as low as 26.2 mJ/cm^2 and 79.6 mJ/cm^2 can decrease survival of pre-settlement stage larvae by nearly 50% and 80%, respectively, within four days of exposure (Stewart-Malone et al. 2015).

Chemical Treatment

There are 3 general categories of chemicals used to treat zebra mussel infestations: metallic salts, oxidizing biocides, and nonoxidizing biocides. The most susceptible life stages to chemical treatment are post-spawned mussels that are in a low energy state, and veligers and pediveligers that have undeveloped shells. Application rates and duration data for these compounds come from laboratory studies, power plants, and water treatment plants.

- Metallic salts (electrolytically dissolved metallic ions) are effective on adult mussels because of the incomplete sealing of their shells.
  - Potassium salts at a concentration of 50 mg/l have successfully prevented the settlement of zebra mussels. Higher concentrations between 88 and 288 mg/l are necessary to cause mortality. Such concentrations will likely kill native mussels, but these concentrations are non-toxic to fish. In 2006, KCl was used to successfully eradicate zebra mussels from a rock quarry pond in Virginia. A 100% kill was attained with minimal environmental impacts to other aquatic species and to the drainage waters downstream. This method is effective in a closed system if a lethal concentration of KCl can be maintained for a two to three-week period. More information about this project can be found at: https://www.westernais.org/qz-eradication-projects. Juvenile salmonids do not experience mortality at the concentrations of potash commonly used to kill dreissenids (US Geological Survey and US Fish and Wildlife Service 2018). As much as 800 mg/L potash, which is eight times greater than the dose used to kill dreissenids, did not contribute to the mortality, behavioral changes, or gross morphological effects on juvenile brook trout and Chinook salmon (US Geological Survey and US Fish and Wildlife Service 2018). In addition, significant mortality among sensitive aquatic invertebrate species is not expected at concentrations used to kill dreissenids (US Geological Survey and US Fish and Wildlife Service 2018).
  - The product known as "BioBullets" has been developed that uses the encapsulation of an active ingredient (KCl, e.g.) in microscopic particles of edible material designed for ingestion by mussels. It has also been demonstrated to be effective to control Asian clams (Aldridge et al. 2006). Biobullets reduce the use of chlorine in water supplies, thus reducing a major human and animal aquatic toxin.
  - Chloride salts are also effective and safe for most fish species, however high dosages are required. Copper ions at concentrations of 5 mg/l have resulted in 100% veliger mortality. The recommended application rate for copper sulfate is 2 mg/L of produce, which is a 0.5 mg/L of copper equivalent (Claudi et al. 2014).
- Oxidizing biocides, such as chlorine, have been used by the water treatment industry for disinfection since the late 1800s. Because these chemicals have been in use for such a long period of time, their effect on the environment is understood and documented (Claudi and Mackie 1994). In mussels, oxidizing chemicals work by oxidizing the gill lamellae and other parts, eventually causing death. Zebra mussels can recognize oxidizing chemicals as toxins. In response to exposure, zebra mussels expel the offending water and close their valves for several days. Periodically, they reopen their valves to "test" the water. Depending upon water temperature, respiration rate, and stored nutrient reserves, zebra mussels can remain closed and withstand exposure for many days before reopening their valves to resume respiration and feeding. Therefore, required exposure time for oxidizing biocides is usually 1 to 3 weeks.

  Chlorine, bromine, hydrogen peroxide, ozone, and potassium permanganate are examples of oxidants that facilitate zebra mussel mortality.

— Chlorination in various forms, such as hypochlorite, sodium chlorite, chlorine dioxide, and chloramines is the most common method of zebra mussel treatment. The use of chlorine and its various forms is usually limited to non-open water situations because of its high toxicity to other forms of aquatic life. Treated waters must either be dechlorinated or held until the residual chlorine has dissipated before discharge.

  An example of chlorine use that may be applicable to a small isolated population of zebra mussels is the practice of using tarps to seal off an area and then injecting chlorine into the enclosed area. The State of Washington Department of Fish and Wildlife used this method in October of 2004 to successfully eradicate a small population of non-indigenous tunicates in Puget Sound near the City of Edmonds (Meacham and Pleus 2007). This method was also utilized in Huntington Harbor, California to eradicate a marine alga, *Caulerpa taxifolia* (Anderson 2005). Patches of Caulerpa were treated by covering them with black PVC tarp and injecting liquid chlorine under the tarp. The edges of the tarp were sealed to the bottom with sandbags. All of the organisms under the tarps were killed by the treatment, and the tarping method avoided impacts to surrounding areas.

— Although hydrogen peroxide is toxic to zebra mussels, it is rarely used because of the high dosage rates and the associated costs (Van Benschoten et al. 1993, Mackie and Claudi 2010).

— Ozone is effective at relatively low concentrations. A total of 0.5 mg/l has been 100% effective on veligers in 5 hours and adults in 7–12 days. Ozone dissipates quickly and is less harsh on the environment, but expensive because of the effort needed to maintain exposure.

— Potassium permanganate is effective at reducing or eliminating zebra mussels at high dosage rates, however, it is also very toxic to other aquatic species. (Minnesota Dept of Natural Resources 2005).

Non-oxidizing biocides are drawn into the mussel's body and attack the cell walls. The cells lose the ability to maintain their chemical balance, and the mussel dies. Zebra mussels do not detect most non-oxidizing chemicals and continue to filter water, exposing themselves to the chemical. Treatment with non-oxidizing chemicals can be accomplished in hours compared to weeks for oxidizing chemicals.

The most commonly used non-oxidizing compounds are proprietary molluscicides (e.g., Clam-Trol, Bulab, and Bayluscide). These are very effective at zebra mussel control but are also highly toxic to many fish and other aquatic species. They are applied at high concentrations, and, in most cases, the water must be detoxified after treatment. These compounds are usually deactivated by releasing a slurry of bentonite clay into the water. The cationic or surfactant active ingredients bind onto the clay, becoming inactive. The clay settles out of the water column and becomes part of the bed sediments. The compound is microbially degraded into nontoxic products. These chemicals are less effective at lower water temperatures, thsu treatment is recommended during warmer months. The chemicals are usually administered with equipment supplied by the vendors. An example of the successful use of non-oxidizing

chemicals to control the Asian clam in the southeastern US can be found in a paper entitled "Strategies for application of non-oxidizing biocides" (Green 1995).

Bacterial Toxin

Zequanox®

Zequanox®, a molluscicide which includes *Pseudomonas fluorescens* strain CL145A, has been used to control zebra and quagga mussels in closed and semi-open water systems. *Pseudomonas fluorescens* is ubiquitous in the environment, and lab studies have indicated that when zebra or quagga mussels ingest artificially high densities of strain CL145A, a toxin within these bacterial cells destroys their digestive system. Dead bacterial cells are as lethal as live cells, providing evidence that the mussels die from a toxin, not from infection.

The natural product lethal to dreissenids is associated with the cell wall of *P. fluorescens* CL145A, is a heat-labile secondary metabolite, and has degradable toxicity within 24 h when applied to water (Molloy et al. 2013). CL145A appears to be an unusual strain of P. fluorescens since it was the only one among the ten strains tested to cause high mussel mortality. Pipe trials conducted under once-through conditions indicated: (1) P. fluorescens CL145A cells were efficacious against both zebra and quagga mussels, with high mortalities achieved against both species, and (2) as long as the total quantity of bacterial cells applied during the entire treatment period was the same, similar mussel mortality could be achieved in treatments lasting 1.5-12.0 h, with longer treatment durations achieving lower mortalities. The efficacy data presented herein, in combination with prior demonstration of its low risk of non-target impact, indicate that P. fluorescens CL145A cells have significant promise as an effective and environmentally safe control agent against these invasive mussels.

Zequanox® was registered by the Environmental Protection Agency for enclosed systems in 2012, and for open water use in 2014.

In April of 2018, Marrone Bio Innovations, Inc. signed an exclusive distribution agreement with Solenis, a global expert in water treatment and process chemistries, to provide Zequanox® molluscicide treatment programs for enclosed and semi-enclosed water systems in the United States and Canada. As of July 2018, Zequanox® was registered in 37 states for both enclosed system and open water uses where zebra and/or quagga mussels are present. The procude is also registered in California for enclosed and semi-enclosed systems, with an open-water label amendment pending.

EarthTec QZ™

EarthTec QZ™ is a copper-based algaecide/bactericide (a formulation of copper sulfate pentahydrate) labeled to control zebra and quagga mussels. EarthTec QZ is registered in all 50 states as an algaecide/bactericide and in Montana and Washington as a molluscide. EarthTec QZ is documented as achieving 100% mortality of mussels when exposed to the product for 96 hours (Watters et al. 2012). The product can be spread on the surface of a water body or pumped into a water body, and disperses rapidly. The product's active ingredient is delivered in the cupric ion form (Watters et al. 2013). Lethal dose and exposure time of zebra mussels to

EarthTecQZ™ has been identified under laboratory conditions (Watters et al. 2013, Claudi et al. 2014), and has been tested in the field.

The cupric ion Cu^{2+} form of copper is considered the most toxic form of copper to aquatic life because it is the most bioavailable (Eisler 2000, Solomon 2009). In addition, the cupric ion form of copper is more lethal in soft water compared to hard waters rich in cations because cations reduce the bioavailability (Pagenkopf 1983, Paquin et al. 2002). The toxicity of copper to fish and other aquatic life depends on its bioavailability, which is strongly dependent on pH, the presence of dissolved organic carbon (DOC), and water chemistry, such as the presence of calcium ions.

- Juvenile rainbow trout (*Oncorhynchus mykiss*) were exposed to either hard water or soft water spiked with copper for 30 days (Taylor et al. 2000). Fish in the hard-water, high dose (60 µg/L) treatment groups showed an increased sensitivity to copper.
- The mean 96-hour LC_{50} (with 95% confidence limits) for copper exposure in alevin, swim-up, parr and smolt steelhead (*Salmo gairdneri*) are 28 (27–30), 17 (15–19), 18 (15–22), and 29 (>20) µg/L of copper respectively (Chen and Lin 2001). The mean 96-hour LC_{50} for copper exposure in alevin, swim-up, parr and smolt Chinook salmon (*Oncorhynchus tshawytscha*) are 26 (24–33), 19 (18–21), 38 (35–44), and 26 (23–35) µg/L of copper respectively. The experiments were done by adding copper as CuC_{l2}.
- Aquatic snails (*Biomphalaria glabrata*) had a 24-hour and 48-hour LC_{50} (with 95% confidence intervals) of 1.868 (1.196- 3.068) and 0.477 (0.297-0.706) mg/L Cu, respectively (de Oliveira-Filho et al. 2004).
- 1-day-old freshwater snail eggs (*Lymnaea luteda*) were exposed to copper at concentrations from 1 to 320 µg/L of copper for 14 days at 21 °C in a semi-static embryo toxicity test (Khangarot and Das 2010). Embryos exposed to copper at 100 to 320 µg/L died within 168 hours. At lower doses from 3.2-10 µg/L, significant delays in hatching and increased mortality were noted.

The product's active ingredient is delivered in the cupric ion form—a biologically active form of copper (Watters et al. 2013). Lethal dose and exposure time of zebra mussels to EarthTecQZ had been identified under laboratory conditions (Watters et al. 2013, Claudi et al. 2014). EarthTec QZ® does not have any degradation byproducts, and no adjuvants or surfactants are used in the application. EarthTec QZ™ is a liquid formulation that is miscible in water and has ionic diffusion properties that cause it to readily disperse throughout the water column. Application methods vary depending on the scale of project. It would be applied at a rate of up to 2 mg/L, not to exceed 0.1 mg/L total copper. Concentrations may be held constant up to 30 days (depending on dose) to achieve effective treatment for all dreissenid life stages. EarthTec QZ™ copper is highly water soluble and does not precipitate. The product will remain suspended until uptake by bacteria and algae occurs (Master Label for EarthTec, EPA Reg. No. 64962-1). Dispersion into the waterbody would quickly reduce concentrations to below effect levels outside of the isolated treatment area.

EarthTec QZ™ is miscible in water and has ionic diffusion properties that cause it to readily disperse throughout the water column. It would be applied near the water

surface and allowed to disperse, or delivered via hose and pump to the depths,

sites, and surfaces of the area of infestation. When applying to large areas, it would be dispensed along a route with gaps no greater than 200 feet. Generally, when fish are present, no more than one-half of the body of water is treated at a time, starting near one shore and moving outward in bands so as to allow fish to move away. When treating half of a body of water, the second half must not be treated within 14 days from the last treatment. For effective control of adult and juvenile mussels, it would be applied at the recommended rate of 2 to 16 parts per million (i.e., 2 to 16 gallons of EarthTec per million gallons of water) to yield a rate of 0.120 to 0.960 mg/L (ppm) metallic copper. A total of at least 4 days is required for mortality of dreissenids to occur. Colder water temperatures may require longer exposures and doses closer to the high end of the allowable range. Within the half of the water body being treated, repeat applications may be needed to maintain lethal concentrations of copper for sufficient time period. The second half of the water body would not be treated within 14 days of the last treatment of the first half. Effective control can also be achieved by longer exposures (e.g., 5–30 days) at lower doses (1 to 5 parts per million EarthTec, to yield a rate of 0.06 to 0.30 mg/L (ppm) metallic copper.) When reapplying, a concentration of 1.0 mg/L (ppm) metallic copper in the treated water would not be exceeded.

No-Growth Materials (anti-fouling paints)

Anti-fouling paints do not contain biocides and are considered non-toxic, relying on physical properties to prevent mussel attachment. Foul-release coatings improve resistance to water and ions and improve erosion resistance compared to traditional epoxy coatings. Foul-release coatings are not abrasion, impact, or gouge resistant, yet are easily damaged, and UV stable (Skaja 2015).

Three foul-release coatings were assessed to determine their effective service life to mitigate the impacts of dreissenids (Wells and Sytsma 2016). Of the three coatings, Intersleek900 was effective on both concrete and steel, and did not exhibit significant physical damage caused by service periods of up to 30 months in the mainstem of the Columbia River (Wells and Sytsma 2016). A study conducted in 2015 (Skaja 2015) determined that 19 materials and coatings prevented mussel attachment, or are easily cleaned, including fluorinated silicon foul-release coatings (International Paint Intersleek970), silicone foul-release coatings (Sherwin Williams Sher-Release, PPG Sigmaglide890, CMP Bioclean SPG-H, CMP Bioclean HB, Sherwin Williams Sher-Release Optimized Formulation, Nusil9707, International Pain Intersleek425, Hempel Hempasil X3, Jotun Sealion Repulse, Sherwin Williams Sher-Release Oil Free), silicone epoxy foul-release coatings (Jotun Sealion Resilient), two undisclosed coating types (2012-MTA-8-1003 #1 and 2012_MTA-8-1003), automotive RTV silicone gasket (Permatex Red, Permatex Clear), copper metal antifouling coating, copper metal, and bronze metal.

Costs to apply a foul-release type coating to components of a Federal Columbia River Power System facility to mitigate the potential effects of dreissenids were estimated at $1,111,855 to apply Sher-Release/Duplex manufactured by FUJIFILM Smart Surfaces LLC (Wells and Sytsma 2013). This cost estimate included costs associated with applying the system to 1,300 diffuser gratings and 156 flat steel bars in adult fish passage facilities at The Dalles Dam Project. Total surface area of the diffuser gratings and bars was estimated to be 10,390 m^2, thus the cost was estimated at $\$107/m^2$.

The following three tables provide a more detailed review of these control methods, including target populations, application rates, efficiency and toxicity. Table 2 details non-chemical methods. Table 3 describes chemical control methods and Table 4 identifies some of the most common commercial products.

Table 2. Chemical treatment methods for dreissenid control.

NON- OXIDIZING CHEMICALS	TARGET AGE		CONTACT TIME/ CONCENTRATION	
Potassium salts (KCL)	Juveniles/ adults All	Prevent settlement 50% 95-100%	50 mg/l 48 hrs @ 150 mg/l 3 weeks @ 95 – 115 mg/l	Lethal to other mussel species, non-toxic to fish at required dose rate
Potassium ion ($KH2PO_4$)	All	100%	continuous @ 160-640 mg/l	As above
Potassium ion (KOH)	All	100%	Less than 10 mg/l	As above
Chloride salts (Nail,)	Veligers/ juveniles	95-100%	6 hours @ 10,000-20,000 mg/	Low cost, low environmental Impacts, high dosage rates
Copper ions	Veligers	100%	24 hours @ 5 mg/l	Lethal to other aquatic species
Copper sulfate	All	55% 40% 50%	5 hrs 300 mg/l @ 22. 5 C 5 hrs 100 mg/l @ 22. 5 C 48 hrs 2 – 2. 5 mg/l @ 17 C	Lethal to other aquatic species
OXIDIZING CHEMICALS	**TARGET AGE**	**EFFICIENCY**	**CONTACT TIME/ CONCENTRATION**	**COMMENTS**
Chlorine	Veligers All Adults Adults	100% 90% 95% 75%	0. 25-5mg/l in 1 to 9 days 2. 0 mg/l continuous 0. 3 mg/l 14-21 days 0. 5 mg/l 7 days	Lethal to many aquatic species
Chlorine dioxide ClO_2	Veligers	100%	0. 5 mg/l 24 hours	Most successful on veligers
Chloramine	Veligers	100% 95%	1. 2 mg/l 24 hours 1. 5 mg/l continuous	Less toxic to other aquatic life than chlorine
Hydrogen peroxide	Veligers Juveniles	100%	6 hours	High dosage rates required. Lethal to other aquatic species
Ozone	All	100%	Veligers in 5 hours @ 0.5 mg/l Adults in 7 days @ 0.5 mg/l	Lethal to other aquatic species
Potassium permanganate	All	90-100 %	2. 0 mg/l for 48 hours	Must have high continuous dosage, lethal to other species

Virkon	All	100%	2% Virkon Aquatic® solution for 10 minutes (adults and larvae); 0.5% Virkon Aquatic® solution for 10 minutes for larvae	Virkon is corrosive to soft metals.

Table 3. Non-oxidizing chemical treatment methods (commercial products) for dreissenid control.

QUATERNARY AMMONIUM COMPOUNDS	TARGET AGE	EFFICIENCY	CONTACT TIME/ CONCENTRATION	COMMENTS
Clam-Trol CT 1	All	100% 48 hrs after exposure	1. 95 mg/l @ 11 C for 12 hrs 1. 95 mg/l @ 14 C for 14 hrs 1. 95 mg/l @ 20 C for 6-14 hrs	More toxic to veligers than adults and more toxic to mussels than to trout
Calgon H-130	All	100% after 48 hrs	0. 85-1. 12 mg/l	1. 1 mg/l toxic to salmonids, must be deactivated, corrosive, flammable
Macro-Trol 9210	All	100%	5-50 mg/l continuous	Lethal to aquatic organisms, must be detoxified
Bulab 6002	All	100%	2 mg/l 7-10 days 4 mg/l 5-8 days	Lethal to fish, especially salmonids
AROMATIC HYDROCARBONS	**TARGET AGE**	**EFFICIENCY**	**CONTACT TIME/ CONCENTRATION**	**COMMENTS**
Mexel 432	Deters veliger settlement		Dose at 1-4 mg/l once a day	96 hrs LC 50 for rainbow trout 11mg/l, corrosive
EVAC – endothal formulation	All	100%	0. 3-3 mg/l for 5 to 144 hrs	Lethal to fish but rapidly degrades, does not bioaccumulate
Bulab 6009	All	100%	2 mg/l 4 to 10 days 4 mg/l 3 to 8 days	96 hr LC 50 for rainbow trout 1,1 mg/l, corrosive

NOTE: The commercial products listed above have been approved for aquatic use by EPA if applied according to label instructions by a licensed applicator. It is important to note that they may not have been approved by the individual states and must have that approval before they can be applied. The molluscicides have been primarily developed for use at water impoundment and hydropower facilities, treatment facilities, water intake structures, etc. Their use in open water is not generally recommended but might be possible under certain circumstances. For example, the herbicide Endothal, has been shown to be effective against zebra mussels and has been permitted for use in open waters in Washington State to control noxious weeds.

References for Appendix D are incorporated in the main document.

D-2. Rapid Response Scenarios

The detection of dreissenid mussels into the Columbia Basin could occur through numerous scenarios. The following cases may be more probable based on risk factors and recent history, and should be considered both for planning purposes as well as during initial investigations of actual reports. They also relate to Appendix D-3 (table of scenario-based response options).

- Veligers found in the main-stem Columbia or Snake Rivers; no adults detected
- Settled mussels found growing on moored watercraft and/or fixed structures within the main-stem Columbia or Snake Rivers; no veligers detected (*eradication might be feasible in this scenario)*
- Veligers and/or settled mussels found in an isolated, non-draining water body within the CRB (*eradication might be feasible in this scenario)*

Eradication would be unlikely if reproductive mussels and veligers were found in the mainstem Columbia or Snake Rivers and/or a hydrologically connected water body.

D-3. Scenario-based eradication and control options

(FROM: MESSER, C. AND T. VELDHUIZEN 2005)

Eradication and control options for various zebra mussel waterbody infestation scenarios.		
Population level Waterbody	Isolated Population	Widespread Population
Pond, Isolated, non-draining	• Evaluate for natural control (e.g. Winter freeze, summer desiccation) • Chemically treat area and buffer zone • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Mandatory cleaning of departing vessels and equipment	• Chemically treat entire waterbody • Stop water diversions, if any, and chemically treat diversion infrastructure • Mandatory cleaning of all departing vessels and equipment • Quarantine and/or stop all recreational uses
Pond, draining	• Chemically treat released water or prevent water release • Chemically treat area and buffer zone • Monitor for spread within pond and downstream • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Mandatory cleaning of departing vessels and equipment	• Minimize or prevent water release • Chemically treat released water • Chemically treat diversion infrastructure, if any • Monitor for spread downstream • Chemically treat entire waterbody • Mandatory cleaning of all departing vessels and equipment • Quarantine and/or stop all recreational and commercial uses
Small Reservoir	• Minimize water releases • Chemically treat released water • Chemically treat area and buffer zone • Monitor for spread within reservoir and downstream • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Mandatory cleaning of departing vessels and equipment	• Evaluate need to reduce reservoir volume through water releases • Chemically treat released water • Chemically treat diversion infrastructure, if any • Monitor for spread downstream • Chemically treat entire waterbody • Mandatory cleaning of all departing vessels and equipment • Quarantine and/or stop all recreational and commercial uses
Large Reservoir	• Reduce reservoir volume • Chemically treat released water	• Chemically treat released water • Monitor for spread downstream

Eradication and control options for various zebra mussel waterbody infestation scenarios.		
Population level Waterbody	Isolated Population	Widespread Population
	• Chemically treat infested area and buffer zone • Monitor for spread within reservoir and downstream • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Mandatory cleaning of departing vessels and equipment	• Chemically treat diversion infrastructure, if any • Evaluate potential for a water level drawdown to reduce the population • Evaluate ability to chemically treat entire waterbody • Prevent spread to upstream waterbodies and other watersheds • Quarantine and/or stop all recreational and commercial uses • Mandatory cleaning of all departing vessels and equipment
River, Small Volume	• Minimize or stop inflow and increase upstream water diversions to reduce stream volume and flow rate • Install veliger settlement materials at downstream end of population • Create pool conditions at downstream end of population to facilitate veliger settlement (e.g., installation of temporary weir) • Treat with molluscicide • Detoxify downstream of infested area • Monitor for spread downstream • Prevent spread to upstream waterbodies and other watersheds • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Installation of travel barrier and mandatory cleaning station for all vessels traveling upstream via waterway • Mandatory cleaning of all departing vessels and equipment	• Minimize or stop inflow and increase upstream water diversions to reduce stream volume and flow rate • Treat with molluscicide • Detoxify downstream of infested area • Monitor for spread downstream • Prevent spread to upstream waterbodies and other watersheds • Quarantine and/or stop all recreational and commercial uses • Installation of travel barrier and mandatory cleaning station for all vessels traveling upstream via waterway • Mandatory cleaning of all departing vessels and equipment

Eradication and control options for various zebra mussel waterbody infestation scenarios.		
Population level Waterbody	Isolated Population	Widespread Population
River, Large Volume	• Minimize inflow and increase upstream water diversions to reduce stream volume and flow rate • Install veliger settlement materials at downstream end of population • Create pool conditions at downstream end of population to facilitate veliger settlement (e.g., installation of temporary weir) • Treat with molluscicide • Detoxify downstream of infested area • Monitor for spread downstream • Prevent spread to upstream waterbodies and other watersheds • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Installation of travel barrier and mandatory cleaning station for all vessels traveling upstream via waterway • Mandatory cleaning of all departing vessels and equipment	• Prevent spread to upstream waterbodies and other watersheds • Quarantine and/or stop all recreational and commercial uses • Mandatory cleaning of all departing vessels and equipment • Installation of travel barrier and mandatory cleaning station for all vessels traveling upstream via waterway • Closure of unattended boat ramps, especially In zebra mussel-free areas • Mandatory inspection/cleaning of all vessels entering zebra mussel-free waterbodies • Evaluate ability to chemically treat

Eradication and control options for various zebra mussel waterbody infestation scenarios.		
Population level Waterbody	Isolated Population	Widespread Population
Estuary	• Install veliger settlement materials at perimeter of population • Divert upstream water to reduce river volume and flow rate (e.g. Rock barrier) • Create pool conditions at downstream end of population to facilitate veliger settlement (e.g., installation of temporary weir, tidal flow/rock barrier) • Treat with molluscicide • Detoxify downstream of infested area • Monitor for spread • Prevent spread to upstream waterbodies and other watersheds • Quarantine and/or stop all recreational and commercial uses in infested area and buffer zone • Installation of travel barrier and mandatory cleaning station for all vessels traveling upstream via waterway • Mandatory cleaning of all departing vessels and equipment	• Eradication doubtful • Implement population level control measures (e.g., Salt water intrusion during spawning season and veliger settlement) • Prevent spread to upstream waterbodies, other watersheds, pumping plants, and aqueducts/diversion canals • Mandatory cleaning of all departing vessels and equipment • Closure of unattended boat ramps, especially in zebra mussel-free areas • Installation of travel barrier and mandatory cleaning station for all vessels traveling upstream via waterway • Mandatory inspection/cleaning of all vessels entering zebra mussel-free waterbodies • Establish regulations for ships traveling to/from ports of the Columbia River • Evaluate treatment/spread prevention at all points of diversion

Eradication and control options for various zebra mussel waterbody infestation scenarios.		
Population level Waterbody	Isolated Population	Widespread Population

Water Diversions	• If only one facility is impacted, transfer all diversions to alternate facility (ies)
	• Drain and desiccate facilities, chemically treat standing water
	- OR -
	• Isolate infested area and buffer zone with temporary barriers, chemically treat
	• Chemically treat removed water or quarantine and discharge the mussel-infected water to safe disposal area
	• Monitor for downstream spread
	• Mandatory cleaning of all vessels and equipment
	• Quarantine and/or stop all recreational and commercial uses of aqueduct
	• Retrofit facility (ies) to minimize impacts
		• If only one diversion system is impacted, transfer all diversions to other facility (ies);
		• Drain and desiccate facilities, chemically treat standing water
		• If both facilities/water transfer infrastructure are impacted:
		  ○ Chemically treat water before transferring to "downstream" uses
		  ○ Chemically treat water before entrance into the facilities)
		  ○ Mandatory cleaning of all vessels and equipment departing facility (ies)
		  ○ Quarantine and/or stop all recreational and commercial uses of contaminated facilities
		  ○ Desiccate and chemically treat one facility and aqueduct at a time; continue diversions through alternate facility (ies)
		• Retrofit facility (ies) to minimize impacts

Appendix D-4. Method for in-situ evaluation of chemical control effectiveness

(MESSER AND VELDHUIZEN 2005)

Mortality Monitoring

- Suspend test cages containing attached live mussels into the water to be treated.
- Use at least 10 mussels per cage and multiple cages per waterbody or use a statistically designed replication study.
- Monitor kill rate as chemical is administered.
- Conduct multiple tests for alternative chemical concentrations based on kill success of mussels in test cages.
- Follow by extensive inspections of the facility (ies) (surface and by diver) looking for live mussels.

Visual determinations of dead mussels

- Valve gaping with no response of exposed mantle tissue to external stimuli.
- For mussels with gaping shells failure of plantigrade mussel to respond to the touch of a probe.
- If shell is closed absence of ciliary beating and adductor muscle activity when inserting probe between the valves of the mussel.

Mortality verification

- Monitor test cages conducting mortality counts every 24 hours post-treatment or in accord with the chosen statistical design.
- Transfer test cages to recovery tank(s) to test for false-positive kill observations.
- Transfer in-situ-killed mussels to recovery tank(s) for false-positive kill observations.

Appendix E. Regulatory Requirements

I. Introduction

The decision to use chemical agents and/or physically change the aquatic environment to treat an infestation of dreissenids in the waters of the Columbia River Basin will be costly as well as environmentally and politically sensitive. Establishing a transparent, well documented, and effectively communicated decision-making process is essential. It is also essential that the process comply with all relevant rules and regulations governing chemical applications. Because of the importance of regulatory issues, the CRB Coordination and Support Staff has established a Compliance Technical Specialist within the Planning Function. In addition to staffing this position, the following steps will help ensure appropriate regulatory review and compliance:

- Determine the permits, regulatory reviews, and applicable emergency provisions required for chosen eradication methods.
- Identify existing permits and/or templates for required permits.
- Assign Agency Representative from each regulatory agency to facilitate permit approval in a timely manner within their respective agency.
- Determine if an environmental impact statement or environmental assessment is required and if so, ensure assignment is staffed appropriately and completed in a timely fashion.

Some of the primary permits and regulatory reviews that may be necessary before treatment can begin:

- Corps of Engineers Section 10 permit for discharge of dredge/fill material
- Clean Water Act Section 404 permit for work in navigable waters from Corps of Engineers
- Clean Water Act National Pollutant Discharge Elimination System (Section 402) permit (or modification of existing general permit) from Environmental Protection Agency or delegated state
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) – particularly Section 18 emergency exemption
- National Environmental Policy Act reviews, such as Environmental Impact Statements (triggered by other federal authorizations) – includes provisions for emergency consultations
- Endangered Species Act Section 7 consultations by U. S. Fish and Wildlife Service and/or National Oceanic and Atmospheric Administration consultations (triggered by other federal authorizations)

II. Regulatory Requirements for the Use of Chemicals

The four tables below describe the regulatory regime, from the perspective of the states, that could be involved in the decision-making process leading up to the emergency chemical treatment of a dreissenid infestation in the CRB.

The NPDES permitting program regulates discharges from pesticide applications consistent with section 402 of the Clean Water Act (CWA). Point source discharges of biological pesticides and chemical pesticides that leave a residue into waters of the U.S. are required to comply with NPDES requirements. EPA and the states issue PGPs to offer coverage for pesticide operators. Activities not eligible for coverage under the PGP may be eligible for coverage under an individual permit.

The agency that issues an NPDES permit for discharges from pesticide applications depends on the location of those applications. In most cases, the state environmental protection regulatory agency (e.g., the Department of Environmental Quality or Department of Natural Resources) is the NPDES permitting authority and issues the NPDES permits for activities in their state.

EPA issues the PGP only for areas and activities where the states are not authorized. In Oregon, Washington, and Montana, the state environmental protection agency is the NPDES permitting authority and issues the NPDES permits for activities in their state. EPA is the NPDES permitting authority for pesticide discharges in federal facilities in Washington, and all Indian country.

Pesticide State Contacts:

Oregon (Department of Environmental Quality):
https://www.oregon.gov/deq/wq/Pages/default.aspx

Washington (Department of Ecology): https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Aquatic-pesticide-permits/Aquatic-invasive-species-management

Montana (Department of Environmental Quality):
http://deq.mt.gov/Water/SurfaceWater/mpdes/pesticides

Idaho: The EPA is the NPDES permitting authority.

As can be seen in tables 2–5 below, each of the four states in the CRB have different approaches to implementing the laws that apply to pesticide application. Users of this plan need to understand those differences because it may affect the method and timing of implementing control measures. The tables are not all inclusive because, depending on the circumstances, local issues and concerns may add additional steps to the approval process.

The following assumptions have been made in developing the tables:

A. The goal is to eradicate the population before it spreads to other locations.

B. The control method of choice is a pesticide. Note that any chemical used as a treatment method for controlling aquatic pests is by EPA definition, a pesticide, and thus

falls under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

C. The laws and regulations described below are applicable but not necessarily limited to the following three situations if no physical alterations are made to the landscape:

1. Juvenile or adult zebra mussels found on boats or within the confines of a protected marina in a CRB waterbody connected to the mainstem; no mussels or veligers found outside marina.

2. Juvenile or adult zebra mussels found on a shallow, low current substrate that could be isolated from main stem flows;

3 Live zebra mussels in any life stage found in an isolated (no direct hydraulic connection) water body within the CRB (e.g., Lenore Lake in Grant County, Washington.).

Tables 1–4 have been developed to address a situation where a dreissenid population could be isolated from the main river flow without altering the landscape. **Where currents, water depth, location and extent of the population preclude the possibility of physically isolating the population and the negative downstream impacts cannot be controlled or mitigated, the possibility of obtaining approval for the rapid deployment of pesticides would be remote and pesticide treatment should probably not be considered.**

At the end of this appendix is a series of recommendations aimed at filling existing gaps in knowledge, addressing regulatory issues and improving response capabilities.

Table 1. Pesticide Use Matrix for an Isolated Zebra Mussel Infestation in the Columbia River Basin (Washington).

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) administered by US EPA. Pesticide licensing and application authority delegated to Washington State Dept of Agriculture (WSDA). Implemented under the **Washington Pesticide Control Act (RCW 15. 58) and the Pesticide Application Act (RCW 17. 21)**	• Pesticides approved for aquatic application by the WSDA must also be covered under a general NPDES permit or a State Waste Permit issued by the Dept of Ecology. (see below) • For commercial pesticides not currently approved by WSDA, a formal Section 3 application process would be required. The requesting body would submit an application through the WSDA. • For an emergency situation, FIFRA provides for exemptions under Sections 18 and 24. See next column.	• Section 18 of FIFRA allows for an emergency use exemption for a pesticide that is not already approved. The request would go through the WSDA[5] who would evaluate the request and forward it to EPA. EPA would then have 50 days to do a risk assessment. The total process would have to be completed in 120 days if it is a new request, 80 days if is a repeat request. If approved, the approval would last for one year. • Section 18 also allows for a crisis exemption that would allow unregistered use for 15 days. The requesting entity would have to justify the crisis to WSDA who would then notify EPA, EPA would do a cursory review, confer with the state and give crisis exemption. Use beyond the 15 days requires an emergency exemption. • Section 24 (c) allows the states to register an additional use of a federally registered pesticide or a new use as long as there is a "special local need" and a current tolerance for the use approved by EPA. The request would go through the WSDA for review and approval and then be submitted to EPA for review.
Endangered Species Act (ESA). The ESA is administered jointly by the U. S. Fish and Wildlife Service (USFWS) for freshwater and terrestrial species, and NOAA Fisheries	• Pesticide-related response actions undertaken in the CRB could affect species or critical habitat listed under the ESA. In those cases, an ESA Section 7 consultation would need to occur. See next column for Section 7 consultation emergency provisions.	• Federal agency requests to EPA for FIFRA Section 18 or Section 24 approval to use pesticides for emergency response actions that may affect a listed species or critical habitat would trigger the requirement for an ESA Section 7 consultation between EPA and NOAA Fisheries and/or the FWS depending on the species and critical habitat affected.

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
for anadromous and marine species. Washington Dept of Fish and Wildlife (WDFW) maintains **a state species of concern list (WAC 232-12-297)**		• Under emergency circumstances, such consultation would be conducted informally during the emergency and formal consultation would be initiated, as appropriate, as soon as practicable after the emergency is under control. • If formal consultation is required, the FWS and/or NOAA Fisheries provide an after-the-fact biological opinion to the EPA that documents the effects of the emergency response action on listed species and/or critical habitat. • If informal consultation is appropriate, the FWS and/or NOAA Fisheries provide written concurrence to the EPA that the response action is not likely to adversely affect listed species or critical habitat. • Under non-emergency circumstances, the same response action would be the subject of a completed consultation in advance of the response action being implemented. • WDFW would have to be consulted if a state species of concern was at risk.
National Environmental Policy Act (NEPA) administered by US EPA. **State Environmental Policy Act (SEPA)** administered by Dept of Ecology**. (RCW 43. 21)**	• Any federally initiated action or action on federal lands or action that uses federal funds must also comply with the provisions of NEPA. An environmental assessment (EA) would be required and a finding of no significant impact needed before the action could take place. For an emergency situation, see next column. • SEPA provides a statewide process for identifying and evaluating the potential adverse environmental impacts of a proposal. SEPA concerns are addressed in the Ecology permit process described in the next section below.	• NEPA provides for an emergency action through consultation with the Council on Environmental Quality. The lead federal action agency would call CEQ, write a letter of notification, and prepare an environmental action statement. CEQ would respond in 24 hours. After the action is complete, a formal EIS or EA would have to be prepared • In an extreme situation where no permits exist, see the discussion in the next section below.

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Clean Water Act (CWA) administered by US EPA with authority delegated to the Washington Dept of Ecology (Ecology) for regulating pollutants in state waters. Implemented under the **Washington Water Pollution Control Law (RCW 90. 48)**	• A number of pesticides approved for aquatic applications are covered by Ecology issued NPDES permits but currently there are no approved applications for mollusk eradication. • A State Waste Permit or NPDES Permit (see notes below) would be required for bodies of water that are not man made, are larger than 5 acres, and that have drainage. The process would involve the development of a permit for zebra mussel eradication that would include using one or more pesticides such as KCl. Each approved pesticide must undergo a risk assessment conducted by Ecology in coordination with the WSDA and WDFW and Wildlife. The analysis takes from 6 to 9 months for each chemical. The permit would be written simultaneously and would include addressing SEPA provisions. As much as possible local jurisdictional issues would be addressed as well. Once the permit was issued to a state agency such as WDFW, they would do a statewide SEPA process. Once complete, the permitted chemical could be used immediately. • For an emergency situation where a facility has an existing NPDES permit or State Waste Permit, Washington law allows for a short-term water quality modification (see next column) • For an extreme situation where there are no existing permits, an emergency order can be issued. (see next column)	• Under either Section 18 or Section 24, the applicant would also have to comply with Washington state law WAC 173-201A-110 which provides for short term water quality modifications to an existing permit. The request would be made to Ecology using forms available on line 30 days prior to the anticipated use. Ecology would conduct a quick risk assessment and allow an exemption if no detrimental effects were found and the use complied with the State Environmental Policy Act. • In an extreme situation where no permits exist, an emergency order could be issued that would provide for a short-term action. Turnaround time for the order would be within one week of the request. Prior efforts to coordinate with local jurisdictions would likely minimize local issues. This process has been successfully used on an isolated tunicate population in Puget Sound.
Resource Conservation and Recovery Act administered by US EPA with authority delegated to the Washington Dept of	• Pesticide waste must be managed in a non-leak, closed container or tank that is appropriately labeled • Properly managed containers may be stored for up to one year	• Releases must be immediately contained and transferred to appropriate container. Releases over 200 #s or 25 gallons must be reported to the National Response Center 1-800-424-8802 and to the Washington Emergency Management Division 1-

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Ecology **Dangerous Waste Regulations (WAC 173-303)**	• Containers must be transported to permitted hazardous waste facility following Washington and Federal Dept of Transportation regulations	800-258-5990 and the appropriate Ecology regional office

Notes:

WSDA provides guides on line for requesting Section 18 and Section 24 exemptions. Requests are made through the Special Pesticide Registration Program Coordinator in the Pesticide Management Division of WSDA in Olympia. The contact number is 1-360-902-2030 or 2078.

The Washington Dept of Ecology has determined that it will continue to issue permits for the application of pesticides to waters of the State of Washington. At the present time, Ecology has identified the need to develop a permit for invasive animal species such as zebra mussel eradication and has identified some potential pesticides to be assessed but has not begun the risk assessment process or set a time table for its completion.

The SEPA program can be contacted at (360) 407-6922.

Table 2. Pesticide Use Matrix for an Isolated Zebra Mussel Infestation in the Columbia River Basin (Oregon).

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) administered by US EPA. Pesticide licensing and application authority delegated to Oregon Dept of Agriculture (ODA). Implemented under the **Oregon Pesticide Control Law (OAR 603-57)**	• Pesticides approved for aquatic application by the ODA need no approval from DEQ or ODFW if they are applied according to label and license requirements. • For commercial pesticides not currently approved by ODA, a formal Section 3 application process would be required. The pesticide registrant would submit an application through the ODA. • For an emergency situation, FIFRA provides for exemptions under Sections 18 and 24. See next column.	• Section 18 of FIFRA allows for emergency use exemption for a pesticide that is not already approved. The request would go through the ODA who would evaluate the request and forward it to EPA. Requests should be submitted 100 to 120 days prior to expected use. This timeframe includes the EPA 50-day risk assessment. If approved, the approval would last for one year. • Section 18 also allows for a crisis exemption that would allow unregistered use for 15 days. The state agriculture department would notify EPA, EPA would do a cursory review, confer with the state and give crisis exemption. Use beyond the 15 days would require an emergency exemption • Section 24(c) allows the states to register an additional use of a federally registered pesticide or a new use as long as there is a "special local need" and a current tolerance for the use approved by EPA. The request would go through the ODA for review and approval and then be submitted to EPA for review.
Endangered Species Act (ESA). The ESA is administered jointly by the U. S. Fish and Wildlife Service (USFWS) for freshwater and terrestrial species, and NOAA Fisheries for anadromous and marine species.	• Pesticide-related response actions undertaken in the CRB could affect species or critical habitat listed under the ESA. In those cases, an ESA Section 7 consultation would need to occur. See next column for Section 7 consultation emergency provisions. Oregon's Endangered and Sensitive Species Rules would also need to be addressed.	• Federal agency requests to EPA for FIFRA Section 18 or Section 24 approval to use pesticides for emergency response actions that may affect a listed species or critical habitat would trigger the requirement for an ESA Section 7 consultation between EPA and NOAA Fisheries and/or the FWS depending on the species and critical habitat affected. • Under emergency circumstances, such consultation would be conducted informally during the emergency and formal consultation would be initiated, as appropriate, as soon as practicable after the emergency is under control. If formal consultation is required, the

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
		FWS and/or NOAA Fisheries provide an after-the-fact biological opinion to the EPA that documents the effects of the emergency response action on listed species and/or critical habitat. • If informal consultation is appropriate, the FWS and/or NOAA Fisheries provide written concurrence to the EPA that the response action is not likely to adversely affect listed species or critical habitat. • Under non-emergency circumstances, the same response action would be the subject of a completed consultation in advance of the response action being implemented.
Oregon Dept of Fish and Wildlife (ODFW) administers the **Oregon Endangered Species Rules** and **Oregon Sensitive Species Rules** for species native to Oregon. (OAR 635-0100)		• ODFW would have to participate on an informational basis in ESA consultations if the species of concern was listed as sensitive, threatened or endangered in Oregon
National Environmental Policy Act (NEPA) administered by US EPA	• Any federally initiated action or action on federal lands or action using federal funds must also comply with the provisions of NEPA. An environmental assessment (EA) would be required and a finding of no significant impact (FONSI) needed before the action could take place. For an emergency situation, see next column.	• . NEPA provides for an emergency action through consultation with the Council on Environmental Quality. The lead federal action agency would call CEQ, write a letter of notification, and prepare an environmental action statement. CEQ would respond in 24 hours. After the action is complete, a formal EIS or EA would have to be prepared.
Clean Water Act (CWA) administered by US EPA with authority delegated to the Oregon Dept of Environmental Quality	• No NPDES or WPCF permits are required in this situation.	

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
(DEQ) for regulating pollutants in state waters. Implemented under the **Oregon Water Quality Act (OAR Chapter 340, Division 45)**		
Resource Conservation and Recovery Act administered by US EPA with authority delegated to the Oregon Dept of Environmental Quality under **Oregon Hazardous Wastes Laws (OAR Chapter 340, Division 109)**	• Pesticide waste must be managed in a non-leak, closed container or tank that is appropriately labeled • Properly managed containers may be stored for up to one year • Containers must be transported to permitted hazardous waste facility following Oregon and Federal Dept of Transportation regulations	• Releases must be immediately contained and transferred to appropriate container. Releases over 200 #s or 25 gallons must be reported to the Oregon Emergency Response System. 1-800-452-0311 and the National Response Center at 1-800-424-8802.

Note:

Section 18 requests should go to the Section 18 coordinator at the Pesticides Division of the ODA (phone: 503-986-4656).

Table 3.Pesticide Use Matrix for an Isolated Zebra Mussel Infestation in the Columbia River Basin (Idaho).

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) administered by US EPA. Pesticide licensing and application authority delegated to Idaho State Dept of Agriculture (ISDA). Implemented under **IDAPA 02 Title 22 Chap 34**	• Pesticides approved for aquatic application by ISDA need no approval from Idaho DEQ or Idaho Fish and Game if they are applied according to label and license requirements. • For commercial pesticides not currently approved by ISDA, a formal Section 3 application process would be required. The pesticide registrant would submit an application through the ISDA. • For an emergency situation, FIFRA provides for exemptions under Sections 18 and 24. See next column.	• Section 18 of FIFRA allows for emergency use exemption for a pesticide that is not already approved. The request would go through the ISDA who would evaluate the request and forward it to EPA. Requests should be submitted 100 to 120 days prior to expected use. This timeframe includes the EPA 50-day risk assessment. If approved, the approval would last for one year. • Section 18 also allows for a crisis exemption that would allow unregistered use for 15 days. The state agriculture department would notify EPA, EPA would do a cursory review, confer with the state and give crisis exemption. Use beyond the 15 days would require an emergency exemption • Section 24(c) allows the states to register an additional use of a federally registered pesticide or a new use if there is a "special local need" and a current tolerance approved by EPA. The request would go through the ISDA for review and approval and then be submitted to EPA for their review.
Endangered Species Act (ESA). The ESA is administered jointly by the U. S. Fish and Wildlife Service (USFWS) for freshwater and terrestrial species, and NOAA Fisheries for anadromous and marine species.	• Pesticide-related response actions undertaken in the CRB could affect species or critical habitat listed under the ESA. In those cases, an ESA Section 7 consultation would need to occur. See next column for Section 7 consultation emergency provisions. Idaho's Endangered and Sensitive Species Rules would also need to be addressed.	• Federal agency requests to EPA for FIFRA Section 18 or Section 24 approval to use pesticides for emergency response actions that may affect a listed species or critical habitat would trigger the requirement for an ESA Section 7 consultation between EPA and NOAA Fisheries and/or the FWS depending on the species and critical habitat affected. • Under emergency circumstances, such consultation would be conducted informally during the emergency and formal consultation would be initiated, as appropriate, as soon as practicable after the emergency is under control. • If formal consultation is required, the FWS and/or NOAA Fisheries provide an after-the-fact biological opinion to the EPA that documents the effects of the emergency response action on listed species and/or critical habitat.

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
		• If informal consultation is appropriate, the FWS and/or NOAA Fisheries provide written concurrence to the EPA that the response action is not likely to adversely affect listed species or critical habitat. • Under non-emergency circumstances, the same response action would be the subject of a completed consultation in advance of the response action being implemented. • Idaho Fish and Game would have to participate on an informational basis in these discussions if the species of concern was listed as sensitive, threatened or endangered in Idaho.
National Environmental Policy Act (NEPA) administered by US EPA	• Any federally initiated action or action on federal lands or action using federal funds must also comply with the provisions of NEPA. An environmental assessment (EA) would be required and a finding of no significant impact (FONSI) needed before the action could take place. For an emergency situation, see next column.	• NEPA provides for an emergency action through consultation with the Council on Environmental Quality. The lead federal action agency would call CEQ, write a letter of notification, and prepare an environmental action statement. CEQ would respond in 24 hours. After the action is complete, a formal EIS or EA would have to be prepared.
Clean Water Act (CWA) administered by US EPA authorizes EPA to issue NPDES permits for regulating pollutants in Idaho waters. The Idaho Dept of Environmental Quality (DEQ) issues CWA 401 certification that permitted projects meet state water quality standards under **IDAPA 58 Chap 01 Title 02**	• No NPDES or WPCF permits are required in this situation.	

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Resource Conservation and Recovery Act administered by US EPA with authority delegated to the Idaho Dept of Environmental Quality under **IDAPA 58 Chap 01 Title 05**	• Pesticide waste must be managed in a non-leak, closed container or tank that is appropriately labeled • Properly managed containers may be stored for up to one year • Containers must be transported to permitted hazardous waste facility following Idaho and Federal Dept of Transportation regulations	• Releases must be immediately contained and transferred to appropriate container. Releases over 200 #s or 25 gallons must be reported to the Idaho Emergency Response System. 1-800-632-8000 and the National Response Center at 1-800-424-8802.

Table 4. Pesticide Use Matrix for an Isolated Zebra Mussel Infestation in the Columbia River Basin (Montana)

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) administered by US EPA. Pesticide licensing and application authority delegated to Montana Dept of Agriculture (MDA). Implemented under **Montana Pesticide Act Title 80 Chapter 8**	• Pesticides approved for aquatic application by the MDA must also be authorized by the Montana Department of Environmental Quality under the Montana Water Quality Act (see below). • For commercial pesticides not currently approved by MDA, a formal Section 3 application process would be required. The pesticide registrant would submit an application through the MDA. • For an emergency situation, FIFRA provides for exemptions under Sections 18 and 24. See next column.	• Section 18 of FIFRA allows for emergency use exemption for a pesticide that is not already approved. The request would go through the MSDA who would evaluate the request and forward it to EPA. [i] Requests should be submitted 100 to 120 days prior to expected use. This timeframe includes the EPA 50-day risk assessment. If approved, the approval would last for one year. • Section 18 also allows for a crisis exemption that would allow unregistered use for 15 days. The state agriculture department would notify EPA, EPA would do a cursory review, confer with the state and give crisis exemption. Use beyond the 15 days would require an emergency exemption • Section 24 (c)) allows the states to register an additional use of a federally registered pesticide or a new use as long as there is a "special local need" and a current tolerance for the use approved by EPA. The request would go through the MDA for review and approval and then be submitted to EPA for their review.
Endangered Species Act (ESA). The ESA is administered jointly by the U. S. Fish and Wildlife Service (USFWS) for freshwater and terrestrial species, and NOAA Fisheries for anadromous and marine species.	• Pesticide-related response actions undertaken in the CRB could affect species or critical habitat listed under the ESA. In those cases, an ESA Section 7 consultation would need to occur. See next column for Section 7 consultation emergency provisions. Montana's Endangered and Sensitive Species Rules would also need to be addressed.	• Federal agency requests to EPA for FIFRA Section 18 or Section 24 approval to use pesticides for emergency response actions that may affect a listed species or critical habitat would trigger the requirement for an ESA Section 7 consultation between EPA and NOAA Fisheries and/or the FWS depending on the species and critical habitat affected. • Under emergency circumstances, such consultation would be conducted informally during the emergency and formal consultation would be initiated, as appropriate, as soon as practicable after the emergency is under control. • If formal consultation is required, the FWS and/or NOAA Fisheries provide an after-the-fact biological opinion to the EPA that documents the effects of the emergency response action on listed species and/or critical habitat.

Montana Fish, Wildlife and Parks (MFWP) maintains a list of threatened and endangered Montana species		• If informal consultation is appropriate, the FWS and/or NOAA Fisheries provide written concurrence to the EPA that the response action is not likely to adversely affect listed species or critical habitat. • Under non-emergency circumstances, the same response action would be the subject of a completed consultation in advance of the response action being implemented. • MFWP would have to be consulted if a state species of concern was at risk.
National Environmental Policy Act (NEPA) administered by US EPA **Montana Environmental Policy Act (MEPA)** administered by the Montana DEQ under Title 75 Chapter 4 Rule 17 of the Montana Code	• Any federally initiated action or action on federal lands or action using federal funds must also comply with the provisions of NEPA. An environmental assessment (EA) would be required and a finding of no significant impact (FONSI) needed before the action could take place. For an emergency situation, see next column. • Requires state agencies to review any action that will significantly affect the quality of the environment. A written environmental assessment (EA) must be done to determine if an EIS is needed. The EA process usually takes 2 months. For an emergency, see next column.	• NEPA provides for an emergency action through consultation with the Council on Environmental Quality. The lead federal action agency would call CEQ, write a letter of notification, and prepare an environmental action statement. CEQ would respond in 24 hours. After the action is complete, a formal EIS or EA would have to be prepared. • Under MEPA, immediate action can be taken without an EIS if a project is undertaken to prevent or mitigate immediate threats to public health, safety, welfare or the environment. The Governor and the Environmental Quality Commission must be notified in 30 days. Rule 17. 4. 632.
Clean Water Act (CWA) administered by US EPA with authority delegated to the Montana Department of	• No NPDES or WPCF permits are required in this situation. (see notes below) (2), however, Section 308 of the Montana CWA authorizes the MDEQ to	• MDEQ may issue a short-term exemption from surface water quality standards for emergency pesticide application under Section 308 of the Montana Water Quality Act if significant risk to the public is prevented and existing and designated uses are

Environmental Quality to issue NPDES permits for regulating pollutants in Montana. under the Montana CWA Title 75 Chapter 5	approve the application of pesticides to surface waters to control aquatic nuisance organisms. See next column.	protected. Application forms are available on line at http://www.deq.mt.gov/wqinfo/default.mcpx
Resource Conservation and Recovery Act administered by US EPA with authority delegated to the Montana Dept of Environmental Quality under **Title 75 Chap 10 Part 4**	• Pesticide waste must be managed in a non-leak, closed container or tank that is appropriately labeled • Properly managed containers may be stored for up to one year • Containers must be transported to permitted hazardous waste facility following Montana and Federal Dept of Transportation regulations	• Releases must be immediately contained and transferred to appropriate container. Releases over 200 #s or 25 gallons must be reported to the Montana Disaster and Emergency Services 1-406-841-3911 and to the National Response Center 1-800-484-8802.

III. Regulatory requirements for non-chemical control methods

Table 2 (Appendix D) provides an array of possible non-chemical control methods that might be effective against dreissenids under certain conditions. Except for natural predation, they all have some environmental consequences and would thus also fall under the federal/state regulatory umbrella. FIFRA would no longer play a role for non-pesticide control methods, however, the Endangered Species Act (ESA), Clean Water Act (CWA), and National Environmental Policy Act (NEPA) as well as state and federal land use laws would be included in that regulatory regime. The procedures described in Tables 2–5 for ESA and NEPA compliance remain the same. The following paragraphs describe other Federal regulatory requirements that could apply to the use of non-pesticide dreissenid control methods. Note that any of the federal authorizations discussed in this section may also require an ESA consultation if the authorized action "may affect" a listed species or designated critical habitat. Following the Federal requirements is a discussion of the individual state's requirements and coordination with Federal laws.

Federal Permits and Authorities

Section 10 of the Rivers and Harbors Act of 1899 gives the US Army Corps of Engineers authority to authorize the erection of structures within navigable waterways of the United States. The formal process requires filing an application with the District Engineer who then has 15 days to review the application and issue a public notice. The public notice is usually for 30 days. The District Engineer has 60 days to decide. During this process, the District Engineer must determine whether the project with meet the requirements of the CWA, ESA, NEPA and Coastal Zone Management Act.

Two options exist for shortening the process. The first, a "Letter of Permission," provides an abbreviated process for a project in which the District Engineer determines that the work is minor, has no individual or cumulative impacts on environmental values, and should encounter no appreciable opposition. The District Engineer would coordinate with Federal and state fish and wildlife agencies during the determination.

The second option provides for emergency procedures. Division engineers are authorized to approve special processing procedures in emergency situations. An "emergency" is a situation which would result in an unacceptable hazard to life, a significant loss of property, or an immediate, unforeseen, and significant economic hardship if corrective action requiring a permit is not undertaken within a period less than the normal amount of time needed to process the application under standard procedures. Reasonable efforts will be made to receive comments from interested Federal, state, and local agencies and the affected public. Also, notice of any special procedures authorized and their rationale is to be appropriately published as soon as practicable.

Section 401 of the CWA requires that any activity that may affect water quality receive certification from the EPA that water quality standards for the waterbody will not be violated. The EPA has delegated this authority to states and tribes where the discharge originates. States and tribes downstream of the jurisdiction where a discharge originates does not have 401 authority (US EPA 2010). The states have 60 days to respond to the 401 notification with a determination regarding state water quality standards. In an emergency situation, the states would be consulted, but the formal process would be waived until the emergency had been resolved.

Section 404 of the CWA gives the Secretary of the Army authority to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into the navigable waters at specified disposal sites. The formal process which could take up to a year can be shortened under the following circumstances.

A "Letter of Permission" In those cases subject to section 404 of the CWA can be issued after:

1. The district engineer, through consultation with Federal and state fish and wildlife agencies, the Regional Administrator, Environmental Protection Agency, the state water quality certifying agency, and, if appropriate, the state Coastal Zone Management Agency, develops a list of categories of activities proposed for authorization under LOP procedures;

2. The district engineer issues a public notice advertising the proposed list and the LOP procedures, requesting comments and offering an opportunity for public hearing; and

3. A 401 certification has been issued or waived and, if appropriate, CZM consistency concurrence obtained or presumed either on a generic or individual basis.

Emergency Procedures: (same as for a Section 10 Permit see above)

Coastal Zone Management Act (CZMA) strives to balance the protection of coastal resources with coastal development, including energy development. The district engineer must ensure that the proposed activity is consistent with the approved state CZMA Program (see sections below for individual state programs).

Washington State Permits and Authorities

CZMA Consistency: The coastal zone extends from the coast to the downstream end of Puget Island on the Columbia River. Under Washington's Program, activities undertaken by a federal agency, that use federal funding or require federal approval that affect any land use, water use, or natural resource of the coastal zone must comply with the enforceable policies within the six state laws. They are:

- the Shoreline Management Act (including local government shoreline master programs)
- the State Environmental Policy Act (SEPA)
- the Clean Water Act
- the Clean Air Act
- the Energy Facility Site Evaluation Council (EFSEC)
- the Ocean Resource Management Act (ORMA)

The federal consistency process allows the public, local governments, Tribes, and state agencies an opportunity to review Federal actions likely to affect Washington's coastal resources or uses. The federal consistency coordinator can be reached at the Department of Ecology (360) 407-6068.

State Environmental Policy Act ("SEPA", Chapter 43. 21C RCW) was adopted in 1971 to ensure that environmental values were considered during decision-making by state and local agencies. The environmental review process in SEPA is designed to work with other regulations to provide a comprehensive review of a proposal. All state and local agencies that have a role to play in a proposal are included as part of the SEPA process. See the following website for the state and local agencies that participate: https://ecology.wa.gov/regulations-permits/SEPA-environmental-review. Applications for permits to conduct activities in or near the waters of the state automatically entail a SEPA review as part of the application process. The SEPA program can be contacted at (360) 407-6922, sepahelp@ecy.wa.gov.

Joint Aquatic Resources Permit Application: Washington State has developed a simplified permitting procedure called the Joint Aquatic Resources Permit Application (JARPA). The following permits can be obtained through one application.

1. U. S. Army Corps of Engineers(Corps): Section 10 and 404 permits
2. Washington Department Ecology: 401 Water Quality Certifications. 401 certifications are issued by the appropriate Ecology Regional Office. The SW Region Office in Olympia (360-407-6300), the Central Region Office in Yakima (509-575-2490) and the Eastern Region Office in Spokane (509-329-3400).
3. Washington Department of Fish and Wildlife: Hydraulic Project Approvals (see below)
4. Washington Department of Natural Resources: Use Authorizations for State-Owned Aquatic Lands (see below)

JARPA information, contact numbers, and forms can be accessed through the following website: https://www.epermitting.wa.gov/site/alias__resourcecenter/jarpa_jarpa_form/9984/jarpa_form.aspx.

The following permits are specific to the State of Washington and might be required for zebra mussel control activities in the Washington State portion of the Columbia River Basin.

Hydraulic Use Approval: Any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water or saltwater of the state, requires a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife (WDFW). Permit processing can take up to 45 days following receipt of a complete application package

RCW 77. 55. 021 (8) provides for emergency situations when there exists an immediate threat to property or life. In such cases, immediate verbal approval can be obtained for work necessary to alleviate the emergency. A "hotline" telephone number is available for emergency calls during non-working hours. That number is (360) 902-2537. During normal hours, contact the nearest WDFW office.

Aquatic Use Permit: To protect and manage the use of state owned aquatic lands, consistent with Chapter 79. 105 RCW, any activity that takes place on state-owned aquatic lands will require this permit. The application which is called 'Application for Authorization to use State-Owned Aquatic Lands', is online and can be downloaded at https://www.dnr.wa.gov/publications/aqr_or_roe_scientificcollection23087263.pdf. The process usually takes 6 months, but in an emergency, the following DNR regional offices should be contacted to determine if the proposed action is on state owned lands and to request an emergency authorization.

Northeast
225 S Silke Road
Colville, WA 99114
509-684-7474
northeast.region@dnr.wa.gov

Northwest
919 N Township Street
Sedro Woolley, WA 98284
360-856-3500
northwest.region@dnr.wa.gov

Olympic
411 Tillicum Lane
Forks, WA 98331
360-374-2800
olympic.region@dnr.wa.gov

Pacific Cascade
601 Bond Road
PO Box 280
Castle Rock, WA 98611
360-577-2025
pacific-cascade.region@dnr.wa.gov

South Puget Sound
950 Farman Avenue N
Enumclaw, WA 98022
360-825-1631
southpuget.region@dnr.wa.gov

Southeast
713 Bowers Road
Ellensburg, WA 98926
509-925-8510
southeast.region@dnr.wa.gov

Shoreline Conditional Use Permit: Before undertaking any action that will affect the shoreline, local jurisdictions should be contacted. A Shoreline Conditional Use Permit may be required. Information can be obtained through the JARPA website.

Section 401 Certification

Section 401 of the Federal CWA provides that an applicant for a Federal license or permit to conduct any activity that may result in a discharge to waters of the State must provide the permitting agency with a water quality certification issued by the State from which the discharge originates. In the State of Oregon, the Department of Environmental Quality is the designated agency for issuing certifications. For Section 10, 404 and Fill and Removal certification, contact DEQ at (503) 229-6030.

CZMA Consistency: In Oregon the Department of Land Conservation and Development is the state's designated coastal management agency and is responsible for reviewing projects for consistency with the Oregon Coastal Management Plan and issuing coastal management decisions. DLCD's reviews involve consultation with local governments, state agencies, federal agencies, and other interested parties in determining project consistency with the OCMP. The state federal consistency coordinator can be contacted at 503-373-0050 Ext. 260.

Oregon Permits: A guide to State of Oregon water use permits is available at the following website: https://www.oregon.gov/owrd/pages/wr/index.aspx.

The following permits and authorities would likely be applicable to dreissenid control activities in the Oregon portion of the Columbia River Basin.

Removal Fill Permit; Oregon Division of State Lands (DSL) under ORS 198-600 and OAR 141-085-0005 requires a permit for the following activities:

- Projects requiring the removal or fill of 50 cubic yards or more of material in waters of the state.
- The removal or fill of any material regardless of the number of cubic yards affected in a stream designated as essential salmon habitat. Click on "Essential salmonid habitat areas" at left for maps.
- The removal or fill of any material from the bed and banks of scenic waterways regardless of the number of cubic yards affected.

The form: The application form is a joint form with Corps of Engineers Section 10 and Section 404 permitting process. The form is available on line at the following address: https://www.oregon.gov/DSL/WW/Pages/Permits.aspx.

The process: State law requires DSL to determine whether an application for a joint removal-fill permit is complete within 30 days of receipt and to issue a decision within 90 days of the completeness determination. The applicant may request a deadline extension.

In an emergency, DSL can authorize work in advance verbally as soon as all the necessary information about the project is available. The emergency authorizations are available only for very limited, unforeseen circumstances. The DSL can be contacted at the following number: 503-378-3805.

Temporary Use Permit: A Temporary Use Permit is an authorization issued by the DSL allowing short-term use, usually less than one (1) year, of a specific area of publicly-owned submerged and/or submersible land for a specific use under specific terms and conditions. The DSL should be contacted to determine if a Temporary Use Permit is needed. 503-378-3805.

Other Oregon Agencies

Other Oregon agencies that could be involved in this process and may need to be notified include:

The Oregon State Marine Board which has responsibility for boating regulations and some authority over marinas. (503-378-8587)

The Water Resources Department which has authority over water withdrawals. (503-986-0900)

The Oregon Parks and Recreation Department for state parks and cultural and historic preservation sites. The OPRD houses the State Historic Preservation Office which reviews projects to reflect the interests of the State and its citizens in the preservation of Oregon's cultural and historic heritage (503-986-0674)

Section 401 Certification

Section 401 of the federal CWA provides that an applicant for a federal license or permit to conduct any activity that may result in a discharge to waters of the State must provide the permitting agency with a water quality certification issued by the State from which the discharge originates. In the State of Idaho, the Department of Environmental Quality is the designated agency for issuing certifications. For NPDES, Section 10 and 404 permits water quality certification, contact DEQ at (208-373-0502).

Joint Application for Stream Channel Alteration Permit

The Idaho Department of Water Resources under Title 58 Section Chapter 142 of the Idaho Code permits instream construction activity through a joint permit in coordination with the Corps of Engineers Section 404 permit. The permit form is available on line at https://www.idwr.idaho.gov/streams/stream-channel-alteration-permits.html. In an emergency, an emergency permit may be obtained at the same website. Contact the Department of Water Resources at 208-287-4800.

Request for Assignment of Encroachment Permit

The Idaho Department of Lands requires a permit for activities that may encroach on a navigable waterway under Title 58 Chapter 13 of the Idaho Code. That permit is available on line at https://www.idl.idaho.gov/lakes-rivers/procedures-manual/atc_16-encroachment_assignment_form.pdf. Contact the Idaho Department of Lands at 208-334-0200.

Other Idaho Agencies

Office of Species Protection: Coordinates Idaho's actions related to the Endangered Species Act. Contact the Office of Species Protection at 208-334-2189

Department of Parks and Recreation: Manages Idaho's state parks. Contact number 208-334-4199.

State Historic Preservation Office: The National Historic Preservation Act requires federal agencies to consult with the SHPO during the planning of any federal action that may endanger cultural resources. The role of the SHPO in federal project review is to reflect the interests of the State and its citizens in the preservation of Idaho's cultural heritage. Contact number 208-334-3861.

Montana State Permits and Authorities

Section 401 Certification

Section 401 of the federal CWA provides that an applicant for a federal license or permit to conduct any activity that may result in a discharge to waters of the State must provide the permitting agency with a water quality certification issued by the State from which the discharge originates. In the State of Montana, the Department of Environmental Quality is the designated agency for issuing certifications. For Section 10 and 404 permits water quality certification, contact DEQ at 406-444-4626.

Montana Environmental Policy Act

Administered by Montana DEQ, Title 75 Chapter 4 Rule 17. 4 requires state agencies to integrate and review any action of state government that will significantly affect the quality of the environment. It requires a written environmental assessment (EA) to determine if an Environmental Impact Statement (EIS) is needed. All state agencies that have a role to play in a particular proposal are included as part of the MEPA process. Contact the MEPA program at 406-444-2544.

Joint Application for Proposed Work in Montana's Streams, Wetlands, Floodplains and Other Water Bodies

Montana DEQ under Title 75 Chapter 5 permits instream construction activity through a joint permit in coordination with the Corps of Engineers Section 10 and 404 permitting process. The permit form is available on line at http://dnrc.mt.gov/licenses-and-permits/stream-permitting. In an emergency, contact the DEQ at 404-444-0371.

Stream Protection Act 124 Permit:

The Fisheries, Wildlife and Parks Department issues SPA 124 permits for instream work. Contact the MFWP at 406-444-2535.

Other Montana Agencies

The State Historic Preservation Office located in the Montana Historical Society reviews federal and state projects to ensure the protection of Montana's cultural and historic heritage. Contact number: (406) 444-0388.

The Department of Natural Resources and Conservation manages water rights and water resources. Contact number: (406) 444-2074.

Summary of Control Methods and Applicable Regulations

The following table provides an overview of how the federal and state regulations described in the tables and sections above might apply to the various control methods. It does not cover all situations and should be used as reference only.

	PESTICIDES	BACTERIAL TOXINS	FREEZING & DESSICATION DEWATERING	THERMAL SHOCK & OXYGEN STARVATION	SOUND	VIBRATION	ELECTRICAL	UV RADIATION
FIFRA LICENCING	YES	YES	NO	NO	NO	NO	NO	NO
CWA / NPDES PERMIT	NO, but recommended for facilities	NO	NO	NO	NO	NO	NO	NO
ESA SECTION 7	YES	YES	YES	YES	YES	YES	YES	YES
NEPA	YES	YES	YES	YES	YES	YES	YES	YES
RHA SEC 10 CWA SEC 404	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO unless structure needed
CWA SEC 401	NO, unless toxins released	NO, unless toxins released	YES, unless WQ standards not affected	YES, unless WQ standards not affected	NO	NO	YES, unless WQ standards not affected	YES, unless WQ standards not affected
CZMA CONSISTENCY	NO, unless isolation structure needed	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
RCRA STORAGE & DISPOSAL	YES	MAYBE	NO	NO	NO	NO	NO	NO
WASHINGTON SEPA	YES	YES	YES	YES	YES	YES	YES	YES

	PESTICIDES	BACTERIAL TOXINS	FREEZING & DESSICATION DEWATERING	THERMAL SHOCK & OXYGEN STARVATION	SOUND	VIBRATION	ELECTRICAL	UV RADIATION
WASHINGTON NPDES PERMIT	YES	YES	NO	NO	NO	NO	NO	NO
WASHINGTON HYDRAULIC PROJECT APPROVAL	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
WASHINGTON AQUATIC USE PERMIT	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
OREGON REMOVAL FILL PERMIT	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
OREGON CONDITIONAL USE PERMIT	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
IDAHO STREAM CHANNEL ALTERATION PERMIT	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
IDAHO ENCROACH-MENT PERMIT	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed	NO, unless structure needed
MONTANA SECTION 308 EXEMPTION	YES	YES	NO	NO	NO	NO	NO	NO

	PESTICIDES	BACTERIAL TOXINS	FREEZING & DESSICATION DEWATERING	THERMAL SHOCK & OXYGEN STARVATION	SOUND	VIBRATION	ELECTRICAL	UV RADIATION
MONTANA MEPA	YES	YES	YES	YES	YES	YES	YES	YES
MONTANA FILL REMOVAL PERMIT	NO, unless isolation structure used	NO, unless isolation structure used	YES	NO, unless isolation structure used	NO, unless isolation structure used	NO, unless isolation structure used	NO, unless isolation structure used	NO, unless isolation structure used
MONTANA SPA 124 PERMIT	NO, unless isolation structure use	NO, unless isolation structure used	YES	NO, unless isolation structure used	NO, unless isolation structure used	NO, unless isolation structure used	NO, unless isolation structure used	NO, unless isolation structure used

Appendix F. Contingency Plans

RECLAMATION

Managing Water in the West

Facility Vulnerability Assessment for Howard Hanson & Mud Mountain Dams

Invasive Quagga and Zebra Mussels

U.S. Army Corps of Engineers
Seattle District

Facility Vulnerability Assessment for Howard Hanson & Mud Mountain Dams

Invasive Quagga and Zebra Mussels

Prepared for U.S. Army Corps of Engineers Seattle District

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically

Disclaimer

The information provided in this report is believed to be appropriate and accurate for the specific purposes described herein, but users bear all responsibility for exercising sound engineering judgment in its application, especially to situations different from those reported. References to commercial products do not imply endorsement by the Bureau of Reclamation and may not be used for advertising or promotional purposes.

Cover Photo: Mud Mountain Dam.

Contents

Executive Summary

The purpose of this assessment is to provide U.S. Army Corps of Engineers (USACE) management and project staff with information regarding the vulnerability of facility features to invasive mussel impacts. This report is not intended to be a risk assessment or prediction of the potential for a future mussel infestation. Instead it is intended to assist project management and staff in anticipating and planning for impacts should a future infestation occur.

Findings

Howard Hanson and Mud Mountain Dams are not complex. Water quality data provided suggest a low probability of mussel establish at Eagle Gorge Reservoir namely due to very low calcium levels which appear to be below what is considered the threshold for establishment.

Furthermore, Howard Hanson Dam is in a closed watershed that is not accessible to the public and hence has no recreational boating. No calcium or alkalinity data were provided for Mud Mountain Dam. However, there is limited recreational access reducing the risk of introduction and reported pH and conductivity appear to be marginal. Such conditions would suggest low infestation levels should mussels ever become established. Furthermore, widely varying pool elevations due to flood control operations would generally be expected to have significant mitigating effects on infestation levels. Nevertheless, should an infestation occur, certain facilities features may be impacted depending on infestation levels. Impacts would generally be expected for the outlet works and include fouling on portions of the trashracks, stoplog slots, gates, small diameter piping, valves, associated equipment and instrumentation.

Recommendations

The following recommendations are provided for consideration:

- It is recommended that this report be used in conjunction with regional or basin-wide response plans to develop site-specific actions in the event of a future mussel infestation affecting either Howard Hanson or Mud Mountain facilities. One specific response action worth considering would be the inclusion of mussel impacts and associated requirements in the SOP and O&M schedules where possible based on infestation levels should an infestation occur. Appendix B provides some management options for response planning, including links to various response planning guidelines and online examples.

Introduction

Purpose and Objectives

The purpose of this assessment is to provide U.S. Army Corps of Engineers (USACE) management and project staff with information regarding the vulnerability of facility features to invasive mussel impacts. This report is not intended to be a risk assessment or prediction of the potential for future mussel infestation. Instead, it is intended to assist project management and staff in anticipating and planning for impacts should a future infestation occur.

Brief Project Description

Howard Hanson Dam is rolled earth and rock fill structure that forms Eagle Gorge Reservoir and provides flood control, fisheries enhancement, and water storage for the City of Tacoma water supply. The facility is comprised of an outlet works and gated spillway structure. The Outlet works on the left bank consist of an approach channel, an intake structure providing upstream control via two taineter gates, a 19-ft-diameter concrete-lined horseshoe tunnel, a stilling basin, and an auxiliary 48-in-diameter low flow bypass pipe. The gated spillway on the left abutment has two 45 by 30-ft tainter gates which allows for reservoir storage to elevation 1,206 ft without utilizing the spillway for discharge. The dam is owned, operated, and maintained by the USACE Seattle District

Mud Mountain Dam is a 432-ft-high zoned earth and rock fill embankment structure that provides flood control for the White and Puyallup River valleys. The Outlet works consist of a trash rack intake tower, a 9-ft outlet tunnel for smaller releases, and a 23-ft tunnel for large releases. The dam also contains an uncontrolled concrete lined spillway. The dam is owned, operated, and maintained by the USACE Seattle District.

Background on Potential Invasive Mussel Impacts

Quagga and zebra mussels (adult lengths typically average about 1 in) are unique in that they can firmly attach to the underwater surfaces using byssal threads. They begin spawning by emitting eggs and sperm into the water column when water temperatures reach about 10ºC (50ºF); though spawning has been observed at slightly lower temperatures in some cases. On a population-wide basis, egg production can occur in astronomical levels (on the order of 30,000 eggs per female per reproductive cycle). Depending on temperature and environmental suitability, multiple reproductive cycles may occur in a single year. Fertilized eggs develop into freely swimming larvae or veligers (ranging in sizes from 60 to 250 micron as they develop) which may be transported by water currents for many miles. Within a few weeks and if water conditions are suitable, the veligers will settle (i.e., attach to hard surfaces) and continue growth to adulthood.

Successful settlement is mediated by a number of environmental conditions inherent in the natural water system. These include calcium, alkalinity/hardness, pH, nutrients, dissolved

oxygen, temperature and conductivity. It should be noted that some of these parameters are indirect indicators of others. For example, alkalinity/hardness is presumptive for calcium and magnesium. It is generally accepted that highly successful mussel colonization occurs when calcium levels exceed about 24 mg/L. Successful establishment is more in question when calcium values fall below about 10 mg/L. With the possible exception of nutrients (implied indicators of food supply) in high mountain lakes, the remainder of listed parameters seems fairly well represented as having adequate levels in most Western waters where data are available. Table 1 provides water quality parameters suitability criteria for invasive mussels. It should be noted that this information may not be entirely applicable to all water bodies in the Western U.S. Nevertheless, it provides an approximate indication of suitability requirements.

Table 1. Presumptive infestation-level suitability criteria for invasive mussels.

Parameter	Low Probability of Survival	**Infestation Levels**		
		Low	Moderate	High
Calcium (mg/L)	<10 (QM) <8 (ZM)	10-12 (QM) 8-15 (ZM)	12-30 (QM) 15-30 (ZM)	>30
Alkalinity/Total Hardness (mg $CaCO_3$/L)	<35 (QM) <30 (ZM)	35-42 (QM) 30-55 (ZM)	42-100 (QM) 55-100 (ZM)	>100
pH	<7.0 >9.5	7.0-7.8 9.0-9.5	7.8-8.2 8.8-9.0	8.2-8.8
Dissolved Oxygen (mg/L)	<3	5-7	7-8	>8
Dissolved Oxygen (% saturation)	<25%	25-50%	50-75%	>75%
Mean Summer Temperature (°F)	<64 >86	64-68 83-86	68-72 77-83	72-75
Conductivity (µS/cm)	<30	30-60	60-110	>110
Salinity (g/L)	>10	8-10	5-8	<5
Secchi depth (m)	<0.1 >8	0.1-0.2 2.5-8	0.2-0.4	0.4-2.5
Chlorophyll a (µg/L)	<2.0 >25	2.0-2.5 20-25	8-20	2.5-8
Total phosphorous (µg/L)	<5 >50	5-10 35-50	10-25	25-35

It is important to note that mean summer temperature does not imply temperature thresholds. Adult mussels have been observed to survive at temperatures near freezing. The low- temperature threshold for mussel growth is thought to be around 45 °F. This would imply that mussels are more likely to colonize systems with raw water temperatures greater than about 45°F, with a lower probability of colonization for sustained temperatures below this threshold. On the upper end, temperatures greater than about 84-86 °F for extended periods are not generally expected to support mussel survival. For additional information see Mackie G. & R. Claudi, Monitoring and Control of Macrofouling Mollusks, 2nd Ed., CRC Press, 2010.

Operational conditions of the structures themselves may also influence veliger settlement and subsequent colonization. Within a facility, veliger settlement is prohibited or greatly reduced in pipes where water velocities continuously exceed 6 feet per second (ft/s). However, intermittent operations or lower velocities may lead to successful settlement. Once attached, mussels can sustain that attachment even when flow velocities are well above 6 ft/s. Ideal areas for mussel colonization are those areas with continuous flows of moderate velocities (<6 ft/s) and ample supplies of food and oxygen. Piped systems which are seldom utilized or idle for prolonged periods and which have depleted oxygen are not generally supportive of successful colonization. A major exception is a situation where leaking valves allow constant flows and replenishment to such seldom used systems.

Invasive mussels pose serious threats to water resources infrastructure and operations. Of major importance to facilities is the ability of mussels to rapidly colonize hard surfaces at densities of tens of thousands per square meter. Heavy accumulation can lead to costly operations and maintenance problems. Flow restriction is the foremost concern because mussels can clog water intake structures, such as trashracks, pipes and screens, thereby threatening water delivery to critical systems at hydropower plants and reducing pumping and conveyance capacities of water distribution systems.

Assessment Findings

Potential Infestation Levels

Water Quality

Of importance for estimating potential infestation levels are those parameters necessary for establishment and growth of mussel populations discussed above (namely calcium, pH, dissolved oxygen, temperature, and nutrients). Though it should not be construed as a complete water quality analysis or prediction of future conditions, based on limited available water quality data that were provided, calcium levels below Howard Hanson Dam appear to vary between 3.7-5.8 mg/L while pH in Eagle Gorge Reservoir near the dam is in the range of 5.7-7.1 with alkalinity in the range of 14-28 mg$CaCO_3$/L. These levels are generally considered to be below the threshold for establishment and suggest that Eagle Gorge Reservoir may not be capable of supporting invasive mussels.

The conditions at Mud Mountain Dam appear slightly more conducive for mussels, but still marginal. Though no calcium data were available, pH levels downstream of Mud Mountain Dam appear to range between about 6.9-7.8 while conductivity is in the range of about 34-78 µS/cm. These data, if representative of future seasonal and annual variability, suggest that conditions at Mud Mountain Dam could perhaps support low levels of infestation.

Howard Hanson Dam

Spillway

No direct impacts to the spillway would be expected should an invasive mussel infestation occur at Eagle Gorge Reservoir. The spillway radial gates are rarely submerged and the spillway has never required operation.

Figure 1. Spillway tainter gates at Howard Hanson Dam

Outlet Works

Should an infestation occur, the primary impacts to the outlet works may include mussel settlement and fouling on the intake trashrack, the tainter gates, and the bypass piping and associated equipment. While the trashracks don't appear susceptible to significant flow restriction due to the large size of the openings, mussel fouling on the gates could possibly damage seals during gate operation or degrade seal performance over time. Other impacts at the intakes could include mussel fouling along the slots for the roller chain gate which could possibly affect gate seating follwing closure.

The 48-in bypass may also be exposed to impacts from mussel settlement and shell debris, but the relatively large diameter pipe is not considered susceptible to complete clogging. Fouling and shell debris may adversely affect the ball valve and vertical slide gate with a potential for degraded seal performance and increased maintenance, but it is not likely to render the system inoperable. The bypass fill and vent piping may also be exposed to some fouling from settlement and shell debris. Due to the relatively small size of that piping, mussel settlement and shell debris could render that subsystem inoperable depending on levels of infestation. The 36-in diameter branch and associated slide gate would likely be exposed to similar impacts depending on operating conditions. Any drainage and unwatering sumps and pumps (if so equipped) could also be adversely affected by mussels including fouling and shell debris accumulation in drain lines and sump pits which could lead to failure of pumping systems in

extreme cases of heavy shell debris loads. Generally degraded discharge capacity may also be possible particularly where intake screens are installed on intakes for sump pumps.

Figure 2. Outlet works intake tower reservoir level stilling well.

Mud Mountain Dam

Spillway

The spillway does not appear susceptible to mussel related impacts due the basic design and low frequency of operation (i.e., has never required operation).

Outlet Works

The large fluctuations in pool elevations are likely a significant mitigating factor which would limit long-term mussel impacts to the outlet works. Components that do remain submerged continuously could experience some settlement which can reduce sealing performance for gates and valves depending on operating conditions. Impacts to the emergency gates may also be possible with the potential for seal damage during operation. The stoplog slots and seats for the lower level of the intake may also be susceptible to mussel settlement and shell debris accumulation, however it appears that the stoplog seats are equipped with a water jetting system to remove sediment which may also be effective for removing mussel shell debris.

Figure 3. Mud Mountain intake upper trashrack structure.

Figure 4. Lower intake structure stoplog slots.

Instrumentation

Any temperature, flow and level measurement instrumentation in contact with raw water is generally susceptible to errors or inoperability due to mussel fouling. This includes stilling wells inlets, tubing, floats, pressure transducers, and acoustic flowmeters.

Crane & Hoist Certification

If water weight bags are used for crane or hoist testing, the contract statement of work must include language for preventing the spread of invasive species from one site to another. The watershed where Howard Hanson Dam is located has a mandatory decontamination program in place for all equipment used in the closed watershed.

Conclusions

Howard Hanson and Mud Mountain Dams are not complex. Water quality data provided suggest a low probability of mussel establish at Eagle Gorge Reservoir namely due to very low calcium levels which appear to be below what is considered the threshold for establishment.

Furthermore, Howard Hanson Dam is in a closed watershed that is not accessible to the public and hence has no recreational boating. No calcium or alkalinity data were provided for Mud Mountain Dam. However, there is limited recreational access reducing the risk of introduction and reported pH and conductivity appear to be marginal. Such conditions would suggest low infestation levels should mussels ever become established. Furthermore, widely varying pool elevations due to flood control operations would generally be expected to have significant mitigating effects on infestation levels. Nevertheless, should an infestation occur, certain facilities features may be impacted depending on infestation levels. Impacts would generally be expected for the outlet works and include fouling on portions of the trashracks, stoplog slots, gates, small diameter piping, valves, associated equipment and instrumentation.

Recommendations

Response Planning

It is recommended that this report be used in conjunction with regional or basin-wide response plans to develop site-specific actions in the event of a future mussel infestation affecting either Howard Hanson or Mud Mountain facilities. One specific response action worth considering would be the inclusion of mussel impacts and associated requirements into the SOP and O&M schedules where possible based on infestation levels should an infestation occur. Appendix B provides some management options for response planning, including links to various response planning guidelines and online examples.

Facility Protection Options

While a variety of solutions may be possible (or new technologies may become available), not all solutions are applicable to all situations or all facility components. Some options may be as straightforward as routine manual cleaning while submerged or inaccessible structures and systems may require unique measures, including consideration for redesign or retrofit, to deal effectively with invasive mussels. The options provided below are initial suggestions on where to begin should a future infestation occur, but they do not substitute for thorough planning and engineering.

Outlet Works

The outlet works at both Howard Hanson and Mud Mountain Dams are the primary features for which impacts would be expected should an infestation ever occur.

Trashracks

Although trashracks at both facilities would likely experience minimal impacts owing mainly to the size of the open spacing, heavy mussel settlement on continuously submerged portions could be limited by manual cleaning using hydrojetting at regularly scheduled intervals or as needed. Doing so can reduce the shell debris loads and avoid acute impacts from heavy shell debris that can be drawn into and impact downstream piping and related systems.

Intake Gates

Available options for proactively protecting the intake gates are generally limited to increased maintenance involving manual cleaning at regular intervals and to maintain seals. A means for cleaning stoplog slots and seats prior to installation may also be required for adequate seating and sealing.

Drainage & Unwatering Sump

Drainage and unwatering sumps would likely require regular manual cleanout when possible to manage mussel fouling on continuously submerged surfaces and remove accumulated mussel shell debris. Increased inspection and maintenance frequencies for sump float operator arrangements and pump intake screens (where so equipped) would also likely be required to ensure reliable operation of the system.

Instrumentation

The reservoir level monitoring system at Howard Hanson may require frequent inspection and cleaning to maintain accurate and reliable operation. In the event of an infestation, all critical instrumentation for safe systems operation (level alarms, flow controllers, etc.) should be inventoried and priority schedules developed to inspect and test frequently to ensure reliable operation.

Appendix A

Facility Vulnerability Checklist

Project Name: **Howard Hanson & Mud Mountain Dams, USACE**

Prepared by: Kubitschek & Willett **Date of Preparation:** 6/3/2014

2. Preparation (Step 1)

Item No.	*Item*	Status [1]	Comments / Plan to Resolve
1	**Planning**		
1.1	Has the project scope – including definition and objectives – been prepared?	Y	
1.2	Has the *Project Scope Statement* been approved?	Y	
1.3	Is there a *Project Plan* against which to measure progress?	Y	Project Management Plan (PMP) & MIPR
1.4	Does the *Project Plan* address the following areas:		
1.4.1	• Project Scope and Deliverables	Y	
1.4.2	• Project Schedule	Y	
1.4.3	• Project Budget	Y	
1.4.4	• Project Organization and Resources	Y	
1.5	Were key project stakeholders brought into the *Project Plan*?	Y	
1.6	Were potential customers involved early in the planning process?	Y	
1.7	If there are vendors, have they signed off on the *Project Plan*?	N/A	
1.8	If there is an independent oversight contractor, have they signed off on the *Project Plan*?	N/A	
1.9	Is the Project Sponsor function identified and defined?	Y	
1.10	Are there alternate persons if key members of the project are not available or become reassigned?	Y	
1.11	Other organization items (*please list*):	None	
2	**Tracking & Monitoring**		
2.1	Are the various types of reports, their contents, frequency, and audience defined and communicated to the Project Team?	Y	
2.2	Are the input requirements from Project Team members clearly documented and communicated?	Y	
3	**Meetings and Input Data**		
3.1	Have the various meetings, purpose, context, frequency, and participants been defined and communicated?	Y	
3.2	Have the drawings and documents from the facility sites been requested?	Y	

[1] *Enter one of the following:* **C** (Complete), **P** (Partially Complete), **Y** (Yes), **N** (No); **NA** (Not Applicable)

2. Preparation (Step 1)

Item No.	*Item*	Status [1]	Comments / Plan to Resolve
4	**Project Assumptions and Constraints**		
4.1	Are there any key assumptions upon which the assessment is based and have these assumptions been documented?	Y	Water quality data provided is assumed representative of seasonal and annual variability
4.2	Does the Project have any Constraints such as:		
4.2.1	• Facility shutdown schedules?	Y	Facilities operating at time of site visit
4.2.2	• Facility access limitations and ventilation requirements?	Y	Access limited to structures, systems, and equipment that could be inspected without shutdown
4.2.3	• Monitoring issues such as availability of reports from sampling plates set out in previous seasons?	N	
4.2.4	• Any training needed for key project staff?	N	
4.2.5	• Any pre-project procurement needed for portable field equipment?	N	

3. In-house Review and Preparation for Field Visits (Step 2)

Item No.	*Item*	Status [2]	Comments / Plan to Resolve
1	**Reviewing**		
1.1	Have drawings and documents from the facility site been reviewed?	Y	Review of available dwgs and water quality information
1.2	Have questions arising from the document review been communicated to and discussed with the site experts?	Y	Generally during site visit
1.3	Did the document review identify any pre-site-visit activities that should be done such as video inspections requiring divers or shutdown of equipment that needs to be scheduled?	N	
1.4	Are all pre-site-visit tasks needed to be done at site completed?	N/A	
1.5	Has the deliverables list been updated based on the information from the site documents?	N/A	
1.6	Have all system checklist sheets been prepared?	Y	

[2] *Enter one of the following:* **C** (Complete), **P** (Partially Complete), **Y** (Yes), **N** (No); **NA** (Not Applicable)

4. Site Visits, Follow-up and Reporting (Step 3)

The general approach should be to follow the path of the water through the site facility. The water path will become more complicated each time the water branches into a specific system. Follow each system in turn and you will have covered the complete flow of water through the facility.

Item No.	*Item*	Status	*Comments / Plan to Resolve*
1	**Field Walkthroughs**		
1.1	Has the pre-meeting at site been completed?	Y	Discussions on mussel related issues and purpose/intent of the assessment with project staff prior to walk thru
1.2	Were all necessary site staff available?	Y	
1.3	Have follow-up discussions with staff not available during the site visit been scheduled and completed?	N/A	
1.4	Have all the system walkthrough checklists been completed?	Y	
1.5	Have all actions arising from the site meeting and system walkthroughs been documented and communicated to the person responsible for the action?	Y	
1.6	Has the draft project report been reviewed by all contributors?	N/A	Will be completed following site visit
1.7	Has the final report been approved for issue?	N/A	Will be completed following site visit
1.10	Has the final report been distributed?	N/A	Will be completed following site visit

5. Mussel Vulnerability Evaluation - Project Team Contact List

Project Name: Howard Hanson & Mud Mountain Dams, USACE

Project Lead: Kubitschek & Willett

Some suggestions for the roles of the various team members and the skills or knowledge that would be helpful for each team member are contained in Appendix A.

Name	***Title***	***Location***	***Office Phone & E-mail***
Joe Kubitschek	Hydraulic Engineer	Reclamation, TSC – Hydraulic Investigations and Laboratory Services, Denver, CO	(303) 445-2148 jkubitschek@usbr.gov
Leonard Willett	LC Region Mussel Task Force Coordinator	Reclamation, LC Region, LC Dams Office, Boulder City, NV	(702) 494-2216 lwillett@usbr.gov
Madelyn Martinez	Environmental Stewardship Program Mgr	USACE – Seattle District	(206) 764-6940 Madelyn.T.Martinez@usace.army.mil
Rick Emry	Operations Maintenance Supervisor	USACE – Mud Mountain Dam	(206) 764-3717 Rick.M.Emry@usace.army.mil

5. Mussel Vulnerability Evaluation - Project Team Contact List

Jon Olson	Operations Maintenance Supervisor	USACE – Howard Hanson Dam	(206) 764-6975 jon.a.olson@usace.army.mil

6. Mussel Vulnerability Evaluation – Sample Facility Deliverables List

Facility Name: Howard Hanson & Mud Mountain Dams, USACE

The deliverables are internal document packages prepared for each system or major structure. Once all deliverables are completed, they are then used to prepare the overall assessment report which would be the only external deliverable. It will be helpful when preparing this list to refer to Appendix D for additional detail about typical systems and components at risk that should be considered.

Major Structure or System	***Reference drawings Used***		***Deliverables***
Dam & Appurtenances	Avail dwgs and systems descriptions provided by USACE		
eg2: pump station unit cooling water system	N/A – No pumping plants		
eg3: powerplant & fire water system	N/A – No powerplants		
Continue with systems or structures until all areas in contact with raw water are covered.			

System Walkthrough Checklist

System or Structure Name: **Howard Hanson & Mud Mountain Dams, USACE**

Prepared by: Kubitschek & Willett **Date of Preparation:** 6/3/2014

1. Instructions for Using this Document

- Prepare one of these sheets for each system or major structure identified in the Deliverables list.
- For each *Item No.* below, complete all blank fields (see footnotes for *Status* and *At Risk of Mussels* columns).
- For some of the components such as valves and strainers there may be several in one system. If more than one component needs to be considered add an extra sheet for that particular component group.
- Refer to Appendix C for additional information and suggestions about various systems and components.
- Add additional rows as required where you identify items that need to be considered and are not covered elsewhere in the list.

2. Walkthrough Checklist

Item No.	*Item*	*Status* [3]	*At Risk* (yes/no)	*Comments*
1	**General for Dams, Reservoirs, Aqueducts**			
1.1	Are there any membranes, control joints, permeable construction media, drains, etc. that will let raw water pass?	Y		No specific structural drainage systems were identified or pointed out during the walk thru. Potential for mussel related impacts to drainage systems currently unknown but unlikely for embankment dams
1.2	Are there any air vents?	Y	N	Outlet works air vents for tunnels downstream of regulating gates are large and not submerged
1.3	Check if the spillway and appurtenances are always wet or dry and record duration of dry period.			Spillways at both facilities have never required operation to date
1.4	How much does the water level (i.e. reservoir water surface elevation) fluctuate?			Pool elevations vary drastically throughout the year at both facilities for flood control operations
1.5	Are all potential water seepage paths inspected on a regular basis?	Y		
2	**Water Intake Structures**			
2.1	Types of intake structures present (more than one may be present):			
2.1.1	• Open Canal Direct into Facility (concrete)	N		
2.1.2	• Open Canal Direct into Facility (other material-specify)	N		
2.1.3	• Forebay (specify lining material)	N		
2.1.4	• Tower (specify construction material)	N		
2.1.5	• Submerged Tunnel or pipe intake (specify construction material)	Y	Y	Outlet works intakes at both facilities
2.1.6	• Penstock intakes (specify construction material)	N		
2.1.7	• Fish Barriers	N		

[3] *Enter one of the following:* **C** (Complete), **P** (Partially Complete), **A** (Absent); **Y** (Yes), **N** (No); **NA** (Not Applicable)

2. Walkthrough Checklist

Item No.	Item	Status [3]	At Risk (yes/no)	Comments
2.2	Is the floor of any intake structures likely to be covered with silt or sediment?	Y		May be possible depending on design and operating conditions
2.3	Are any structures duplicated to provide a backup?	N		
2.4	What is the flow velocity range in the structure?			Velocities will vary depending on operating conditions, but generally well in excess of 6 ft/s during typical operations.
2.5	Is the structure accessible for inspection?	N		Portions of intakes submerged and operating at time of site visit
2.6	Are there any shutdowns to provide easy access and what is their frequency?	Y		For regularly scheduled inspection and maintenance cycles
2.7	Are there scheduled maintenance cycles and what are their frequencies?	Y		Varies depending on the system/equip, but typically annual with the exception of the outlet at Mud Mountain which may require multiple shutdowns for maintenance annually
3	**Trash Racks, Grates, Screens**			
3.1	Record spacing, size and material of trash rack bars.			Unavailable at time of site visit but intake trashracks open spacing is large and not likely to be occluded by mussel settlement
3.2	Are trash racks fixed or easily removable for maintenance?			Fixed concrete
3.3	Is there a planned maintenance frequency for the trash racks? If so what is interval?	N		
3.4	Is there a trash rake or other style of cleaning system?	N		
3.5	Are the rake fingers sufficiently large to remove mussels from sides of trash rack bars?	N/A		
3.6	Record location, material, size and grid spacing of any small intake grates.	N/A		
3.7	Are grates fixed or removable for easy maintenance?	N/A		
3.8	Check if grates at bottom of pipes or channels get covered with silt or sediment.	N/A		
3.9	Record location, material, size and grid spacing of any screens.	N/A		
3.10	Are screens fixed or removable for easy maintenance?	N/A		
4	**Wells and Sumps**			
4.1	Location and material of constructions of wells.	N/A		
4.2	Identify level fluctuations in pump wells.	N/A		
4.3	Distance of pump suction from bottom of wells. Will pump ingest shells that are transported along the floor into the well?	N/A		
4.4	Location and material of constructions of sumps.			Drainage sump noted on drawings for Howard Hanson, but not identified during site visit
4.5	Is there a float or other instrumentation in sump that could become covered with mussels?			Not identified during site visit
4.6	Frequency of sump inspection by plant staff.			Not identified during site visit
5	**Pumps and Turbines**			
5.1	Is pump motor or turbine generator water or air cooled? Water cooled motors are at risk.	N/A		
5.2	Can mussel shells get into wear ring gaps?	N/A		

2. Walkthrough Checklist

Item No.	Item	Status [3]	At Risk (yes/no)	Comments
5.3	Does pump have a mechanical seal?	N/A		
5.4	How is the seal flushed during start-up?	N/A		
5.5	How is the seal flushed during normal running?	N/A		
5.6	Does the turbine have a stuffing box?	N/A		
5.7	Is there a stuffing box lantern ring or other cavity for cooling and flushing water?	N/A		
5.8	How is the ring flushed during start-up?	N/A		
5.9	How is the ring flushed during normal running?	N/A		
5.10	Check if the turbine bearings have water cooled lubrication?	N/A		
5.11	Check if the pump has water cooled bearings?	N/A		
5.12	Can mussel shells get into the water lubricated bearing passages?	N/A		
5.13	Do seal or stuffing box cavities have a means of monitoring or inspection?	N/A		
5.14	Can seals or stuffing box be cleaned without removing generator?	N/A		
6	**Piping**			
6.1	Identify materials of construction for piping.			Steel for outlet works bypass at Howard Hanson Dam, otherwise steel and concrete lined outlets
6.2	What is flow velocity range in piping?			Varies depending on system & operating conditions
6.3	How much time is velocity above 6 ft/sec?			Varies depending on system operation
6.4	How much time is velocity below 6 ft/sec?			Varies depending on system operation
6.5	Are there any offsets or changes in pipe diameter?	Y		Offsets, bends, etc...
7	**Instrument Tubing and Instruments**			
7.1	Identify any small diameter lines (2" diameter or less) including material of construction such as:			Reservoir level stilling well inlet piping and small diameter fill piping for bypass at Howard Hanson Dam.
7.1.1	• Flow measurement taps	N		
7.1.2	• Piezometer taps	N		
7.1.3	• Pressure taps	N		
7.1.4	• Sample lines	N		
7.1.5	• Pressure balance lines	N		
7.1.6	• Other – Outlet works flowmeter	N		
	• Other – Reservoir El. gauge	Y	Y	Stilling well at Howard Hanson Dam and pressure transducers at Mud Mountain Dam
8	**Heat Exchangers**			
8.1	Identify material of construction of plenum.	N/A		
8.2	Identify material of construction of tubing.	N/A		
8.3	What is diameter of tubing?	N/A		
8.4	What is flow velocity range in tubing?	N/A		
9	**Valves**			

2. Walkthrough Checklist

Item No.	*Item*	*Status* [3]	*At Risk* (yes/no)	*Comments*
9.1	Identify all normally open (NO) valves.			Low-flow bypass ball valve and regulating gate at Howard Hanson Dam
9.2	Can NO valves fail to seal properly if valve seat or valve face becomes mussel coated?			May be remotely possible depending on infestation levels
9.3	Identify all normally closed (NC) valves			Secondary bypass pipe for primary bypass at Howard Hanson Dam
9.4	Can NC valves fail to open if valve face becomes coated with mussels?			Not likely
9.5	What is throat diameter of valve? Is it small enough to become plugged by mussel shells?	N	N	Bypass regulating gates and valves at Howard Hanson Dam are large diameter. Fill piping and valves for low-flow bypass may be susceptible to complete clogging depending on levels of infestation.
10	**Strainers and Filters**			
10.1	Identify the style of strainer, material of construction of strainer body and basket as well as the size of the basket pores. Typical styles are:	N/A		
10.1.1	• Fixed In-line strainer	N/A		
10.1.2	• Duplex strainer	N/A		
10.1.3	• Self-cleaning strainer	N/A		
10.1.4	• Wye (Y) strainer	N/A		
10.1.5	• Other type - specify	N/A		
10.2	Identify the style of filter, material of construction of body and filter element, as well as the size of the filter pores. Typical styles are:	N/A		
10.2.1	• Self-cleaning filter	N/A		
10.2.2	• Replaceable cartridge filter	N/A		
10.2.3	• Other type - specify	N/A		

Appendix B

Management Options for Quagga & Zebra Mussel Infestations

Concurrent with Prevention & Public Outreach/Education Actions

Most water bodies in the western United States are now at risk of infestation by invasive quagga and zebra mussels. While the actions taken to prevent or respond to infestation must be tailored to each specific location, the following activities represent options for consideration as part of any readiness planning as well as options for dealing with mussels following detection. Information on preventing the spread of invasive mussels can be found at the 100th Meridian Initiative website http://100thmeridian.org/ and http://protectyourwaters.net.

Procedures have also been developed by Reclamation and are documented in Technical Memorandum No. 86-68220-07-05 *Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species* which provides guidance for inspecting and cleaning vehicles and equipment to help prevent the spread of invasive species during Reclamation activities. The manual can be found at http://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2012.pdf

Actions to consider prior to detection of mussels:

1. Develop Coordinated Response Plan(s) - **This plan would detail policies, command and authority structure, strategies, communications, roles and responsibilities, and response actions to be implemented – Involves multiple federal, state, and local agencies and stakeholders. An example Response Plan for the Columbia River Basin may be found at the 100th Meridian website http://www.100thmeridian.org/Columbia_RBT.asp. The National Parks Service also has information and guidelines for prevention and response planning that can be found at http://www.nature.nps.gov/biology/Quagga/index.cfm.**

2. Perform Infestation Risk Assessment(s) **– This activity may be completed as standalone or as part of the Coordinated Response Plan. The purpose is to identify which water bodies are most at-risk of infestation within the geographic region of interest or management jurisdiction. The likelihood of infestation is typically based upon recreational usage, nearest known infestation, and the extent to which environmental conditions (including calcium, pH, dissolved oxygen, temperature, etc…) are likely to support mussel establishment. This information can be used to prioritize facility vulnerability assessments (below). A variety of examples for risk assessments are available on the web. Information specific to environmental suitability based risk assessments is available at the U.S. Army Corps of Engineers Zebra Mussel Information System (ZMIS) website http://el.erdc.usace.army.mil/zebra/zmis/zmishelp.htm.**

3. Perform Facility Vulnerability Assessment(s) **– This activity may be completed as standalone or following the infestation risk assessment(s) and consists of a detailed inventory of critical water related infrastructure at a water body and how each component is likely to be affected by mussels should infestation occur. The results can be used to prioritize facility protection needs and actions. A facility vulnerability assessment template can be found at www.usbr.gov/mussels/.**

4. Implement Monitoring Program(s) **– Monitoring programs should be considered for high priority water bodies where infestation is either most likely or would cause significant harm to water systems or other key resources. Monitoring programs, designed to provide early detection of mussel larvae (through water sampling and lab analysis), potentially provide 2-3 years of lead time for planning and implementing protective actions before the infestation impairs operations via adult settlement on hydraulic structures or within critical systems. Additional information on monitoring can be found at the U.S. Army Corps of Engineers Zebra Mussel Information System (ZMIS) website http://el.erdc.usace.army.mil/zebra/zmis/zmishelp.htm.**

Actions to consider following detection of mussels:

1. Execute Coordinated Response Plan **– Involves notification, information exchange, and implementation of containment and control actions (i.e., components of the response plan).**

2. Increase Monitoring **– Transition from monitoring for detection to monitoring with increased frequency to confirm detection, identify or locate the presence of adults, and track infestation levels. This activity may also include regular facilities inspections to determine when facilities are being impacted by adult colonization. This information can guide facilities protection actions and assists in anticipating ecological impacts for future mitigation planning.**

3. Identify and Implement Appropriate Facilities Protection Measures **– Identify which actions or technologies are best suited for maintaining water operations and reducing O&M costs or other expenses. Various conventional technologies have been used with reasonable success. The table below provides some conventional as well as experimental options, each of which has advantages and disadvantages. It should be noted that there are a number of commercial treatment products that have not been listed, but may be applicable in various situations.**

Table 1 – Control and facilities protection options for various applications.

Technology	Example Applications
Filtration to prevent mussel entry to piped systems – Self-cleaning 40-80 micron filters may be more than adequate depending on exclusion requirements. Exclusion avoids the need for treating infested systems.	Low volume systems - Facilities service water, unit or transformer cooling water, HVAC, pumped systems, and delivery pipelines
Ultraviolet (UV) Treatment of water in piped systems – In-line UV systems are being evaluated to prevent mussel settlement. UV has additional water treatment benefits and is not expected to require discharge permitting †	Low volume systems - Facilities service water, unit or transformer cooling water, HVAC, pumped systems, and delivery pipelines
Chemical Treatments – Injection or delivery of chemicals (oxidizing and nonoxidizing) to kill mussels or impair ability to attach to surfaces • Bromine • Chlorine • Chlorine dioxide • Hydrogen peroxide • Ozone • Potassium salts • Potassium permanganate • Sodium Hypochlorite • Salinity	Low and medium volume systems - Facilities service water, unit or transformer cooling water, HVAC, pumped systems, and delivery pipelines. Permitting often required for chemical treatment methods
Alternative Treatments – Alternatives to kill mussels or impair ability to attach • Thermal • Biological • Desiccation	Low and medium volume systems – Facilities service water, unit or transformer cooling water, HVAC, pumped systems and delivery pipelines. Desiccation requires capability to dewater system for extended durations
Coatings to protect exposed surfaces† – Prevents mussel attachment or facilitates cleaning (anti-fouling & foul-release)	Hydraulic Structures & Equipment - Gates, valves, penstocks, intake structures, trashracks, fish screens
Alternative Materials – To prevent mussel attachment or facilitate cleaning • Copper • Galvanizing (requires high zinc content)	Intake grating, piping/tubing, heat exchangers, HVAC systems
Mechanical Removal – For routine maintenance • Mechanical raking/scraping • Hydrojetting/water spraying • Pipeline pigging Traveling intake screens (self-cleaning)	All structures, systems, equipment, and instrumentation where access is possible – Diversion structures, pipelines, trashracks, intakes, fish screens. For instrumentation, noncontact methods should be considered where possible
Redundant Systems – Multiple intakes or duplicate systems for switching during treatment or cleaning to provide uninterrupted service	All systems for which retrofit is possible/practical

† - Under development or being field tested.

Technologies selection for each application depends on a number of considerations including periodic or continuous mussel exclusion requirements, operations and maintenance requirements, permitting requirements, environmental impacts, and cost; to name a few. If conventional technologies are not applicable then alternatives should be developed and demonstrated as early as possible to meet unique facilities requirements. Operational strategies may also be available to reduce or eliminate mussel impacts. However, such strategies are often limited depending on the type of system and available flexibility. Additional information on control strategies and facilities protection methods may be found in The Practical Manual for Zebra Mussel Monitoring and Control, R. Claudi & G.L. Mackie, CRC Press, Inc. (2000) and at the U.S. Army Corps of Engineers Zebra Mussel Information System (ZMIS) website http://el.erdc.usace.army.mil/zebra/zmis/zmishelp.htm

4. Identify Ecological Impacts **– Involves developing and initiating actions to measure and track ecological changes, develop mitigation plans, and implement long-term mitigation actions (considers endangered species, food webs, aquatic weeds, water quality, etc.)**

Table 1. General list of most vulnerable project facilities and some potential preventative actions to reduce the impacts of a zebra mussel infestation. It is not intended that the project immediately begin making changes but, rather, to provide information that could be used to modify facilities during the normal course of project maintenance and replacement activities.

Facility	Level of Risk	Reason for Risk Level	Potential Preventative Actions
Turbine cooling systems	High	Use raw water with no domestic water backup	- Provide redundancy in supply lines - Provide additional water supply capacity - Repair/replace leaking valves
Fire suppression systems	High	Use raw water with no domestic water backup	- Provide redundancy in supply lines - Provide additional water supply capacity - Repair/replace leaking valves - Provide domestic water backup
Fish passage facilities	High	Use raw water with no domestic water backup	- Provide redundancy in supply lines - Provide additional water supply capacity - Repair/replace leaking valves - Provide/improve access to all components/facilities in contact with raw water - Eliminate leakage of raw water into unwatered facilities - Provide backup equipment for removable components (e.g., various screens and gratings)

Facility	Level of Risk	Reason for Risk Level	Potential Preventative Actions
Drains and sumps	High	Exposure to raw water	- Provide redundancy in drain lines - Repair/replace leaking valves - Provide backup pumps
Monitoring facilities			
- Forebay/tailwater sensors	High	Exposure to raw water	- Provide redundant sensing capability
- Oil/water separators	High	Exposure to raw water	- Provide redundancy in supply lines - Provide additional water supply capacity - Repair/replace leaking valves
- Dissolved gas monitors	High	Exposure to raw water	- Provide redundant monitoring capability
HVAC[1] systems	High	Use raw water with no domestic water backup	- Provide redundancy in supply lines - Provide additional water supply capacity - Repair/replace leaking valves - Convert to domestic water
Turbine intake trashracks	High	Exposure to raw water	- Provide backup equipment to allow replacement of racks for cleaning
Boats	High	Exposure to raw water	- Provide site for storing boat out of the water when not in use
Air compressors	Medium	Use domestic water with raw water backup	- Repair/replace leaking valves in raw water system
Gland water for cooling/lubricating	Medium	Use domestic water with raw water backup	- Provide redundancy in supply lines - Provide additional water supply capacity - Repair/replace leaking valves
Spillway	Medium	Exposure to raw water but should remain operable	- Paint with protective, antifouling coating
Navigation lock - floating mooring bits	Medium	Exposure to raw water but should remain operable	- Paint with protective, antifouling coating
Irrigation systems	Medium	Seasonal use raw water with no domestic water backup	- Repair/replace leaking valves - Provide domestic water backup - Provide capability to drain systems when not in use
Ice and trash sluiceways	Low	Exposure to raw water (at high velocity)	
Bonneville hatchery	Low	Use well water and Tanner Creek	
Visitor centers	Low	No exposure to raw water	

[1] Heating, ventilation and air conditioning

ATTACHMENT 1. Draft Information Paper: Introduction of Zebra Mussels into the Columbia River Basin

1. Background: Since zebra mussels (*Dreissena polymorpha*) were introduced into the United States in the late 1980s from Eastern Europe, they have rapidly dispersed throughout the Great Lakes and major river systems including the Hudson, Ohio, Mississippi, lower Missouri, and other rivers to the south and east covering 22 states and two Canadian provinces. This rapid dispersal is due primarily to its tremendous reproductive capability and the fact that larval zebra mussels are able to remain free-floating for several weeks before settling. This ability allows them to be dispersed by downstream water currents, which has been the major vector for their rapid expansion in North America. They are also dispersed by attaching to various types of watercraft moving within or from infested waters. They are particularly troublesome because of their ability to attach to any submerged hard surface, preferring secluded areas with moving water.

If zebra mussels are introduced and become established within the CRB, it is uncertain how densely they will colonize. They can probably be expected to thrive at least as well as the invasive Asian clam (Corbicula fluminea) that is already widely distributed in the CRB. Densities ranging up to hundreds of thousands per square meter could be attained under favorable conditions – enough to completely cover surfaces several layers deep. The severity of impacts on hydropower, navigation, and fish passage facilities and extent and frequency of mitigation actions will depend on mussel production levels.

2. Potential Impacts: If zebra mussels colonized the Columbia River Basin (CRB) they could affect all submerged components and conduits in contact with raw water in the Federal Columbia River Power System (FCRPS) such as trash racks, raw water distribution systems, turbine cooling systems, diffuser gratings, service and fire suppression systems, drains, navigation locks, and fish passage facilities. Zebra mussel larvae attach to substrates, including in moving water where they can find irregularities such as cracks and crevices and scaling in older pipes and flanges that provide lower velocity refugia for settlement. The attached mussels then grow and produce additional low flow refuges, allowing colonization to progress in otherwise inhospitable flow environments. Settlement can also occur when water flow is reduced during generation or other facility down-time when conditions may become more conducive to attachment.

3. Risk to Corps Facilities: Critical facility components that could be affected by zebra mussels include turbine cooling systems, fire suppression systems, adult and juvenile fish passage facilities, drains and sumps, and some monitoring equipment. Heavy zebra mussel infestations could force these facilities out of service until remedial actions could be taken. Aside from the serious economic impacts of forcing the turbines out of service, or biological effects of disrupted fish passage, the river flow might have to be diverted through the spillway which could have other negative effects (e.g., high dissolved gases downstream).

4. Response Actions: Initial response is to determine if zebra mussels are present, where they

have settled, and how dense the population is. If critical facilities are in imminent danger of failure, then remedial actions will be developed. If components can be removed and replaced or backup systems can be used, the response can be more rapid and effective. If facilities are accessible but not removable, then the mussels must be physically removed until prevention/control measures can be installed. Inaccessible areas will be most difficult and may need to be taken out of service until access is achieved or control measures can be installed. At this time, effective chemical or other control measures are limited due to risks to the environment.

ATTACHMENT 2. Draft Talking Points: Introduction of Zebra Mussels into the Columbia River Basin

1. Where did zebra mussels come from?

Zebra mussels originated in the Balkans, Poland, and the former Soviet Union and were introduced in the mid-1980s into the Great Lakes as a result of ballast water discharge. Since their introduction, zebra mussels have spread to 22 states and two Canadian provinces. They rapidly dispersed throughout the Great Lakes and much of the Mississippi River basin due to their tremendous reproductive capability, the planktonic nature of the larvae allowing water currents to cause downstream drift over great distances, and ability to attach to boats traveling within and from infested waters. The recently-discovered population in _____ is believed to have been from mussels attached to _____ (a recreational boat) that was brought from _____.

2. What is the problem?

If zebra mussels colonized the Columbia River Basin (CRB) they could affect all submerged components and conduits in contact with raw water in the Federal Columbia River Power System (FCRPS) and throughout the rest of the basin. These small mussels could reach densities in excess of 100,000 per square meter and no effective means of eradication exists to eliminate established populations. All other public and private facilities on or in contact with infected waters would also be affected.

3. How will they affect Corps of Engineers facilities?

Critical facility components that could be affected by zebra mussels include turbine cooling systems, fire suppression systems, adult and juvenile fish passage facilities, drains and sumps, and some monitoring equipment. Heavy zebra mussel infestations could force these facilities out of service until remedial actions could be taken. Aside from the serious economic impacts of forcing the turbines out of service, or biological effects of disrupted fish passage, the river flow might have to be diverted through the spillway which could have other negative effects (e.g., high dissolved gases downstream).

4. What can/is being done to deal with them?

A comprehensive, coordinated regional effort, led by _____ Team, has been assembled to address the problem. First priority is to contain and control the existing population to prevent further dispersal into the region. This could include a general quarantine of the infected area with access restricted to authorized parties or _____. At the same time, discussions are underway to determine if any practical means of eliminating the zebra mussels exists. As this is unlikely, long-term management options are also being developed. These efforts are being guided by a Rapid Response Plan that was developed by the Columbia River Basin Coordinating Committee in 2006 to deal with this very problem.

5. What is the Corps doing?

The Corps of Engineers is participating with the regional coordination team to assist in

development and implementation of a regional response strategy. We are also evaluating potential impacts to Corps facilities and developing remedial actions to protect the integrity of project facilities and to prevent the interruption of vital services. Our priority is to protect critical facilities, including those listed above, while at the same time not inflicting any environmental damage on non-target species.

Attachment 3. Draft Press Release Example: Introduction of Zebra Mussels into the Columbia River Basin Raises Concerns

[Public Affairs Office review for style/content]

The recent discovery of zebra mussels in _____ has raised serious concerns among regional experts about their potential effects on our aquatic resources and economy. This small freshwater mussel, originally from Eastern Europe, was introduced into the Great Lakes area in the late 1980s and rapidly spread throughout the eastern United States and Canada. They are believed to have been brought into our area by _____.

Some estimates of the economic impact of these small mussels to water intake and conveyance facilities in the eastern U. S. are several $1 billion. Much of the existing infrastructure had to be modified or replaced to deal with the prolific mussels that are able to attach to about every hard surface in contact with raw water supplies. Possibly even more significant, are the as of yet unquantified, monetary impacts they are expected to have on recreation and natural resource values.

It is not certain how great the impact will be in _____ (the Northwest) but an interagency coordinating group, led by _____, is extremely concerned. Once the zebra mussels become established, it is almost impossible to get rid of them. The best hope is to launch an early, coordinated program to contain the current infestation and hopefully determine a means of control.

The _____ (group) is fortunate to have a head start using a rapid response strategy that was developed earlier in anticipation of just this kind of problem. Other similar rapid response programs have been most successful when there was early detection of an invasive species and all of the agencies that had to be involved were able to quickly respond with a well-coordinated plan.

In the meantime, the _____ (agency) has _____ (restricted access) to _____ (infected location) to help prevent further dispersal of the zebra mussels. The public can help by avoiding the ____ (infected area) and following some good general guidelines. They should clean all boats, trailers, and other equipment after leaving a lake or stream and never release any live organisms into the wild.

Additional information could be added about other species already in the region and how they are being dealt with – Eurasian watermilfoil, New Zealand mudsnails, Asian clam, and kudzu (which showed up in Oregon and was successfully eradicated).

Quotes:

- "We have been aware of problems zebra mussels have caused in the Great Lakes region and have been working with various agencies organizations since the early 1990s to prevent their introduction into the West."
- "Although eradication is extremely difficult, our first concern is to contain the zebra mussel infestation within _____ to avoid it being spread to other vulnerable areas."

- "Although the recent discovery of zebra mussels is alarming, we are fortunate to have a Rapid Response Plan available to facilitate a coordinated regional effort to deal with this new invader. "The successes we have seen in other areas were the result of the region's ability to rapidly respond with a coordinated intense effort. "

Appendix F-2. Dreissenid Response Strategies at Lower Columbia River Basin Hydroelectric Fish Facilities

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ACRONYMS

AWS	auxiliary water supply or auxiliary water system
BiOp	Biological Opinion
Corps	Corps of Engineers
CRB	Columbia River Basin
ESA	Endangered Species Act
DO	dissolved oxygen
ESBSs	extended-length submersible bar screens
FCRPS	Federal Columbia River Power System
FDS	Fish and Debris Separator
FPOM	Fish Passage Operations and Maintenance Coordination Team
FPP	Fish Passage Plan
JBS	juvenile bypass systems
PIT	passive integrated transponder
PA	pre-anesthetizing
PDS	primary dewatering structure
ROV	remotely operated vehicle
SDS	secondary dewatering system
SMF	smolt monitoring facilities
SMP	Smolt Monitoring Program
STSs	submersible traveling screens
VBSs	vertical barrier screens

I. Introduction

The purpose of this document is to evaluate the potential impacts of a zebra mussel (*Dreissena polymorpha*) or quagga mussel (*Dreissena bugensis*) infestation on the Federal Columbia River Power System's (FCRPS) hydroelectric juvenile fish passage facilities and adult fishways and determine potential impacts and appropriate rapid responses should an infestation occur. Although this response plan is specific to the Corps of Engineers (Corps) projects at John Day Dam and Bonneville dams on the lower Columbia River mainstem, sections may apply to the other six Corps projects, privately owned Public Utilities District, or Bureau of Reclamation hydroelectric projects which maintain similar adult and juvenile fishways in the Columbia River Basin (CRB). Many projects have unique fish passage operations and components that would require site specific knowledge and evaluation to assess risk from invasive dreissenid mussels (Four of the other Corps projects have juvenile fish transportation facilities).

II. Background

The mainstem Columbia River Basin hydroelectric projects provide power, flood control, irrigation, navigation, and recreational opportunities throughout the Pacific Northwest and are vulnerable to potential impacts from an invasive mussel infestation. An overview of Bonneville Lock and Dam Project components that may be at risk of colonization can be found in Section C, Appendix H (Athearn and Darland 2006). In addition, a review of the risks to Corps project fish facilities such as Juvenile Bypass Systems (JBS), Smolt Monitoring Facilities (SMF), and adult fishways can be found in Athearn (1999). Salmon and steelhead pass through numerous dams on the mainstem Columbia and Snake Rivers. The fish passage facilities must function properly to allow both upstream and downstream migration of salmon and steelhead, many of which are listed for protection under the Endangered Species Act (ESA). An invasive mussel infestation impact on fish passage facilities are of particular concern because hydroelectric project operations (i. e. power generation) are often determined by federal regulations regarding salmonids passage. Surface fouling created by attached dreissenid mussel on structures such as fish ladders, as well as clogging inflows, drainages, and screened areas, could create hazardous passage conditions for fish.

Even small fluctuations in flow due to debris accumulation or changes in river flow can cause weirs, valves, and screens to operate out of fish passage criteria which may cause delay or injury. At John Day Dam, approximately 90% of the spring and summer juvenile salmonid out-migrants use the bypass facility between April 1 and June 2 and the majority of the fall out-migrants (80%) pass between June 14 and August 2 (Martinson, et al, 2006). Any unnecessary facility outages due to additional cleaning or maintenance associated with a mussel infestation should be avoided during this period. Unscheduled generation unit outages can cause increased,

involuntary spill which might lead to unsafe levels of atmospheric gas supersaturation for aquatic organisms, unsafe flood control conditions in reservoirs, and lost generating revenue for BPA.

A Corps document called the Fish Passage Plan (FPP) is part of the current strategy to reduce conflicts between various river users and fish passage. The FPP is updated annually by the Corps in coordination with regional fish agencies, Indian tribes, the Bonneville Power Administration, and other participants through the Fish Passage Operations and Maintenance Coordination Team (FPOM). The plan is incorporated in the most current NOAA Fisheries and U. S. Fish and Wildlife Biological Opinions (BiOp) and contains a comprehensive list of criteria, by project, that are intended to comply with BiOp performance standards. Increased duration of maintenance periods or other emergency deviations during fish passage seasons caused by a mussel infestation would require coordination with FPOM and the Technical Management Team and consultation with NOAA Fisheries.

Invasive Bivalve Populations and Assessing the Risk for Bypass Components: The significance of any impact caused by dreissenids in the CRB will depend on their colonization potential and level(s) of infestation. Seasonal growth rates and mussel density will be determined by water quality, water quantity, and fluctuations in plankton density. Some risks at the bypass facilities associated with a mussel infestation are more easily imagined and obvious while other risks are difficult to qualify due the uncertainty surrounding how equipment and mussels will interact. Almost all risk is related to:

1. The amount of time components are submerged in raw water,
2. The level of accessibility for inspection and cleaning or replacement of key components,
3. The amount of redundancy built into the design of the system, and
4. The level of interaction between a component and fish.

In many cases submerged components are dewatered for regularly scheduled winter maintenance but good accessibility and maintenance opportunities are limited to these periods. Any built in redundancies, such as the installation of a second auxiliary water supply (AWS) pipe, would be very costly and require additional planning and funding (Phillips et al. 2005). Components such as dewatering screens, porosity plates, and separator bars have near constant interaction with fish and would need increased monitoring and more frequent maintenance and cleaning.

Asian Clam *(Corbicula fluminea),* an Indicator Bivalve: Regional hydropower projects have been interacting with and working around an introduced bivalve, the Asian clam for decades. The Asian clam is believed to have been introduced into the Pacific Northwest in the early 1930's (Burch 1944) and has since become one of the most common bivalves in the CRB (Newell 2003).

Due to the clam's prolific nature and ubiquitous distribution in the Pacific Northwest, it is found in abundance at most mainstem dams. In fact, this non-native bivalve is the predominant bivalve mollusk in many of the aquatic environments at projects and large piles of clam shells can accumulate in the collection channels, fishways, under diffuser grating, inside water lines or behind valves, and behind dewatering screens. Asian clams have been found living in some drain galleries inside the dams. They also cause direct physical injury to fish when they become lodged in dewatering screens or on separator bars. Although Asian clams differ from dreissenids in many ways, they are similar aquatic organisms and lessons and observations regarding clams may aide in predicting the impact of dreissenids. One significant difference is the encrusting nature of dreissenids (up to several inches thick) and their ability to attach to vertical surfaces through the use of byssal threads. It is unknown how *Corbicula* might interact with introduced mussels, but clam shells do provide suitable attachment sites for juvenile mussel colonization. Larval *Corbicula* complete most of their development inside the female clam whereas dreissenids have free living, veliger larvae. It is unknown which group of bivalves would have any competitive advantage regarding reproduction or colonization, but the encrusting nature and feeding behavior of dreissenids has been shown to be a serious threat to native bivalves in other parts of North America. Of course, the site-specific nature of aquatic environments, unique construction materials and flow situations at dams, and the unpredictable nature of invasive biological organisms challenge the amount of certainty in any assessment of future risk.

III. Potential Impacts and Responses - John Day Dam and Bonneville Dam Juvenile Bypass System Components

Juvenile Bypass Facilities: The juvenile facilities at John Day and Bonneville dams consist of two major components, the juvenile bypass system (JBS) (Figure 1) and the smolt monitoring facilities. At John Day Dam, both parts of the system operate together April 1 through September 15, passing fish through a passive integrated transponder (PIT) tag detector, sample gate, and the SMF. The smolt sampling season at Bonneville Dam operates March 1 through October 31. The primary risk to both parts of the bypass is that they utilize raw river water and very few components or supply lines have built in redundancies which would be beneficial should a mussel invasion occur. From September 16 through December 15, submersible traveling screens (STSs) remain in operation to prevent adult salmonids from falling back through turbine units. At this time, fish, water, and debris are routed out of the JBS, down the ogee ramp, and out to tailrace through the juvenile outfall structure. After December 16 and until the start of fish passage season in April, the STSs are stored in their respective gatewell slots and non-guided fish and debris continue to passively use the bypass system for the remainder of the year except for a short period when it is dewatered for an annual inspection. In general, the operation and shut down dates are important because they represent well established maintenance periods which usually do not conflict with juvenile or adult fish passage. Similar details and schedules specific to each Corps project can be found in the current year FPP and in Table 2.

In many cases, equipment vulnerability and associated risk may require the modification of

maintenance schedules, increased inspection and maintenance, improved cleaning techniques, installation of higher capacity pipes and redundant supply lines, and purchase of spare parts or backup equipment (Table 3, Appendix F-1.).

An upstream to downstream list of components and their associated vulnerability to dreissenids follow in the text and are listed in Table 1, and a schematic showing the project layout for John Day Dam can be found in Figure 2.

1. Powerhouse and Auxiliary Water Supply Trashracks: The trashracks prevent most large woody debris from entering the turbine intake or auxiliary water supplies for the adult fish ladders and juvenile facilities. The spacing of the bars on the trashracks varies from 3/4 inch on fish turbine intakes to 6 inches for main generator units. River debris is removed by lowering a large rake to the bottom of the trashrack which then collects debris as it is pulled back up to the surface. Units must be turned off during the raking process which is performed as needed during the juvenile passage season, often coinciding with the some of the season's highest in-river flows and debris loads. The main auxiliary water supply at John Day Dam provides add-in water for the adult fishways, flushing water for the main components of the juvenile bypass system downstream of the tainter gate, and irrigation water. No duplicate water source is currently available for these locations.

Potential Impacts: These structures are permanently submerged and at high risk of colonization by mussels. Although most trashracks have relatively large openings (approx. 1 ft^2), severe fouling with mussel shells may cause more tumbleweeds and willows to accumulate which would contribute to elevated descaling and injury of fish. Any increase in the frequency of trashrack raking could pose limitations on power production by having units shut down that could be generating power. Inoperable units during high flow periods would require extra spill, amount to lost power generating revenue, and create potentially hazardous river conditions for fish. The extra weight or associated difficulty of removing debris encrusted with zebra mussels would have to be considered among the potential elevated costs of increased maintenance. The AWS and penstock area is susceptible to mussel accumulation which could cause malfunctioning adjustments to water volume or inefficient delivery to fishways or the SMF.

Response: Periodic (weekly or monthly) inspection for and hand clearing of mussel debris from sensitive guide slots or cables associated with trashrack raking may be needed. More frequent cleaning of trashracks may be necessary due to mussel shells that can catch and hold more debris than non-encrusted surfaces. Consider providing backup equipment which can be used to while trashracks are periodically removed and cleaned. Design, manufacture, test, and deploy a mussel removing brush for use with current trashrack raking structures. Duplicate auxiliary water supply pipes do not currently exist but may be required if an infestation becomes extreme and mussel growth limits the current pipe capacity.

2. Bypass Screens (STS, ESBS, and VBS): These screens are so essential to safe fish passage that units are shut down if screens are damaged or clogged with debris (USACE 2006). At least three types of bypass screens are utilized in the Columbia and Snake River mainstem dams, submersible traveling screens (STSs), extended-length submersible bar screens (ESBSs), and vertical barrier screens (VBSs). Both STSs and VBSs are made of a fine plastic screen mesh

(approx. 2mm opening, or 40% minimum porosity) whereas ESBSs are made of wedge wire with a 2 mm gap width (Johnson or Hendrix wedge wire screen) backed by perforated metal plates with of various diameter holes. These bypass screens work in tandem with the bypass channel to move out-migrating juvenile and adult salmonids from the forebay to the tailrace with minimum injury or delay. Bypass screens vastly improve turbine unit fish guidance efficiency and help determine orifice passage efficiency. John Day Dam is equipped with three STSs for each main unit in service April 1 through December 15. These screens are about 20' long and the plastic screen mesh surface rotates when deployed so that any debris caught on the upstream surface is carried to the downstream side and into the turbine intake or up into the gatewell towards the VBS and orifice. At John Day Dam, a total of three ESBSs were installed in Unit 7 for research purposes by the Corps and NOAA. These bypass screens are used successfully at other mainstem dams (e.g. McNary Dam), but were not deemed successful for use at JDA. The ESBSs are about 40' long and do not rotate for cleaning but utilize a traveling brush to remove debris. Both types of screens are deployed through bulkhead (upstream) gatewell slots, lowered down through the gatewell, and positioned into the flow of the turbine intake area. The screens direct flow, fish, and debris up through the gatewell slot towards the 14" orifices and into the bypass channel or back toward the turbine through the VBS. At most projects the upstream and downstream gatewells are separated by a VBS to confine migrating fish in the vicinity of a bypass orifice and to keep them from re-entering the turbine intake via the downstream gatewell. The VBSs are a critical component of the fish bypass system and are susceptible to debris accumulation. Too much debris disturbs the gatewell environment and creates turbulent conditions for migrating fish. Units with STS bypass screens have 3 VBS screens per gatewell and units with ESBSs are fitted with 9 VBSs per gatewell. The VBSs are currently left in place, fully submerged, during the fish passage season and during the winter. The STSs at John Day Dam are generally raised and stored in the gatewell slot between December 16 and April 1.

Potential Impacts: Both types of bypass screens and the VBS screens are at high risk and susceptible to zebra mussel attachment and fouling. The screens are submerged and in use during the most active period of the year for dreissenid reproduction, veliger dispersal, and colonization (Table 1). Although flows through and around these screens are generally fast (3-5 fps), several irregular angles and crevices would provide suitable attachment conditions for mussels, particularly on the backside of ESBS screens. The STS screen mesh could be damaged by impacts from druses that may break off the trashrack or face of the dam just upstream. Mussel encrusted river debris could become more difficult to remove by brushing or rotating mesh and lead to increased fish injury. Ongoing maintenance and repair to the drive units, seals and other components of the bypass screens may increase in frequency.

Response: Increased camera or manual inspection of bypass screens and VBSs for mussel accumulations would be likely. The STSs must currently be inspected once per month and VBS screens once every two months (Fish Passage Plan, USACE - March, 2006). Any increases to inspections would require more coordination between fisheries and reduced operations. Most inspections are possible only when a unit is out of service. If screens were found fouled with juvenile mussels, a rotating schedule of in-service and out-of-service would have to be developed. In the "off" season, STSs are routinely stored in a gatewell slot, with the lower portion submerged in river water. The water in this environment below the screen and above the

gatewell is relatively slow and conducive to zebra mussel attachment. Although veliger presence would likely be lower during colder water temperatures in the winter months, juvenile and adult mussels may detach themselves and move to more favorable conditions. Thus, a new location or improved storing technique would have to be developed to keep zebra mussels from attaching to STSs and ESBSs. If screens continue to be stored in gatewell slots, more time should be scheduled to include cleaning any mussels which may have attached during the winter months. Currently, VBS screens are left in place between the upstream and downstream gatewell slots year-round, leaving them susceptible to mussel accumulation. Even minor blockage of flow through a VBS has the potential to create a turbulent gatewell environment for fish and unfavorable conditions for power generation due to excessive flow. A rotating schedule for periodic removal and cleaning of VBSs would help prevent an overabundance of mussels that could cause screen failure or poor gatewell conditions. Based on average daily air temperatures in Rufus, Oregon, approximately 79 days a year have an average below freezing and would be available if lethal temperatures for mussels are needed. Considerable time, effort, and equipment would be saved if storage or cleaning station location could be established out of the water on site.

3. Gatewells, Orifices and Juvenile Collection Channel: These three components of the JBS are interconnected and work together to move fish through the inside of the dam. The bypass screens divert water, fish, and debris from the turbine intake area, past a flow vein, and up gatewells towards the orifices and collection channel or through a VBS. The gatewell slots allow an operating gate or bulkhead gate to be lowered from the intake deck into the turbine intake for maintenance or emergency shutoff procedures. At John Day Dam, there are three bulkhead (upstream) gatewell slots and three roller gate (downstream) slots per unit and one 14 inch orifice in each upstream slot (some projects have 12 inch orifices). Orifices are fitted with pneumatic knife gates, cycled regularly to reduce the risk of debris plugs, and are fitted with an orifice light which helps attract juvenile out-migrants through the orifice into the collection channel. The collection channel flows are variable depending on the location in the channel because the overall height, width, and shape of the channel vary. Flows are generally in excess of 10 fps, but slower flow areas exist along the lower edge of the channel and near irregularities in the walls.

Potential Impacts: All of these components are at moderate risk due to the fact that they are submerged for the entire year under normal operating situations. Adult mussels would probably find the gatewell environment favorable due to the large amount of cement surfaces for attachment, moderate flows, and constant exposure to aquatic nutrients. A typical gatewell environment has gaps and crevices that may provide a starting point for veliger growth. Gatewell dip-netting or ROV inspections of STS or VBSs could be affected if mussels colonize guide rails or cables and prohibit deployment. Other methods of inspection are time consuming and costly and require dewatering of the unit. Cleaning would have to be done during any routine maintenance or repairs, probably in the winter months during annual inspections. Currently, dewatering, fish salvage, and water up occur in the same day. Periodic cleaning would require more time out of service. Water velocity through the orifices is too high for mussel attachment, but there is some risk to the knife valve armature due to the lower flow conditions just before the orifice. The main collection channel is usually operated with flows approximately

10-15 fps, but the irregular contours, rough cement surfaces, orifice entrance recesses, and access portals (orifice light holes and drainage holes from the forebay deck) create slow flow areas that would be favorable for mussel colonization. Extremely slow flow areas exist along the floor and wall of the collection channel towards the tainter gate and would provide suitable conditions for mussel growth (personal observation, Jan. 2007). Fluctuating water levels throughout the season could create areas along the waterline or near leaks that would be susceptible to druse formation.

Response: Increased frequency of orifice cycling during the fish passage season may be required to decrease the chance of mussels collecting in valve guides or other sensitive areas associated with the orifices. Increased cycling during the winter months may also help deter colonization, but the current method of having two out of three orifices closed during the winter months to conserve water would have to be reconsidered or modified because orifices closed or open for any extended period of time may allow mussels the opportunity to attach. Orifice light recesses would have to be inspected and cleaned if mussel growth is observed so accumulations would not block attraction light. Inspection and removal of druse or individual mussel accumulations along the lower edge of channel should occur during annual dewatering.

4. Tainter gate, Elevated Chute, and Crest Gate: The tainter gate regulates the amount of water flowing out of the JBS and over the crest gate into the elevated chute. The total volume ranges between 450 to 600 cfs and depends upon forebay elevation and the number of generating turbine units. In general, flow through the chute is very fast, approximately 15-20 fps and depth varies, approximately 4-18 ft. The crest gate is made mostly of concrete and weighs several tons. When lowered, synthetic gaskets along the edges seal the gap between the gate and the wall inhibit leakage into the ogee. At the end of the smolt monitoring season, the crest gate is raised and the elevated chute is subsequently dewatered. Water flows into the elevated chute April 1 through September 15.

Potential Impacts: The tainter gate has a low risk of being affected by zebra mussels due to its associated high flows and frequent movement. Submerged sensors may be affected by mussel growth and severe accumulation would require a re-design or modifications which allow access for cleaning or replacement. If mussels were to become established in a low flow area behind the gate or in the gate guide, they would probably not have the opportunity to grow very large before being scraped off by the tainter gate motion. The crest gate is also at low risk due to very high flows and the fact that it is dogged off completely out of the water after the fish passage period and has sufficient time to dry out and freeze before the next seasons use. The majority of the surface area of the inside of the elevated chute would dry out and be exposed to freezing air temperatures in winter. One exception could be the expansion joints, many of which have gaps and holes that could be colonized by mussels. Irregular contours in the floor trap some water after the dewatering, but it is not known if that water freezes in winter. In addition, the grated walkway on top of the structure allows precipitation to enter and accumulate.

Response: Routine inspection and cleaning of sensors for mussel accumulation would be recommended during the winter maintenance dewatering. Determine if the amount of water

remaining in the elevated chute after dewatering freezes in winter or if it is enough to provide a refuge for mussels. Periodically check for and brush out any water that accumulates in the floor of the elevated chute. Check all expansion joints and crest gate seal for mussels and remove.

5. Ogee Ramp and Tailrace Outfall Flume: The ogee ramp carries all the fish, water, and debris from the juvenile collection channel to the tailrace outfall flume when the crest gate is in bypass mode. These components are dewatered during the smolt monitoring season, April 1 through September 15. The flow out of the collection channel into the ogee and outfall flume travels at approximately 10-15 fps, and usually enters the tailrace above the surface of the water except during high river flow periods, typically in the spring.

Potential Impacts: The ogee and outfall flume have a low to moderate risk of impact from mussel colonization due to normal high flow situations. Leakage from the crest gate into the ogee during the smolt monitoring season may promote mussel growth which would then pose a risk to bypassed fish when the main passage season ends. The outfall flume exit may be susceptible to mussel growth if high tailrace water levels persist for long periods.

Response: Inspect the crest gate seal for wear to prevent leakage into the ogee. If leaking persists, it may be necessary to devise a method of diverting the leaking water away from the ogee and outfall flume during the smolt monitoring season. Inspect outfall flume during the winter maintenance dewatering and remove mussels as needed.

6. Primary Dewatering Structure (PDS), Modulating Weirs, and Adult Drain: The PDS removes about 95% of the water routed down the elevated chute from the JBS. This excess water, approximately 500 cfs, flows through a series of dewatering screens and returns to the river via a 6 ft diameter underground conduit. The dewatering screens are made of stainless steel wedge wire panels with a gap width of 2 mm and are backed by perforated plates. They are lowered into guide slots on the inside walls of the bypass channel which runs the length of the structure. Dewatering screens placed vertically help minimize the velocity through the screens and reduce debris accumulation. They also help satisfy safe fish passage criteria by making it easier to maintain constant, laminar flow, to help minimize juvenile and adult fish delay. The screens are fitted with screen cleaning brushes which can be run in manually or in auto depending on debris loads. Automatic modulating weirs situated behind the dewatering screens regulate the amount of water removed from the structure. The adult drain is situated near the floor of the structure and is activated by raising a large pneumatic knife gate. Typically, it is opened at the end of the annual dewatering process in September and allows fish that become trapped in the PDS to exit and return to river without being netted, transported, and released by hand. After the initial surge of flushing water from the PDS, a 3-inch flushing water supply valve pushes fish downstream where they dump into the corrugated transport flume. The PDS is dewatered September 16 through April 1.

Potential Impacts: These components are at low to moderate risk of colonization by zebra mussels. All the screen surfaces, perforated plates, drains, and valves associated with the PDS dry out and are exposed to freezing winter temperatures. In season accumulation of mussel shells would be hampered by periodic use of the screen cleaning brushes, although brushing may not be effective in removing all mussels. Access to the PDS channel is possible during the winter and

hand cleaning with pressurized water to remove mussels after they are dried and frozen would be possible, although providing water to this remote location is difficult. Sediment, clam shells, and other debris currently collect between the wedge wire dewatering screen and the perforated plate directly behind the screens. Even heavy accumulation of shells would have a limited impact due to the nature of the modulating weir functions which is that they would just "modulate" lower to compensate for any inefficiency caused by clogging. The adult drain is located in a recess about 2' deep into the wall of the elevated chute and may provide a slow flow area where zebra mussels could attach and grow or accumulate after dying. Any leakage from this valve into the adult transport pipe during fish passage season could possibly sustain juvenile mussels which could injure fish during dewatering as they slide through the pipe.

Response: Check for areas of shell accumulation and remove as needed to prevent clogging and inefficiency of modulating weirs. Inspect screen cleaner brushes for wear and replace regularly so brushes can continue to deter mussel growth. Clear mussels from any knife valve guides or channels before winterizing procedures. There is currently no method of clearing mussels from the adult drain valve recess area before the adult drain is used during dewatering and mussels could cause serious damage to fish as they are forced to pass by this route. Modifications designed to eliminate this recess or retrofitting a type of plug or barrier to prevent mussel access to this area should be considered. In addition, the adult drain flushing water valve would also need to be purged periodically to remove any mussels.

7. Corrugated Transport Flume and Conveyance Pipe: The corrugated transport flume (JDA bypass only) and conveyance pipe (Bonneville PH2 bypass only) move water and fish from the PDS to the secondary dewatering structure (SDS) and porosity unit. Approximately 30 cfs of water flows down the transport flume at about 9 fps. A continual series of ½-inch corrugations on the floor and sides slows the water as it flows downstream and helps maintain safe passage conditions for fish. The length of the flume is approximately 1,000 feet long and is covered by sun shading grated panels, most of which can be removed to provide access for inspections or cleaning. The transport flume is dewatered September 15 through April 1.

The conveyance pipe at Bonneville contains about 33-38 cfs and flows at 4-5 fps. It is approximately 9,000 feet long and has a smooth high-density polyethylene surface with minor irregularities occurring at the seams between sections of pipe. The majority of the pipe is buried underground and a series of inspection ports exist about every 1,000 feet to provide access between the powerhouse and the smolt monitoring facility. The conveyance pipe is dewatered approximately December 15 through February 28.

Potential Impacts: In general, the corrugated transport flume at John Day is at low risk of impact from zebra mussels due to the high flows experienced during the passage season (in excess of 6 fps). In addition, the flume is dewatered for most of the winter months and dries out almost completely. However, the degree to which juvenile mussels may be able to colonize the slow flow areas between the corrugations is unknown. Unfortunately, Asian clams are not a helpful surrogate bivalve in this situation because, unlike mussels, they are unable to attach to the substrate with byssal threads and cannot attach to the vertical surfaces of the flume.

The conveyance pipe at Bonneville Dam is probably a low to moderate risk area, although uncertainty exists regarding potential mussel colonization along the waterline and inside seams. Mussel growth on the smooth surface of the pipe could slow water and fish passage and seriously injury fish.

Response: These two fish passage routes should be inspected following their respective dewaterings. Seasonal cleaning may be required if mussels are able to attach and grow in the slow flow areas between corrugations, at the waterline, or inside seams. Accumulations left in place could break off during fish passage season and cause injury to fish at the separator bars, inside distribution flumes, or in sample holding tanks. Difficulty in gaining access to certain areas should be figured into any cleaning schedule. The conveyance pipe is a permit requiring confined space and presents a very difficult area to enter and clean. Should it be needed for mussel removal, providing water or electricity to these relatively remote work sites could be a major challenge. In addition, the surfaces are slippery, the environment is moist, and it is completely dark making complete removal of small mussels unlikely. Freezing air temperatures could not be relied upon to help kill mussels in the conveyance pipe because it is underground and somewhat insulated from outside temperatures.

8. Switch Gates and Flushing Valves: The switch gate is a large pivoting blade that directs the flow in the corrugated transport flume or conveyance pipe to either the bypass (back to river) or sample (to monitoring facility) flumes. A series of neoprene gaskets on the underside of the gate inhibit leakage between flumes and a perforated plate under the gate provides access for flushing water. At John Day Dam, the switch gate is dewatered and completely dry September 15 to April 1. The switch gate at Bonneville Dam continues to have water passing one side after the fish passage season until the conveyance pipe is dewatered in December.

Potential Impacts: The switch gate and associated flushing water valves have a low risk of being affected by zebra mussels because both components are dewatered during the winter months and are exposed to freezing air temperatures. In season accumulation of mussels under the gate could abrade or cut the neoprene gasket, but the gate is moved by a pneumatic cylinder set at 80 psi or greater and mussel shells would not likely inhibit gate movement. The flushing water valves could be more sensitive to mussel shell accumulation due to their location on the floor of the flume. Clearing mussel shells from behind the perforated plates could pose a challenge if a significant number of juvenile mussels grow inside flushing water supply lines. Seasonal growth rates will determine whether mussels grow large enough to be trapped behind the plates or if they will remain small enough to pass through. Also, some water may remain after dewatering in the hopper under the switch gate and could provide a winter refuge for mussels. Multi-season shell accumulations could clog the inflow and render the flushing water useless, making the seasonal dewatering experience less optimal for fish.

Response: Inspection and cleaning should take place during the winter maintenance months when the switchgate is dewatered. Mussel shells should be manually cleared from any surfaces on or near the gasket under the switch gate blade. The perforated plate below the gate should be cleaned annually and a larger diameter drain valve should be installed below the switch gate flushing water hopper to insure efficient evacuation of any seasonal buildup of mussels. Increased maintenance efforts and costs would be incurred if seasonal shell accumulations pose

a clogging threat and require removal, cleaning, and reinstallation of perforate plates.

9. Fish and Debris Separator (FDS) - Secondary Dewatering System (SDS), Porosity Unit, Wetted Separator Bars, Juvenile Collection Hopper, and Distribution Flumes: These four components remove most of the remaining 30 cfs of flow in the corrugated transport flume and separate juvenile and adult fish and debris. The SDS and Porosity Unit are regulated with a series of manually adjusted weirs that discharge screened water into the head tank. The wetted separator bars have a gap width of ¾" and allow juvenile fish to fall through the bars into the juvenile collection hopper and adult fish to slide over and return to the river. Smaller debris typically falls through the bars and larger debris is usually stranded on top and requires periodic manual removal. The separator bars are continually sprayed and wetted with river water to provide a slick, slippery surface for fish. The juvenile collection hopper is directly below the bars and serves to route approximately 1 cfs and all juvenile fish into the distribution flumes. The distribution flume is the final stage before fish are routed towards the PIT tag detectors and rotating sample gates. These components are dewatered September 16 through April 1.

Potential Impacts: These components exhibit a moderate risk of impact from a zebra mussel invasion due to their intimate interaction with bypassed fish and the fact that they are watered up during the most active period of zebra mussel reproduction and dispersal. All bypassed fish would be susceptible to irregular flows and subsequent poor passage conditions such as flooding of the collection hopper or drying of the porosity unit perforated plate that can be caused by mussel shell accumulation under the screens. Fish could sustain direct physical injuries if the dewatering wedge wire or perforated plates become clogged or trap shells. In addition, the separator bars can be a very dangerous place for fish if they are forced to be separated when river debris such as chunks of wood, tumble weeds, plastic, dead fish, or druses get stranded and prevent separation. Fish forced at high velocity into debris can sustain fatal injuries to their head, gills, and body. The slick, wet surfaces of the separator bars are maintained by continual spraying and could be compromised by the accumulation of mussel shells inside the bars. The dryer, rougher surfaces that would be exposed if spray water is inhibited could contribute to elevated levels of descaling and poor fish condition. Currently, juvenile Asian clams accumulate in the separator bars and are purged several times per season by removing neoprene plugs screwed into the end of the bars. It is likely that mussels would also find these water supply lines as suitable habitat and increase the risk of plugging. Removal of the plugs can be done without any major impact to fish, but access is very difficult. The final distribution flume utilizes add-in water to help stabilize velocities and could be susceptible to mussel shell accumulation behind regulating valves.

Response: It is essential that flow conditions remain within fish passage criteria at this stage in the bypass system. Routine brushing and scraping of the FDS dewatering wedge wire and perforated plate at the porosity unit would need to be continued and potentially increased. Currently, cleaning and brushing of the FDS occurs at least every 30 minutes and more frequent monitoring prompted by mussel accumulation would limit the time used for other inspection duties. The rate of mussel shell accumulation would help determine an appropriate schedule for regular purging of the spray water system. Regular inspection and purging of add-in water valves would prevent unwanted blockage.

10. Tertiary Dewatering Units, Passive Integrated Transponder (PIT) Tag Detectors, and Rotating Sample Gates: Flow velocities through these components range about 8-10 fps. In general, the flume surfaces are smooth but small crevices between the transitional sections of pipe create some flow irregularities. The tertiary dewatering units were designed to allow flows exiting the juvenile collection hopper to be "fine-tuned" in the distribution flumes. At John Day Dam, the wedge wire dewatering screens have been modified by inserting solid PVC pipes inside to prevent these units from losing any flow. The modifications were prompted by the seasonal accumulation of sediment and Asian clams inside the dewatering baffles which was extremely difficult to remove during the winter maintenance period. The PIT tag detectors automatically record tag data when tagged fish pass an electromagnetic field created by an antenna coiled around the PVC pipe. Two antenna coils upstream of the 3-way sample gate help ensure complete code detections and data is downloaded several times a day to a database. Just downstream of the PIT tag detectors, the 3-way rotating gate is used to obtain the smolt monitoring sample and research fish (Figure 3). When rotated west, all fish and debris are diverted into the sample holding tank; when rotated east, all fish are routed to the research flume; and in the center or default position, all fish go to the tailrace outfall. Sample gate activity varies but operates at least 2 to 6 times per hour during April 1 through September 15. The gate is pneumatically operated (90 psi) and, when activated, moves extremely fast and powerfully.

Potential Impacts: This section of the bypass system is at low to moderate risk and impact due to mussel colonization. The components become very dry when it is dewatered from September 16 through April 1 and are exposed to freezing air temperatures in winter. Several sections of the distribution flume and PIT tag detectors do not have access ports near pipe junctions so cleaning any accumulation of mussels would be difficult. Add-in water ball valves and supply lines could be vulnerable to mussel accumulations which would restrict flow and potentially effect PIT tag detection efficiency by slowing water velocities.

Response: Tertiary dewatering units would continue to be cleaned as needed. Even heavy buildup inside the baffles would not affect fish passage. New access ports near transition seams could be installed for easier cleaning or perhaps a method of scouring interior surfaces from the ends of the pipes could be devised. Periodic purging of add-in water valves during scheduled inspections would help reduce mussel accumulations during fish passage seasons.

IV. Potential Impacts and Responses - Smolt Monitoring Facility - Laboratory at John Day Dam and Bonneville Dam

1. Holding Tank, Inflow Butterfly Valves, and Crowder Panels: These components are all located inside the SMF and are routinely cleaned using water and brushes throughout the fish passage season by Smolt Monitoring Program (SMP) staff. The sample holding tank contains about 1,795 gal (6,795 L) of water and holds fish that were diverted by the sample gate throughout the day and night until they are anesthetized, sorted, and tallied by SMP personnel each morning. Fresh river water constantly flows in and out of the tank through perforated plates located in the front and the back of the tank. The total volume of water in the tank is exchanged every few minutes to remove fish waste, increase dissolved oxygen (DO) levels, and

sustain suitable water temperatures for fish. This inflow water supply is delivered through a 12-inch diameter pipe on the upstream end of the tank and is regulated by a butterfly valve. The crowder panel separates groups of fish sampled at different rates or on different days. It also serves to move or crowd fish toward the pre-anesthetic (PA) chambers without causing too much stress. It is made of perforated plate and is pushed or pulled through the tank either manually or with the aid of a winch. A flexible neoprene flap is installed along the edges and bottom of the crowder panel to provide a tight seal between the crowder and tank so small fish cannot pass through or get stuck. These components are dewatered September 16 to April 1.

Potential Impacts: These components are at low risk of colonization by mussels due to the fact that they become dry during the winter months when the facility is dewatered, but in-season mussel shell accumulation in sensitive areas could injure fish. Any mussel growth associated with the perforated plate on the crowder will make it more difficult to move through the sample tank and potentially injure fish. Shells stuck to the neoprene flap could cause increased wear or tearing and cause descaling or mortality if fish try to squeeze through. Currently the butterfly valve that regulates flow into the holding tank is periodically purged to release any clam shell accumulations and mussel shell accumulations or growth could add to the current problem involving clams.

Response: Appropriate responses to a mussel infestation may include increased maintenance and cleaning by fisheries staff, scheduled purging of inflow butterfly valves, and more frequent replacement of the neoprene seal. In-season pressure washing to periodically remove any mussel buildup on the perforated plates would be difficult because fish are always in the tank and the cleaning process would cause increased stress. A method of temporarily hoisting the crowder out of the tank and washing it on the side of the holding tank might have to be developed if mussels become too difficult to remove by hand and prohibit movement of the crowder or injure fish.

2. Pre-anesthetizing (PA) Chambers, Fish Lifts, Drainage Pipes, and Flushing Water: Fish are hand maneuvered into the PA chambers using a panel net and a metal slide gate is lowered behind the fish to separate them from the holding tank. Two chambers exist at the upstream side of the holding tank and can be used alternatively if a problem with one occurs. Water drains out of the chamber to a prescribed level dictated by the height of the valve in the side of the chamber. At John Day Dam, this drain consists of a 2-inch PVC supply line and ball valve and drains directly back to the return to river flume. At the Bonneville juvenile facility, fish lifts raise the PA chamber from the holding tank in the basement to the sample laboratory on the main floor. Fish anesthetic (Finquel, MS-222) is added to the remaining volume of water (48 liters) and fish become sufficiently anesthetized in 2-3 minutes. A pneumatic knife gate is activated and fish and water are then flushed through a 6-inch diameter PVC pipe, across a final dewatering perforated plate, and into the sorting trough for examination. Flushing water is supplied through a 2-inch supply line and regulated by a ball valve which is currently susceptible to sediment and clam buildup even though it is operated several times daily.

Potential Impacts: These components are at low risk of colonization by mussels due to the fact that they become dry when the facility is dewatered, but at moderate risk in-season because mussel shell accumulation in sensitive areas could injure fish or restrict flow. Mussels could

interfere with the slide gate if they accumulate in the guide and could cause leakage into the PA chamber. The guides are made of Delrin and are particularly difficult to clean due to their position at the end of the tank and partly under water. Any irregular seal and subsequent leakage would impact the sampling effort by increasing the time it takes to anesthetize fish and process samples. Severe leaks could hamper processing and even halt sampling if anesthetizing fish becomes impossible. The drain line and ball valve are continually submerged during fish passage seasons and are susceptible to mussel growth. Blockage or constriction of flow would increase PA chamber time for fish which increases stress. The upstream side of the knife gate and bottom surface of the flushing pipe into the sorting trough is also susceptible to mussel growth.

Response: The PA chambers, slide gates, and Delrin slide gate guides may have to be cleaned more frequently than the 2-3 times per week they currently experience. Use of the existing PA chambers could be alternated every week or so which would allow the non-used chamber to be dried and or cleaned. Flushing water supply lines may need isolation and drain valves so that they could be dried out between active periods. The knife gate and 6-inch transport pipe are extremely difficult to access and may require installation of access portals or the development of a "brush on a pole" scouring method of cleaning if mussels accumulate in this area.

3. Sorting Trough, Return Pipe, and Recovery Tanks: The sorting trough receives anesthetized fish from the PA chamber and is the location for all fish identification, data collection, counting, and condition examinations. Excess water in the trough is automatically drained and flows into the anesthetic reservoir tank in the basement of the SMF. Following the data collection process, fish are released into the return pipe and transported to one of two available recovery tanks. The return pipe is supplied with raw water from a 1-inch hose and operates throughout the smolt monitoring season. Recovery tanks allow anesthetized fish to recover and become more alert before being returned to the river. Both tanks receive a constant inflow of fresh river water regulated by a 9-inch butterfly valve. A minimum of 25 minutes is required before release, so alternating between the two tanks allows sampling to continue uninterrupted. Water exits through a perforated plate and down standpipes back to the river. Fish are flushed to the exit when the perforated plate and standpipes are removed.

Potential Impacts: These components are at low risk of mussel colonization due to the fact that they become dry when the facility is dewatered. In-season risks include mussel accumulation behind the return pipe hose valve or inside the return pipe itself. Mussels may also collect behind the butterfly valves that provide fresh water to the recovery tanks.

Response: In-season cleaning of the recovery tank return pipe water is difficult but could be accomplished if it is found that mussels grow inside the pipe. Periodic shut down and temporary removal of this pipe would increase maintenance time but probably not incur much extra cost. Replacement hoses and valves should be kept on hand so serious clogs to the return pipe flushing water would not stop sampling. Inflow butterfly valves to the recovery tanks should be regularly purged to prevent excess mussel buildup. At least weekly inspections of the interior of the tanks should be performed so that any mussel growth could be brushed or scraped away before posing a threat to fish condition. Devise a scouring method for cleaning inaccessible areas.

4. Release Pipes and Exit to River Flume: The release pipes are made of PVC and convey fish from the recovery tank in the laboratory to the exit to river flume outside. Water is released through two standpipes and all fish are usually evacuated within 4-5 minutes. The exit to river flume flows at about 8-10 fps, it is constructed of concrete, and directs fish into the outfall flume which empties into the tailrace. They are both dewatered during the winter maintenance period.

Potential Impacts: These two components are at moderate risk of mussel colonization. In-season mussel growth on the inside surface of the release pipes could injure fish as they are being released to river. Upon release, fish are forced at high velocity into contact with this pipe and even small mussels could cause cuts and scrapes which could increase mortality. The injuries could be difficult to detect because monitoring for fish condition does not occur after this point on project. The exit to river flume is also vulnerable to mussel growth in-season although consistently higher flows would be less suitable for juvenile mussel attachment and the relatively wide flume would allow fish to avoid contact with the walls.

Response: The main portion of the release pipe currently provides limited access or no access for inspection purposes. Both ends of the release pipe can be accessed however, and it may be possible to clean by scouring or hot water treatment. The exit flume is more easily inspected, but a heavy grating covers the entire length of the flume and prevents in-season cleaning. In addition, the flume is exposed to precipitation during the winter and may not become completely dry or frozen.

5. Recirculation Pump, Water Chiller, and MS-222 Filters: The recirculating system at the smolt monitoring facilities allows reuse of water containing MS-222. Because these systems have the unintended potential to grow and transfer fish pathogens such as bacterial kidney disease, they are generally not used for more than one day at a time. The recirculating tank contains a water chiller that helps monitoring personnel maintain river water temperatures which reduces fish stress during handling. Water is regularly drained from the sorting trough to keep DO, temperature, and waste levels safe for fish. This water is temporarily held in a storage tank in the basement of the facility until it is pumped through a series of 55-gallon Calgon brand activated charcoal filters. The filters are replaced annually or semi-annually depending on the condition of the metal drums and filtering ability of the charcoal. The filters remove some or all of the MS-222 before it is discharged to the soil outside the facility for further breakdown.

Potential Impacts: The recirculation pump and water chiller are at low risk of impact from a mussel infestation because they are not usually used for an extended period of time and are completely dewatered September 16 to April 1. Periodic inspection and cleaning of the main line debris trap may be needed if mussels build up during the season. Drain lines leading to the filter tank in the basement are at moderate risk because they are not easily accessed or cleaned and remain wet during the most active period for dreissenids. The storage tank in the basement is at moderate risk because it remains partially full of water all year and has a small, 2-inch discharge valve that is susceptible to mussel accumulation and blockage. The filter pump, water lines between filter canisters, canister interiors, and final discharge hose are also vulnerable to clogging which could cause the storage tank to overflow.

Response: The recirculating pump and chiller can be drained thoroughly after use to avoid any mussel accumulation. Pump components should be inspected annually to check for extra wear potentially caused by mussel shells. The storage tank can be vacuumed out or flushed clean at the end of the sampling season so debris does not accumulate and impact the pump and filters. Cleaning of the discharge lines could be accomplished using high-pressure water, compressed air, or by capping for chemical or hot water treatment. Consider installing a backup system in case of heavy shell buildup and blockage.

6. Research Activities - Temporary Holding Tanks, Degassing Columns, and Transportation Tanks: Research tagging activities focusing on juvenile salmonid behavior at the SMF often use temporary or semi-permanent components that are connected to raw water supplies. After sorting and identification, fish are held in temporary holding tanks for up to several days before being transported off-site for release to the river. The tanks are made of plastic or fiberglass and water is delivered through either 2-inch or 4-inch lines regulated with ball valves. Degassing columns made of 12-inch PVC pipes have been installed just upstream of the research holding tanks to help limit the potential risk to fish caused by supersaturated river water. Water is forced to flow through the medium inside the columns and allows any supersaturated gasses to come out of solution. If tagging occurs on-site, fish to be released at another location are held in transportation tanks designed with wheels to facilitate loading onto a vehicle. These components are dewatered during the same time frame as the smolt monitoring facilities, September 15 to April 1.

Potential Impacts: The research holding tanks are at moderate risk to impact from mussels because even small fluctuations in water flows can be lethal for fish by limiting DO or causing tanks to over flow. Their water supply lines and valves are susceptible to clogging and access for cleaning is limited. Degassing columns are at risk because they would probably provide suitable mussel attachment sites inside on the degassing medium. Too much debris accumulation in the columns could cause them to overflow and malfunction. Transportation tanks are at low risk because they are regularly cleaned and dewatered after each fish holding event to decrease the chance of transferring pathogens.

Response: These SMF components are dewatered during the winter and become completely dry. All valves are opened and drained for winter so most of the risk is associated with mussel accumulation occurring during the fish passage season by restricting flow. In-season risk can be reduced by maintaining the current routine cleaning protocol for holding and transportation tanks to reduce the chance of pathogen transfer. The tanks could be regularly inspected for mussel growth and mussels could be manually removed. Degassing columns should be taken down and cleaned as needed depending on the rate of mussel accumulation. Water supply lines that can be easily isolated and cleaned should be maintained and installation of a redundant supply system should be considered. Current transportation tank cleaning and dewatering protocols should continue.

7. Avian Hydrocannons: The avian hydro-cannons help deter avian predators such as gulls, cormorants, and terns from targeting temporarily disoriented fish at the outfall exit. The cannons are positioned at the very end of the structure and spray water in a large arc over the tailrace surface. The hydro-cannon at John Day Dam have not been used in recent years. The

cannons at Bonneville are typically used throughout the juvenile spill passage season (April 1-August 31). The water for the hydro-cannon comes from the AWS and is dewatered after September 1. The supply line is isolated and purged of water using compressed air during the winter maintenance period.

Potential Impacts: The hydro-cannons are at low risk of impact from mussel colonization because the water supply line is dewatered and purged annually. Accelerated wear to the nozzle may occur due to mussel shells. There is also a risk of blockage to the isolation valve from in-season mussel accumulation, which could hamper the purging process.

Response: Continue purging the hydro-cannon water supply line after seasonal use and determine if any mussel or clam accumulation can be noticed. If mussels are found to restrict flow, a redundant supply line could be installed to provide a backup. Inspect the nozzle for wear and replace as needed.

V. Potential Impacts and Responses - Adult Fishway Components - John Day Dam

1. Adult Collection Channel: The adult collection channel runs the length of the powerhouse below the tailrace deck and increases the number of locations an adult salmonid may encounter attraction water leading to a fish ladder entrance. A series of floating orifice gates can be used to provide fish access into this channel at various locations. These orifices can automatically move up and down to allow the collection channel differential and velocity to constantly adjust with changing tailrace elevations. A series of diffuser pools provide supplemental water throughout the length of the channel. Standard diffuser gratings consist of one-inch gaps with ¼-inch width galvanized metal bars. The collection channel can be dewatered in sections using cross channel bulkheads and is usually dewatered during the winter maintenance period (see FPP for project specifics).

Potential Impacts: The adult collection channel is at low to moderate risk of impact due to a dreissenid infestation. Although large amounts of surface area would be susceptible to fouling, the relatively large height and width of the channel does not force fish into contact with the channel surfaces. In addition, the floating orifices are large and heavy enough that they would probably not be affected by the presence of mussel shells. The pressure sensitive transducers used to measure the tailrace and collection channel differentials may not work correctly if mussel accumulations interfere with their measurements. Incorrect readings would lead to changes in velocities in the collection channel potentially delay upstream migrants. The gratings over the diffuser pools would be susceptible to mussel accumulation because any restriction to flow in this area can force the grating to blow out which would allow fish access into the auxiliary water supply system. In addition, fish ladders are taken out of service until diffuser gratings can be repaired and, depending on the time of year, could disrupt adult fish passage.

Response: The gratings covering the diffuser pools may have to be cleaned during the winter maintenance period to keep mussel accumulations from restricting flow during the fish passage

season. In addition, in-season scheduled transducer sensor cleaning may be required if mussel accumulations cause the sensors to malfunction. If fouling is severe, in-season cleaning and maintenance may be needed and this would require installation of a removable sensor that could be cleaned without dewatering the channel.

2. South Fishway Entrance: This fishway entrance is a transitional area between the adult collection channel, the fish ladder entrance, and the fish ladder weirs. Large amounts of water are added diffuser pools with grating located on the floor of the structure. This add-in water attracts adult fish into the ladders and is regulated with a series of valves. It is possible to dewater the fish ladder entrance separately from the collection channel and it is usually dewatered during the winter maintenance period (see FPP for project specifics).

Potential Impacts: This area is relatively large and easily accessible although it is only accessible when dewatered during the winter maintenance period. Mussel growth on the walls or floor would pose a low threat to fish because they are not forced into contact with the edges of the structure. The diffuser pool grating and regulating valves are at moderate risk of impact due to mussel accumulation because any flow restriction through the 1-inch gaps could loosen the gratings and allow upstream migrants access to the diffusion chambers under the gratings where they would be trapped and, unless removed, would eventually die.

Response: Regular inspections for mussels in this area may need to occur during the annual dewaterings. If mussels accumulate on the grating surfaces, cleaning and removal may be necessary to minimize flow restrictions. Currently, many diffuser pools have large amounts of *Corbicula* shells, rocks, sand, and woody debris that accumulate under the gratings and affect the amount of flow passing through the gratings. It is likely that a mussel infestation would add to the existing problem and substantially increase the amount of time necessary for maintenance. Debris removal from this area is difficult because the grating has to be moved out of position and then the debris has to be lifted up and out of the entrance area. Furthermore, some areas under the gratings are difficult or impossible to access by hand using rakes or shovels and may require use of a debris vacuum or hose.

3. Fish Pump Intake Basin: Water from this area comes from the tailrace and is pumped back up into the lower section of the fish ladders to provide auxiliary water for fish attraction. Tailrace water entering the basin passes through a trashrack to prevent large fish and debris from entering the basin. The fish pumps then push the water into various diffuser pools through chimney style conduits.

Potential Impacts: In general, this area is at low risk of impact from dreissenids because it is very large and does not usually contain fish. A slight risk of fish injury in the tailrace may occur if mussels accumulate on the trashrack and create high flow areas that could entrain fish as they pass by or capture debris that would then injure fish. The chimney style supply conduits are very large and their flow would probably not be affected by fouling.

Response: Inspections of the differential between the basin and the tailrace may be needed to determine the severity of mussel accumulations on the trashrack. Periodic removal and cleaning

of the trashrack may be needed if mussels or debris are found to restrict flow or if dead fish are noted in the intake basin.

4. Francis Wheel Fish Turbines: The south fish ladder at John Day Dam has three Francis wheel fish turbines that are used to supplement flow in the lower section of the fish ladder. The penstock (approx. 36-inch diameter pipe) takes water from the forebay and provides each turbine with up to 100 cfs of water. The turbine wheels spin through a gear box and power impellers which are able to push up to 300 cfs of tailrace water into the south fish ladder diffuser pools.

Potential Impacts: This area is at low level of risk from dreissenids, but an accumulation of mussels between the penstock and fish turbines could impede flow and reduce turbine and impeller operating efficiency. Although flows are potentially very fast, shells from dead mussels could collect in low areas of diffuser pools. These accumulations and any extra debris trapped due to the mussels' presence could impede flow into diffuser pools. Restrictions in flow may slow or impede fish passage and increase the number of times the fish ladder is out of criteria.

Response: The fish turbines can be dewatered and potentially isolated by closing the penstock intake located in the forebay. This procedure allows access to the fish turbine intake area and would allow cleaning of turbine blades and other exposed surfaces. There is no available access for manual cleaning into the pipe between the penstock and the turbines so a method of removing any mussel accumulations would have to be developed. Water is not available for the south fish ladder diffuser pools or SMF when the penstock is closed, so any dewaterings usually occur during the winter maintenance period or for emergency repairs.

5. Fish Ladder Weirs - Submerged Orifices, Overflow Weirs, and Serpentine Weirs: Several types of weirs are utilized in CRB fish ladders. Submerged orifices are rectangular openings in the weir walls that allow fish to pass into the next weir while staying submerged. Overflow weirs allow fish an alternate route over the top of the weir wall. The water depth at the overflow weir can vary throughout the season and is periodically adjusted depending on desired fish passage criteria. During the peak of the American shad migration, overflow weir depth is kept at approximately 1 foot to facilitate shad passage and help prevent delay of salmonids. The serpentine weirs, located at the upstream end of the ladders, move water through a tall slot in the weir wall which is not directly downstream of other slots. The resulting side to side motion of the water between weirs helps reduce velocities and dissipate energy before water moves into the overflow weir section of the ladder. Some serpentine weirs are fitted with short hydraulic adjustment weirs along the floor to help regulate flow.

Potential Impacts: Although the risk level to this area is probably low**,** the large amount of cement surface area on most weir types make them potentially susceptible to mussel fouling. Many lower flow areas in corners and on the upstream and downstream side of weir walls would create suitable areas for mussel attachment. Physical injury to fish could occur when they jump between weirs or if they contact walls or edges. Dead mussel shells or associated debris accumulation in the serpentine section of the ladder could change the flow dynamics between weirs and may cause upstream migrants to delay or fall back through the ladder.

Response: Depending on mussel accumulations, it may be necessary to inspect all weir surfaces during dewaterings and remove mussel accumulations as needed. Most vertical and horizontal surfaces inside the weirs are easily accessible during winter dewaterings although it would be difficult to provide electricity and water needed for cleaning equipment to most of these outside areas. Removal of mussel remains would also be challenging due to the elevated location of many of the fish ladder areas. Manual removal would be labor intensive, increase maintenance costs, and increase the number of days fish ladders are out of service.

6. Diffuser Pools: Diffusers pools provide access for the auxiliary water system (AWS) which supplements flow volumes in the fishways. These pools are covered by diffuser gratings and are located in the adult collection channel, at fish ladder entrances, and at several locations in the adult fish ladders. The AWS is approximately 36-inches in diameter and originates from the penstock in the forebay.

Potential Impacts: The gratings over the diffuser pools are one of the most susceptible components of the adult fishways to a dreissenid infestation. Even a small amount of fouling could restrict flow through the 1-inch grating gaps and cause them to dislodge. Even if mussel densities are low, their shells may increase the amount of debris that collects under the grating and amplify the restriction of flow. When gratings are out of position, adult migrants can be attracted to the inflow of auxiliary water and gain access to the diffuser chambers where they can become injured, trapped, or killed. Fish ladders are taken out of service until diffuser gratings can be repaired and, depending on the time of year, could disrupt adult fish passage.

Response: It will be necessary to inspect all diffuser grating surfaces during dewaterings and remove mussel accumulations as needed. Severe debris accumulations (mussel shells, rocks, woody debris, etc.) under intact gratings may have to be periodically removed to inhibit blow out potential while operating during fish passage season.

[Note: numbers 7 – 17 below are incomplete and will be finalized in the future]

7. Transition Pool, Counting Station Window, and Picketed Leads: The transition pool is located directly downstream of the adult fish counting window. This pool provides a resting and staging opportunity for fish before they move upstream through a constriction in the channel positioned in front of the counting station window. The picketed leads funnel flow and fish into the counting window area. They consist of a series of vertical metal bars spaced at about 1 inch and are designed to allow much of the flow to pass through. These components are very susceptible to debris accumulation and are usually cleaned once a day or as needed during daily inspections.

Potential Impacts:

Response:

8. Fish Ladder Exit, Trashrack, and Debris Boom: The fish ladder exit is a short area of transition from the serpentine weirs to the forebay. A trashrack with 1-foot gaps at the exit prevents most large woody debris from entering the adult fish ladder but still allows fish to exit. A floating log boom is installed upstream of the fish ladder exits to help prevent floating debris

from reaching the trashrack.

Potential Impacts:

Response:

9. Upstream Migrant Channel (UMT) - Bonneville Dam:

10. Adult Fish Facility (AFF) - Bonneville Dam:

11. Sea Lion Exclusion Device (SLED):

12. Removable Spillway Weirs (RSW):

13 Temporary Spillway Weirs (TSW):

14. Juvenile Transportation Program (barges, holding raceways, loading and unloading facilities):

15. Behavioral Guidance Screens:

16. Ice and Trash Sluiceway - The Dalles Dam:

17. Spillway Guide Wall - The Dalles Dam:

Table 1. Juvenile Fish Facility Components, Potential Risk Due to a Dreissenid Infestation, Reason for Risk Level, and Response and Preventative Actions at John Day and Bonneville Dams *[Note: Information on Adult "Reason for Risk Level" and "Response and Preventative Actions" is incomplete and will be finalized in the future].*

Juvenile Fish Facility Component	Potential Risk	Reason for Risk Level	Response and Preventative Actions
Powerhouse and Auxiliary Water Supply Trashracks	High	Submerged all year, difficult to access and clean, excess debris accumulation can cause fish injury	More frequent maintenance and cleaning, design trashrack brush or backup equipment
Bypass Screens: -STS -ESBS -VBS	 High High High	Submerged during veliger season or all year (VBS), difficult access, mesh and wedge wire screens are susceptible to fouling, units must be shut down for cleaning/maintenance , storage slots in water	Increased camera or manual inspections, periodic removal of VBSs for cleaning, establish on-site cleaning station for screens
Gatewells, Orifices, and Juvenile Collection Channel	Moderate	Submerged almost all year, generally high flows, but slow flow areas may produce druses, difficult to access and clean	Increased orifice cycling, inspect and clean orifice light recesses, remove druse accumulation during annual dewatering
Tainter Gate, Elevated Chute, and Crest gate	Low	Generally high flows, dewatered after fish passage season, easy access, crest gate seal may experience excess wear, sensor fouling potential	Check and clean expansion joints and crest gate seal, remove water accumulation in winter if needed
Ogee Ramp and Tailrace Outfall Flume	Low to Moderate	Leakage from crest gate during fish passage season may promote mussel growth in ogee and flume	Inspect and maintain effective seal on crest gate, re-route leakage
Primary Dewatering Structure, Modulating Weirs, and Adult Drain	Low to Moderate	Submerged during fish passage season, slight risk of mussel growth on dewatering screens, adult drain leakage may promote mussel growth	Remove mussels during winter maintenance, inspect and clean adult drain, design plug for this area
Corrugated Transport Flume and Conveyance Pipe	Low to Moderate	Submerged during fish passage season, normal high flows, very difficult to access conveyance pipe	Seasonal inspection and cleaning after dewatering
	Low	Normal high flows, leakage may allow mussel growth in	Inspect and clean in winter, purge flushing water in-

Juvenile Fish Facility Component	Potential Risk	Reason for Risk Level	Response and Preventative Actions
Switch Gates and Flushing Valves		bypass flumes, flushing water blockage	season, increase drain diameter, inspect seal for wear
Fish and Debris Separator – Secondary Dewatering System, Porosity Unit, Wetted Separator Bars, Juvenile Collection Hopper, and Distribution Flumes	Moderate	Submerged during fish passage season, normal high flows, dewatering screen, perf plate, and separator bar fouling, difficult access to parts of distribution flumes	Frequent inspection and cleaning, periodically purge supply valves and separator bars, provide improved access to flumes
Tertiary Dewatering Units, PIT Tag Detectors and Rotating Sample Gates	Low to Moderate	Submerged during fish passage season, smooth surfaces, high flow areas, access possible but limited, flushing water supply valves vulnerable to fouling,	Clean units as needed, purge flushing water supply lines and valves, provide improved access to flumes, devise scouring method for cleaning inaccessible areas
SMF Laboratory: Holding Tank, Butterfly Valves, and Crowder Panels	Low	Submerged during fish passage season with periodic cleaning, discharge water perf plate fouling, inflow valve clogging potential	Increased cleaning, periodic purging of butterfly valves, inspect and replace crowder seal as needed
Pre-anesthetizing Chambers, Fish Lifts, Drainage Lines, and Flushing Water	Low to Moderate	Submerged during fish passage season, difficult to access, even small accumulations can cause problems for fish and smolt monitoring personnel	Increase cleaning, improve water supply line isolation capabilities, install access portals to drain lines, devise scouring method for cleaning inaccessible areas
Sorting Trough, Return Pipe, and Recovery Tanks	Low	Daily dewatering and cleaning, mostly easy access, water supply and valve clogging potential	Provide backup return pipe or devise scouring method for cleaning inaccessible areas
Release Pipes and Exit to River Flume	Moderate	Submerged during fish passage season, difficult to access, problems would be difficult to detect	Improve access for inspections, implement cleaning as needed
Recirculation Pump, Water Chiller, and MS-222 Filters	Low	Submerged during fish passage season, difficult to access, many small diameter supply lines, increased pump wear and charcoal filter replacement	Remove seasonal accumulation of debris from storage tank, purge or clean lines to filters, maintain pump
Research Activities - Temporary Holding Tanks, Degassing Columns, and	Low to Moderate	Submerged during fish passage season, inflow supply lines, valves, and degassing column clogging potential	Maintain tank cleaning protocols, purge supply valves daily, inspect and clean degassing columns as needed

Juvenile Fish Facility Component	Potential Risk	Reason for Risk Level	Response and Preventative Actions
Transportation Tanks			
Avian Hydro-cannons	Low	Uses raw water, supply line mostly buried and susceptible to clogging and wear, no backup	Purge water supply line after use, inspect nozzles for wear
Adult Fishway Components	**Potential Risk**		
Adult Collection Channel	Low to Moderate		
South Fishway Entrance	Low		
Fish Pump Intake Basin	Low		
Francis Wheel Fish Turbines	Low		
Fish Ladder Weirs, Submerged Orifices, Overflow Weirs, and Serpentine Weirs	Low		

Table 2. Fish Management Details for Some Hydro-electric Dams in the Columbia and Snake River Basins.

Mainstem Hydro-electric Project	Project Managed by	Juvenile Fish Passage Season	Bypass Screen Type and Material	Juvenile Bypass Facility	Juvenile Fish Transportation	Operate for Adult Passage	Adult Fishway
Bonneville Dam- PH1	USACE - Portland District	3/1- 10/31	No screens	Out of service	No	3/1 – 11/30	1, Bradford Island
Bonneville Dam- PH2	USACE - Portland District	3/1- 10/31	STS/VBS	Yes	No	3/1 – 11/3	2, Cascades Is. , WA shore

The Dalles Dam,	USACE - Portland District	4/1 – 11/30	VBS	No	No	3/1 – 11/3	2, North and East
Public Utility District	Northern Wasco County Public Utility District	April - July	Dewatering screens only	Yes	No	NA	NA
John Day Dam	USACE - Portland District	4/1 – 9/15	STS/VBS/ESBS	Yes	No	3/1 – 11/3	2, North and South
McNary Dam	USACE - Walla Walla District	4/1 – 9/20	ESBS/VBS	Yes	Yes	3/1 – 12/31	2, North and South
Public Utility District	Northern Wasco and Klickitat Co.	No sampling	Dewatering Screens only	No	No	NA	NA
Ice Harbor Dam	USACE - Walla Walla District	4/1 – 12/15	STS/VBS	Yes	No	3/1 – 12/31	2, North and South
Lower Monumental Dam	USACE - Walla Walla District	4/1 – 9/30	STS/VBS	Yes	Yes	10/1 – 12/15	2, North and South
Little Goose Dam	USACE - Walla Walla District	4/1 – 10/31	ESBS/VBS	Yes	Yes	11/1 – 12/15	1, South
Lower Granite Dam	USACE - Walla Walla District	3/26 – 10/31	ESBS/VBS	Yes	Yes	11/1 – 12/15	1, South
Rock Island Dam	Chelan County - Public Utility District No. 1	4/1 – 8/31	VBSs, but no bypass screens	Yes	No	?	3 total

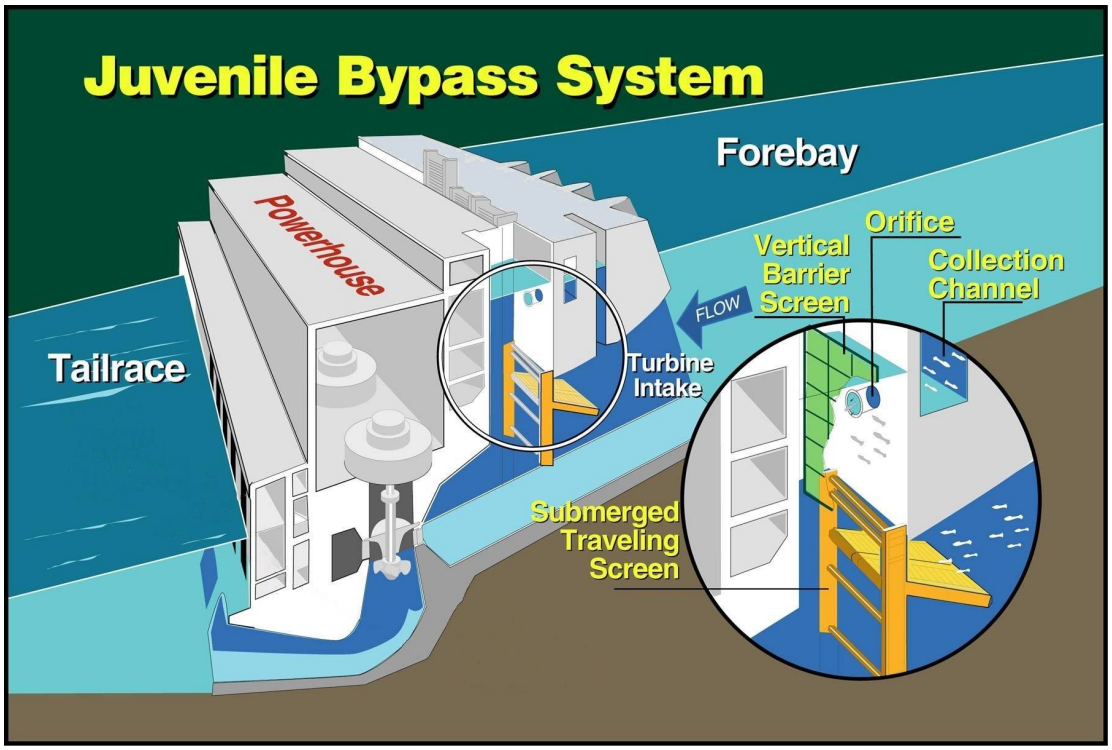


Figure 1. Generalized Juvenile Bypass System (Picture compliments USACE).

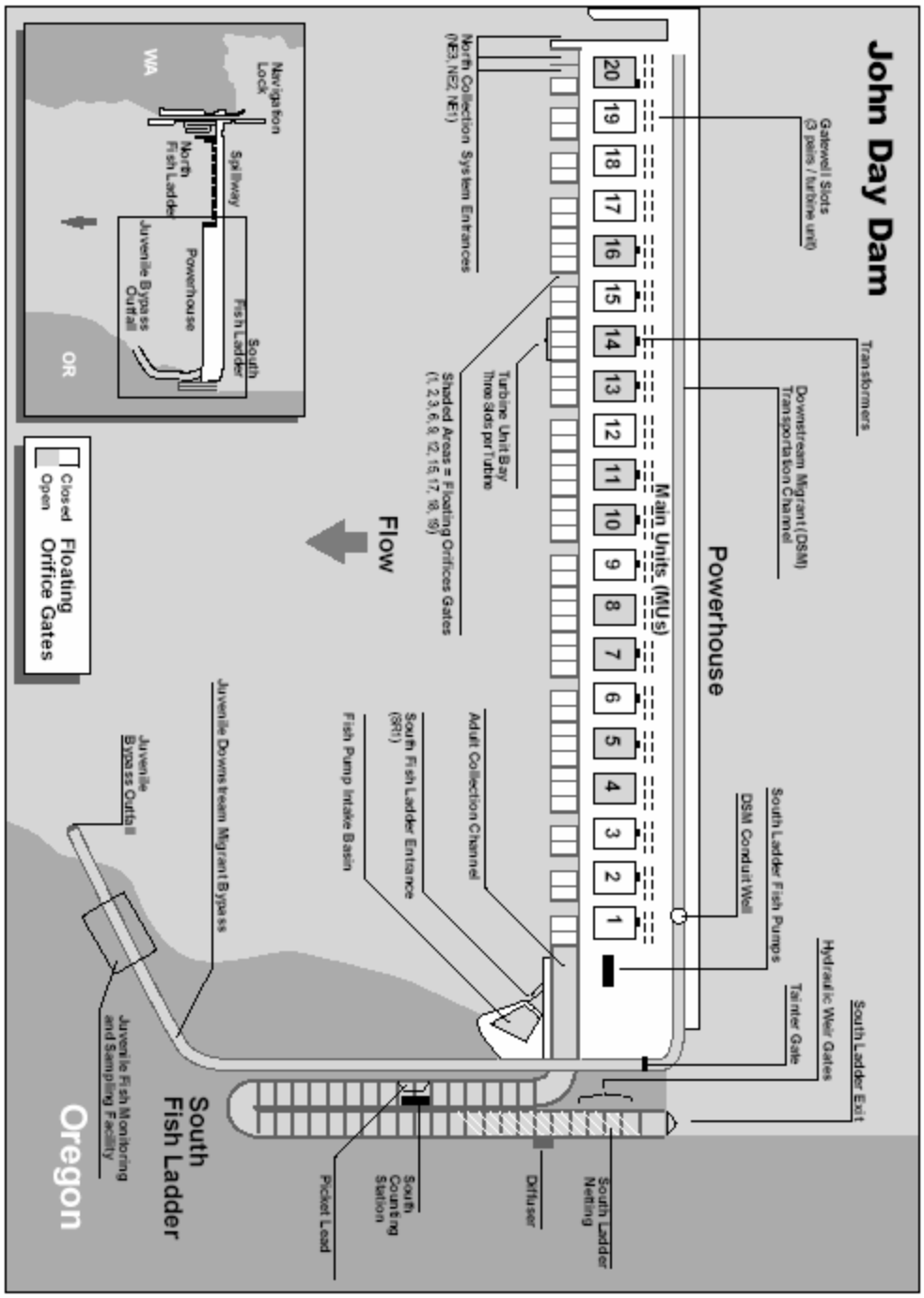


Figure JDA-1 John Day South Fish Ladder and Powerhouse Collection System.

JDA–2

Figure 2. Project Plan of John Day Dam- South Fish Ladder and Powerhouse (Diagram compliments of the U. S. Army Corps of Engineer, Fish Passage Plan, 2006).

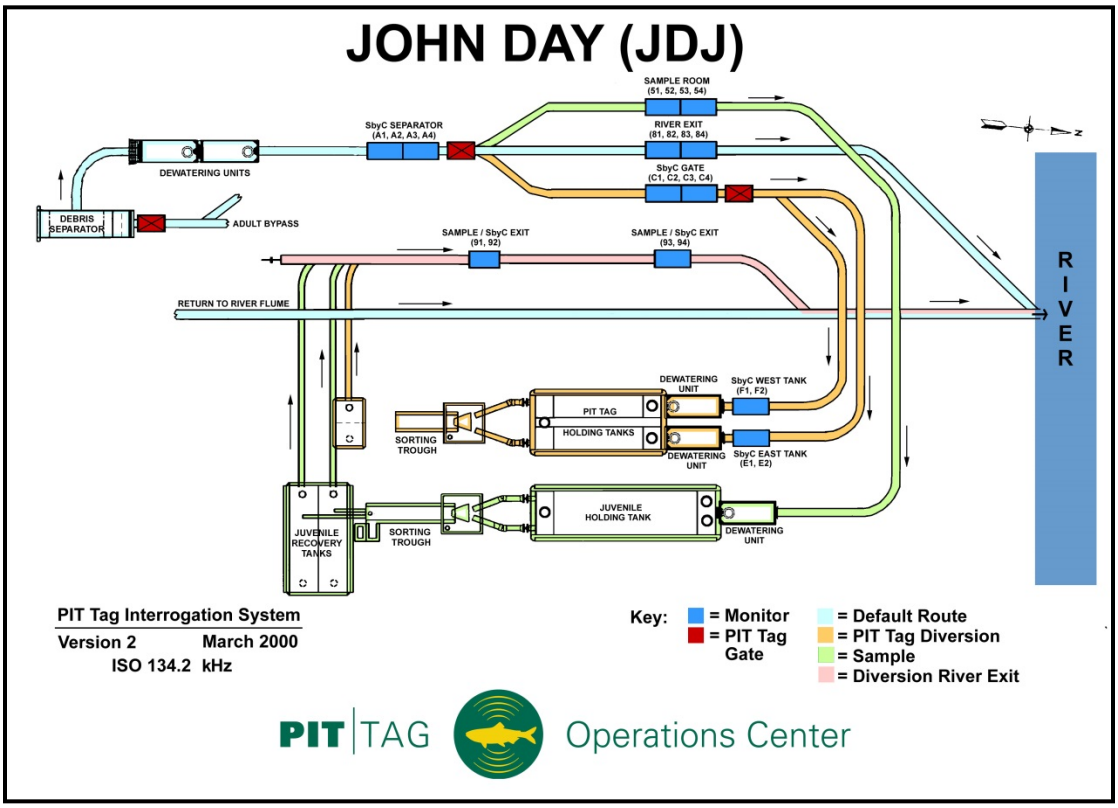


Figure 3. Passive Integrated Transponder (PIT) Tag Detection Schematic, John Day Dam Smolt Monitoring Facility (Diagram by PITAGIS, 2000).

Appendix G. Sample Documents

G-1. Model Letter of Agreement

Date

Agency

This letter affirms that [insert agency/entity] adopts the *Columbia River Basin Interagency Response Plan for Zebra Mussels and Other Dreissena Species* (Plan) as its guiding document if zebra mussels or other *Dreissena* species are introduced into Columbia River Basin waters. As such, [insert agency/entity] agrees to:

- Treat the introduction of zebra mussels or other *Dreissena* species in the Columbia River Basin as a natural resources emergency that merits immediate and significant response if opportunities exist to contain or eliminate the invasion.
- Appoint staff to serve on the organizational elements described in the Plan.
- Coordinate our organization's monitoring, public information, and other rapid response activities through the organizational elements described in the Plan.
- Evaluate our preparedness to respond to an invasive mussel introduction into the Columbia River Basin and take steps to enhance our capabilities as outlined in the Plan and as resources allow.

Signed this _____ day of _____

[signature block]

G-2. Sample Press Release in the Event of Discovery of Dreissenid Mussels in the Columbia River Basin

100th Meridian Initiative logo

Date

Lead agency contact information:

On [date], [agency] received a report that live zebra [and/or/quagga] mussels were present in _____. This report has been initially verified by [agency/recognized expert], and efforts are underway to [describe what's next, if anything, to confirm i.d.].

This discovery is a serious environmental and economic concern for the Pacific Northwest. Zebra mussels are small nonnative freshwater mollusks that have caused major problems in the eastern United States after their introduction in the 1980s.

[Insert quote from a lead agency administrator]

Officials have not yet determined how these mussels arrived to the Pacific Northwest. Recreational boats are known to be a major source of zebra mussel spread in the United States, and there are numerous past incidents where boats fouled by live invasive mussels have been intercepted prior to launching in Northwest waters. [If quagga mussels are found/suspected, insert information on the Colorado River invasion].

Under the national 100th Meridian Initiative campaign, regional aquatic invasive species experts have been preparing for this unfortunate incident, and recently completed a rapid response plan for zebra and quagga mussels in the Columbia River Basin. As called for by this Plan, agencies are coordinating activities such as measuring the extent of invasion, evaluating control options, and initiating measures to prevent further spread.

[Insert more details on specific next steps for surveys, etc.]

<u>Background on Zebra and Quagga Mussels</u>:

Zebra mussels are native to Eastern Europe. They were introduced into the Great Lakes area in the late 1980s, likely via ballast water from commercial ships. They have since rapidly spread throughout the eastern United States and Canada.

Zebra mussels are freshwater bivalve mollusks that typically have a dark and white (zebra-like) pattern on their shells, but may be any combination of colors from off-white to dark brown. Zebra mussels are usually about an inch or less long, but may be larger. When healthy, they attach to hard substrates.

Until the mid-1980s there were no zebra mussels in North America. That changed when they were inadvertently introduced into waters near the Great Lakes region. It is suspected that zebra

mussels hitched a ride in ballast water tanks of commercial ships. Zebra Mussels were first discovered in the United States in Lake St. Clair near Detroit, Michigan in 1988. Since the 1980s, zebra mussels have spread, unchecked by natural predators, throughout much of the eastern United States. They currently infest much of the Great Lakes basin, the St. Lawrence Seaway, and much of the Mississippi River drainage system. The have begun to spread up the Missouri River and Arkansas River. In 2008 zebra mussels were confirmed in California and Colorado.

Zebra mussels negatively affect the environment by reproducing quickly and in large numbers. Zebra Mussel densities have been reported to be over 700,000 individuals per square meter in some facilities in the Great Lakes area. Zebra mussels are biofoulers that obstruct pipes in municipal and industrial raw-water systems, requiring millions of dollars annually to treat. They produce microscopic larvae that float freely in the water column, and thus can pass by screens installed to exclude them. Monitoring and control of zebra and quagga mussels cost millions of dollars annually. As filter feeders, zebra mussels remove suspended material from the habitat in which they live. This includes the planktonic algae that is the primary base of the food web. Thus, zebra mussels may completely alter the ecology of water bodies in which they invade.

Some estimates of the economic impact of these small mussels to water intake and conveyance facilities in the eastern U. S. are several billion dollars. Much of the existing infrastructure had to be modified or replaced to deal with the prolific mussels that can attach to about every hard surface in contact with raw water supplies. Possibly even more significant, are the monetary impacts they are expected to have on recreation and natural resource values.

It is not certain how great the impact will be in _____ (the Northwest) but an interagency coordinating group, led by _____, is extremely concerned. Once the zebra mussels become established, it is almost impossible to get rid of them. The best hope is to launch an early, coordinated program to contain the current infestation and hopefully determine a means of control.

The _____ (group) is fortunate to have a head start using a rapid response strategy that was developed earlier in anticipation of just this kind of problem. Other similar rapid response programs have been most successful when there was early detection of an invasive species and all of the agencies that had to be involved were able to quickly respond with a well-coordinated plan.

In the meantime, the _____ (agency) has _____ (restricted access) to _____ (infected location) to help prevent further dispersal of the zebra mussels. The public can help by avoiding the ____ (infected area) and following some good general guidelines. They should clean all boats, trailers, and other equipment after leaving a lake or stream and never release any live organisms into the wild.

Additional information could be added about other species already in the region and how they are being dealt with – Eurasian watermilfoil, New Zealand mudsnails, Asian clam, and kudzu (which showed up in Oregon and was successfully eradicated).

<u>How can boaters help prevent the spread of zebra mussels</u>:
These aquatic nuisance species can hitch a ride on our clothing, boats, and items used in the

water. When visitors go to another lake or stream, the nuisance species can be released. And, if the conditions are right, these introduced species can become established and create drastic results. By following a simple procedure each time boaters leave the water, they can help stop aquatic hitchhikers. Knowing which waters contain nuisance hitchhikers is not as important ---- as doing the procedure every time boaters leave any lake, stream or coastal area:

- Remove any visible mud, plants, fish or animals before transporting equipment
- Eliminate water from equipment before transporting
- Clean and dry anything that came in contact with water (Boats, trailers, equipment, clothing, dogs, etc.)
- Never release plants, fish or animals into a body of water unless they came out of that body of water.

Additional information can be found at www.westernais.org.

Possible Quotes:

- "We have been aware of problems zebra mussels have caused in the Great Lakes region and have been working with various agencies organizations since the early 1990s to prevent their introduction into the West."
- "Although eradication is extremely difficult, our first concern is to contain the zebra mussel infestation within _____ to avoid it being spread to other vulnerable areas."
- "Although the recent discovery of zebra mussels is alarming, we are fortunate to have a Rapid Response Plan available to facilitate a coordinated regional effort to deal with this new invader. "The successes we have seen in other areas were the result of the region's ability to rapidly respond with a coordinated intense effort."

G-3. Sample State Declaration of Emergency

Note: the below template is provided as a resource to governmental agencies that intend to issue an emergency proclamation/order in response to an introduction of invasive mussels in the Columbia River Basin. It is not intended to obligate any government to take such action.

DREISSENID MUSSEL INVASIVE SPECIES PROCLAMATION OF EMERGENCY AND EXECUTIVE ORDER

[DATE]

WHEREAS, Dreissenid mussels are harmful, highly invasive species, not native to the United States. Dreissenid mussels, more commonly known by the species names of zebra or quagga mussels, were discovered in the Great Lakes region in and around 1988. Since this time, dreissenid mussels have spread throughout much of the eastern United States, including infesting much of the Mississippi, Missouri, and Arkansas River drainages. This infestation has caused billions of dollars in economic costs to public agencies and private industry. The environmental costs have been significant, too.

WHEREAS, Live dreissenid mussels were discovered in [INSERT WATER BODIES] on [DATE], and additional surveys may reveal the presence of dreissenid mussels within other waterbodies within the State of _____.

WHEREAS, their presence in the [INSERT WATER BODIES] greatly advances the known range of dreissenid mussels, emphasizing the fact that that dreissenid mussels can readily move from place to place, either as free-swimming larvae contained in hydrologically connected or transported water, or as adults that are attached to boat hulls, makes their presence in or near [INSERT STATE] a threat to rivers, lakes and reservoirs throughout the state.

WHEREAS, Dreissenid mussels alter the natural food web of aquatic ecosystems. They filter nutrients like planktonic algae that are the primary base of the food chain, from the water making these nutrients unavailable for native species, resulting in decline or extirpation of native species and disruption to the ecological balance of the water body. If allowed to reach other Pacific Northwest waters, these mussels would further threaten sensitive fish species that are already in severe decline. Maintaining the ecological balance of [INSERT STATE]'s waterbodies is critical to the long-term sustainability of native species, and to [INSERT STATE} businesses, recreational sites and local communities.

WHEREAS, dreissenid mussels foul submerged pipes and other infrastructure including water diversion structures, piers and pilings, power plant intakes and cooling systems, fish screens, and boat hulls. These mussels reproduce quickly and in large numbers. They have been reported in densities of over 700,000 per square meter in some facilities in the Great Lakes.

WHEREAS, should they become established in the Pacific Northwest, the impact of dreissenid mussels on region's extensive hydropower system and irrigated agriculture is difficult to

estimate but would significantly increase costs due to the mussel's capacity to clog pipes, pumps and delivery systems, and potentially cause major service disruptions.

WHEREAS, dreissenid mussels damage the hulls, props, and motors of boats and other watercraft, imposing additional costs and burdens on recreational boaters and diminishing the attraction of water-based recreation in [INSERT STATE].

WHEREAS, the [INSERT APPROPRIATE STATE AGENCY] has extensive authority over non-native species. For example, [CITE RELEVANT LAWS/REGS REGARDING POSSESSION, ETC.] However, these authorities do not provide [INSERT APPROPRIATE STATE AGENCY] with all of the tools it needs to deal with this crisis.

[REPEAT ABOVE FOR OTHER RELEVANT AGENCIES]

NOW, THEREFORE, I, [INSERT GOVERNOR NAME**],** Governor of the State of [INSERT STATE], in light of the aforementioned, find that a condition of extreme peril to the safety of persons and property exists in and around the various waterbodies of the State of [INSERT STATE] due to the infestation of dreissenid mussels. I further find that the ability of the agencies and departments of the State of [INSERT STATE] to effectively control the spread of these mussels in the State is limited. Accordingly, under the authority of the [CITE APPROPRIATE STATE EMERGENCY LAW/CODE], I hereby proclaim that a State of Emergency exists within the State of [INSERT STATE].

IT IS HEREBY ORDERED that all departments and agencies of state government utilize and employ state personnel, equipment and facilities for the performance of any and all activities consistent with the *Columbia River Basin Interagency Response Plan for Zebra Mussels and other Dreissena species* and associated incident response plans and interagency agreements. This includes assisting with the education of the public on the risks posed by the presence and spread of Dreissenid mussels within the state.

FURTHER, employees of the [INSERT APPROPRIATE AGENCIES], and their designees (hereinafter referred to as "inspectors") may stop and conduct inspections of boats and other watercraft entering into or present within [INSERT STATE] to determine if dreissenid mussels could be present. If the inspectors make this determination, the inspectors can take such actions they determine are reasonably necessary to kill the dreissenid mussels and thereby reduce the possible spread of this damaging species within the state. These actions may include, but are not limited to, temporarily stopping vehicles with boats or other watercraft, ordering that areas in the boat or other watercraft that contain water be drained and/or dried, that areas that cannot be completely drained or from which water cannot be eliminated be decontaminated, that boats or other watercraft may be impounded or quarantined for such time as is necessary to ensure that dreissenid mussels can no longer live on or within that boat or watercraft.

FURTHER, the inspectors may order that waterbodies where dreissenid mussels are found to be present on marinas, boat launch facilities, or other property be closed, quarantined, or access otherwise limited in such a manner as will not permit the spread of dreissenid mussels within the state. Any such property may be decontaminated, impounded or quarantined for such time as is necessary to ensure that dreissenid mussels can no longer live on or within that property.

I FURTHER DIRECT that as soon as hereafter possible, this proclamation be filed in the Office of the Secretary of State and that widespread publicity and notice be given of this proclamation.

IN WITNESS WHEREOF I have hereunto set my hand and caused the Great Seal of the State of [INSERT STATE] to be affixed on this [INSERT DATE].

G-4. Sample Delegation of Authority

Everglades and Dry Tortugas National Parks

Homestead, Florida

As of 1800, May 20, 20XX, I have delegated authority to manage the Ingraham Fire number 8930 to Incident Commander XXXXXXXXX and her Incident Management Team.

The fire is burning in legislated wilderness. My considerations for management of this fire are:

Provide for firefighter safety.

I would like the fire managed under a containment strategy with suppression actions done with as little environmental damage as possible. The NPS definition of containment is attached.

Key cultural features requiring priority protection are: Mahogany Hammock, overlook boardwalks, park headquarters, the Pinelands campground and residential area, Royal Palm Visitor Center, hydrostations with recording equipment.

Key resource considerations are: protecting endangered species by providing aircraft telemetry monitoring of Florida panther, preserving as much Cape Sable Sparrow habitat as possible, and avoiding wildlife entrapment situations.

Restrictions for suppression actions are no tracked or wheeled vehicles in the wilderness except where roads exist and are identified for use, and no retardant will be utilized.

Tools approved for use are Type II/III helicopters, chainsaws, and weed whips.

My Agency Advisor will be the park Fire Management Officer.

The NE flank of the fire borders Florida Department of Forestry (DOF) protection. Chekika State Park must be protected if threatened. The District Forester will be the DOF representative.

Managing the fire cost-effectively for the values at risk is a significant concern.

Providing training opportunities for the South Florida parks personnel is requested to strengthen our organizational capabilities.

Minimum disruption of visitor access of the main park road consistent with public safety.

_____

Superintendent, Everglades and Dry Tortugas National Parks

Amendment to Delegation of Authority

The Delegation of Authority dated May 20, 20XX, issued to Incident Commander XXXXXXXXX for the management of the Ingraham Fire number 8930 is hereby amended as follows. This will be effective 1800 May 22, 20XX.

Key cultural features requiring priority protection are: Mahogany Hammock, overlook boardwalks, park headquarters, the Pinelands campground and residential area, Royal Palm Visitor Center, hydrostations with recording equipment, Shark Valley, Hammock 55, Binky Hammock Chain.

Use of tracked vehicles authorized to protect the Miccosukee Strip.

_____

Superintendent, Everglades and Dry Tortugas National Park

Appendix H. Forms

The attached list of forms is commonly used during a PSMFC response with the deployment of the Rapid Response Team and Technical Specialists.

Form:	**Form Number**
ANS Initial Report Form	PSMFC 1
Incident Action Plan Cover Sheet	PSMFC 2
Incident Briefing	ICS-201
Incident Objectives	ICS-202
Organization Assignment List	ICS-203
Division Assignment List	ICS-204
Radio Communications Plan	ICS-205
Phone Communication Plan	ICS-205a
Medical Plan	ICS-206
ICS Organization Chart	ICS-207
Incident Status Summary	ICS-209
Check In List	ICS-211
General Message	ICS-213
Resource Request Message	ICS-213RR
Unit Log	ICS-214
Operational Planning Worksheet	ICS-215
Incident Meeting Schedule	ICS-230
Resources At Risk	ICS-232
Open Action Tracker	ICS-233
Work Analysis	ICS-234
Technical Specialist Report	ICS-234a
Technical Specialist Analysis	ICS-234b

1. Incident Name	2. Prepared by: (name) Date: Time:	INCIDENT BRIEFING ICS 201 PSMFC RRT

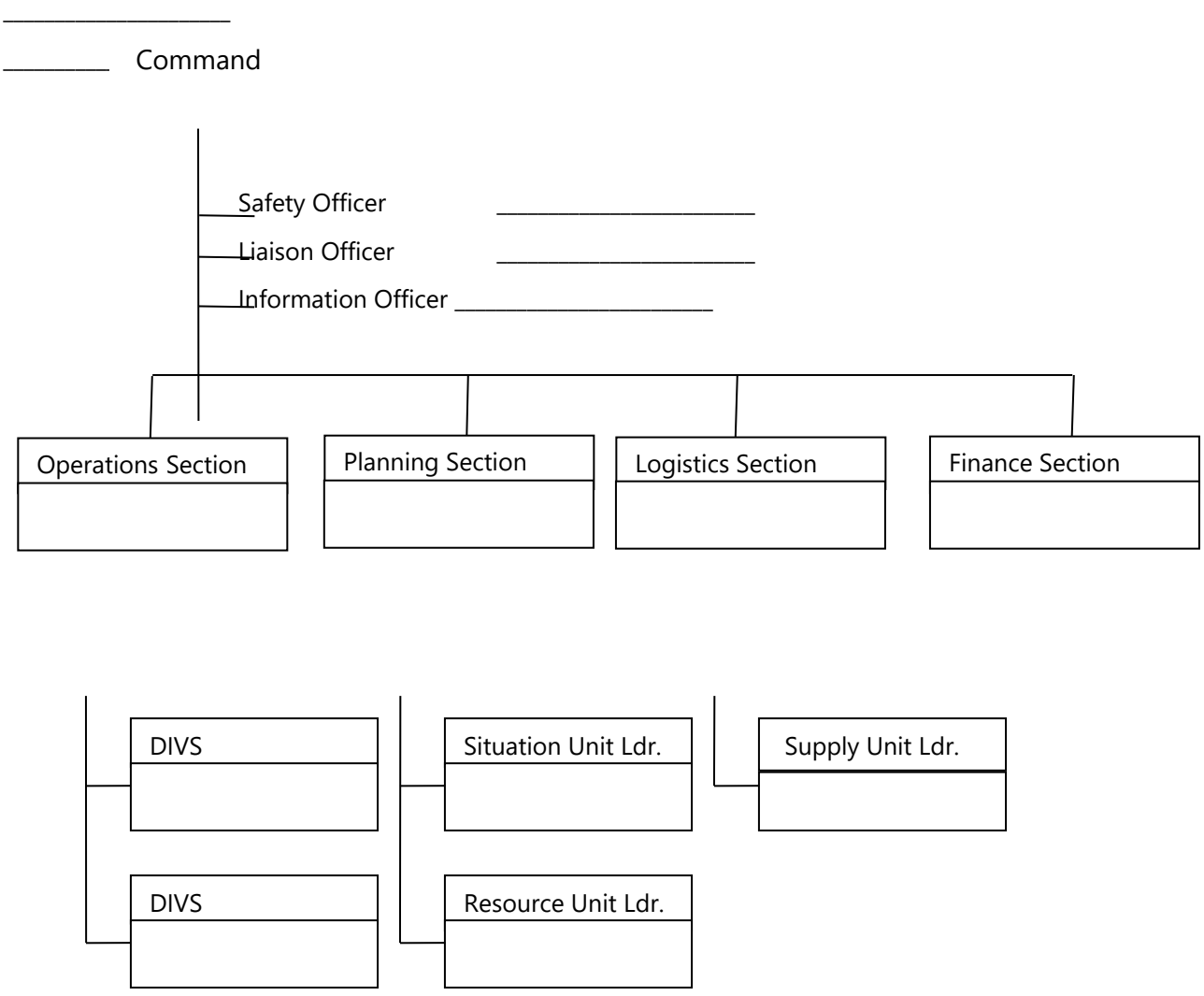
3. Map/Sketch (include sketch, showing the total area of operations, the incident site/area, overflight results, trajectories, impacted shorelines, or other graphics depicting situational and response status)

4. Current Situation

1. Incident Name	2. Prepared by: (name) Date: Time:	INCIDENT BRIEFING ICS 201 PSMFC RRT

5. Initial Response Objectives, Current Actions, Planned Actions, Potential	
	Objectives:
	Priorities:
	Current Actions:
	Planned Actions:
	Potential:
	Key Decisions:

6. Current Organization (fill in additional appropriate organization)



7. Resources Summary

1. Incident Name	**2. Prepared by:** (name) Date: Time:	INCIDENT BRIEFING ICS 201 PSMFC RRT

Resource	Resource Identifier	Date Time Ordered	ETA (X)	On-Scene	NOTES: (Location/Assignment/Status)

1. Incident Name	2. Operational Period to be covered by IAP (Date/Time) From: To:	IAP COVER SHEET PSMFC RRT

3. Approved by Incident Commander(s):

ORG NAME

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

INCIDENT ACTION PLAN

The items checked below are included in this Incident Action Plan:

☐ ICS 202 (Response Objectives)

_____

☐ ICS 203 (Organization List)

_____

☐ ICS 204's (Assignment Lists)

One Copy each of any ICS 204 attachments:

_____

☐ ICS 205 (Communications Plan)

_____

☐ ICS 206 (Medical Plan)

☐ ICS 208 (Site Safety Plan) or Note SSP Location _____

☐ Map/Chart

☐ Weather forecast / Tides/Currents

Other Attachments

☐ _____

☐ _____

☐ _____

☐ _____

4. Prepared by: **Date/Time**

1. Incident Name	2. Operational Period (Date/Time) From: To:	**INCIDENT OBJECTIVES** **ICS 202 PSMFC RRT**
3. Objective(s)		
4. Operational Period Command Emphasis (Safety Message, Priorities, Key Decisions/Directions) **Approved Site Safety Plan Located at:**		
5. Prepared by: (Planning Section Chief)	**Date/Time**	

1. Incident Name	2. Operational Period (Date/Time) From: To:	**ORGANIZATION ASSIGNMENT LIST** **ICS 203 PSMFC RRT**

3. Incident Commander(s) and Staff

Agency	IC	Deputy

Safety Officer:	
Information Officer:	
Liaison Officer:	

4. Agency Representatives

Agency	Name

5. PLANNING/INTEL SECTION

Chief	
Deputy	
Resources Unit	
Situation Unit	
Documentation Unit	
Demobilization Unit	
Technical Specialists	

6. LOGISTICS SECTION

Chief	
Deputy	

a. Support Branch

Director	
Supply Unit	
Facilities Unit	
Ground Support Unit	

b. Service Branch

Director	
Communications Unit	
Medical Unit	
Food Unit	

7. OPERATION SECTION

Chief	
Deputy	
Deputy	
Staging Area Manager	

a. Branch – Division Groups

Branch Director		
Deputy		
Division Group		
Division Group		

b. Branch – Division/Groups

Branch Director		
Deputy		
Division/Group		
Division/Group		
Division/Group		
Division/Group		
Division/Group		

c. Branch – Division/Groups

Branch Director		
Deputy		
Division/Group		
Division/Group		
Division/Group		
Division/Group		

d. Air Operations Branch

Air Operations Br. Dir	
Helicopter Coordinator	

8. FINANCE/ADMINISTRATION SECTION

Chief	
Deputy	
Time Unit	
Procurement Unit	
Compensation/Claims Unit	
Cost Unit	

9. Prepared By: (Resources Unit) **Date/Time**

1. Incident Name	2. Operational Period (Date/Time) From: To:	**Assignment List** **ICS 204 PSMFC RRT**
3. Branch	**4. Division/Group/Staging**	

5. Operations Personnel Name Affiliation Contact # (s)

Operations Section Chief: _____

Branch Director: _____

Division/Group Supervisor/STAM: _____

6. Resources Assigned "X" indicates 204a attachment with additional instructions

Strike Team/Task Force/Resource Identifier	Leader	Contact Info. #	# of Persons	Reporting Info/Notes/Remarks	
					☐
					☐
					☐
					☐
					☐
					☐

7. Work Assignments

8. Special Instructions

9. Communications (radio and/or phone contact numbers needed for this assignment)

Name/Function Radio: Freq. /System/Channel Phone Cell/Pager _____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

Emergency Communications

Medical _____ Evacuation _____ Other _____

10. Prepared by Date/Time	11. Reviewed by (PSC) Date/Time	12. Reviewed by (OSC) Date/Time

1. Incident Name	2. Operational Period (Date / Time) From: To:	INCIDENT RADIO COMMUNICATIONS PLAN ICS 205 PSMFC RRT

3. BASIC RADIO CHANNEL USE

SYSTEM / CACHE	CHANNEL	FUNCTION	FREQUENCY	ASSIGNMENT	REMARKS

4. Prepared by: (Communications Unit) **Date / Time**

INCIDENT RADIO COMMUNICATIONS PLAN ICS 205 PSMFC RRT

1. Incident Name	2. Operational Period (Date / Time) From: To:	**COMMUNICATIONS PHONE LIST** **ICS 205a** **PSMFC RRT**

3. Basic Local Communications Information

Assignment	Name	Method(s) of contact (radio frequency, phone, pager, cell #(s), etc.)

4. Prepared by: (Communications Unit) **Date / Time**

COMMUNICATIONS LIST ICS 205a PSMFC RRT

1. Incident Name	2. Operational Period (Date / Time) From: To:	**MEDICAL PLAN** **ICS 206** **PSMFC RRT**

3. Medical Aid Stations

Name	Location	Contact #	Paramedics On site (Y/N)

4. Transportation

Ambulance Service	Address	Contact #	Paramedics On board (Y/N)

5. Hospitals

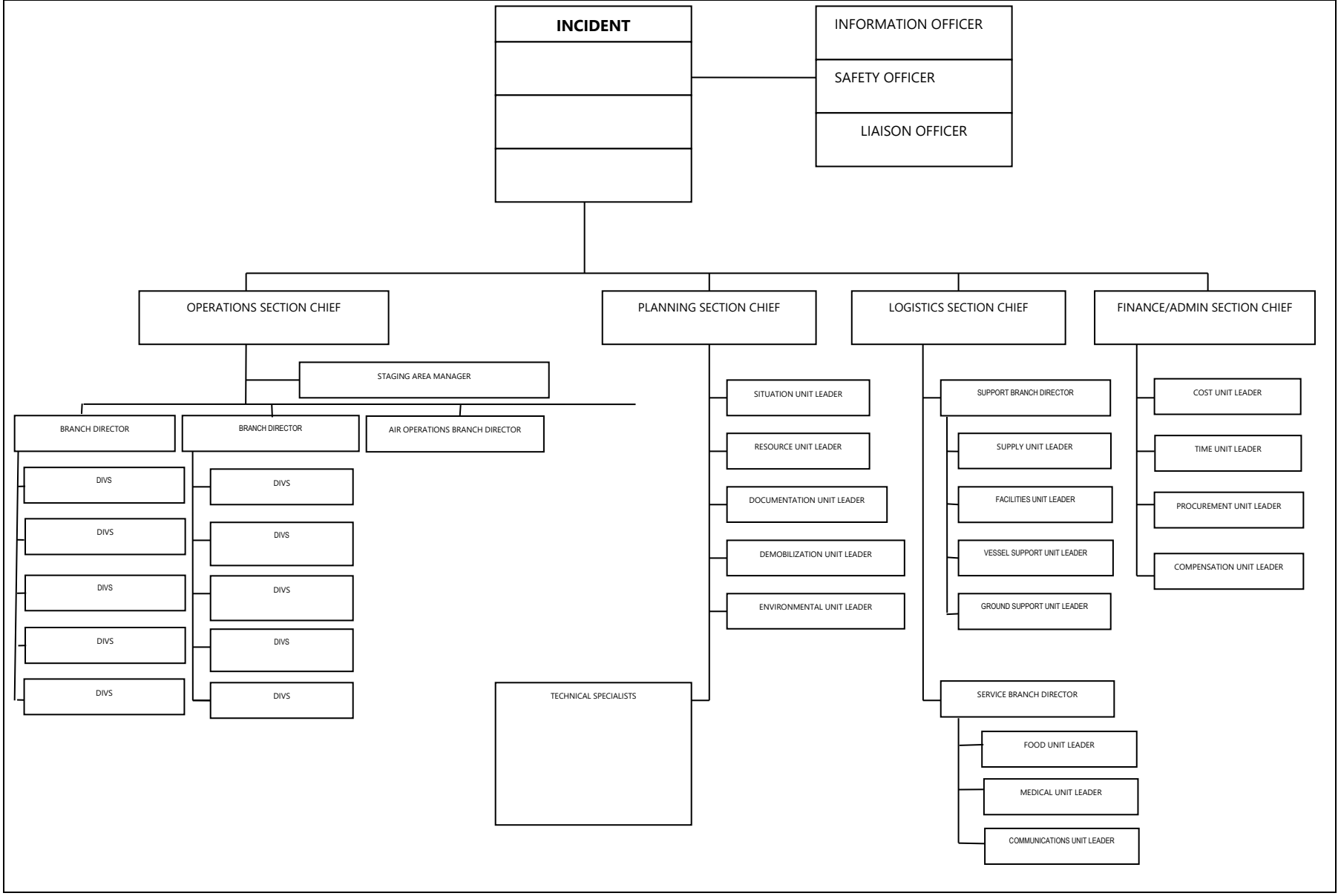
Hospital Name	Address	Contact #	Travel Time		Burn Ctr?	Heli-Pad?
			Air	Ground		

6. Special Medical Emergency Procedures

7. Prepared by: (Medical Unit Leader) **Date/Time**	**8. Reviewed by: (Safety Officer)** **Date/Time**

MEDICAL PLAN ICS 206 PSMFC RRT

1. Incident Name	2. Operational Period (Date/Time) From: To:	INCIDENT ORGANIZATION CHART ICS 207 PSMFC RRT



1. Incident Name	2. Operational Period (Date / Time) From: To: Time of Report	INCIDENT STATUS SUMMARY ICS 209 PSMFC RRT

3. Type of Incident

☐	Oil Spill	☐	HAZMAT	☐	
☐	Marine Disaster	☐	SI/Terrorism	☐	
☐	Civil Disturbance	☐	Natural Disaster	☐	
☐	Planned Event	X	ANS Discovery		

4. Situation Summary as of Time of Report:

5. Future Outlook/Goals/Needs/Issues:

6. Status Summary

	Since Last Report	Adjustments To Previous Op Period	Total
Mussel Finds			
Zebra Mussel Confirmation			
Vessels Involved			
Facilities Involved			
Responder Injuries			

Property Damage Summary

Vessel	$ Unknown
Cargo	$ Unknown
Facility	$ Unknown
Other	$ Unknown

8. Attachments with clarifying information

☐	Costs	☐		☐	
☐		☐		☐	
☐		☐		☐	

9. Equipment Resources

Kind	Notes	# Ordered	# Available	# Assigned	# Out of Service

10. Personnel Resources

Agency	**Total # of People**
WDFW	
WA-SCS	
USCG	
USFW	
PSMFC	
State	
Local	
Contractors	
Other	
Total Personnel Resources Used From all Organizations:	

11. Prepared by:	**Date/Time Prepared:**

CHECK-IN LIST	1. INCIDENT NAME	2. CHECK-IN LOCATION	3. DATE/TIME

CHECK-IN INFORMATION

4. LIST PERSONNEL (OVERHEAD) BY AGENCY NAME – OR LIST EQUIPEMENT BY THE FOLLOWING FORMAT: S=Supplies H=Helicopter O=Overhead VL=Vessels E=Equipment C=Crew A=Aircraft VH=Vehicle			5. ORDER/ NUMBER	6. DATE/TIME CHECK-IN	7. LEADER'S NAME	8. TOTAL NO. PERSONNEL	9. INCIDENT CONTACT INFORMATION	10. INCIDENT LODGING INFO/CONTACT INFO	11. HOME UNIT	12. METHOD OF TRAVEL	13. INCIDENT ASSIGNMENT	14. SENT TO RESTAT TIME/INT.
AGENCY	**RESOURCE IDENTIFIER**	KIND										

15. ICS 211-CG PAGE _____ of _____	16. PREPARED BY (Name and Position) USE BACK FOR REMARKS OR COMMENTS

1. Incident Name	2. Date and Time of Message	GENERAL MESSAGE ICS 213 PSMFC RRT
3. TO:	ICS Position	
4. FROM:	ICS Position	
5. Subject:		
6. Message		
7 Reply		
8. Signature/Position (person replying)	**Date/Time of reply**	
GENERAL MESSAGE		ICS 213 PSMFC RRT

1. Incident Name	2. Operational Period (Date/Time) From: To:	**UNIT LOG** **ICS 214** **PSMFC RRT**
3. Unit Name/Designators	**4. Unit Leader (Name and ICS Position)**	

5. Personnel Assigned

NAME	ICS POSITION	HOME BASE

6. Activity Log (Continue on Reverse)

TIME	MAJOR EVENTS

7. Prepared by: **Date/Time**

UNIT LOG ICS 214 PSMFC RRT

1. Incident Name	2. Operational Period (Date/Time) From: To:	UNIT LOG (CONT.) ICS 214 PSMFC RRT

6. Activity Log (Continue on Reverse)

TIME	MAJOR EVENTS

7. Prepared by: **Date/Time**

UNIT LOG ICS 214 PSMFC RRT

1. Incident Name	2. Operational Period (Date/Time) From: To:	DAILY MEETING SCHEDULE ICS 230 PSMFC RRT

3. Meeting Schedule (Commonly-held meetings are included)

Date/ Time	Meeting Name	Purpose	Attendees	Location
	Tactics Meeting	Develop primary and alternate Strategies to meet Incident Objectives for the next Operational Period.	PSC, OPS, LSC, EUL, RUL & SUL	
	Planning Meeting	Review status and finalize strategies and assignments to meet Incident Objectives for the next Operational Period.	Determined by the IC/UC	
	Operations Briefing	Present IAP and assignments to the Supervisors / Leaders for the next Operational Period.	IC/UC, Command Staff, General Staff, Branch Directors, Div. Sups. , Task Force/Strike Team Leaders and Unit Leaders	
	Unified Command Objectives Meeting	Review/ identify objectives for the next operational period.	Unified Command members	

4. Prepared by: (Situation Unit Leader) **Date/Time**

DAILY MEETING SCHEDULE ICS 230 PSMFC RRT

1. Incident Name	2. Operational Period (Date/Time) From: To:	**RESOURCES AT RISK SUMMARY** **ICS 232 PSMFC RRT**

3. Environmentally-Sensitive Areas and Wildlife Issues

Site #	Priority	Site Name and/or Physical Location	Site Issues

Narrative

4. Archaeo-cultural and Socio-economic Issues

Site #	Priority	Site Name and/or Physical Location	Site Issues

Narrative

5. Prepared by: (Environmental Unit Leader) **Date/Time**

RESOURCES AT RISK SUMMARY ICS 232 PSMFC RRT

1. Incident Name		**OPEN ACTION TRACKING**			ICS 233 PSMFC RRT		
2. No.	3. Item	4. For	5. Status	6. Start Date	7. Briefed	8. Target Date	9. Actual Date
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							

OPEN ACTION TRACKING Page 1 of 1 ICS 233 PSMFC RRT

	WORK ANALYSIS MATRIX ICS 234-PSMFC RRT

1. Operation's Objectives DESIRED OUTCOME	2. Optional Strategies HOW	3. Tactics/Work Assignments WHO, WHAT, WHERE, WHEN

TECHNICAL SPECIALIST REPORT **ICS-234a PSMFC RRT**	1. Incident	2. Date/Time
3. Situation Assessment		
4. Hazard Analysis		
5. Mitigation Strategies		
6. Weather		

Page 1 of _____	Technical Specialist (Signature)

Recommended		Strategic/Tactical Option	Analysis
Yes	No		

Page _____ of _____	Technical Specialist (Signature)

	Technical Specialist Analysis ICS-234b PSMFC RRT
Tactical Options (From ICS-234)	**Analysis**
1.	**Recommended/Not Recommended**. (Explain)
2.	**Recommended/Not Recommended**. (Explain)
3.	**Recommended/Not Recommended**. (Explain)
4.	**Recommended/Not Recommended.** (Explain)
5.	**Recommended/Not Recommended.** (Explain)
	ICS-234b PSMFC RRT

1. Sighting Report	2. Report Date / Time Date Time of Report	3. Reported by: (Name and Agency)

4. Type of Sighting

☐	Zebra Mussel	☐	Other		
☐	Quagga Mussel	☐	Other		
☐	Chinese Mussel	☐	Other		
☐	Unknown	☐	Other		

5. Site Description: (Affected water body, landmarks, mile marker, GPS)

6. Mussel Colony Description: (Number, density and extent)

7. Incident Summary

	Initial Report	Update Report	Total
Size of Find			

8. Facilities involved

Vessels	
Docks/Piers/Moorings	

Natural Barriers	
Other	

9. Attachments with clarifying information

☐	Photographs	☐	Lab Results		
☐	Maps/Charts	☐	Narrative		
☐	Sample	☐			

10.	**Narrative:**

11. Prepared by: Date/Time:

Appendix I. Glossary

Aquatic Nuisance Species (ANS): Also called "aquatic invasive species (AIS)" are aquatic organisms that have been introduced into new ecosystems and cause harmful impacts on the natural resources in these ecosystems and the human use of these resources.

Aquatic Nuisance Species Task Force: An intergovernmental organization dedicated to preventing and controlling aquatic nuisance species, and implementing the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990. http://www.anstaskforce.gov/

Bivalve: A type of mollusk with two hinged shells (e.g., clams and mussels).

Columbia River Basin: The entire region, including watersheds in Canada, which drains into the Columbia River.

Columbia River Basin (CRB) Team of the 100th Meridian Initiative: The Columbia River Basin Team has been established as part of the 100th Meridian Initiative to address the special needs of the Columbia River Basin. The CRB Team includes state, federal, Tribal, and university ANS managers and researchers. https://www.westernais.org/regional

Coordination and Support Staff: Provide technical, scientific, and logistical support to the MAC Group, the Interagency Rapid Response Team, and local affected agencies/entities, including positive confirmation of extent and scope of the zebra mussel infestation. The Coordination and Support Staff include subject matter experts activated in response to the needs of the reported infestation, and assist in identifying appropriate containment, control, and eradication efforts.

Multiagency Coordination (MAC) Group: A group of interagency representatives with decision making authority for their agencies that coordinates the overall management policy for a response, and may be convened at the national level, the geographic area level (e.g. Columbia River Basin), and/or at the local or zone level.

CRB Notification Coordinator: A designated staff member by the MAC that has the authority and responsibility to convene the rest of the CRB MAC Coordination and Support Staff and the standing members of the CRB MAC Group, and to ensure all organizations on the Priority One notification list (see Appendix C) have been notified of the infestation.

Joint Information Center (JIC): A centralized support system comprised of federal, state, and other external communications staff that coordinates development and dissemination of information to the media, public and other interest groups.

Interagency Rapid Response Team (IRRT): Interagency personnel that may be assigned to provide on-scene technical support to the Coordination and Support Staff, the MAC Group, or incident management support at the request of the impacted jurisdiction/entity and the approval of the MAC Group. Assist in confirming the presence and determining the scope of the infestation, as well

as identifying and implementing appropriate containment, control, and eradication efforts. Team members will be selected based on the technical and management needs of the specific infestation.

Druse: Large colonies of young mussels that settle on older, larger zebra mussels, forming a clump.

Dreissenid: Referring to freshwater mussels in the family Dreissenidae, which includes zebra (*Dreissena polymorpha*) and quagga mussels (*Dreissena rostriformis bugensis*).

Epilimnetic Zone: The surface water mass in a lake above the thermocline which is well mixed and therefore of uniform temperature; the surface mixed layer.

Eutrophic: High in nutrients. Water clarity is generally lower in eutrophic water bodies due to high amounts of plant growth, including phytoplankton.

Hazard Analysis and Critical Control Point (HACCP): An internationally recognized planning tool that identifies potential introduction pathways of unwanted hazards and facilitates development of associated preventative measures.

Hypolimnetic Zone: The deepwater layer below the thermocline in a stratified lake.

Incident Command System (ICS): A systematic tool used for the command, control, and coordination of emergency response. ICS allows agencies to work together using common terminology and operating procedures to control personnel, facilities, equipment, and communications at a single incident scene. It facilitates a consistent response to any incident by employing a common organizational structure that can be expanded and contracted in a logical manner based on the level of required response.

Larvae: Juvenile form of certain organisms. For dreissenids, also called "veligers."

Mitigation: Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards. Examples of zebra mussel mitigation measures for industrial systems include chlorination, mechanical cleaning, and dewatering.

National Incident Management System (NIMS)— A system mandated by Homeland Security Presidential Directive 5 that provides a consistent nationwide approach for governments, the private sector, and non-governmental organizations, to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents, regardless of cause, size, or complexity.

Oligotrophic: Low in nutrients. Oligotrophic water bodies have relatively few plants and algae, and tend to be very clear.

100th Meridian Initiative: A cooperative effort between state, provincial, and federal agencies and other partners to 1) prevent the spread of zebra mussels and other aquatic nuisance species (ANS)

into the western United States and 2) monitor and control zebra mussels and other ANS if detected in these areas. (https://www.westernais.org/regional).

Pathway: The means by which a species are transported into a geographical region or into an ecosystem. For example, recreational watercraft are one of the pathways by which zebra and quagga mussels have spread across the country.

Polymerase Chain Reaction (PCR): A method for creating millions of copies of a particular segment of DNA. If a scientist needs to detect the presence of a very small amount of a particular DNA sequence, PCR can be used to amplify the amount of that sequence until there are enough copies available to be detected. This technique has successfully been used in monitoring for zebra and quagga mussels.

Priority 1 Notifications: Agency staff identified in this Plan (see Appendix C: Notification Lists/Procedures) that are the first to be contacted by the CRB Notification Coordinator in the event of a reported zebra mussel infestation.

Quagga Mussel (*Dreissena rostriformis bugensis*): A small freshwater bivalve mollusk that resembles the zebra mussel, but is rounder, with shells that appear asymmetrical when viewed from the front or ventral side.

Rapid Response: Immediate actions taken to contain a recently discovered invasive species before a final determination has been made that further containment or eradication is no longer feasible or warranted.

Smolt: A juvenile salmon or steelhead that has completed rearing in freshwater and migrates into the marine environment. A smolt becomes physiologically capable of balancing salt and water in the estuary and ocean waters. Smolts vary in size and age depending on the species of salmon.

Thermocline: **layer within a water body (e.g., a lake)** where there is an abrupt change in temperature that separates the warmer surface water from the colder deep water.

Vector: See definition for Pathway.

Veliger: A larval stage of a mollusk (e.g., zebra mussel) characterized by the presence of a velum: the locomotory and feeding organ provided with cilia.

Western Regional Panel (WRP): A regional committee of the national ANS Task Force. Formed by a provision in the National Invasive Species Act of 1996, the WRP is comprised of western region representatives from Federal, State, and local agencies and from private environmental and commercial interests. The WRP seeks to protect limited western aquatic resources by preventing the introduction and spread of exotic nuisance species into western marine and freshwater systems though coordinated management and research activities. https://www.fws.gov/answest/

Zebra mussel (*Dreissena polymorpha*) -- The zebra mussel is a small freshwater bivalve mollusk with two matching half shells. Its name is derived from the striped pattern on its shell.

Appendix J. Dreissenid Mussel Laboratories and Sampling Methods

Link to information on laboratories in the United States and Canada that process dreissenid samples

A Comprehensive Report on the Workshops "Dreissena Early Detection Best Practices" and "Dreissena Early Detection Laboratory Standards"

Dreissenid mussels sampling and monitoring protocol (Western Regional Panel on Aquatic Nuisance Species, 2018)

Link to sampling methods

Procedures for conducting underwater searches for invasive mussels (Dreissena sp.) (US Dept Interior, US Geological Survey 2010)

Appendix K. Past Rapid Response Field Exercises

- Washington State Rapid Response Exercise After Action Report, Lincoln Rock State Park, Wenatchee, WA (October 2017)
- Jackson Lake Rapid Response Exercise After Action Report, Jackson Lake Wyoming (May 2016)
- 2013 Columbia River Basin Interagency Invasive Species Rapid Response Exercise, Prineville Reservoir, Oregon (April 2013)
- 2011 Columbia River Basin Interagency Invasive Species Rapid Response Exercise, Lake Koocanusa, Libby, Montana (October 2011)
- 2010 Columbia River Basin Interagency Invasive Species Rapid Response Exercise, Lake Roosevelt, Spokane, Washington (September 2010)
- 2009 Columbia River Basin Interagency Invasive Species Rapid Response Exercise, Boise Idaho (April 2009)
- 2008 Columbia River Basin Interagency Invasive Species Rapid Response Exercise, Portland, Oregon (October 2008)
- 2007 Columbia River Basin Interagency Invasive Species Rapid Response Exercise, Vancouver, Washington (October 2007)

Appendix L. Operationalizing a Response to an Introduction of Dreissenids

Pacific States Marine Fisheries Commission worked with the US Fish and Wildlife Service and National Marine Fisheries Service to develop an Endangered Species Act Manual to inform, expedite, and facilitation Section 7 consultations to include response actions that will minimize impacts of invasive mussels on listed species and their designated critical habitats (https://www.westernais.org/esa-manual). The effort will improve coordination, collaboration, and preparedness among the entities that would be engaged in invasive mussel rapid response actions in the Columbia River Basin. Using emergency consultation procedures, in conjunction with this manual, would ensure that entities are able to rapidly respond to mussels in the basin while minimizing impacts to listed species and critical habitats.

Entities that seek to respond quickly to a detection of dreissenids would initiate the emergency consultation process, and then initiate formal consultation after the emergency is under control.

Typically, under an emergency situation, the entity that seeks to take a control action would contact the US Fish and Wildlife Service by telephone if quagga or zebra mussels are detected in proximity to listed species or critical habitat. Upon contact, the entity would be provided an emergency consultation number. At that time, the US Fish and Wildlife Service will request as much detail as possible about the location and severity of the quagga or zebra mussel detections as well as anticipated response actions. Specific information regarding known, or suspected, potential impacts to listed species or their critical habitats is provided at this time. Subsequent calls can add or update information, as appropriate. At this initial contact and throughout the emergency response, the US Fish and Wildlife Service will provide recommendations to avoid or minimize impacts to listed species and their critical habitats, which ideally should include using best management practices that have been jointly developed and described in the ESA Manual.

As soon as practical after the rapid (emergency) response is under control, the entity should then determine whether the emergency response action(s) "may affect" listed species and/or critical habitat. If so, the entity develops a biological assessment and initiates after-the-fact consultation. The biological opinion will contain an evaluation of whether and how the best management practices were incorporated during the rapid response. Take, or other adverse effects resulting from the presence of quagga or zebra mussels, are not attributable to the response. Rather, incidental take by the entity would only occur because of the rapid response to the emergency. Because the incidental take statement is addressing an after-the-fact situation, reasonable and prudent measures would not be included in the incidental take statement accompanying the biological opinion for the emergency actions unless actions that go beyond the initial emergency response are likely to result in the incidental take of listed species.

The ESA Manual should be consulted for specifics on approach and best management practices associated with a dreissenid response.

ESA Manual Contents:

- Introduction/Background
- ESA/Emergency Consultation Process
- Control Measures
- Summary of Vulnerable Listed Species in the Columbia River Basin
- Effect Analysis
- Best Management Practices
- Post-emergency Consultation
- Appendices include water-body specific information in the four Columbia River Basin states