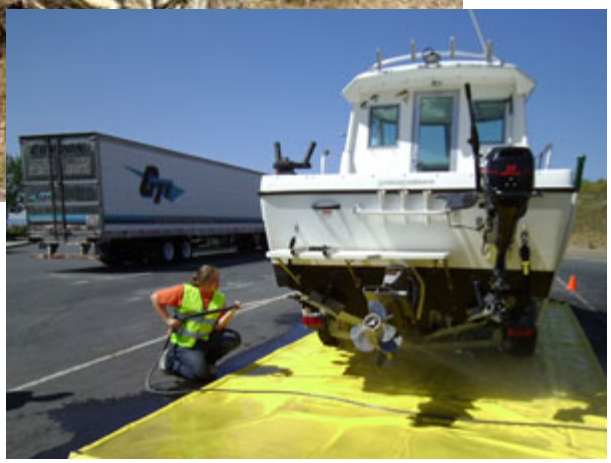
Oregon Dreissenid Mussel Rapid Response Plan



OREGON Fish & Wildlife

OREGON STATE MARINE BOARD

Portland State UNIVERSITY

OREGON DREISSENID MUSSEL RAPID RESPONSE PLAN

Prepared by: Robyn Draheim, Rick Boatner, Glenn Dolphin, and Lisa DeBruyckere

Center for Lakes and Reservoirs - Portland State University
Oregon Department of Fish and Wildlife
Oregon State Marine Board

October 2013 (Amended April 2017)

Table of Contents

INTRODUCTION

In 2007, both zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena rostriformis bugensis*) were found to have established populations west of the Rocky Mountains, and in 2016, the perimeter of the Pacific Northwest was breached when dreissenid veligers were detected in two Montana reservoirs.

The risk posed to the Pacific Northwest by the proximity of the Montana detections is significant. This plan was developed in response to the increasing likelihood of the successful transport and introduction of these species into the State of Oregon and Pacific Northwest. Although prevention remains the most cost-effective means of addressing potential infestations of aquatic invasive species, if prevention efforts fail, the State of Oregon must be prepared to respond rapidly and effectively to minimize environmental and economic impacts and reduce the risk of spread.

The purpose of this plan is to protect Oregon's waters, aquatic resources, and facilities from the deleterious effects of dreissenid mussel establishment. This plan serves as a guidance document for natural resource managers to plan for and provide a rapid response effort to a dreissenid mussel infestation in Oregon waters. This plan is intended to complement the *Columbia River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other Dreissena Species* drafted by the Columbia River Basin 100th Meridian Team as well as provide stand-alone guidance should mussels be found in Oregon but outside of the Columbia River Basin. This plan applies to all dreissenid mussels, although the current focus is on zebra and quagga mussels. Many of the strategies listed herein can be applied to rapid response efforts for other aquatic invasive species (AIS) of concern.[1]

[1] Although devised specifically to respond to dreissenid mussels, this plan should be useful for responding to any invasive freshwater animal. Freshwater plants fall under the purview of the Oregon Department of Agriculture and are governed by different rules and regulations regarding response. Marine plants and animals will require unique considerations not included in this plan.

OBJECTIVES

This plan is designed to align with a comprehensive regional effort to protect aquatic resources in the Pacific Northwest by preventing the introduction of AIS, including dreissenid mussels, by employing detection strategies to discover incipient infestations early enough to facilitate successful eradication or control efforts.

Although eradication should always be the foremost goal of any rapid response plan, eradication may not always be feasible, especially in aquatic systems where removal and/or treatment can be challenging, if not impossible. In these cases, responders must determine which goals are attainable and cost-effective. The final response may have one of several possible goals, such as containing the invasion to a given area, suppressing population densities to reduce the rate of spread, prohibiting high-risk transport vectors, or in the worst-case scenario, developing adaptive strategies to co-exist with the invader.

There is a limited window of opportunity to respond once an introduction is suspected, or a population identified, thus it is imperative that the State of Oregon have a plan outlining tasks, actions and responsibilities to increase response effectiveness. Such a plan is considered a "working" document, updated and/or revised to reflect new information and emerging technologies. The foundation for the response plan is the Incident Command System (ICS), a standardized protocol for cooperation and coordination among state and federal agencies as well as industry and others (visit the FEMA website to access the latest ICS forms: https://www.fema.gov/media-library/assets/documents/33584). It addresses:

- Responsibilities and authorities for rapid response beginning with the discovery of an introduction and continuing through containment and response.
- Long-term monitoring and control of infestations should eradication be deemed unfeasible.

Objectives include responding to and minimizing impacts of infestations of dreissenid mussels; providing timely and accurate information to managers, stakeholders and the general public; and providing for the safety of the public as well as all personnel involved at any stage of a response.

The response plan is divided into the following functional sections: pre-planning, initial response (incident action plan), and extended response.

BACKGROUND

Developing a state response to an AIS introduction, such as dreissenid mussels, requires an understanding of the threat, the existing AIS response framework, and the management and response capacity of the state. Although eradication should always be the foremost goal of any AIS rapid response plan, eradication is not always feasible, especially in aquatic systems in which removal and/or treatment can be challenging, if not impossible. In these cases, responders must identify attainable and cost-effective goals. The final response may have one of several possible outcomes, such as containing the invasion to a given area, suppressing population densities to reduce the rate of spread, prohibiting high-risk transport vectors, or in the least desirable scenario, developing adaptive strategies to co-exist with the invader.

In addition to the numerous options that can be considered as part of any rapid response, there are key steps integral to any such effort, including: (1) responding to and minimizing impacts of infestations; (2) providing timely and accurate information to managers, stakeholders and the general public; (3) providing for the safety of the public as well as all personnel involved at any stage of a response; and (4) coordinating with neighboring and regional jurisdictions on immediate response and long-term management, as appropriate. Developing a shared understanding of these important steps prior to a response is critical to effective prevention efforts, and greatly enhances the ability of jurisdictions to coordinate and cooperate.

Time is of the essence once a dreissenid introduction is suspected, or a population identified, thus it is imperative that Oregon have a plan outlining tasks, actions and responsibilities to increase response effectiveness. Such a plan is considered a "working" document, updated and/or revised routinely to reflect new information and emerging technologies.

The foundation for the response plan is based on the Incident Command System (ICS), a standardized protocol for cooperation and coordination among federal, state, and local governments, and other entities.

THE THREAT[2]

Zebra and quagga mussels are closely related filter-feeding freshwater mussels in the genus *Dreissena*. These bivalves produce free-swimming planktonic larvae that eventually settle out of the water column and attach to hard surfaces using byssal threads. First discovered in Lake Erie in 1988, dreissenid mussels have spread rapidly throughout North America and are found in all of the Great Lakes and many drainages in the Midwest, North Atlantic and Southwestern United States.

Dreissenid mussels are introduced into new water bodies through both natural and human-mediated transport. Natural dispersal occurs through larval drift, or by the transport of adults attached to floating objects. Human-mediated dispersal occurs through the movement of larvae in the ballast water tanks of vessels, via internal water stored in engine compartments of trailered boats, or via the movement of adults attached to the hulls of conveyances. Also, mussels may be introduced to new water bodies in contaminated bait livewells and fishery stocking programs.[3, 4]

Adult mussels may survive out of water up to five days in dry environments and for several weeks in wet areas and compartments of boats, motors, trailers, and other conveyances, making overland transport by recreational boaters a high-risk pathway for the introduction of zebra and quagga mussels into Oregon waters.[5, 6] The chance of establishment of aquatic invasive species by overland transport increases by a factor of the square of the distance from existing populations.[7]

---

[2] Excerpted and revised from the OISC Zebra Quagga Mussel Risk Assessment http://www.oregon.gov/OISC/calendar_may10.shtml

[3] Johnson L.E, A. Ricciardi, J.T. Carlton. 2001. Overland dispersal of aquatic invasive species: a risk assessment of transient recreational boating. Ecological Applications. 11(6): 1789-1799.

[4] Karatayev, A. Y., D.K. Padilla, D. Minchin, D. Boltovskoy, L.E. Burlakova. 2007. Changes in global economies and trade: the potential spread of exotic freshwater bivalves. Biological Invasions. 9:161-180.

[5] Johnson L.E, A. Ricciardi, J.T. Carlton. 2001. Overland dispersal of aquatic invasive species: a risk assessment of transient recreational boating. Ecological Applications. 11(6): 1789-1799.

[6] Timar, L., and D.J. Phaneuf, 2009. Modeling the human-induced spread of an aquatic invasive: The case of the zebra mussel. Ecological Economics. 68(12):3060–3071.

[7] Leung, B., J.M. Bossenbroek, and D.M. Lodge. 2004. Boats, Pathways, and Aquatic Biological Invasions: Estimating Dispersal Potential with Gravity Models. Biological Invasions. 8(2): 241–254.

Many factors contribute to the risk of dreissenid introduction and establishment, including environmental parameters (e.g., dissolved calcium, pH), and the extent and types of public usage (e.g., total day use, presence of boat ramps and marinas, proximity to transportation corridors, motorized boating, fishing). Boat transport from contaminated waters is the most likely pathway of introduction to new water bodies in Oregon.[8, 9, 10, 11] Once introduced, pH and calcium concentrations are likely to determine the success of the introduction. These factors are considered critical environmental parameters for dreissenid mussel survival and growth.[12, 13]

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 and thus shift production from the pelagic to the benthic portion of the water column.[14] 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. Dreissenid mussels can also affect dissolved oxygen through respiration, and dissolved calcium carbonate concentrations through shell building.[15]

---

[8] Lucy, A., J. Buchan, and D.K. Padilla, 1999. Estimating the Probability of Long Distance Overland Dispersal of Invading Aquatic Species. Ecological Applications. 9(1):254-265.

[9] Frischer, M.E., B.R. McGrath, A.S. Hansen, P.A. Vescio, J.A. Wyllie, J. Wimbush and S.A. Nierzwicki-Bauer, 2005. Introduction Pathways, Differential Survival of Adult and Larval Zebra Mussels (*Dreissena polymorpha*), and Possible Management Strategies, in an Adirondack Lake, Lake George, NY. Lake and Reservoir Management. 21(4):391-402.

[10] Johnson L.E, A. Ricciardi, J.T. Carlton. 2001. Overland dispersal of aquatic invasive species: a risk assessment of transient recreational boating. Ecological Applications. 11(6): 1789-1799.

[11] Karatayev, A. Y., D.K. Padilla, D. Minchin, D. Boltovskoy, L.E. Burlakova. 2007. Changes in global economies and trade: the potential spread of exotic freshwater bivalves. Biological Invasions. 9:161-180.

[12] Hincks, S.S. and G.L. Mackie. 1997. Effects of pH, calcium, alkalinity, hardness, and chlorophyll on the survival, growth, and reproductive success of zebra mussel (*Dreissena polymorpha*) in Ontario lakes. Can. J. Fish. Aquat. Sci. 54:2049-2057.

[13] McMahon, R.F., 1996. The Physiological Ecology of the Zebra Mussel, *Dreissena polymorpha*, in North America and Europe. Amer. Zool. 36:339-363.

[14] Sousa, R., J.L. Gutiérrez, and D.C. Aldridge, 2009. Non-indigenous invasive bivalves as ecosystem engineers. Biological Invasions. 11(10):2367–2385.

[15] Strayer, D.L., 2009. Twenty years of zebra mussels: lessons from the mollusk that made headlines. Front Ecol. Environ. 7(3): 135–141.

Dreissenid mussels can cause substantial economic damage by infesting municipal, industrial, and agricultural water systems and attaching themselves to the hard substrates of pipes, dams, and diversion pathways. This restricts the flow of water through the systems impacting component service life, system performance, and maintenance activities. The annual cost to power plants and municipal drinking water systems in North America has been estimated between $267 million and $1 billion dollars.[16, 17]

Establishment of dreissenid mussels in the Columbia River Basin would be expensive, requiring extensive maintenance to the nuclear power plant and the hydroelectric dams, fish ladders and irrigation pumping. In an economic impact report prepared for Bonneville Power Administration, the one-time cost to install mussel treatment systems was estimated at more than $23 million dollars; annual costs were estimated at $1.5 million.[18] Because of the high value of fishery and aquatic resources in the CRB, and because no controls exist for mussels in open natural systems, the ecological costs of a Columbia basin invasion could be much larger than other costs.[19]

---

[16] Connelly N., C.R. O'Neill, B.A. Knuth, and T.L. Brown. 2007. Economic Impacts of Zebra Mussels on Drinking Water Treatment and Electric Power Generation Facilities. Environmental Management. 40(1): 105–112.

[17] Pimentel, D., 2005. Aquatic Nuisance Species in the New York State Canal and Hudson River Systems and the Great Lakes Basin: An Economic and Environmental Assessment. Environmental Management 35(5):692–701.

[18] Phillips, S., T. Darland, and M. Sytsma. 2005. Potential Economic Impacts of Zebra Mussels on Hydropower Facilities in the Columbia River Basin. Prepared for Bonneville Power Administration. 22 pg.

[19] Independent Economic Analysis Board. 2013. Invasive Mussels Update: Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin. Task Number 201. Document IEAB 2013-2. 42pp.

THE COLUMBIA RIVER BASIN INTERAGENCY INVASIVE SPECIES RESPONSE PLAN

In 2008, the 100th Meridian Initiative's Columbia River Basin Team (CRB Team) drafted a *Columbia River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species.*[20] The purpose of the 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 into CRB waters. The plan is updated on a continual basis to ensure the information, particularly notification lists, is current.

The CRB Plan includes 10 response objectives to delineate and control zebra, quagga, and other dreissenid mussel populations if detected in the CRB.

Rapid Response Objectives:

1. Make initial notifications
2. Activate appropriate organizational elements of the CRB Interagency Response Plan
3. Verify reported introduction
4. Define extent of colonization
5. Establish external communications system
6. Obtain and organize resources
7. Prevent further spread via quarantine and pathway management
8. Initiate available/relevant control actions
9. Institute long-term monitoring
10. Evaluate the response and the plan

Of the 10 objectives presented, six of them rely on action or planning and response by the state invasive species coordinator or the lead agency with response authority as determined by the location of the infestation.

[20] http://100thmeridian.org/ActionTeams/Columbia/CRB%20Dreissenid%20Rapid%20Response%20Plan%20OCTOBER%201%202008.pdf

OREGON AIS MANAGEMENT AND RESPONSE CAPACITY

AUTHORITY, LEADERSHIP AND ORGANIZATION

Agencies and entities authorized to respond to a discovery of dreissenid mussels will largely depend on the location of the initial discovery. The entities with primary responsibility for dreissenid mussel management and response in Oregon are the Oregon Department of Fish and Wildlife (ODFW) – designated lead agency – Oregon State Marine Board (OSMB) and Portland State University (PSU); each has an AIS or invasive species coordinator tasked with varied responsibilities relating to AIS, and all three entities are ex-officio members of the Oregon Invasive Species Council (OISC). For the purposes of this response plan, these three entities comprise the initial AIS coordination team. Numerous other agencies have AIS management and/or coordination responsibilities (Table 1). Because of the importance of the role of the Office of Emergency Management in terms of declaring an emergency in the State of Oregon, information is included about them along with the three lead entities.

Table 1. Agencies and entities with AIS management and coordination responsibilities or interests in Oregon and/or regionally (entities listed in bold have primary responsibility for dreissenid mussel management and response in Oregon).

- Bureau of Land Management (BLM)
- Bureau of Reclamation (BOR)
- City and County Emergency Management Coordinators
- Bonneville Power Administration (BPA)
- City and County Governments
- Columbia River Basin 100th Meridian Team
- **Columbia River Inter-tribal Fish Commission (CRITFC)**
- Governor's Natural Resource Cabinet
- Individual Tribes in Oregon
- National Park Service (NPS)
- NOAA Fisheries
- Northwest Power and Conservation Council (NWPCC)
- Oregon Department of Agriculture (ODA)
- Oregon Department of Environmental Quality (DEQ)
- **Oregon Department of Fish and Wildlife (ODFW)**

- Oregon Department of Forestry(ODF)
- Oregon Invasive Species Council (OISC)
- Oregon Office of Emergency Management (OEM)
- Oregon Parks and Recreation Department (OPRD)
- Oregon Sea Grant (OSG)
- **Oregon State Marine Board (OSMB)**
- Oregon State Police (OSP)
- Pacific States Marine Fisheries Commission (PSMFC)
- **Portland State University (PSU)**
- Ports
- US Army Corps of Engineers (USACE)
- US Department of Agriculture (USDA)
- US Environmental Protection Agency (EPA)
- US Fish and Wildlife Service (USFWS)
- US Geological Survey (USGS)
- USDA Forest Service (USFS)
- Western Regional Panel on Aquatic Nuisance Species

OREGON STATE MARINE BOARD (OSMB)

The OSMB is the state agency responsible for managing recreational boating, and has the lead role to implement the Aquatic Invasive Species Permit Program (AISPP). This permit program is an important funding mechanism for boat inspection teams, public education and outreach efforts and other related AIS awareness and prevention activities. The AIS coordinator for the OSMB is engaged in public education and outreach activities about AIS topics. The coordinator develops and distributes printed material (brochures, posters, signs, etc.) to statewide partners, including recreational water sport businesses. Coordination and law enforcement training is an OSMB and ODFW shared activity.

OREGON DEPARTMENT OF FISH AND WILDLIFE (ODFW)

Charged with managing wildlife by preventing the depletion of indigenous species while providing optimum recreational benefits, ODFW is the state agency tasked with managing invasive species. The ODFW AIS coordinator participates in education and outreach activities and is also involved with statewide projects to manage species of concern and implement strategies that address eradication, control or containment of AIS. ODFW is the primary agent responsible for implementing state boat inspection stations (outlined in the AISPP). Stations are

staffed by trained ODFW employees with the necessary skills and equipment to decontaminate watercraft and engage with the public in education and outreach efforts. Inspectors also sample water bodies for the presence of dreissenids and other AIS.

PORTLAND STATE UNIVERSITY (PSU)

The Center for Lakes and Reservoirs (CLR) at PSU assists state and federal agencies in researching and mitigating nonindigenous, invasive aquatic species in Oregon and works with communities to develop effective management strategies for lakes and reservoirs. The CLR created and coordinates the Oregon Aquatic Nuisance Species Management Plan, which was approved by the Governor of Oregon and the Aquatic Nuisance Species (ANS) Task Force in 2001.

OREGON OFFICE OF EMERGENCY MANAGEMENT (OEM)

The OEM executes the Governor's responsibilities to maintain an emergency services system by planning, preparing and providing for the prevention, mitigation and management of emergencies or disasters that present a threat to the lives and property of citizens and visitors to the State of Oregon. The agency is responsible for coordinating and facilitating emergency planning, preparedness, response and recovery activities with the state and local emergency services agencies and organizations.

Oregon Revised Statute 401.165[21] authorizes the Governor to declare a state of emergency by proclamation at the request of a county. All such requests by a county governing body are sent to the OEM. Cities must submit requests through the governing body of the county in which the majority of the city's property is located. Requests from counties include a certification signed by the county governing body that all local resources have been expended; and a preliminary assessment (including property damage or loss, injuries and deaths). The proclamation of a state of emergency specifies the geographical area covered by the proclamation. The governing body of each county has a procedure for receiving, processing and transmitting to the Office of Emergency Management[22] a request to declare a state of emergency in a timely manner. If the Governor issues an emergency or disaster

[21] http://www.leg.state.or.us/ors/401.html

[22] http://www.oregon.gov/OMD/OEM/docs/plan_train/locals_list.pdf

declaration, OEM will be contacted via the Oregon Emergency Response System (OERS) for possible allocation of State resources to support the response.

Columbia Inter-tribal Fish Commission

The Columbia River Inter-tribal Fish Commission coordinates management policy and provides fisheries technical services for the Yakama, Warm Springs, Umatilla, and Nez Perce tribes. Its mission is to ensure a unified voice in the overall management of the fishery resources, and as managers, to protect reserved treaty rights through the exercise of the inherent sovereign powers of the tribes. CRITFC has a fish science department that consists of watershed ecology, production and restoration, and planning, monitoring, and evaluation. The CRITFC Sturgeon Project Lead participates in numerous Columbia River Basin forums.

Funding and Resources

The OISC administers a state invasive species emergency fund, The Oregon Invasive Species Control Account, for the purposes of eradicating or controlling new infestations or infections of invasive species in Oregon (ORS 570.810).[23] The OISC may be petitioned and asked to declare an Invasive Species Emergency and release funds for a rapid response (See Appendix I for eligibility and the process for the release of funds). The fund is currently valued at $70,000 (April 2017) and was originally intended (when it was valued at $350,000) to be considered as seed funds to initiate a response. Existing funds are inadequate to implement a large-scale rapid response that would likely be needed (statement based on a recent economic evaluation of rapid response fund options for California recommended a starting dollar amount of $1–2 million).[24] When the fund was created, there was intent to add funds to the account annually until the balance in the account reached $5 million. Because of economic and other issues in the State of Oregon, no new funds have been added to the account since it was created, and the fund has been tapped on several occasions to address Japanese beetle issues adjacent to Portland

---

[23] http://www.oregonlaws.org/ors/570.810

[24] Cardno ENTRIX and A. Cohen 2011. California Aquatic Invasive Species Rapid Response Fund an Economic Evaluation. Prepared for the USFWS. https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=AquaticInvasiveSpecies

International Airport as well as Sudden Oak Death. A new and aggressive strategy needs to be developed to increase this fund to a level that will support a major invasive species response.

In addition, the AIS Prevention Program enacted in 2009 provides annual income for Oregon Watercraft Inspection Team (WIT) teams. The CRB Plan charges that all signatories to the plan develop and maintain a list of resources in the event of a dreissenid introduction (Appendix II).

Quarantine Establishment and Enforcement

To prevent or slow the spread of dreissenid mussels, it may be necessary to mobilize a quarantine or emergency closure of the affected water body immediately upon the detection and verification of an introduction. This may be difficult, if not impossible, in large open water bodies, or flowing systems, such as rivers, and water bodies that span multiple jurisdictions. Various management actions may require quarantine authority to protect other areas from infestation or to slow spread in a regional context.

Although closure may be impractical for larger water bodies, there may be isolated water bodies or unique infestation scenarios that provide for the ability to quarantine an area. The ability to close or limit ingress and/or egress to all vehicles and equipment capable of carrying dreissenid mussels and to maintain closures or limited (controlled) access until an acceptable management plan has been developed and implemented is critically important.

A current OSMB statute, ORS 830.175 (3) has a provision that would authorize the closure of a waterbody to boating activity if OSMB receives a formal request from ODFW to temporarily or permanently close a waterbody to boating to protect fish and wildlife resources: "The board may make special regulations relating to the operation of boats, including the establishment of designated speeds and prohibition of the use of motorboats for the protection of game fish at the request of the State Fish and Wildlife Commission."

Individual entities with jurisdiction and/or direct ownership of water bodies and/or boat ramps may choose to respond by closing or limiting access. It may be likely that an emergency rule by the Governor's office could temporarily grant quarantine authority. If a dreissenid infestation is found in Oregon and the agency responsible for the management of the water body does not have the incident management capability or technical expertise to conduct quarantine and pathway management

tasks, it may formally delegate that responsibility to the CRB Interagency Rapid Response Team.[25]

Granting quarantine authority to a state agency has precedent. In Oregon, quarantine authority is granted to ODA in response to animal and plant health issues (ORS 561.510, 561.540) as well as noxious weed issues (ORS 561.180, 561.350). Other wildlife departments in western states, such as California[26], Montana[27], and Utah[28], have recently been granted quarantine authority through legislative action to respond to dreissenid mussels.

PRE-PLANNING

ENVIRONMENTAL REGULATORY COMPLIANCE

The success of any eradication effort aimed at dreissenid mussels will depend on the availability of tools for rapid response. A combination of pre-planning efforts and adaptability to advances in control technology and efforts by other entities will be needed. Contingency planning exercises will allow managers to determine what tools will be appropriate to which areas, whether or not environmental compliance standards have been met (Appendix III), and what regulatory compliance and permitting actions are required prior during and following control tactic operations.

If (in accordance with integrated pest management (IPM) principles) it is determined that pesticides will be required to meet the eradication or control objectives, then applications must comply with regulatory processes as outlined in Appendices IV and V. In particular, pesticide applications to waters of the state must meet the terms and timelines identified by both the state CWA/NPDES pesticide general permit (administered by ODEQ), as well as product label directions and restrictions identified under the Federal Insecticide Fungicide Rodenticide Act (FIFRA) as administered by the Oregon Department of Agriculture. For products not currently registered for aquatic use in Oregon (or at application

---

[25] http://www.100thmeridian.org/ActionTeams/Columbia/CRB_Dreissenid_Rapid_Response_Plan_September_19_2011.pdf

[26] http://law.onecle.com/california/fish/2301.html

[27] http://data.opi.mt.gov/bills/2011/billhtml/HB0621.htm

[28] http://www.rules.utah.gov/publicat/code/r657/r657-060.htm

rates necessary for mussel eradication), emergency exemption FIFRA labels may be attained by requests made to ODA.

If an infestation occurs in habitat that supports threatened and endangered species, NEPA and Endangered Species Act consultation will be required with appropriate state and federal agencies prior to implementing any control measures.

The EPA can authorize, via Section 18, exemptions to registrations under emergency conditions, which are considered urgent, non-routine situations. Four conditions must exist for an emergency to be considered[29]:

1. No effective, registered pesticides are available that have labeled uses for control of the pest.
2. No economically feasible alternative practices which provide adequate control are available.
3. The situation involves the introduction or dissemination of a pest new to or not previously known to be widely prevalent or distributed in the state or specific area.
4. It must be substantiated that this (new) pest or problem will cause a significant economic loss.

Emergency exemptions are applied for by state or federal agencies. In the case of Oregon, the Oregon Department of Agriculture is responsible for making an application request to the EPA. All Section 18 exemptions are designated for specific use, in a specific area, and for a specific amount of time, and use must be followed by submittal of a Use Report that document the use, results, economic benefits, acres treated, and benefits or comments concerning any problems surround the use of the exemption. Details on the information needed to request a Section 18 Emergency Exemption of FIFRA can be found in Appendix XI.

If an infestation occurs in habitat that supports threatened and endangered species, NEPA and Endangered Species Act consultation will be required with appropriate state and federal agencies prior to implementing any control measures.

The following provides information about required permits and registration of pesticides likely to be used in an AIS invasive mussel rapid response scenario, including a set of recommendations to best position Oregon for such an occurrence. Invasive mussels are used as the case study because it represents one of the more

[29] http://agr.mt.gov/Portals/168/Documents/Archive/PesticideReg/00-sec18Guide.pdf

challenging scenarios Oregon would face relative to permitting and preparation for a control action.

- The National Pollutant Discharge System (NPDES) permit program controls water pollutions by regulating point sources that discharge pollutants into waters of the United States; it is authorized by the Federal Clean Water Act of 1972. Oregon's Pesticide General Permit (PGP)[30] is the wastewater discharge permitting mechanism for anyone that applies pesticides over, into, or within three feet of waters of the state. The permit is regulated under the Oregon Department of Environmental Quality Pollution Discharge Elimination System (PDES) program. Beth Moore is the DEQ permit coordinator (moore.beth@deq.state.or.us; phone (503) 229-6402).
- If the application of pesticides occurs within the boundaries of Indian Lands, the owner/operator will need to comply with the requirements of the EPA's Pesticide General Permit.[31]
- The Environmental Protection Agency (EPA) authorizes Oregon to administer NPDES permits through the Oregon Department of Environmental Quality (DEQ).

Options exist for how Oregon could navigate through permitting requirements to respond to an introduction of AIS, from the development of a Habitat Conservation Plan or programmatic Environment Impact Statement to using existing emergency procedures, such as a Section 18 (see below). The EPA registers all pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act of 1979 (FIFRA), which assures pesticides are properly labeled and will not cause harm to the environment if used in accordance with label.

- Section 3 FIFRA – EPA has reviewed and approved information and uses on product label.
- Section 24(c) FIFRA – The Oregon Department of Agriculture's Pesticides and Fertilizer programs enforce state and federal regulations regarding the licensing, distribution and use of pesticide and fertilizer products. Oregon's Pesticide Control Law (Chapter

[30] http://www.oregon.gov/ODA/shared/Documents/Publications/PesticidesPARC/NPDESFaqForestryAg.pdf

[31] https://www.epa.gov/npdes/pesticide-applications-1

634),[32] is enforced by ODA, and regulates the formulation, distribution, storage, transportation, application, and use of pesticides.

- Section 18 – States, or the region, may petition EPA for section 18 emergency exemption from full section 3 registration – temporarily expands the terms of the pesticide label to include additional emergency uses – users must obtain directions from lead agency. A Section 18 can be applied for regionally whereas Special Local Needs must be applied for on a state-by-state basis.

A joint programmatic opinion from NOAA and the USFWS is likely not the best approach for Oregon because of the potential number of locations where an introduction of AIS may occur and the complex issues associated with numerous sensitive, threatened, and endangered species that are known to exist in and adjacent to Oregon waters. To facilitate a more streamlined, realistic approach to working with key federal partners to address a dreissenid introduction, the Pacific States Marine Fisheries Commission, in concert with NOAA and the USFWS, is exploring other models that have similar elements to a mussel response, e.g., oil spill response, to identify best options for how states, such as Oregon, could navigate permitting requirements, especially those associated with threatened and endangered species (e.g., salmonids) to quickly respond to an introduction of AIS. Likely options would require:

- Best management practices for Oregon's water bodies, river systems, and watersheds.
- Inclusion of terrestrial species in terms of potential effects of a control action.
- Identification of pesticides that would most likely be used in a control action.
- Identification of sensitive, threatened, and endangered species in the control area (and downstream of the control area, if applicable).
- Addressing downstream habitats and how they might be affected by control actions.
- Setting goals and geographic scope to any likely control action.

Appendix XI contains an example of a template Oregon could use to apply to the EPA for a FIFRA Section 18 Emergency Exemption.

---

[32] https://www.oregonlegislature.gov/bills_laws/ors/ors634.html

Recommendations

- Pesticide Registration— To discharge a pesticide to waters of the state to control invasive mussels in Oregon, the pesticide product must be registered by the state (ODA), have a legal use in Oregon, and be included in the states' NPDES General Permit. In addition, the applicator has to be covered under the NPDES permit.
    - Oregon should take steps to register new and emerging products designed to control AIS with minimal impacts to non-target species.
        - Oregon should continually refine and maintain a list of Section 3 pesticides that would most likely be used in an AIS control action. For example, potential registered Section 3 pesticides that could be used for an introduction of dreissenids include copper-based algaecides (in locations without salmonid populations), copper sulfate, copper carbonate, Endothal, potassium salts, bacterial toxins, and *Pseudomonas fluorescens* (Zequanox®).
    - Oregon should take steps to ensure all aspects of the NPDES permit reflect control activities most likely to occur in the event of an introduction.
    - Oregon should maintain an updated list of its impaired waterbodies (303d listings) and be aware of additional constraints on pesticide products that may be used if the waterbody being treated is on the list.
    - State and federal authorities have described critical habitat areas or times of the year when specific pesticides cannot be applied. For example, juvenile salmon and ESA-listed species must not be present at the time of treatment with Endothal is being applied. This list of recommended treatment windows should be maintained.

- PDMP—Create and maintain an updated Pesticide Discharge Management Plan[33] that includes the types of pesticides and control

[33] http://deq.mt.gov/Portals/112/Water/WPB/MPDES/pdfs/DEQ-PDMP_template.pdf

options that would likely occur for an AIS control action.

- Funding—It is imperative to identify sources of funding to initiate control and monitoring actions in advance of an introduction.

Early Detection and Rapid Response

Early detection is the key to successful rapid response. Early detection often provides the only chance at eradication, especially for aquatic invasive species, which are notoriously difficult to eradicate, successfully control or manage. The cost to respond to a population that was not detected during early stages of an invasion increases exponentially over time.

Reports of Suspected Detections

Reports of suspected detections of AIS originate from a variety of sources. In Oregon, the recommended venue for reporting sightings of aquatic invasive species:

- The OISC staffs http://www.oregoninvasiveshotline.org, an online hotline to report suspected sightings of invasive species. Upon reporting a suspected sighting of an aquatic invasive species to the hotline, experts in aquatic invasive species identification immediately receive an email.

The first participating agency to discover or receive a report of a potential dreissenid [or other AIS infestation] will notify the ODFW Invasive Species Coordinator. The initial recipient should collect:

- Date and time of the report.
- Name and contact information of the report recipient
- Name and type of organism (e.g. zebra mussel, seaweed, etc.)
- 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 any)
- Details of the location of the infestation
    - Name of the affected water body,
    - Landmarks, highway mile, and other identifying details
    - GPS (if possible)

    - Description of surface attached to (if fouling organism) or substrate found on/in if appropriate
    - Other relevant conditions (draw down, low tide, etc.)
- An estimate of the number, density, and extent of the introduction
- Digital or other photographs (with scale indicator), ideally images shot from multiple angles
- If no photograph possible, obtain a detailed description of organism (size, coloration, flowering, etc.). Ensure reporter is looking at actual specimen not at an ID card/wanted poster.
- A sample of the organism (inform caller of proper storage/handling if necessary)
- Comments: These might include notes about the condition the specimen was in when found, how reporter came across organism, had they seen it before, access limitation to site, etc.

Notification of positive results from veliger monitoring (either through cross-polarized light microscopy or PCR) should be sent directly to the State Aquatic Invasive Species Coordinator(s) along with all supporting documents and the sample collection information (Appendix VII describes documentation requested for veliger analysis).

EARLY DETECTION EFFORTS

Early detection of dreissenid mussels relies upon the discovery of either veligers in the water column or juveniles and adults colonizing hard substrates. Oregon has thousands of lakes—there are limited resources available for early detection. Efforts must be focused on high-risk water bodies—those with both high risk of introduction and risk of establishment should receive the highest monitoring priority.

HIGH RISK WATER BODIES[34]

Recreational boating is the primary vector for overland transport of mussels and increases the risk of inter-basin dreissenid introduction.[35, 36, 37] The ongoing discovery of recreational trailered-watercraft with attached mussels in the CRB, and throughout the western United States, corroborates the importance of this vector. Total day use of a water body, presence of boat ramps and marinas, water body size and access, and the presence of motorized boating and fishing activities, including angling tournaments that attract boats from outside the Pacific Northwest, are important risk determinants.

The risk of dreissenid establishment is also influenced by environmental parameters, such as dissolved calcium, pH, water temperature, salinity, dissolved oxygen, and substrate. Veliger survivorship increases from 3% at 12 mg Ca^{2+}/L to 20–25% at 47 mg Ca^{2+}/L.[38] North American dreissenid juveniles show initial growth at calcium concentrations between 8.5 and 11 mg Ca^{2+}/L[39, 40] and moderate shell growth between 25 and 26 mg Ca^{2+}/L.[41] In general, dreissenid adults inhabit waters with calcium concentrations greater than or equal to 15 mg Ca^{2+}/L, and populations become dense at concentrations greater than or equal to 21 mg Ca^{2+}/L.[42] Dissolved calcium concentrations and pH are likely the most limiting environmental

---

[34] Wells, S., T.D. Counihan, A. Puls, M. Sytsma and B. Adair. 2010. Prioritizing Zebra and Quagga Mussel Monitoring in the Columbia River Basin Prepared for Bonneville Power Administration and the Pacific States Marine Fisheries Commission BPA Contract Number: 00003373 TI Project Number: 152.

[35] Lucy, A., J. Buchan, and D.K. Padilla, 1999. Estimating the Probability of Long Distance Overland Dispersal of Invading Aquatic Species. Ecological Applications. 9(1):254-265.

[36] Johnson L.E, A. Ricciardi, J.T. Carlton. 2001. Overland dispersal of aquatic invasive species: a risk assessment of transient recreational boating. Ecological Applications. 11(6): 1789-1799.

[37] Karatayev, A. Y., D.K. Padilla, D. Minchin, D. Boltovskoy, L.E. Burlakova. 2007. Changes in global economies and trade: the potential spread of exotic freshwater bivalves. Biological Invasions. 9:161-180.

[38] Sprung, M. 1987. Ecological requirements of developing *Dreissena polymorpha* eggs. Archiv für Hydrobiologie Supplement 79:69–86.

[39] Hincks, S.S. and G.L. Mackie. 1997. Effects of pH, calcium, alkalinity, hardness, and chlorophyll on the survival, growth, and reproductive success of zebra mussel (*Dreissena polymorpha*) in Ontario lakes. Can. J. Fish. Aquat. Sci. 54:2049-2057.

[40] McMahon, R.F., 1996. The Physiological Ecology of the Zebra Mussel, *Dreissena polymorpha*, in North America and Europe. Amer. Zool. 36:339-363.

[41] Ibid.

[42] Ibid.

parameters to dreissenid establishment in the CRB and greater Northwest.[43, 44] Water temperature is not expected to limit growth, as dreissenids inhabit a wide range of temperatures in North America. They are found in the Great Lakes at temperatures less than 5°C, and in the lower Mississippi where temperatures reach and exceed 30°C.[45]

Table 2 is a prioritized partial listing of water bodies for dreissenid monitoring in Oregon (for complete table, see Appendix V). The prioritization is based on an assessment of the relative risk of introduction and establishment of dreissenids into individual lakes, reservoirs, and rivers.

Dreissenid mussel surveys of water bodies with the greatest risk of introduction and establishment should employ standardized protocols for the examination of solid surfaces and sediment samples for adult mussel detection, plankton samples for veliger analysis, and shoreline walks to search for mussel shells, particularly in reservoirs that have been drawn down. Monitoring should be coordinated regionally.

[43] Hincks, S.S. and G.L. Mackie. 1997. Effects of pH, calcium, alkalinity, hardness, and chlorophyll on the survival, growth, and reproductive success of zebra mussel (*Dreissena polymorpha*) in Ontario lakes. Can. J. Fish. Aquat. Sci. 54:2049-2057.

[44] McMahon, R.F., 1996. The Physiological Ecology of the Zebra Mussel, *Dreissena polymorpha*, in North America and Europe. Amer. Zool. 36:339-363.

[45] Ibid.

Table 2. Top high-risk water bodies in Oregon based on water chemistry and boat use data.[46] Detailed information about the top five water bodies can be found in Appendix VI.

Water Body Name	Ca++ mg/L	pH	Establishment	Introduction
Prineville Reservoir	33.4	7.72	High	High
Owyhee Reservoir	28.2	7.55	High	High
Paulina Lake	28.0	8.25	High	High
East Lake	25.5	7.25	High	High
Snake River, Brownlee Reservoir	31.3	8.13	High	High
Snake River, Hells Canyon Reservoir	31.0	8.20	High	Medium
Applegate Reservoir	18.1	7.75	Medium	High
John Day River	17.3	7.79	Medium	High
Columbia River, Lake Celilo	17.0	8.07	Medium	High
Columbia River, Lake Bonneville	16.5	8.11	Medium	High
Ochoco Reservoir	20.1	8.40	Medium	Medium
Wallowa Lake	14.0	8.09	Low	High
Emigrant Lake	12.6	7.02	Low	High

[46] Wells, S., T.D. Counihan, A. Puls, M. Sytsma and B. Adair. 2010. Prioritizing Zebra and Quagga Mussel Monitoring in the Columbia River Basin Prepared for Bonneville Power Administration and the Pacific States Marine Fisheries Commission BPA Contract Number: 00003373 TI Project Number: 152.

Verification and Initial Response to Dreissenids and Other AIS Reports

Determining the credibility of any AIS report and further verifying an AIS or Dreissenid mussel introduction can be difficult and time consuming. The initial response to an AIS report, including that of dreissenids, depends on protocols and steps established before any introduction. Clearly anticipating the nuances of any report can be difficult, and final determination of status/action is ultimately determined by the AIS Coordinators. Guidelines have been established for verifying a report, assigning a status to water bodies of concern, and addressing the tasks associated with each status level to facilitate the objectives of the CRB Plan as well as prepare for a complete response to a positive introduction. Steps are primarily focused on information gathering and preventing further spread while awaiting final confirmation of dreissenid or other AIS presence.

Verify Reported Introduction

Oregon has a three-step process relative to positive mussel identification (Table 3). The process assigns a status level to the water body in question and sets forth a list of corresponding actions to be undertaken by the AIS coordinators as the verification proceeds. Figure 2 shows a mock timeline of how these actions might unfold along the report verification timeline.

The verification process is divided into categories based on life stage and identification technique: adult mussel, veliger discovered under cross-polarized light microscopy (XPLM), or veliger detected using a PCR assay. Each of these categories is subdivided to allow for various levels of confidence within each type of sample/report.

After an initial detection report is received and evaluated by the AIS coordinators, the verification matrix is activated. In an ideal situation, no more than 7 business days elapse between the results of the initial notification and the verification step. In reality, times will likely vary divergently on a case-by-case basis.

If the verification results are contradictory or vague, the status of the water body will remain “Inconclusive” until further verification results are available. The status remains “Inconclusive” until a rationale is provided and accepted. This may require additional sampling the following season or reevaluating

archived samples from the water body. This will be undertaken on a case-by-case basis by an advisory team assembled by Oregon AIS coordinators.

If further verification efforts fail to confirm the initial detection, the Oregon AIS coordinators may evaluate the situation and determine if down-grading the status of the water body or further research/exploration is warranted and in accordance with the de-listing protocols below.

It should be noted that verified reports for the presence of dreissenid veligers or a single adult mussel does not indicate that a water body is "positive" for a mussel infestation or "infested" i.e. supports a reproducing mussel population (see definitions below).

Definitions for water body status categories and requirements for delisting are as follows:

Definitions:

- **Verification** – the scientifically-based process to confirm the presence of Aquatic Invasive Species (AIS).
- **Detect or detected** – the verified presence of AIS.

Water body definitions:

- **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, but has had one positive test result.

Management Trigger →

- **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 population of AIS.

De-listing a Water Body for Dreissenids:

- **Inconclusive** – 1 year of negative testing including at least one sample taken in the same month of subsequent year as the positive sample (accounting for seasonal environment variability) to get to undetected/negative.
- **Suspect** – 3 years of negative testing to become undetected/negative.
- **Positive** – 5 years of negative testing to become undetected/negative.
- **Infested** – Following a successful eradication or extirpation event including a minimum of 5 years post-event testing/monitoring with negative results.

Table 3. Protocols for verifying adult and veliger stages of dreissenids, with corresponding water body determinations.[47]

Adult		**Veliger/Microscopy (XPLM)** (Veliger sample preservation/handling to meet minimum PCR requirements (e.g., 70% buffered EtOH, cold storage)			**Veliger/PCR** (PCR results require gel Polaroid and sequencing data for review, PCR results without corresponding XPLM confirmation may require multiple gene targets, qPCR and/or other information as the technology continues to develop)	
Visual ID of settled adult by expert	Plausible report, no shell/specimen available, survey water body	Strong positive visual ID [multiple larval states, high quality sample]	Positive visual ID [lacking "strong" criteria]	Weak visual ID [suspect bivalve, poor quality sample]	Positive	Suspicious/ weakly positive result → evaluate sample preservation and handling; evaluate PCR technique; gene sequencing; seek confirmation by independent lab, rerun split/other samples where available
Confirmation of visual ID by additional expert [photo okay]		Independent expert confirmation of dreissenid veliger [photo okay] – must be confirmed by at least 2 independent experts	Same as "strong"	[Evaluate other samples if avail.]	Validation of PCR results through independent review	
Confirmation of ID and determination of species		Microscopy by independent lab and/or PCR by independent lab	Same as "strong"	PCR confirmation X 2 and gene sequence match	Microscopy verification by an independent lab and 2 PCR confirmations by independent labs	

"Suspect"

State Preparation Begins

"Inconclusive"

[47] Unusual or contradictory results to be evaluated on a case-by-case basis by committee. Microscopy refers to cross-polarized light microscopy or XPLM. Protocols for scanning electron microscopy or SEM have not yet been developed.

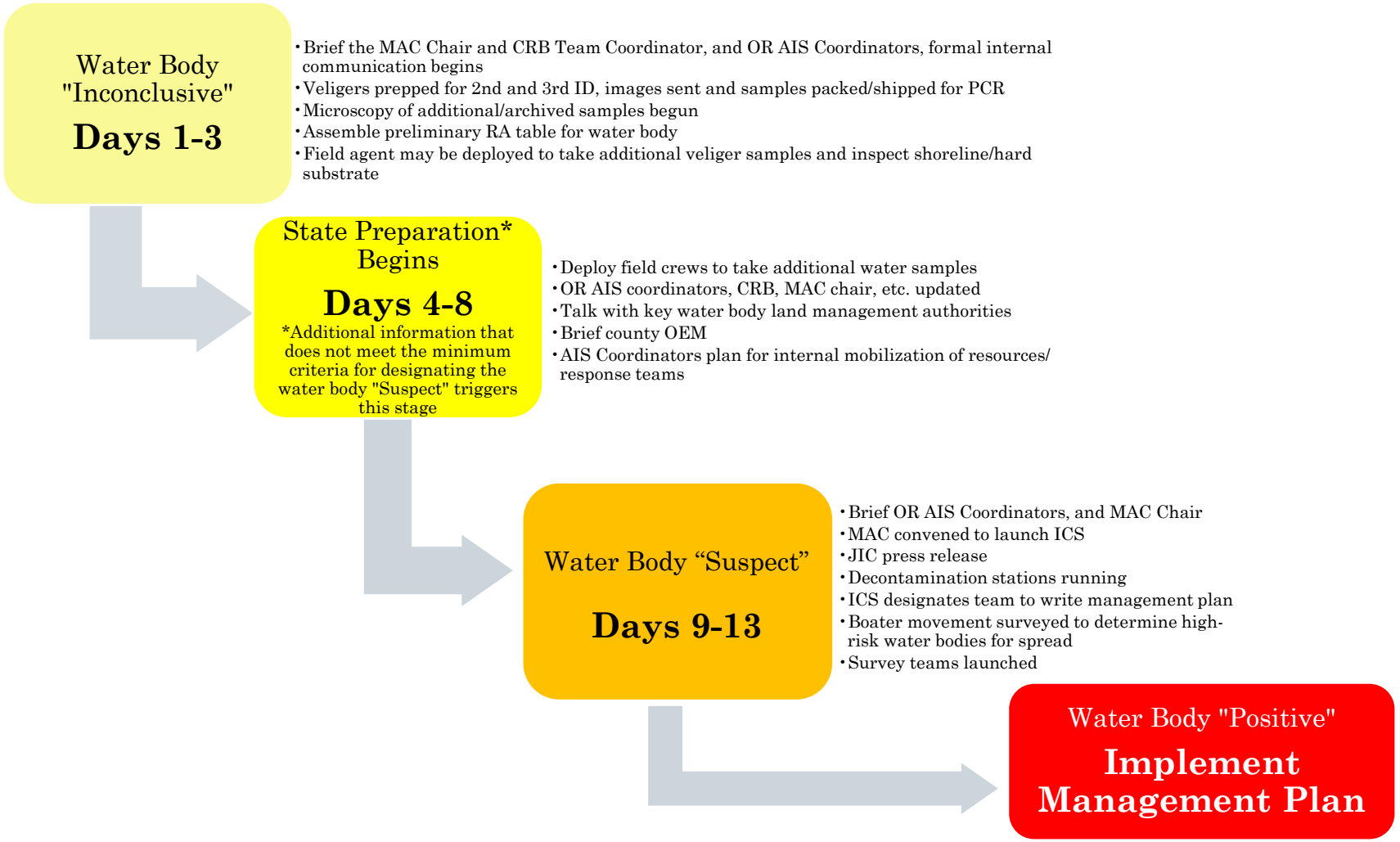


Figure 2. Mock timeline (in days) showing verification of identification, accompanying tasks and water body status following preliminary identification/reporting of dreissenid mussel veligers.

Status Levels and Corresponding Actions

Water Body Status: INCONCLUSIVE

- Brief the MAC Chair and CRB Team Coordinator, and OR AIS Coordinators, formal internal communication begins
- Veligers prepped for 2nd and 3rd ID, images sent and samples packed/shipped for PCR
- Microscopy of additional/archived samples begun
- Assemble preliminary RA table for water body
- Field agent may be deployed to take additional veliger samples and inspect shoreline/hard substrate

State Preparation Begins

- Deploy field crews to take additional water samples
- OR AIS coordinators, CRB, MAC chair, etc. updated
- Governor's office, ODFW director, and OISC ex-officio members notified
- Talk with key water body land management authorities
- Brief county OEM
- AIS Coordinators plan for internal mobilization of resources/ response teams

Water Body Status: SUSPECT

- Brief OR AIS Coordinators, and MAC Chair
- MAC convened to launch ICS
- Joint Information Center press release
- Decontamination stations running
- ICS designates team to write management plan
- Boater movement surveyed to determine high-risk water bodies for spread
- Survey teams launched:
    - Veliger samples taken (re-sample at 2 week intervals minimum in spawning season)
    - Additional WQ sampling as needed
    - Shoreline and fixed/temporary hard substrate surveys for adults (including any Portland Samplers, or exposed infrastructure - stakeholders)

- Benthic sampling and or diver/snorkeler surveys of hard substrate
- Survey moored boats/moorages/marinas if any for potential "carriers"

NOTIFICATION

OREGON AIS INCIDENT SYSTEM

The ICS coordinating structure is designed to comply with the requirements of a National Incident Management System (NIMS) and describes the composition of the Oregon Incident Command Structure Team, which focuses on interagency decision-making and communication.

In the case of a mussel report, the Oregon AIS Coordinator will alert the other state AIS coordinators and the Regional USFWS AIS coordinator. Should the Columbia River Basin Rapid Response Plan (CRBRRP) be deemed by the MAC to not be the appropriate response structure to respond to the introduction,[48] Oregon's ICS will be used. The ICS structure has also been created to fit into the CRBRRP incident command structure to implement those objectives that are delegated to the state or responsible agency (see Table 1).

The objective of notification is to ensure that all parties that have jurisdiction over response decisions are engaged quickly and at the appropriate stage of any response. Table 2 of this document lists the agencies and entities with AIS management and coordination responsibilities or interests in Oregon. Additional stakeholders may need to be notified in the course of a response, including, but not limited to, irrigation districts, municipal water users, marinas, and boat ramp operators.

Although the lead entity for undertaking initial notifications at the alert and suspect levels is ODFW, it may be appropriate for other agencies to take the lead in notifying their existing partners (e.g., OSMB could notify marina and boat ramp operators).

[48] This may happen for one of several reasons: the infestation may be located outside of the Columbia River Basin (e.g., in the Klamath Basin); the CRB MAC deems a situation to be better situated to a single state response; the plan is used for a non-dreissenid AIS response; etc.

Appendix VIII provides the contact information for individuals that should be notified when water bodies are determined to be inconclusive and suspect.

Inconclusive notification:

- ODFW
- OSMB
- PSU
- USFWS RO, CRB MAC chair
- State/Federal AIS Coordinators as appropriate if shared waters

Suspect Notification (in addition to the above)

- Oregon MAC/Incident Command, CRB MAC
- Primary stakeholders, OISC
- Governor's Office/ Governor's Natural Resource Cabinet
- Initial Press Release and briefing
- Notification of affected user groups
- Communicating with stakeholders and other agencies

Generic language for this initial release of information about the initial infestation is as follows:

> *We are currently investigating reports of* [name of invasive species] *in the vicinity of* [general location]. *Experts from the* [Columbia River Basin Interagency Team or OR AIS Coordinators] *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, the briefing is the only place where officials are authorized to speak about the incident and confirmed information will be available. Thank you for your assistance.*

A sample press release for a Suspect water body is provided in Appendix IX.

An external communications system will be established and activated consistent with the guidance for a CRBANS. The Communications Team (CommTeam) is responsible for the coordinated formulation and release of information about the infestation to the news media, the public, and other agencies. The CommTeam is also responsible for disseminating summary information on the project if and when the ICS is disbanded.

Lead Agency: CommTeam: ODFW, OSMB Public Information Officers

OREGON MULTI-AGENCY COORDINATION GROUP (OR MAC)

The Oregon Multi-Agency Coordination Group (OR MAC) will be led by ODFW and include OSMB, CLR, USFWS, ODEQ, ODA, the Chair of the OISC, a representative of the Governor's Natural Resources Board and others as determined by the incident (e.g., USFS, BLM, OPRD, etc.) and the incident location.

Reporting directly to the OR MAC is the Planning and Response Coordinator. This will be staffed by ODFW. The Planning and Response Coordinator will oversee the Planning Team, the Response Team and any logistics staff.

The composition of the Planning Team, similar to the MAC, will be dependent on the location of the incident, but will include all the state AIS leads and major stakeholders.

The Joint Information Center will be a shared position staffed by ODFW and the OSMB Public Information Officers.

The Scientific Advisory Panel membership will include academia, AIS responders with experience in dreissenid infested waters and others who can provide planning advice and review response plans.

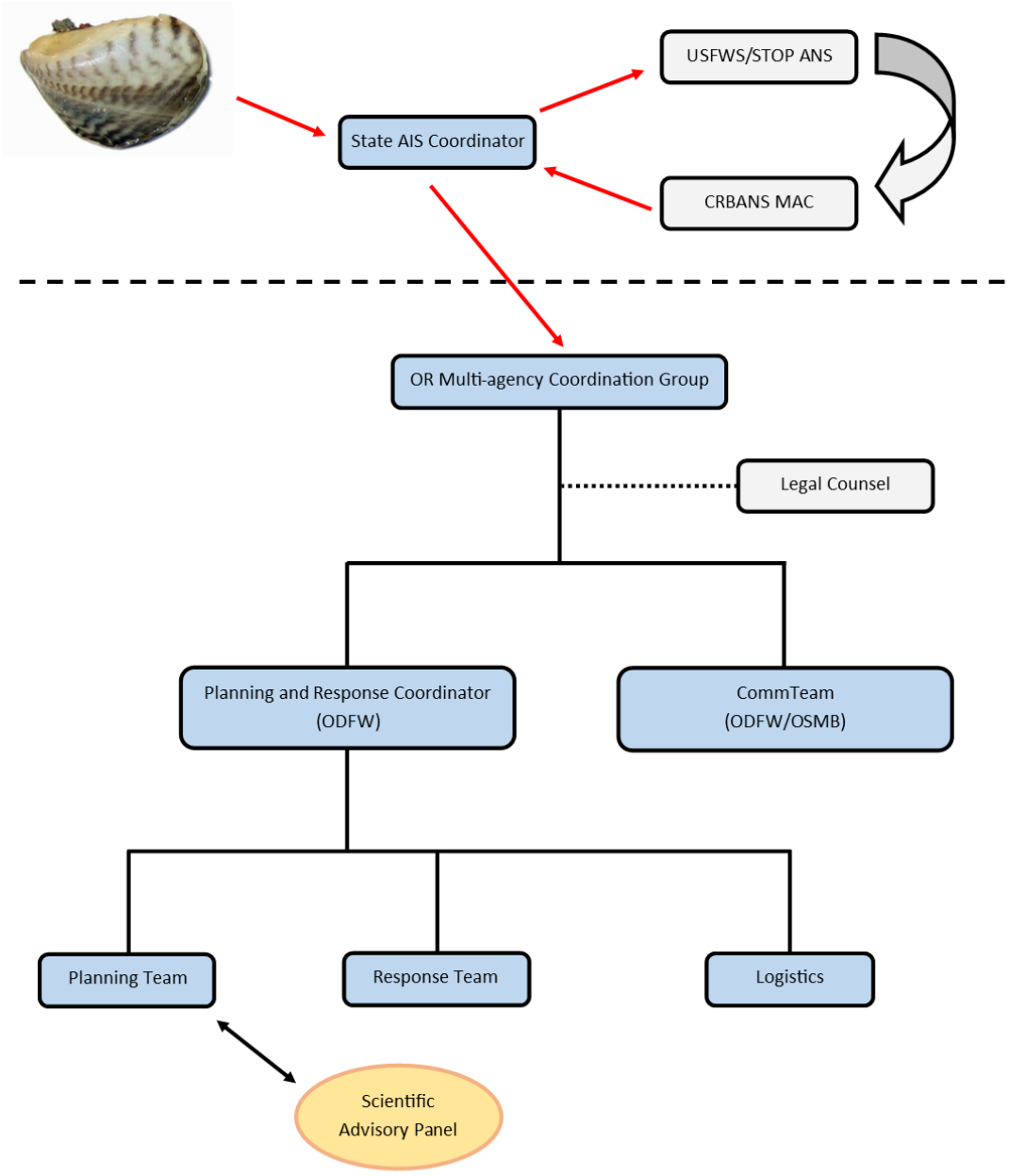


Figure 2. Oregon Incident Command System (ICS).

Defining the Extent of Colonization

To inform policy and tactical response to the infestation, survey crews will establish the physical range of infestation and identify the life-cycle phase(s)/age of infestation of mussels present. These demographics will guide subsequent management decisions, including survey design. Investigation of the geographic extent of infestation will require surveying upstream and downstream areas and any connected water bodies.

Lead entity: ODFW, lead agency where incident occurs, CLR

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
   - plankton sampling. Plankton sampling may be analyzed microscopically or via Polymerase Chain Reaction (PCR) genetic analysis. 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.

5. Ensure that surveys are completed and that results are reported

Preventing Further Spread

Preventing spread of an original introduction is crucial to the success of EDRR. The use of a quarantine or temporary closure will be necessary until prevention techniques can be implemented to manage the pathways that spread dreissenid mussels. The duration of the emergency closure will last until a prevention plan is implemented for the water body. If closure is untenable, WIT Teams must be on hand for decontamination.

Lead entity: ODFW, OSMB, CLR

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 introduction.
- 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.

A template that includes information that should be included in a management plan is described in Appendix X.

Initiating Available/relevant Control Actions

Evaluate management options and proceed either with eradication efforts or containment/mitigation activities. Convene scientific advisory team to consult.

Lead entity: ODFW

Tasks:

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

- Cost versus benefit of treatment options.
- Type of water body (e.g., 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 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 much 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.
    - Use of area by Threatened and Endangered species.

2. If eradication is attempted, select appropriate method(s).

3. If eradication is not possible or fails, develop control objectives and select/design appropriate control measures.

4. Obtain relevant permits and regulatory agency concurrence (see Appendices IV and V).

5. Implement eradication or control strategies.

Extended Response

Long-term Monitoring

This objective provides data for adaptive management and long-term evaluation of management and control efforts, and will be included in the management plan for each water body.

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

Tasks:

1 Continue control strategy developed during Initial Response.

2. Develop long-term control objectives

3. Design a monitoring program to evaluate the status of the zebra/quagga mussel populations, emphasizing veliger sampling. Monitoring activities should be implemented in coordination with other field operations, such as environmental monitoring requirements associated with control action regulatory compliance (e.g., National Pollutant Elimination Discharge System [NPDES] permits).

4. Disseminate findings through an easily-accessible, consolidated, coordinated real-time database and listserv.

5. Evaluate control strategy against results of monitoring program and revise strategy as needed to meet long-term control objectives.

APPENDICES

Appendix I.	Oregon Invasive Species Control Account.
Appendix II.	List of State Resources for *Dreissena* Response.
Appendix III.	Oregon Environmental Regulatory Compliance Framework.
Appendix IV.	Flow Chart of Permitting Alternatives and Associated Contacts.
Appendix V.	At-Risk Water Bodies.
Appendix VI.	Details for Top Five High-Risk Water Bodies in Oregon.
Appendix VII.	Veliger Analysis Documentation.
Appendix VIII.	Notification List for Reports of Dreissenids in Oregon.
Appendix IX.	Sample Press Release.
Appendix X.	Outline for Draft Management Plan.

APPENDIX I. OREGON INVASIVE SPECIES CONTROL ACCOUNT

609-010-0100
Definitions
As used in this division of administrative rules, unless the context requires otherwise:
(1) "Agreement" means a document describing an understanding between the Council and a recipient of Funds, including but not limited to a grant, loan, or memorandum of understanding.
(2) "Council" means the Oregon Invasive Species Council.
(3) "Emergency" means that one or more Invasive Species that is new to the state, or that exhibits a substantial range expansion within the state, threatens the health and integrity of Oregon's native flora and fauna.
(4) "Funds" means money in or disbursed from the Invasive Species Control Account.
(5) "Invasive Species" has the meaning given that term in ORS 570.755.
(6) "Invasive Species Emergency" means a declaration by the Council that an Emergency exists or is imminent, and that the Emergency is of such magnitude that Funds are needed to terminate or lessen the threat.

609-010-0110
Purpose
The purpose of this division of rules is to provide criteria and procedures for administration of the Oregon Invasive Species Control Account.

609-010-0120
Eligible Applicants
(1) A person, state or local government, unit of state or local government, an Indian tribe, or a unit of the federal government, may request that the Council declare an Invasive Species Emergency and release Funds.
(2) The request must be sent to the Council in writing and include a response plan with the following elements:
(a) A risk assessment for the Invasive Species;
(b) Information about efforts implemented to control or eradicate the Invasive Species in other locales;
(c) Methodology proposed to eradicate or control the infestation;
(d) Budget to respond to the infestation;
(e) Timeline for activities associated with response to the infestation; and
(f) Methods to evaluate control or eradication success.
(3) Requests not meeting review standards may be returned for correction or

completion, or may be denied further consideration.

609-010-0130
Standards to Determine Eligibility for Release of Funds
(1) The Council may release Funds only after declaring an Invasive Species Emergency and determining that the action items that are described in the response plan:
(a) Are economically, scientifically, and environmentally defensible and sound;
(b) Contribute to the effective control or eradication of Invasive Species populations or infections;
(c) Achieve a favorable cost/benefit ratio relative to other options considered; and
(d) Respond to an Invasive Species that the Council has deemed to be a high risk to Oregon's economy and environment.
(2) The following expenditures are not eligible for funding through the Oregon Invasive Species Control Account:
(a) Operational costs of managing Invasive Species that are widely established in Oregon; and
(b) Any cost that the Council deems is not necessary to respond to an Emergency.
(3) Outreach, education, and research related to Invasive Species are not generally eligible, but in a specific Emergency they might be part of an appropriate response plan and may be approved by the Council.

609-010-0140
Process for Declaration and Release of Funds
(1) Council members will review the request to declare an Invasive Species Emergency.
(2) During the review process, the Council may consider technical and other information obtained from sources other than the applicant, including, but not limited to, the Governor's Natural Resources Cabinet.
(3) If the Council declares an Invasive Species Emergency, the Council may enter an agreement with a person, state or local government, unit of state or local government, Indian tribe, or federal government that will be responsible for implementing a portion or all of the response plan. The agreement must include all terms required by law and include provisions for the following:
(a) Incorporation of the response plan.
(b) The maximum amount of Funds to be disbursed.
(c) Disbursement of the Funds according to a payment schedule that is incorporated as an integral part of the agreement.
(d) The recipient of Funds shall submit one or more interim reports for evaluation by the Council. The recipient of Funds shall submit the reports either on a schedule that is incorporated into the agreement or upon the request of the Council. Each

report must include:
(A) Documentation of project results to date;
(B) Projections of short-range and long-range results;
(C) Any modifications to the response plan;
(D) Budget status; and
(E) An update on the likelihood of successful eradication.
(e) In the event an interim report is deemed unsatisfactory by the Council, the Council reserves the right to cancel the agreement and stop payments.
(f) Within six months of the official close of the action items designated in the agreement, the Fund recipient shall submit a final report to the Council. This report will provide the most current and detailed information on project benefits as compared with the original criteria.
(g) In the event that a Fund recipient cannot complete any project within the agreement timelines, the Fund recipient shall inform the Council and request a formal extension for use of the Funds.
(h) The Fund recipient shall return all unexpended Funds to the Council for deposit in the Invasive Species Control Account.
Stat. Auth.: ORS 570.800
Stats. Implemented: ORS 570.800, 570.810

APPENDIX II. LIST OF STATE RESOURCES FOR *DREISSENA* RESPONSE.

WIT 1 and II Level Trained Personnel

Name		Level I	Level II	
Last	**First**	**Year**	**In-house**	**Lake Mead**
Allen	**Roger**	2010		
Bailey	**Tim**	2011		2011
Beyer	**Garth**	2013	2013	
Bingham	John	2010		
Boatner	**Rick**	2009		2009
Coulter	**Jessica**	2013	2013	
Craft	**Nadine**	2011		2011
Crafton	Jamie	2010		
Demaris	Rick	2013		
Dodenhoff	**Sam**	2010		2010
Dolphin	Glenn	2007		2008
French	**Rod**	2012		2012
Hamilton	**Darin**	2013	2013	
Hayden	Patrick			2016
Helms	Bruce	2011		
Helms	Debbie	2011		
Hill	Becky	2010		
Howell	**Hayden**	2010		2010
Kinney	**Shane**	2013	2013	
Little	**Christian**	2013	2013	
McNassar	**Gabe**	2013	2013	
Mohler	**June**	2013	2013	
Norris	Larry	2012		
Parker	**Beth**	2011	2011	
Parker	Blaine	2007		2008
Patterson	**Dirk**	2010		2010
Phillips	Stephen	2011		
Raymond	Chase	2013		
Reesman	**Martyne**	2010		2010
Sanders	**Dale**	2013		2013
Shelton	Chris			2016

Name		Level I	Level II	
Last	First	Year	In-house	Lake Mead
Space	**Jason**	2012	2012	
Stanton	**Holly**	2011	2011	
Teem	Jason	2010		
Tinniswood	**Bill**	2012		2012
Warren	**Ray**	2013	2013	
Wood	Dennis	2010		
Bold - current employees of ODFW				

Appendix III. Oregon Environmental Regulatory Compliance Framework

Of particular relevance to the application of pesticides to state waters is the recently revised status of Clean Water Act NPDES permitting requirements. Prior to 2009, the Environmental Protection Agency (EPA) ruled that a CWA NPDES permit was not required when legally registered pesticides are applied for pest control purposes (Federal Register Vol. 71, No. 227, November 27, 2006). In response to legal challenges in 2009, however, the sixth circuit federal court determined that EPA must issue NPDES permits for all chemical pesticide applications that leave a residue or excess pesticide in water (as well as biological pesticide applications). In response, EPA issued a Pesticide General Permit in October 2011 to cover discharges in areas under their permitting authority, which included six states (including Idaho), most tribal lands, and federal facilities in four additional states (including Washington). States with EPA delegated authority to issue NPDES permits (e.g., Montana, Oregon, Washington) have developed state-specific permitting approaches that may be similar or more stringent than the federally issued Pesticide General Permit.

Fact Sheet:

http://www.deq.state.or.us/wq/pubs/factsheets/permits/2300APesticides.pdf

Pesticide General Permit (2300A)

PESTICIDE APPLICATIONS COVERED UNDER THE PERMIT

"Nuisance animal control for invasive or other nuisance animals and pathogens in water and at the water's edge. Coverage extends to but is not limited to, control of fish, mollusks, fungi and bacteria. The term "in water" includes, but is not limited to applications made to creeks, rivers, lakes, riparian areas, wetlands, and other seasonally wet areas when water is present. The term "water's edge" means within 3 feet of waters of the state and conveyances with a hydrologic surface connection to waters of the state at the time of pesticide application. The 3 feet is measured horizontally from the water's edge and conveyance."

TABLE III1. PESTICIDE USE MATRIX FOR AN ISOLATED ZEBRA MUSSEL INFESTATION IN OREGON'S COLUMBIA RIVER BASIN.

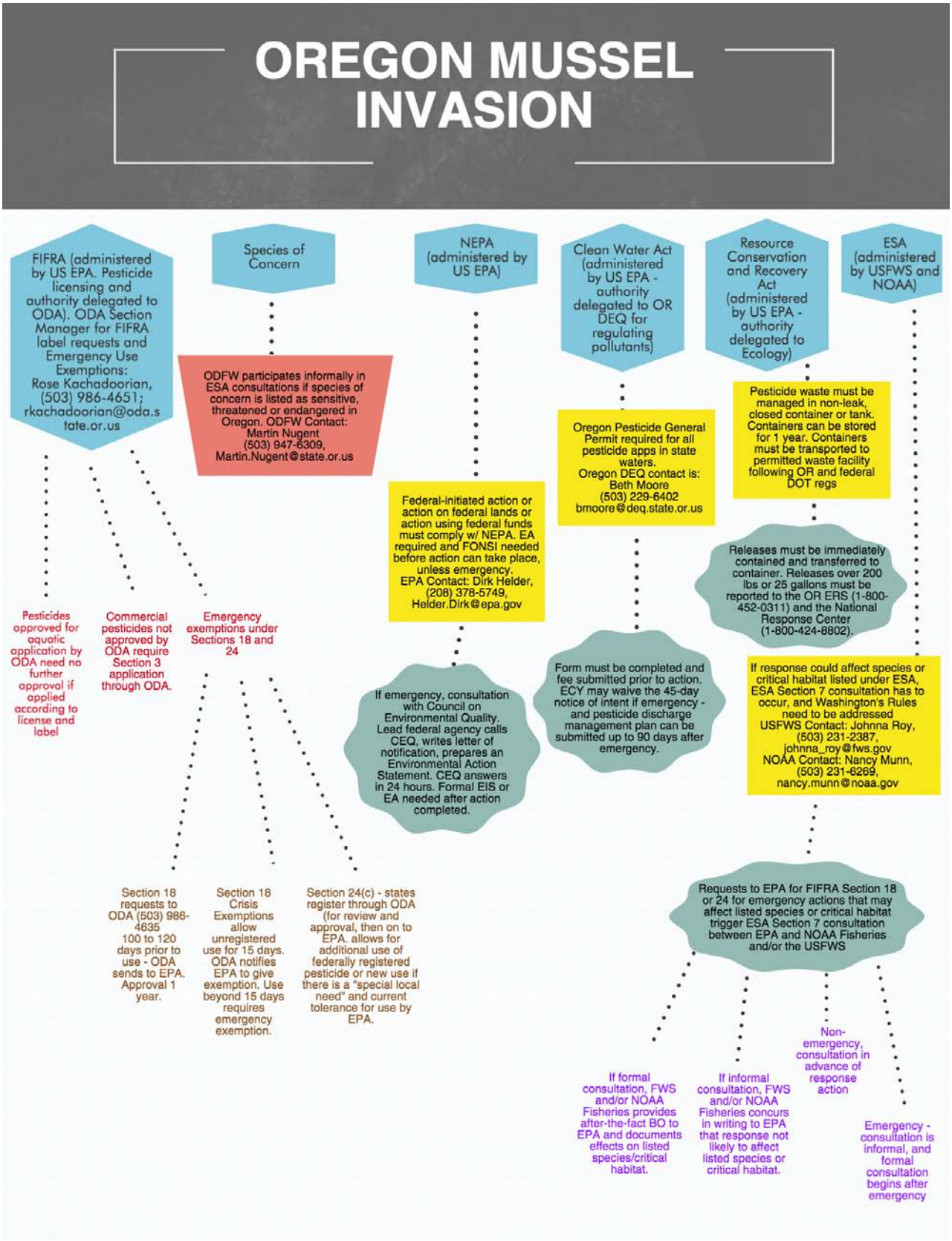
REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) administered by US EPA. Pesticide licensing and application authority delegated to Oregon Department of Agriculture (ODA). Implemented under the **Oregon Pesticide Control 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

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
		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.
Oregon Department 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	▪ The Oregon Pesticide General Permit, 2300-A (http://www.deq.state.or.us/wq/wqpermit/pesticides.htm), is required for all pesticide application to state waters. Large-scale applications,	▪ Oregon PGP coverage requires that the application form must be filled out and fee submitted prior to planned activity. However, during a declared pest emergency situation ODEQ may waive the 45 day

REGULATORY REGIME	REGULATORY APPROVAL PROVISIONS	EMERGENCY PROVISIONS
Department of Environmental Quality (DEQ) for regulating pollutants in state waters. Implemented under the **Oregon Water Quality Act (OAR Chapter 340, Division 45)**	federal and state agencies must register with ODEQ for permit coverage. The permit covers pesticides applied in accordance with FIFRA label instructions, does not allow for application of pesticides to a waterbody that is already listed as impaired by that pesticide or its by-products, and must not cause or contribute to water quality standards violations.	advance notice of intent on a case-by-case basis and the required pesticide discharge management plan (PDMP) may be submitted up to 90 days after responding to the emergency.
Resource Conservation and Recovery Act administered by US EPA with authority delegated to the Oregon Department 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 Department 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.

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

Appendix IV. Flow Chart of Permitting Alternatives and Associated Contacts



APPENDIX V. AT-RISK WATER BODIES

Table 19. Water bodies in Oregon that have a high to medium relative risk of dreissenid mussel establishment and/or introduction. Risk categories were formulated using best professional judgment. The amount of data used to assign risk categories varied for each water body. Data is summarized in Appendix 1 and II, and risk categories based on one or two data points are flagged with an asterisk. Dreissenids can also establish in areas identified with low to very low risk of establishment.

Water Body Name	mg/L	pH	Risk of Establishment	Risk of Introduction
Prineville Reservoir	33.4	7.72	High	High
Owyhee Reservoir	28.2	7.55	High	High
Paulina Lake	28.0	8.25	High	High
East Lake	25.5	7.25	High	High
Snake River, Brownlee Reservoir	31.3	8.13	High	High**
Snake River, Hells Canyon Reservoir	31.0	8.20	High	Medium
Applegate Reservoir	18.1	7.75	Medium	High
John Day River	17.3	7.79	Medium	High
Columbia River, Lake Celilo	17.0	8.07	Medium	High
Columbia River, Lake Bonneville	16.5	8.11	Medium	High
Ochoco Reservoir	20.1	8.40	Medium	Medium
Wallowa Lake	14.0	8.09	Low	High
Emigrant Lake	12.6	7.02	Low	High
Lake Billy Chinook	11.0	9.00	Very Low	High
Klamath Lake	7.3	7.57	Very Low	High
Howard Prairie Lake	6.9	7.56	Very Low	High
Willamette River	6.8	7.12	Very Low	High
Deschutes River	6.5	7.91	Very Low	High

North Fork Reservoir	5.7	7.48	Very Low	High
Henry Hagg Lake	5.6	7.07	Very Low	High
Fern Ridge Reservoir	5.2	7.80	Very Low	High
Lost Creek Lake	5.0	7.30	Very Low	High
Devils Lake (Lincoln)	4.7	7.8	Very Low	High
Dexter Lake	4.7	7.60	Very Low	High
Foster Reservoir	4.4	7.20	Very Low	High
Loon Lake	4.2	7.00	Very Low	High
Green Peter Lake	4.0	7.30	Very Low	High
Wickiup Reservoir	3.5	7.60	Very Low	High
Detroit Lake	3.5	7.51	Very Low	High
North Tenmile Lake	3.4	7.10	Very Low	High
Mercer Lake	3.0	7.87	Very Low	High
Odell Lake	3.0	7.79	Very Low	High
Lake of the Woods	2.5	7.14	Very Low	High
Diamond Lake	2.5	7.36	Very Low	High
Crescent Lake	2.4	7.20	Very Low	High
Crane Prairie Reservoir	2.2	9.80	Very Low	High
Lava Lake	2.1	7.90	Very Low	High
Simtustus Lake	10.4	8.90	Very Low	Medium
Hyatt Reservoir	10.0	7.34	Very Low	Medium
Phillips Lake	8.9	8.20	Very Low	Medium
Chickahominy Reservoir	8.1	7.70	Very Low	Medium
Agency Lake	7.0	7.46	Very Low	Medium
Dorena Reservoir	6.9	7.63	Very Low	Medium
Cottage Grove Lake	6.4	6.77	Very Low	Medium
Hills Creek Lake	5.3	8.10	Very Low	Medium
Selmac Lake	4.7	-	Very Low	Medium
Pine Hollow Reservoir	4.5	7.40	Very Low	Medium
Timothy Lake	4.5	7.64	Very Low	Medium

Smith Reservoir	4.2	7.20	Very Low	Medium
Fall Creek Reservoir	4.1	7.58	Very Low	Medium
Eel Lake	3.6	7.40	Very Low	Medium
Lemolo Lake	3.5	7.53	Very Low	Medium
Siltcoos Lake	3.4	7.48	Very Low	Medium
Blue River Reservoir	3.2	7.49	Very Low	Medium
Triangle Lake	2.4	7.00	Very Low	Medium
Munsel Lake	2.1	7.05	Very Low	Medium
Cultus Lake	2.0	7.50	Very Low	Medium
Woahink Lake	1.9	7.10	Very Low	Medium
Olallie Lake	0.5	-	Very Low	Medium

** Water body had high relative risk of introduction in Idaho.

APPENDIX VI. DETAILS FOR TOP FIVE HIGH-RISK WATER BODIES IN OREGON

	Prineville Reservoir	Owyhee Reservoir	Paulina Lake	East Lake	Brownlee Reservoir
Type of waterbody	Reservoir	Reservoir	Natural Lake	Natural Lake	Reservoir
Location					
Latitude	44 06'36"N	43 27'41"N	43 43'12"N	43 43'48"N	44 50'32"N
Longitude	120 47'08"W	117 20'18"W	121 15'21"W	121 12'53"W	116 53'56"W
County	Crook	Malheur, Hells Canyon County, OR; Owyhee County, ID	Deschutes	Deschutes	Hells Canyon, Baker County, OR; Washington County, ID
Drainage	Crooked	Owyhee	Newberry Caldera	Newberry Caldera	Hells Canyon
Inflow	Crooked River, Bear Creek, Sanford Creek, Deer Creek, Alkali Creek, Antelope Creek, Owl Creek	Owyhee	Springs/East Lake	Springs	Snake R. Powder R. Burnt R.
Outflow	Crooked River	Owyhee	Paulina Cr.	None	Snake R.
Atlas of Oregon Lakes URL	http://aol.research.pdx.edu/?q=lake/378	http://aol.research.pdx.edu/?q=lake/375	http://aol.research.pdx.edu/?q=lake/376	http://aol.research.pdx.edu/?q=lake/355	N/A
Statistics					
Surface Elevation (ft)	3,257	2,657	6,331	6,370	2,077
Basin Area (mi^2)	2,635	11,160	17	9	72,590
Surface Area (ac)	3,030	13,900	1,531	1,044	15,000
Volume (ac ft)	150,200	715,000	249,850	69,576	1,426,700
Max. Depth (ft)	130	117	250	180	277
Mean Depth (ft)		81	163	67	106
Shoreline length (mi)	43	150	6.7	5	
Realtime water level	www.usbr.gov/pn/hydromet/destea.html	www.usbr.gov/pn/hydromet/ramps/owyhee.html	N/A	N/A	www.idahopower.com/aboutus/companyinformation/search.cfm?q=brownleereservoir

Trophic state	Eutrophic	eutrophic	mesotrophic	mesotrophic	varies
Water quality/monitoring					
pH	7.72	7.55	8.25	7.25	8.13
Ca++	33.4	28.2	28.0	25.5	31.3
Secchi	1.5	6	9-12	6–7	>3–13
Other		Very high phosphorus	Very high alkalinity and conductivity and high sulfate	Very high sulfate and high alkalinity and conductivity	High phosphorus levels
The Center for Lakes and Reservoirs at Portland State University maintains a searchable database of water bodies in the United States that are sampled for dreissenids and *Corbicula*. Results are reported as "non-detect," "unknown," and "results pending," and identify substrate type (e.g., natural, artificial, plankton, SCUBA, ROV, other, and unspecified). For additional information, or updated information not yet loaded into the database, contact: Mark Sytsma Ph. 503-725-2213 Email: sytsmam@pdx.edu Mailing: Portland State University, PO BOX 751-ESM, Portland OR 97207-0751 Physical: Portland State University, 1719 SW 10th Ave, SRTC Rm 218, Portland OR 97201					
Information					
Dam	Arthur R. Bowman Dam	Owyhee Dam	None	None	Brownlee Dam
Owned/ Administered by:	Bureau of Reclamation	Bureau of Reclamation	Forest Service	Forest Service	Idaho Power
URL	http://www.usbr.gov/projects/Facility.jsp?fac_Nae=Arthur+R+Bowman+Dam	http://www.usbr.gov/projects/Facility.jsp?fac_Nae=Owyhee+Dam	http://www.fs.usda.gov/detail/centraloregon/recreation/?cid=stelprdb5269836	http://www.fs.usda.gov/detail/centraloregon/recreation/?cid=stelprdb5269841	http://www.idahopower.com/aboutus/companyinformation/search.cfm?q=brownleereservoir
Contact Info	http://tinyurl.com/d3b43ed				Idaho Power
System	Crooked River Project	Owyhee Project	N/A	N/A	Hells Canyon
Dam type	Zoned earthfill	Concrete	none	none	Earthfill/ Concrete
Draw down y/n			N	N	Y
Irrigation y/n	Y	Y	N	N	Y
Irrigation District	Ochoco Irrigation District	Owyhee Irrigation District	N/A	N/A	
Other Facilities		Snake River Pumps Electric Power Generation			
T&E Species	Contact USFWS Oregon State Office for current species status				

ODFW Contact	High Desert Region (541) 388-6363	High Desert Region (541) 388-6363	High Desert Region (541) 388-6363	High Desert Region (541) 388-6363	Northeast Region (541) 963-2138
Adjacent land managers/owners					
	Crook County (with lease to State Parks)	BLM, BIA, USFS Oregon State Parks; Malheur County	Private	Private	BLM, Oregon State Parks; Baker County
ODFW Contact	High Desert Region (541) 388-6363	High Desert Region (541) 388-6363	High Desert Region (541) 388-6363	High Desert Region (541) 388-6363	Northeast Region (541)963-2138
Access					
Public ramps?	Y	Y	Y	Y	Y
Private ramps?	Y	Y	Y	Y	N
Moorages?	Y	Y	N	Y	N

APPENDIX VII. VELIGER ANALYSIS DOCUMENTATION

Sample information:

Name

Date

Location

Preservation Technique

Handling: (OR Veliger sample preservation/handling to meet minimum PCR requirements (e.g. 70% EtOH, cold storage)

Cross Polarized Light microscopy:

Ideal: Images (with scale bar) of multiple life stages, multiple veligers

Description of matrix

PCR:

Amplification technique

Sequencing data

Gel Polaroid

APPENDIX VIII. NOTIFICATION LIST FOR REPORTS OF DREISSENIDS IN OREGON. NAMES LISTED IN LIGHT GREY BOXES ARE CONTACTED WHEN WATER BODIES ARE DETERMINED TO BE INCONCLUSIVE. NAMES IN DARKER GREY BOXES ARE CONTACTED WHEN WATER BODIES ARE DETERMINED TO BE SUSPECT.

AGENCY	NAME	PHONE	MOBILE	FAX	EMAIL
Portland State University	Mark Sytsma, Director for the Center for Lakes and Reservoirs	(503) 725-2213	(502) 307-6131	(503) 725-3834	sytsmam@pdx.edu
Oregon Department of Fish and Wildlife	Rick Boatner, AIS Coordinator	(503) 947-6308	(503) 302-5294		rick.j.boatner@state.or.us
Oregon State Marine Board	Glenn Dolphin	(503) 378-2625			glenn.dolphin@state.or.us
Pacific States Marine Fisheries Commission	Stephen Phillips	(503) 595-3100			stephen_phillips@psmfc.org
U.S. Fish and Wildlife Service	Linda Beck, Region 1 AIS Coordinator	(503) 736-4722	(503) 539-9577		linda_beck@fws.gov
Oregon Department of Environmental Quality	Rian Hooff, Ballast Water Program Manager	(503) 229-6865		(503) 229-6124	hooff.Rian@deq.state.or.us
Oregon State University	Sam Chan, Assistant Professor	(503) 679-4828		(541) 737-3039	samuel.chan@oregonstate.edu
Columbia River Intertribal Fish Commission	Blaine Parker, AIS Coordinator	(503) 731-1268	(503) 314-8238	(503) 235-4228	parb@critfc.org
Oregon Governor's Office	Nancy Salber, Office of the Governor	(503) 378-6549		(503) 378-3225	nancy.salber@state.or.us
Oregon Department of Fish and Wildlife	Curt Melcher, Director	(503) 947-6044	(503) 507-5159	(503) 947-6042	curt.melcher@state.or.us
Oregon Department of Agriculture	Helmuth Rogg, Administrator	(503) 986-4662		(503) 986-4786	hrogg@oda.state.or.us
Oregon Department of Forestry	Wyatt Williams, Invasive Species Specialist	(503) 945-7472			wwilliams@odf.state.or.us
U.S. Fish and Wildlife Service	Roy Elicker, Assistant Regional Director	(503) 231-2217			Roy_elicker@fws.gov
Washington Department of Fish and Wildlife	Bill Tweit, Special Assistant to Director	(360) 902-2723	(360) 489-2644		william.tweit@dfw.wa.gov
Washington Department of Fish and Wildlife	Allen Pleus, AIS Coordinator	(360) 902-2724	(360) 918-3868		allen.pleus@dfw.wa.gov

Washington Department of Fish and Wildlife	Sgt. Justin Maschhoff, AIS Enforcement Coordinator	(360) 902-2936	(253) 381-7387		justin.maschhoff@dfw.wa.gov
Idaho Department of Agriculture	Lloyd Knight, Administrator	(208) 332-8664	(308) 859-4173		lloyd.knight@agri.idaho.gov
Idaho Department of Agriculture	Tom Woollf, AIS Program Manager, Invasive Species and Noxious Weeds	(208) 608-3404			Thomas.woolf@isda.idaho.gov
Idaho Department of Agriculture	Nic Zurfluh	(208) 332-8686			nicholas.zurfluh@agri.idaho.gov
Idaho Department of Fish and Game	Dave Parrish, Sport Fishing Program Coor.	(208) 287-2773	(208) 539-3937		david.parrish@idfg.idaho.gov
Montana Fish, Wildlife, and Parks	Tom Boos, AIS Coordinator	(406) 444-1267		(406) 444-4952	tboos@mt.gov
Montana Fish, Wildlife, and Parks	Zach Crete, State Liaison	(406) 444-5353			zcrete@mt.gov
Nevada Department of Wildlife	Karen Vargas, AIS Coordinator	(775) 688-1532			kvargas@ndow.org
U.S. Fish and Wildlife Service	Carrie Cook-Tabor, AIS Coor., Western WA F&W Office	(360) 753-9508		(360) 753-9407	carrie_cook-tabor@fws.gov
U.S. Fish and Wildlife Service	Bob Kibler, AIS Coordinator, Idaho F&W Office	(208) 378-5255		(208) 378-5264	bob_kibler@fws.gov
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
U.S. Fish and Wildlife Service	Ron Smith, Region 8 AIS Coordinator	(209) 334-2968, ext. 321			ronald_smith@fws.gov
U.S. Fish and Wildlife Service	Steve Chilton, Northern Nevada AIS Coordinator	(775) 589-5265			steve_chilton@fws.gov
National Oceanic and Atmospheric Administration	Ritchie Graves, Supervisory Fisheries Biologist	(503) 231-6891	(503) 730-5148		ritchie.graves@noaa.gov
Columbia River Intertribal Fish Commission	Rob Lothrop, Acting Executive Director	(503) 731-1291			lotr@critfc.org
Columbia River Intertribal Fish Commission	Mike Matylewich, Fish. Management Director	(503) 731-1251	(503) 756-3329	(503) 235-4228	matm@critfc.org
Bonneville Power Administration	Kim Johnson	(503) 230-3902	(971) 334-1014		kojohnson@bpa.gov
Northwest Power and Conservation Council	Leslie Bach, Manager, Mainstem Passage and River Ops.	(503) 222-5161			lbach@nwcouncil.org

APPENDIX IX. SAMPLE PRESS RELEASE.

Contact
Rick Boatner, ODFWF Invasive Species Coordinator, (503) 947-6308,
rick.j.boatner@state.or.us

The Oregon Department of Fish and Wildlife (ODFW) has declared _____-_____ a "suspect location" for infestation of invasive quagga mussels. This report has been initially verified by [agency/recognized expert], and efforts are underway to [describe what's next, if anything, to confirm identification].

This discovery is a serious environmental and economic concern for the Pacific Northwest. Invasive quagga and zebra mussels are small nonnative freshwater mollusks that have caused major problems in the United States after their introduction in the 1980s.

Officials have not yet determined how these mussels entered _____. Recreational boats are known to be a major source of invasive mussel spread in the United States, and there are a number of past incidents where boats fouled by live invasive mussels have been intercepted prior to launching in Northwest waters.

In preparation for an introduction of invasive mussels in Oregon, officials developed a rapid response plan outlining a set of actions to address the initial finding and monitor the situation long term.

Until additional surveys are conducted, the extent of the infestation is unknown. During this phase of rapid response, the _____ (agency) has _____ (restricted access) to _____ (infected location) to help prevent further potential dispersal of the invasive 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.

ODFW Invasive Species Coordinator Rick Boatner manages Oregon's boat inspection program and commented on its importance. "We recognize the inconvenience to boaters and understand the need for additional sampling and identification to determine if this water body is positive for quagga mussels," said Boatner. "Our staff will ensure that boats will go through the inspection process as efficiently as possible."

Boaters can assist with the process by arriving at _____ with a clean, drained and dry vessel.

For more information, visit ODFW's website at http://www.oregon.gov/ODFW

APPENDIX X. OUTLINE FOR DRAFT MANAGEMENT PLAN

Upon discovery of a suspected infestation, the State of Oregon implements its Dreissenid Rapid Response Plan, which includes:

a. Detection activities—define the extent of the mussel infestation, its distribution and maturity.
b. Coordination activities—define the lead agency, coordinate collaboration among agencies, and allocate resources for a response and coordinate communication.
c. Mitigation and control strategies—to avoid further spread of the infestation, control[49] and reduce the size of the infestation and establish a monitoring plan to assess control effectiveness.

Upon confirmation of an infestation (i.e., a water body is determined to be positive for invasive mussels), the State will develop a management plan for that water body. The plan will include the following elements:

- **Identify objectives, priorities, and timeframes.**
    - **Objective: Determine extent of infestation**
        - Establish training and assessment protocols
        - Conduct surveys
        - Compile findings and distribute online
        - Collect additional samples
        - Identify at-risk infrastructure and coordinate with local infrastructure authorities
    - **Objective: Contain infestation**
        - **Coordinate with land management authority to implement mandatory inspection and decontamination of boats upon entry and exit of water body**

[49] Details on potential treatment methods can be found in Appendix D1 of the *Columbia River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other* Dreissenid *Species*.

- **Ensure decontamination units are available at water body**
- **Communications**
  - **Management Authority-specific**
    - Develop and distribute survey decontamination protocols
    - Train individuals in mussel detection and communication with the public (draft key messages)
    - **Establish and maintain internal communication** protocols with partner agencies.
    - **Establish and maintain communications** with other geographic response organizations.
    - **Develop briefing statements** to inform senior management within the partner agencies.
    - **Establish an interagency public affairs team** to promote coordinated public outreach effort.
    - **Continue to participate in efforts to address quagga/zebra mussels** via 100th meridian, Western Regional Panel, Pacific Northwest Economic Region, and others.
  - **External**
    - **Raise public awareness** via media outlets by issuing news releases, sponsoring a media day event.
    - Post signs at water body and throughout local community.
    - Promote Clean, Drain, Dry

- **Objective: Investigate treatment options**
  - Determine most appropriate option to control or eradication mussels (Review Appendix D1 of the *Columbia River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species* to explore treatment options)

        - Explore and implement permitting requirements needed to effect management actions (Refer to Table IV1. Pesticide Use Matrix For An Isolated Zebra Mussel Infestation In Oregon's Columbia River Basin as well as appendices of *Columbia River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species*).
        - Coordinate with water body land management authority(ies) to manage use of the lake and control implementation actions.

    - **Objective: Identify actions needed to meet statutory responsibility of management agencies**

- **Identify Members of the Scientific Advisory Panel**, composed of both subject matter experts on *Dreissena* spp. as well as limnologists and aquatic ecologists familiar with the watershed (academia, AIS responders with experience in dreissenid infested waters and others), who can provide planning advice and review response plans.

- **Economics**
    - **Accurately track costs and cost estimates** of the response and share with management authorities and the public. Provide justifications for expenditures.
    - Communicate financial responsibility to all incident responders

- **Identify ecological impacts**
    - Measure and track ecological changes, develop mitigation plans, and implement long-term mitigation actions (examples listed below).
        - Food chain
        - Water clarity
        - Bioaccumulation of pollutants and toxic metals
        - Alteration of waterfowl migration
        - Effects on sport fisheries
        - Effects on threatened and endangered species

APPENDIX XI. EXAMPLE OF FIFRA SECTION 18 EMERGENCY EXEMPTION APPLICATION

FIFRA SECTION 18 - EMERGENCY EXEMPTION - QUARANTINE REQUEST

FIFRA SECTION 18 - EMERGENCY EXEMPTION - QUARANTINE REQUEST

Dreissenid Mussel Treatment Plan using KCl for XXXX (Location), Oregon/Washington/Idaho/Montana

(§166.20 Application for a quarantine exemption.)

AGENCY CONTACT PERSON:

Name
Title
Division
Agency
Address
City, State, Zipcode
Email
Telephone

Qualified Experts:

Name
Title
Division
Agency
Address
City, State, Zipcode
Email
Telephone

Registrant (Supplier of product to be used):

Name
Title
Division
Agency
Address
City, State, Zipcode
Email
Telephone

PESTICIDE DESCRIPTION:

Potassium Chloride (KCl) is a metal halide salt also known as Muriate of Potash or Potash. This salt has an unclear mode of action but the potassium (K^+) is the lethal chemical for mussels. Evidence suggests it kills mussels by interfering with gill respiration (Aquatic Sciences Inc. 1997).

> *The application shall contain a description of the pesticide(s) proposed for use under the exemption:*
>
> *(i)* *For a federally registered pesticide product:* **Not applicable**
> *(ii)* *For any other pesticide products:* **KCl**
>
> i. *A confidential statement of formula*: **See Attachment 1**
> ii. *Complete labeling to be used with exemption:* **See Attachment 2 & 2.5**

DESCRIPTION OF THE PROPOSED USE:

Treatment Sites:

The proposed sites for use of KCl are (describe the body of water, its location, including county as well as nearest city and state and attach maps showing the body(ies) of water) (see Attachments 5&6). XXXXX has a surface area of XXXX acres and a maximum depth of XXX feet. The treatment area for the body of water is approximately xx,xxx square feet with an average depth of xx feet. The treatment area the water body is enclosed by a XX-foot tall floating curtain barrier, restricting flow and open water exchange. The barrier outlining the treatment area makes contact with the shoreline and (include any description of structures, such as boat ramp launches). The site is currently closed off from public use. The water body is not used for public drinking water. Overflow of the way body flows into XXXXX from XXX Creek.

Method of Application:

The KCl will be applied in liquid form (as a mixed slurry), similar to two treatment studies conducted in Millbrook Quarry, Virginia, USA (Fernald and Waterson, 2014), and Lake Winnipeg, Manitoba, Canada (DFO 2014), and Christmas Lake and Lake Independence in Minnesota (USA).

A pesticide applicator, licensed by the State Department of Agriculture, will be responsible for all applications of potash. Granular KCl will be mixed on board the applicators watercraft and agitated throughout the treatment. The pesticide will be applied to the surface water using a spray wand and allowed to mix with the water column.

Application Rate & Pesticide Quantities:

The potassium (K^+) concentration in potash required to kill dreissenids is 100 ppm. Fernald and Watson (2014) achieved 100% mortality between 98-115 ppm.

Following the initial dosing for each treatment area (estimated at 1700 lbs. of granular KCl), potassium (K^+) concentrations will be measured either in the field with a potassium ion electrode or analyzed by a certified lab. The pesticide applicator may also monitor for chloride concentrations in the field (as a surrogate for potassium (K^+)) as was the method in Sister Grove Creek in Texas (as per verbal conversation with the Texas Department of Parks and Wildlife). Follow-up applications(s) may be required to maintain 100 ppm potassium (K^+) for a sufficient duration which will be determined by dreissenid bioassays in lake (caged dreissenids within the treatment area monitored daily for mortality) and dreissenids in aquaria lab trials.

According to a report by ASI project E9015 (1997) potassium does not require continual addition to the water column, except to account for leakage. Efficacy will be monitored with dreissenid bioassays in lake (caged dreissenids within the treatment area monitored daily for mortality) and dreissenids in aquaria lab trials.

Total Amount of Pesticide Proposed for Treatments:

Total amount of pesticide proposed for each treatment area depends upon in-lake potassium (K^+) concentration achieved for up to two weeks after the initial dosing treatment. Additional application(s) of potash may be necessary to maintain 100 ppm potassium for up to two weeks. Initial dosing of KCl for each lake is calculated to be:

1700 lbs. dry weight of KCl (equates to 900 lbs. of potassium per treatment area)

Note: the atomic mass percentage of KCl is 53% potassium and 47% chloride

Maximum Number of Applications:

The total number of applications in the initial two-week treatment period will depend on the dispersal and dissolve rates determined during and between applications as well as achieving 100% mortality in the dreissenid bioassays. Water samples will be collected at surface and near bottom (3–4 ft.) depths every 48–96 hours and analyzed at a professional lab. Because the area is enclosed, the State Department of XXXX does not anticipate potassium (K^+) concentrations to dissipate quickly. Dosing will be adjusted accordingly and upon achieving 100% dreissenid mortality the floating curtain will be removed from each lake, allowing the treated

water to mix. One or more additional two–week treatment periods may be necessary within or outside the original treatment areas in Year, Year, and Year, depending on the results of mussel monitoring.

Total Acreage to be Treated:

The total acreage proposed is approximately XXX acres (XX,XXX square feet or XXX acres per lake). Depending upon dreissenid monitoring efforts in the near future, additional acreage may need treatment.

Total Lake Surface Area: XXXX Water Body - XXX acres

Applicable Restrictions and Requirements Concerning the Proposed Use Not on Label:

Although there are no immediate effects of KCl to human health and non-target species (Fernald and Watson, 2014), the Department of XXX will continue to monitor K concentrations (and other water quality parameters) in the water body upon barrier removal and achieved 100% dreissenid mortality. This monitoring will take place over the next consecutive years.

***Duration of Proposed Use*:**

The duration of the proposed use is for 3 years (Month Year – Month Year).

ALTERNATIVE METHODS OF CONTROL:

> *The application shall contain: A detailed explanation of why the pesticide(s) currently registered for the particular use proposed in the application is not available in adequate supplies and/or effective to the degree needed to control the emergency. If the applicant states that an available registered pesticide is ineffective for the given situation, the statement must be supported by field data which demonstrate ineffectiveness of registered pesticides, or, if such data are unavailable, statements by qualified agricultural experts, extension personnel, university personnel or other persons similarly qualified in the field of pest control; and A detailed explanation of why alternative practices, if available, either would not provide adequate control or would not be economically or environmentally feasible.*

The following alternatives are considered less desirable because of environmental concerns, technical infeasibility, logistics, or expense. Below are the listed alternatives and a detailed explanation of why they would not be effective due to lack of 1) adequate control or 2) economic and environmental feasibility.

Chemical Control

Non-oxidizing molluscicides

There are several commercial products in this category, including Clam-trol®, BULAB 6002, Calgon H-130M and others. These are generally labelled for closed system use, such as cooling water treatments, water treatment systems and power plant water lines. Generally, they are toxic to fish and require detoxification by use of some additional substance, such as bentonite clay, prior to discharge to open waters. Clam-trol® was examined for possible use in Iowa and was ruled out as a treatment option in Iowa Great Lakes due to, "… uncertainty of its effectiveness due to potential inadequate mixing in the water column, its short life span and the anticipated kill of most aquatic organisms in the quarry." Their restricted labelling and broader non-target toxicity makes them unsuitable for open water use such as needed in the water body described herein.

> *For more info see here:*
> http://www.iagreatlakes.com/ZQM_Eradication_Control_Options.pdf
> http://www.epa.gov/pesticides/chem_search/ppls/003876-00149-20130709.pdf

Oxidizing molluscicides

Copper products, such as copper sulfate are pesticides used to control snails and swimmers itch in several Midwestern states. In addition, chelated copper products have been used to target dreissenids. However, attempts using copper in open water applications have shown inconsistent results, resulting in non-target impacts to outlet stream invertebrate fauna, "molluscan fauna eliminated, as well as amphipods, mayflies and stoneflies, with some species of caddis flies also showing impacts", while in Nebraska copper sulfate was unsuccessful in eradicating dreissenids in Base Lake, and also resulted in a large fish kill (Schainost 2010). Research conducted by the U.S. Army Corps of Engineers found that adult dreissenids require significantly higher levels of copper for mortality than veligers. Thus, high doses or repetitive copper treatments are needed, and may result in increased non-target impacts. In addition, recent treatments utilizing one copper based product (EarthTec QZ®, copper sulfate pentahydrate) have not produced the desired dreissenid mortality as it has proven difficult to maintain adequate copper levels in open-water applications.

> *For more info see here:*
> http://www.iagreatlakes.com/ZQM_Eradication_Control_Options.pdf
> http://www.ianrpubs.unl.edu/epublic/live/g2173/build/#target5
> http://www.omaha.com/outdoors/invasive-zebra-mussels-confirmed-at-offutt-lake/article_e5327a2a-1507-11e4-b44a-0017a43b2370.html

Bio-pesticides

Zequanox® is a highly selective biological molluscicide that has low toxicity and presents little to no risk towards non-target organisms. Water temperatures below those recommended for optimum efficacy of this control material significantly reduce the efficacy of this product. Once reproduction has occurred, veligers can move throughout the water column, rendering treatment of the area ineffective at eliminating the dreissenids from the water body. In addition, Zequanox® is cost prohibitive in terms of treating large, open waters compared to chemically based products (i.e. copper-based algaecides/molluscicides or KCl).

Physical/Mechanical Removal

It is unrealistic and unfeasible to remove dreissenids through physical or mechanical means. In addition, mechanical means could increase turbidity and a reduce water clarity by stirring up sediment in the cordoned off area. Additionally, if mechanical means were to stir up bottom materials, these could move from the area and potentially carry attached mussels to other areas of the lake.

EFFECTIVENESS OF PROPOSED USE:

> *The application shall contain data, a discussion of field trials, or other evidence that provide the basis for the conclusion that the proposed pesticide treatment will be effective in dealing with the emergency.*

To date there are few instances of open-water applications of potash (KCl) for dreissenid control in lakes and rivers, although the product has been used in closed systems for decades largely for non-pesticide industrial/municipal purposes. The few examples of open-water applications cited in the literature include lake treatments in Millbrook Quarry, Virginia, and Lake Winnipeg, Manitoba, and one stream treatment in Sister Grove Creek, Texas (see details below). The lake treatments were both successful at achieving mortality in the treatment areas, but the stream treatment was not. In addition, treatments of potash were attempted in late 2014 in two lakes in Minnesota.

Millbrook Quarry, Virginia

Zebra mussels were identified in 2002 in Millbrook Quarry, Virginia, by the Virginia Department of Game and Inland Fisheries (Fernald and Watson 2014). This was the first open-water infestation to be documented in the state of Virginia. Millbrook Quarry is 12 acres and has a depth of 93 feet. The quarry was opened in 1947 and has been inactive since 1963. The quarry has been used as a training and recreational dive site since 1970.

After the zebra mussel population delineation and assessment, the decision was made to attempt to eradicate the mussels via the application of potassium under a section 18 emergency exemption authorized by EPA. Treatment was conducted by a

private contractor (Aquatic Sciences LP) during a three-week period in January-February 2006. The contractor injected a solution of 74,000 gallons of potassium chloride (muriate of potash) over the three-week period, aiming for a target concentration of 100 milligrams of KCl per liter of water or 100 ppm KCl. Weekly monitoring of potassium concentrations was conducted during and post-treatment, along with monitoring of adjacent waters. Detected concentrations ranged from 98-115 ppm of potassium within the quarry, and no leaks of potassium in to surrounding waters were detected. The Virginia Department of Fish and Game concluded that the treatment was successful, and that zebra mussel mortality was 100%. Zebra mussel mortality was assessed by four methods, including collection of over 1000 mussels from rocks at sites around the quarry (no live mussels were collected), visual dive surveys of the quarry for live mussels, video surveys of the bottom via robotic camera, and bioassays of caged live zebra mussels exposed to the treated quarry water. No non-target impacts were observed on local aquatic wildlife (including crayfish, mollusks, turtles, and multiple fish species), and unrestricted use of the Quarry for diving was allowed starting on May 6, 2006.

Lake Winnipeg, Manitoba

Lake Winnipeg is a large (9,465 square miles) lake in the province of Manitoba, Canada. It has an average depth of 39 feet, and a maximum depth of 118 feet, and is used extensively for tourism/ recreation, commercial fishing, and in the generation of hydroelectric power. Zebra mussels were first identified in Lake Winnipeg in October 2013 on a private dock. Subsequent searches also identified a private individual who found five dead mussels on a piece of PVC pipe in 2011, but did not report the findings until late 2013.

The October 2013 zebra mussel finding prompted the Province of Manitoba to implement a rapid response protocol in an attempt to eradicate all known populations and suppress the spread of the existing population (Department of Fisheries and Oceans, 2014). As part of the rapid response protocol, a survey was conducted in October 2013 to determine the spatial extent and density of the zebra mussel population, and four harbors were identified as infested. Previously collected data from 2013 spiny waterflea (*Bythotrephes longimanus*) collections across the lake were also analyzed for zebra mussel veligers, and none were found in locations away from the infested harbors. Based on the successful use of liquid potash in Millbrook Quarry, the high toxicity of potash to zebra mussels and its low toxicity to most other aquatic biota, the Province of Manitoba selected potash to use for the treatment in Lake Winnipeg. In 2014, the four harbors were sealed off from the main lake for 60 days using non-permeable geotextile membranes, and treated by a private contractor (ASI Group Ltd-formerly Aquatic Sciences LP). In order to maintain KCl concentrations similar to those in Millbrook Quarry, Virginia (100 ppm), approximately 336 metric tons of 20% KCl solution was used to treat 356,000-

427, 000 m^3 of water (Department of Fisheries and Oceans 2014). All four harbors were treated once within 28 working days. Daily water quality monitoring was conducted during the treatments, along with post-treatment monitoring to assess potassium levels. Zebra mussel mortality was assessed via bioassays of healthy adult zebra mussels exposed to treated harbor water, and via ongoing monitoring of the harbors. The Manitoba minister of Conservation and Water Stewardship described the treatments as 100% effective in the treated areas, but surveys are still taking place outside of the harbors to determine whether a zebra mussel population exists elsewhere in the lake.

Sister Grove Creek, Texas

Zebra mussels were first observed in Texas in 2009, in Lake Texoma. Zebra mussels then moved south, and in 2010 a small, low-density population was documented in a tributary of Lake Lavon, Sister Grove Creek. Lake Lavon is an important water supply source and recreation destination in north Texas, and so the Texas Commission on Environmental Quality and the Texas Parks and Wildlife Department submitted an application to treat 35 miles of Sister Grove Creek for zebra mussels. The treatment took place September-October 2010, and the entire stream length was treated using 35,000 pounds of potash under section 18 emergency exemption authorized by EPA. Conductivity was monitored during the treatments to assess whether target potassium concentrations had been achieved, and post-treatment evaluations examined zebra mussel survival in the upper and lower sections of the creek. While 100% zebra mussel mortality was achieved in the lower section of the creek, some live mussels were found even after a second application of potash in the upper creek. The lack of mortality was attributed to the low flow and low water volumes in the upper section of the creek during the treatment periods. Monitoring of the zebra mussel populations is continuing, since treatment efforts may have set back the zebra mussel population in Sister Grove Creek enough to slow their expansion or to limit their ability to develop a viable breeding population.

DISCUSSION OF RISK INFORMATION:

> *The application shall address the potential risks to human health, endangered or threatened species, beneficial organisms, and the environment expected to result from the proposed use, together with references to data and other supporting information.*

Human health

It is not expected that the application of potash to the proposed treatment area will have any potential risk to human health (see Attachment 3 - MSDS, Hazards Identification). The initial application(s) in 2014-2015 would occur during colder

water temperatures, so any swimming or other related recreational use would not occur. For follow up treatments in the summer/late fall, no direct contact by humans would be expected. The small proposed treatment area will remain contained within the barrier until all treatments have been completed. Data from the Final Environmental Assessment from Virginia (2005) stated that toxicity levels for the potash that was applied to Millbrook Quarry were:

> Acute Oral Toxicity: (mouse, rat) LD50 = 1500 – 2600 mg/kg bw.

As these levels far exceed the proposed application rates (100 ppm) it is unlikely that incidental human contact with treated waters could cause any human health risk. Potassium chloride can be prescribed in pill form to treat low levels of potassium in the body. Thus, any exposure to water or biota from the treatment area would not likely have negative impacts on human health.

Endangered or threatened species

Describe the listed threatened/endangered species in the water body and downstream of the water body.

Non-target effects

Potash has been shown in previous uses to have an extremely high level of non-target organism safety (see MSDS; Toxicological Information and Ecological Information). Toxicity data indicates that the target concentration is not lethal to non-target organisms other than freshwater mollusks (e.g., the threshold effect concentration [TEC] for potassium is 272.6 ppm for *Ceriodaphnia* and 426.7 ppm for fathead minnows; Aquatic Sciences Inc. 1997, USFWS 2005). One major group that could be impacted by potash is molluscs, which include native unionids and gastropods as well as the target pest dreissenids. Surveys in the proposed treatment area have documented XXX native mussel individuals. Freshwater snails would also likely be impacted in the treatment – however, due to the small area of the treatment location, repopulation via existing snail populations within the lake and adjacent to the treatment area would likely be rapid.

COORDINATION WITH OTHER AFFECTED STATE OR FEDERAL AGENCIES:

> *If the proposed use of the pesticide is likely to be of concern to other Federal or State agencies, the application shall indicate that such agencies have been contacted prior to submission of the application, and any comments received from such agencies shall be submitted to EPA.*

The State Department of Agriculture and Department of Fish and Wildlife cooperated in the creation of this Section 18 Quarantine request and has provided the treatment plan as well as background information on KCl. These agencies fully support this request as a prudent control measure for localized dreissenid infestations in (name the state) waters. In addition, the agencies will be gathering valuable data in terms of dreissenid eradication strategies for future localized infestations.

The (state) Department of Environmental Quality (pollution control agency) was also contacted regarding this proposal and they submitted the following response:

> Department of XXXXX staff have reviewed this application and concluded that it poses no significant threat of water quality harm or ecological risk to the two lakes. We note that the chronic standard for chloride in these water bodies (and in most waters of the state) is XXX mg/L, whereas the proposed treatment concentration is less than XX% of this standard (about 50 mg/L in terms of chloride). (initials of agency representatives and date)

ACKNOWLEDGMENT BY REGISTRANT:

> *The application shall contain a statement by the registrants of all pesticide products proposed for use acknowledging that a request has been made to the Agency for use of the pesticide under this section. This acknowledgment shall include a statement of support for the requested use, including the expected availability of adequate quantities of the requested product under the use scenario proposed by the applicant(s); and the status of the registration in regard to the requested use including appropriate petition numbers, or of the registrant's intentions regarding the registration of the use.*
>
> **See Attachment 3**

Description of Proposed Enforcement Program:

> *Prior to approval, the applicant shall provide an explanation of the authority of the applicant or related State or Federal agencies for ensuring that use of the pesticide under the proposed exemption would comply with any special requirements imposed by the Agency and a description of the program and procedures for assuring such compliance.*

Treatment(s) will be permitted and supervised by the state Department of Agriculture. The state Department of Agriculture will take appropriate steps to ensure that the conditions of the exemption are met.

Information Required for a Quarantine Exemption:

An application for a quarantine exemption shall provide all of the following information concerning the nature of the emergency:

The scientific and common name of pest: ***Dreissena rostriformis bugensis*****, quagga mussels**

The origin of pest and the means of its introduction or spread if known:

Dreissenids are a detrimental aquatic invasive species that have invaded North America.

Zebra mussels were first observed in Lake St. Clair in 1986 and spread through ballast waters discharged from commercial ships. They are now widespread in areas such as the Great Lakes, the Ohio and Mississippi River drainage and lakes from Wisconsin to New England. A key vector for spread is watercraft that move from water body to water body after remaining in an infested water body for a period of time (see an updated GIS map on zebra mussel distribution at http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=5).

The quagga mussel was first sighted in the **Great Lakes** in September 1989, when one was found near Port Colborne, Lake Erie, though the recognition of the quagga type as a distinct species was not until 1991. In August 1991, a mussel with a different genotype was found in a random zebra mussel sample from the Erie Canal near Palmyra, New York, and after confirmation that this mussel was not a variety of *Dreissena polymorpha*, the new species was named "quagga mussel" after the "quagga", an extinct African relative of the zebra. The quagga mussel has since been found in Lake Michigan, Lake Huron, Lake Erie, Lake Ontario, Lake St. Clair, Saginaw Bay, and throughout the St. Lawrence River north to Quebec City. The first sighting of quagga mussels outside the Great Lakes basin was made in the Mississippi River between St. Louis, **Missouri** and Alton, **Illinois** in 1995. In January 2007, populations of quagga mussels were discovered in Lake Mead near Boulder City, **Nevada**), and in Lake Havasu and Lake Mohave on the **California/Arizona** border. This was an extremely large leap in their range and cause for much concern to limited water supplies and endangered fishes in the southwestern US. Late in 2007 and early 2008, quagga mussels were discovered in 15 southern **California** reservoirs. Veligers were identified from six **Colorado** reservoirs. In **Utah**, only veligers were collected from Red Fleet Reservoir and just one adult from Sand Hollow Reservoir. They are not considered established in Utah. A reservoir in **New Mexico** tested positive for veliger DNA in 2011 (see an updated GIS map on quagga mussel distribution at http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=95).

The anticipated impact of not controlling the pest:

The dreissenids found represent an isolated population. The likelihood of eradication through chemical control is high. If no action were taken, it is likely that the dreissenids will establish a reproducing, self-sustaining population, which could then serve as another source population and possibly contribute to the infestation of water bodies free from dreissenids. Most importantly, taking no action would mean that agencies and partners would lose a valuable opportunity to learn whether dreissenid mussel eradication/control can be achieved. Information gathered from this study will be beneficial for resource agencies addressing dreissenid introductions in the future.

Dreissenid infestations in other water bodies in North America have caused human health concerns through cuts on recreationists' feet, as well as scrapes on hands and other areas. In Lake Pepin (Mississippi River) people have reported serious cuts to the paws of their dogs which have gone into the water in areas of heavy mussel densities. Reports from Lake Zumbro (southern Minnesota) have included emergency room visits to have stiches put in the feet of water skiers who have jumped from the ski boat onto lake areas with zebra mussels.

Dreissenids have been shown to have a variety of environmental, economic, and recreational impacts. Native mussels are infested by this bio-fouling invasive species and can be quickly killed. Areas of the Great Lakes showed massive declines in native mussel local populations after invasion and heavy infestation. Dreissenids have also been correlated with blooms of toxic blue-green algae in bays within the Great Lakes. Their feeding targets green algae and they reject blue-green forms. This selective feeding removes competition in the algal community for nutrients, permitting potentially high densities of undesirable blue-green algae. Extensive filtering of suspended particulates in the lake by high densities of dreissenids can lead to increased macrophyte growth through increased water clarity. Some contaminants are bio-accumulated by the filter-feeding behavior, and can potentially be passed on to any predators (diving ducks, fish) that eat these mussels. In some areas of the Great Lakes, dreissenids have been implicated in a complex path that has led to large waterfowl die-offs (including loons and other important species) through botulism toxin. Researchers have also suggested that dense extensive populations of dreissenids may interfere with the base of the food chain in lakes, competing with zooplankton for the desirable component of the algal community.

Other issues include clogging of personal water intakes, used for lawn and garden watering, as well as heavy infestations on boats and other watercraft moored in infested waters. The potential for inadvertent spread via recreational gear moved from infested waters increases with new infestations, including but not limited to private sale of docks, lifts, rafts and other recreational gear. Reports from Great

Lakes areas have included alteration of algal community to favor blue-green algae, in some cases creating conditions that favor blooms that can create toxins.

References:

Aquatic Sciences, Inc. 1997. Ontario Hydro baseline toxicity testing of potash using standard acute and chronic methods: ASI Project E9015. In *Eradication of zebra mussels at Millbrook Quarry)\Prince William County, Virginia. Proposal M20065 submitted to the Virginia Department of Game and Inland Fisheries in response to RFP 00375-352.* Orchard Park, NY: Aquatic Sciences L.P.

Department of Fisheries and Oceans (DFO). 2014. Lake Winnipeg Zebra Mussel treatment. DFO Canadian Science Advisory Secretariat Science Response 2014/031.

Fernald, R.T. and Watson, B.T. 2014. Eradication of zebra mussels *(Dreissena polymorph*a) form Millbrook Quarry, Virginia: Rapid response in the real world. Pp. 195-213 in Quagga and Zebra Mussels: Biology, Impacts, and Control (Nalepa, T.F. and Schloesser, D.W. eds.). CRC Press, Boca Raton, FL. 775 pp.

U.S. Fish and Wildlife Service. 2005. Final Environmental Assessment, Millbrook Quarry Zebra Mussel and Quagga Mussel Eradication. Virginia Department of Game and Inland Fisheries, Richmond, VA.
http://www.dgif.virginia.gov/wildlife/final_zm_ea.pdf

Schainoist, S. 2010. Zebra mussels in a Nebraska lake. Powerpoint presentation. Nebraska Game and Parks Commission.
http://snr.unl.edu/invasives/documents/NebraskasZebra-MusselInfestationandEradicationLakeOffutt.pdf.

Waller, D.L., Rach, J.J., Cope, W.G., Marking, L.L., Fisher, S.W.**,** and Dabrowka**,** H. 1993. Toxicity of candidate molluscicides to zebra mussels (*Dreissena polymorpha*) and selected target organisms. J. Great Lakes Res. 19: 695-702.

Attachment 1: Confidential Statement of Chemical Formula

Mosaic

KCl Fine – Untreated

PARTICLE SIZE DISTRIBUTION — SGN = 30			
Tyler Mesh	US Mesh	Opening (mm)	Typical (% Cum.)
20	20	0.841	0.2
28	30	0.600	1.8
35	40	0.420	16
65	70	0.210	72
100	100	0.149	93

PHYSICAL PROPERTIES	Typical
Bulk Density, loose	
- lb/cu foot	72
- kg/cu meter	1153
Angle of Repose (degrees)	26

CHEMICAL ANALYSIS		
Component	Symbol	Typical %
Potassium Oxide Equivalent	K_2O	62.38
Potassium Chloride	KCl	98.74
Potassium	K	51.78
Sodium Chloride	NaCl	1.00
Moisture at 130° C	H_2O	0.070
Chloride	Cl	47.61
Sodium	Na	3935 PPM
Calcium	Ca	250 PPM
Magnesium	Mg	110 PPM
Bromide	Br	560 PPM
Sulfate	SO_4	450 PPM
Water Insoluble	—	100 PPM

Product analyses are typical as tested at minesite. Handling and transportation may affect the analysis of the delivered product.

Revised 11/05

© Copyright 2005. The Mosaic Company. All Rights Reserved.

Attachment 2: Muriate of Potash Label

MOP (Muriate of Potash)

For control of zebra mussels and quagga mussels in specific lakes in Minnesota
For use only by Minnesota Department of Natural Resources personnel and their designees
Section 18 Emergency Exemption
EPA File Symbol: XX-XX-XX

THIS IS AN UNREGISTERED PRODUCT AND MAY BE DISTRIBUTED AND USED ONLY IN MINNESOTA.

EFFECTIVE PERIOD: This exemption becomes effective on MM/DD/14 and expires on MM/DD/17.

ACTIVE INGREDIENT: potassium chloride….99%

OTHER INGREDIENTS: ……..…….1%

TOTAL: ……...…100.0% **NET CONTENTS:** 55 lbs.

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION. Harmful if swallowed. Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Harmful if inhaled. Avoid breathing dust or spray mist. Wash thoroughly with soap and water after handling and before eating, drinking,

chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Wear long-sleeved shirt, long pants, socks, and shoes. Wear waterproof gloves. Wear protective eyewear.

FIRST AID

If swallowed:

– Call a poison control center or doctor immediately for treatment advice.

– Have person sip a glass of water if able to swallow.

– Do not induce vomiting unless told to by a poison control center or doctor.

– Do not give anything to an unconscious person.

If inhaled:

– Move person to fresh air.

– If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.

– Call a poison control center or doctor for further treatment advice.

If on skin:

– Take off contaminated clothing.

– Rinse skin immediately with plenty of water for 15-20 minutes.

– Call a poison control center or doctor for treatment advice.

If in eyes:

– Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing.

– Call a poison control center or doctor for treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For medical emergencies call your poison control center at 1-800-222-1222.

ENVIRONMENTAL HAZARDS

PHYSICAL OR CHEMICAL HAZARDS

When this material is subjected to high temperatures, it may release small amounts of chloride gas.

DIRECTIONS FOR USE

This use is in connection with an emergency exemption authorized under the provisions of section 18 of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended.

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

Any adverse effects resulting from the use of MOP (Muriate of Potash) under this quarantine exemption must be immediately reported to the State Department of Agriculture (651-201-6292).

For use only by _____ (agency) personnel and their designees

- For use only in _____ (water body) and _____ county, state
- For use in control of zebra mussels and quagga mussels
- **Application rate:** 100 ppm potassium (K^+)
- **Method of application:** The KCl will be mixed with water at _____ (water body) and applied to the surface waters of the designated treatment areas. A pesticide applicator, licensed by the State Department of Agriculture, will be responsible for all applications of potash. Granular KCl will be mixed on board the applicators watercraft and agitated throughout the treatment. The pesticide will be applied to the surface water using a spray wand and allowed to mix with the water column.
- **Application frequency:** Following the initial dosing for each treatment area (estimated at 1700 lbs. of granular KCl), xxpotassium (K^+) concentrations will be measured either in the field with a potassium ion electrode or analyzed by a certified lab. The pesticide applicator may also monitor for chloride concentrations in the field (as a surrogate for potassium (K^+). Follow-up applications(s) may be required to maintain 100 ppm potassium (K^+) for a sufficient duration which will be determined by zebra mussel bioassays in lake (caged zebra mussels within the treatment area monitored daily for mortality) and zebra mussels in aquaria lab trials.
- For use only in localized areas.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Keep container closed and away from food, feedstuffs, and domestic water supplies.

PESTICIDE DISPOSAL: Any unused, unregistered product must either be returned to the manufacturer or distributor (unopened containers) or disposed of in accordance with Resource Conservation and Recovery Act regulations following the expiration of the emergency exemption.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. If not available, then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State or local authorities, by burning. If burned, stay out of smoke.

Manufactured by: Contact information for manufacturer

Distributed by: Contact information for distributor

Attachment 2.5: Muriate of Potash Batch Information/Quality Certificate

11855

Mosaic

SK, Belle Plaine - Mosaic
Kalium Road
Belle Plaine SK S0G 0G0
Telephone: 3063458400
Fax:

HAWKINS CHEMICAL INC.
3100 E HENNEPIN AVE
MINNEAPOLIS MN 55413
UNITED STATES OF AMERICA

FAX: 6126178578

Vehicle ID: **SY7410-MB**
Scale Ticket No: **BP60007983**
Deliveries: **1001800321**

Quality Certificate
Date
06/13/2014
Purchase order item/date
527149 / 05/15/2014
Delivery item/date
1001800321 000010 / 06/10/2014
Order item/date
1701420 000010 / 05/15/2014
Customer number
5007820

Material: Our / Your reference
102944 MOP, 62% WHITE FINE UNTR 55 LB BAGS /

Inspection lot 100000064998 from 06/10/2014

Characteristic	Value	Unit	Lower Limit	Upper Limit
Chemical Analysis				
NaCl	0.86	%		
KCl	98.98	%		
K2O	62.53	%		
SH2O	0.040	%		
Physical Analysis				
20 Mesh	1.00	%		
28 Mesh	3.64	%		
35 Mesh	28.71	%		
48 Mesh	64.49	%		
65 Mesh	84.07	%		
100 Mesh	94.39	%		
Lot Number 1 →	14.147			

Additional Vehicles in this shipment:
Additional Deliveries in this shipment:

Pat Mudry
Quality Control Lab Supervisor
Mosaic Potash,Belle Plaine,(306)345-8631

QA Approved
KC 19 Jun 14

Attachment 3: Statement from Supplier

Attachment 4: Muriate of Potash MSDS

Mosaic

MATERIAL SAFETY DATA SHEET
Muriate of Potash

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	Muriate of Potash (MOP), all grades
Chemical Name:	Potassium Chloride
Chemical Family:	Inorganic Salt
Synonyms:	Potash; MOP; Potassium Chloride; Potassium Muriate; Potassium Monochloride
Chemical Formula:	KCl
Primary Use:	Crop nutrient; Industrial applications
Responsible Party:	Mosaic USA LLC 3033 Campus Drive Plymouth, MN 55441
Non-Emergency Technical Contact:	8:00 am - 4:00 pm Central Time, Mon - Fri: 800-323-5523

EMERGENCY OVERVIEW
24 Hour Emergency Telephone Number:
For Chemical Emergencies:
Spill, Leak, Fire or Accident
Call CHEMTREC
North America: (800) 424-9300
Others: (703) 527-3887 (collect)

Health Hazards:	Avoid contact with eyes, skin and clothing. Wash thoroughly after handling. Potassium chloride is generally recognized as safe (GRAS) when used in accordance with good manufacturing practice.
Physical Hazards:	None expected
Physical Form:	Solid
Appearance:	White to reddish-brown, crystalline or granular
Odor:	None

NFPA HAZARD CLASS		HMIS HAZARD CLASS	
Health:	1 (Slight)	Health:	1 (Slight)
Flammability:	0 (Least)	Flammability:	0 (Least)
Instability:	0 (Least)	Physical Hazard:	0 (Least)
Special Hazard:	None		

Status: Revised MSDS — Issue Date: December 1, 2006
Revised Section: 1 — MSDS Number: MOS002

Mosaic

MATERIAL SAFETY DATA SHEET
Muriate of Potash

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	% Weight	Exposure Guideline		
Potassium Chloride CAS No. 7447-40-7	95 - 99.5	NE	OSHA ACGIH	All All
Sodium Chloride CAS No. 7647-14-5	0.3 - 3.7	NE	OSHA ACGIH	All All
Calcium and Magnesium Chlorides and Sulfates CAS No. Various	0.2 - 1.3	NE	OSHA ACGIH	All All

NE = Not established, but the following particulate limits apply to all inert inorganic dusts.

Particulates Not Otherwise Classified (PNOC)	10 mg/m^3 3 mg/m^3	ACGIH	TWA - Inhalable TWA - Respirable
Particulates Not Otherwise Regulated (PNOR)	15 mg/m^3 5 mg/m^3	OSHA	TWA - Total Dust TWA - Respirable

Notes:
State, local or other agencies or advisory groups may have published more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

3. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS	
Eye:	Contact may cause mild eye irritation including stinging, watering and redness.
Skin:	Contact may cause mild irritation including redness and a burning sensation. No information available on skin absorption.
Inhalation (Breathing):	No information available.
Signs and Symptoms:	Effects of overexposure may include irritation of the nose, throat and digestive tract, nausea, vomiting, diarrhea, abdominal cramping, irregular heartbeats (arrhythmias), dehydration, and hypertension. Repeated overexposure to dusts may result in irritation of the respiratory tract, coughing and shortness of breath.
Cancer:	Inadequate data available to evaluate the cancer hazard of this material.
Target Organs:	No data available.
Developmental:	Inadequate data available for this material.
Other Comments:	None.
Pre-Existing Medical Conditions:	Conditions aggravated by exposure may include kidney disorders and high blood pressure (hypertension).

4. FIRST AID MEASURES

Eye:	If irrigation or redness develops, move victim away from exposure and into fresh air. Flush eyes with clean water. If symptoms persist, seek medical attention.
Skin:	Cleanse affected area(s) thoroughly by washing with mild soap and water. If irritation or redness develops and persists, seek medical attention.
Inhalation (Breathing):	If respiratory symptoms develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.
Ingestion (Swallowing):	If large amounts are swallowed, seek emergency medical attention. If victim is drowsy or unconscious and vomiting, place on left side with the head down and do not give anything by mouth. If victim is conscious and alert and ingestion occurred within the last hour, vomiting should be induced for ingestion of large amounts (more than 5 ounces or a little more than 1/2 cup in an adult) preferably under direction from a physician or poison center. If possible, do not leave victim unattended and observe closely for adequacy of breathing.
Note to Physicians:	No information found.

5. FIRE FIGHTING MEASURES

Flammable Properties:	**This product is non-flammable.** Flash Point - Not applicable OSHA Flammability Class - Not applicable LEL/UEL - Not applicable Auto-ignition Temperature - Not applicable
Unusual Fire & Explosion Hazards:	No unusual fire or explosion hazards are expected. When this material is subjected to high temperatures, it may release small amounts of chloride gas.
Extinguishing Media:	Use extinguishing agent suitable for type of surrounding fire.
Fire Fighting Instructions:	Positive pressure, self contained breathing apparatus is required for all fire fighting activities involving hazardous materials. Full structural fire fighting (bunker) gear is the minimum acceptable attire. The need for proximity, entry, flashover and/or special chemical protective clothing (see Section 8) needs to be determined for each incident by a competent fire fighting safety professional. Water used for fire suppression and cooling may become contaminated. Discharge to sewer system(s) or the environment may be restricted, requiring containment and proper disposal of water (see Section 6).

6. ACCIDENTAL RELEASE MEASURES

Muriate of Potash is a crop nutrient and plant food however, large spills can harm or kill vegetation.

- Stay upwind and away from spill (dust hazard).
- Wear appropriate protective equipment including respiratory protection as conditions warrant (see Section 8).
- Prevent spilled material from entering sewers, storm drains, other unauthorized treatment drainage systems, and natural waterways.
- Notify appropriate federal, state, and local agencies as may be required (see Section 13).
- Minimize dust generation.
- Sweep up and package appropriately for disposal.

7. HANDLING AND STORAGE

Handling:	The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits (see Sections 2 and 8). Wash thoroughly after handling. Wash contaminated clothing. Use good personal hygiene practice.
Storage:	Keep container(s) tightly closed. When possible use and store this material in cool, dry, well ventilated areas. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:	If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits (see Section 2), additional ventilation or exhaust systems may be required.

Personal Protective Equipment (PPE)	
Respiratory:	A NIOSH approved air purifying respirator with a type 95 (R or P) particulate filter may be used under conditions where airborne concentrations are expected to exceed exposure limits (see Section 2). Protection provided by air purifying respirators is limited (see manufacturer's respirator selection guide). Use a positive pressure air supplied respirator if there is potential for uncontrolled release, exposure levels are not known or any other circumstances where air purifying respirators may not provide adequate protection. A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed if workplace conditions warrant a respirator.
Skin:	The use of cloth or leather work gloves is advised to prevent skin contact, possible irritation and absorption (see glove manufacturer literature for information on permeability).
Eye/Face:	Approved eye protection to safeguard against potential eye contact, irritation, or injury is recommended. Depending on conditions of use, a face shield may be necessary.
Other PPE:	A source of clean water should be available in the work area for flushing eyes and skin. Impervious clothing should be worn as needed.

9. PHYSICAL AND CHEMICAL PROPERTIES

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm)

Flash Point:	Not applicable
Flammable/ Explosive Limits (%)	LEL/UEL - Not applicable
Auto-ignition Temperature:	Not applicable
Appearance:	White to reddish-brown, crystalline or granular
Physical State:	Solid
Odor/Taste:	None/Strong saline
Molecular Weight of Pure Material:	KCl - 74.6; NaCl - 58.5
pH:	5.4 - 10.0 in a 5% solution
Vapor Pressure MM Hg):	Approximately zero
Vapor Density (air = 1):	2.57
Boiling Point:	Sublimes at 1,500°C (2,732°F)
Freezing/Melting Point:	772 to 776°C (1423 to 1428°F)
Solubility in Water:	99.5 - 99.999%; 34.2 g/100mL at 20°C
Specific Gravity:	1.986 - 1.990
Volatility:	No data available
Bulk Density:	Loose - 64 to 75 lbs/ft^3 (1025 to 1200 kg/m^3)

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable under normal conditions of storage and handling. Material is hygroscopic (May absorb moisture from air when relative humidity >72%).
Conditions to Avoid:	None known
Incompatible Materials:	Avoid contact with hot nitric acid, may cause evolution of toxic nitrosyl chloride. Contact with other strong acids may produce irritating hydrogen chloride gas. KCl may react violently with bromine trifluoride and may explode if mixed with potassium permanganate and sulfuric acid. NaCl can react with most noble metals, such as iron or steel, building materials (such as cement), bromine, or trifluoride. A potentially explosive reaction may occur if NaCl is mixed with dichloromaleic anhydride and urea. Electrolysis of mixtures containing NaCl and nitrogen compounds may form explosive nitrogen trichloride.
Corrosivity:	Similar to salt. Mildly corrosive to metals in the presence of moisture.
Hazardous Decomposition Products:	None known
Hazardous Polymerization:	Will not occur

11. TOXICOLOGICAL INFORMATION

Potassium Chloride:	LD50 (rat, oral) = 2.6 g/kg LD50 (mouse, oral) = 1.5 g/kg LC50: no information available Eye (rabbit): 500 mg/24 H, mild irritant Inadequate carcinogenicity, mutagenicity, or developmental toxicity data located for potassium chloride. No target organ data located for potassium chloride.
Sodium Chloride:	LD50 (rat, oral) = 3 g/kg; LD50 (mouse, oral) = 4 g/kg LC50 (rat) >42 g/m3 / 1 hour Eye (rabbit): 100 mg/24 hour, moderate irritant Eye (rabbit): 500 mg/24 hour, mild irritant Inadequate carcinogenicity, mutagenicity, or developmental toxicity data located for sodium chloride. No target organ data located for sodium chloride.

12. ECOLOGICAL INFORMATION

Ecotoxicity:	Dissolution of large quantities of potassium chloride and sodium chloride in water may create an elevated level of salinity that may be harmful to fresh water aquatic species and to plants that are not salt-tolerant. **Potassium Chloride:** Lepomis macrochirus LC50 - 2010 mg/l Physa heterostrapha LC50 - 940 mg/l Scenedesmus subspicatus EC50 - 2500 mg/l **Sodium Chloride:** Ceriodaphania dubia LC50 - 280,000 - 3,540,000 ug/l Daphnia magnia LC50 - 3,144,000 - 10,000,000 ug/l Daphnia pulex EC50 - 56.40 mM Pimephales promelas LD50 - 6,020,000 - 10,000,000 ug/l
BOD AND COD:	No data found

13. DISPOSAL CONSIDERATIONS

This material, if discarded as produced, is not an RCRA "listed" or "characteristic" hazardous waste. Contamination may subject it to hazardous waste regulations. Properly characterize all waste materials. Consult state and local regulations regarding the proper disposal of this material.

MATERIAL SAFETY DATA SHEET
Muriate of Potash

14. TRANSPORT INFORMATION

Hazard Class or Division:	Not listed in the hazardous materials shipping regulation (49 CFR, Table 172.101) by the U.S. Department of Transportation, or in the Transport of Dangerous Goods (TDG) regulations in Canada.

15. REGULATORY INFORMATION

FDA:	1. Potassium Chloride used as a dietary supplement in food for human consumption is generally recognized as safe (GRAS) when used in accordance with good manufacturing practice [21 CFR 182.5622]. 2. Substance added directly to human food affirmed as GRAS [21 CFR 184.1622].
CERCLA:	Not listed
RCRA 261.33:	Not listed
SARA Title III:	**SARA 302:** RQ: No; TPQ: No
	SARA 311/312: Acute: No; Chronic: No; Fire: No; Pressure: No; Reactivity: No - Exemptions at 40 CFR, Part 370 may apply for agricultural use, or quantities of less than 10,000 pounds on site.
	SARA 313 List: No
TSCA:	8 (b) Chemical Inventory: Yes; TSCA 8 (d): No
Proposition 65: (CA Health and Safety Code Section 25249.5)	Warning: This product contains substances that are known to the State of California to cause cancer and/or reproductive harm.
NTP, IARC, OSHA:	This material has not been identified as a carcinogen by NTP, IARC, or OSHA.
Canada DSL:	Yes
Canada NDSL:	No
WHMIS:	Not controlled

16. OTHER INFORMATION

The information in this document is believed to be correct as of the date issued. Nothing herein contained shall be deemed to be a representation or warranty with respect to the product described herein. **NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THIS INFORMATION, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE, AND ALL SUCH REPRESENTATIONS AND WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED BY MOSAIC.** This information and product are furnished on the condition that the person receiving them shall make their own determination as to suitability of the product for their particular purpose and on the condition that they assume the risk of their use thereof. The conditions and use of this product are beyond the control of Mosaic, and Mosaic disclaims any liability for loss or damage incurred in connection with the use or misuse of this substance.

Status: Revised MSDS	**Issue Date: December 1, 2006**
Revised Section: 1	**MSDS Number: MOS002**

Attachment 5: Map of Proposed Treatment Area