

DECONTAMINATION PROTOCOL

FOR WATERCRAFT & EQUIPMENT

Alberta Environment and Parks



For use by Government of Alberta staff,
contractors, Research Licence and Parks
Collection Permit Holders (mandatory)

August 2017

Alberta
Government

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INTRODUCTION

Aquatic Invasive Species (AIS) and fish disease pose significant risks to the conservation and sustainability of our native species and their habitat. These threats pose both ecological and economic impacts to fisheries, water management infrastructure, tourism, and local communities. Fish diseases (including parasites, bacteria and viruses) represent a substantial threat to the health of Alberta's fisheries, particularly to species at risk. The introduction and/or spread of fish diseases has the potential to decimate fish stocks in affected waters. Aquatic invasive species such as quagga and zebra mussels, non-native carp, flowering rush, and invasive *Phragmites* have the potential to adversely affect our environment, economy, and society. Vigilance on behalf of government staff working with water is required to minimize the chances of introductions and help prevent the spread of AIS and fish disease.

One of the most important aspects of any invasive species response is to implement 'Early Detection, Rapid Response' activities to reduce the risk of further spread. This protocol was developed to address the detection of whirling disease in the province, but is also intended to address additional aquatic invasive species of concern.

In August 2016, whirling disease was detected within Banff National Park; this was the first time the disease has been detected in Canada. Whirling disease is a fish disease that affects salmonids (family of ray-finned fish), including trout and mountain whitefish. The disease is caused by a parasite (*Myxobolus cerebralis*) that has two hosts, a tubifex worm (endemic to Alberta and found in sediment in most waterbodies), and salmonid fish. Once inside a fish, the parasite



affects cartilage of the head, spine and/or gills. While whirling disease can cause high levels of mortality to fish, it is not known how it may affect Alberta fish populations. The federal Canadian Food Inspection Agency (CFIA) is responsible for reportable diseases in Canada, which includes whirling disease. For this reason, they have issued 'declarations' for infected areas within Alberta. Permits will be required from CFIA to move fish or fish culture equipment from the declared zone.

The CFIA declared infected zones are different than the risk maps presented in this protocol. The Decontamination Risk Map is intended to more accurately portray the locations where whirling disease has been detected. The Decontamination Risk Zones that apply to this Protocol are as follows: **1) Red Zone** – zone tested positive for whirling disease, AIS, and/or other fish disease; **2) Yellow Zone** – zone that represents high risk waters for introduction/spread of AIS and fish disease due to one or more of the following criteria: whirling disease susceptible species, high recreational activity/use and access to water, and high population base; **3) White Zone** – zone that does not have any whirling disease susceptible species, has no confirmed high profile AIS or whirling disease and represents lower risk due to lower population base and less activity/use.

It is imperative that Government of Alberta (GOA) staff take the necessary measures to ensure that there is not inadvertent spreading of whirling disease, AIS, or other fish diseases in any provincial waters.

Strict adherence to these protocols is mandatory for all staff working with water across the Government of Alberta. Exceptions are provided only to wildfire management activities and irrigation water pumping program at this time, which have Best Management Practices instead of a mandatory protocol due to the emergency nature of their work. Exemptions may be made for other emergency work on an as-needed basis.

This manual provides consistent protocols for the inspection and cleaning of vehicles, watercraft, and water-based equipment, which will help prevent the spread of AIS during all GOA field activities. The general types of field work that use in- water equipment include but are not limited to:

- Fisheries/Enforcement/Aquatic Invasive Species Control
- Wildlife and Species at Risk
- Monitoring/Research/Flood & Drought Mitigation
- Educational Programming and Tourism
- Wildfire Management

The Protocol will also be mandatory for GOA contractors, Research License and Parks Collection Permit Holders doing work in or near water.

The concept of successful prevention of AIS and fish disease introduction and/or spread is the primary goal of all equipment inspection and decontamination processes and is the main purpose of this protocol. Preventative actions curb the introduction of pests, fish diseases, and invasive species into uninfected locations.

Remember that the GOA is also setting an example for the public and must lead by example; GOA staff are held to a higher standard and must model the desired behaviours that we would want the public to undertake. Therefore, watercraft, trailers, and equipment used by GOA staff should not transfer aquatic vegetation, mud or standing water at any time, regardless of geographic area.

No exceptions.

KEY OBJECTIVES OF DECONTAMINATION PROTOCOLS

1. To provide a decontamination protocol for watercraft and equipment, using best available technologies, information, and feedback from field staff and other jurisdictions. This protocol has been developed with representation from program staff across GOA, and
2. is intended to provide mandatory protocols for all in- water work conducted from this point forward.
3. To provide a decontamination protocol that GOA staff can safely, effectively and efficiently administer in the field, which is effective against whirling disease and the majority of AIS.
4. To provide a decontamination protocol that minimizes harm to the aquatic environment as a direct, or indirect result of implementation of the protocol.
5. To provide a decontamination protocol which is economically viable, sustainable, and practical. This will include both the immediate short-term application of the protocol, as well as future use.
6. To minimize the deleterious effects of the decontamination protocol on equipment (e.g., corrosion of electrofishing, monitoring equipment, jet boats, vehicles, etc.) thereby reducing the necessity of replacing capital assets and reducing the potential for equipment failures.

TRAINING AND QUALITY ASSURANCE

- All GOA staff involved in field work in or near water must understand and be able to implement the application of the mandatory protocols before initiating field work.
- Training may be provided through formal training workshops lead by designated staff. Alternately, staff who have been trained can familiarize staff new to the protocol. In these cases, a trained staff member should be clearly identified as the decontamination field lead, who is responsible for ensuring all decontamination protocols are implemented appropriately and effectively.



- All GOA staff conducting in-water work must be familiar with and be able to demonstrate proper use of prescribed personal protective equipment (PPE).
- Quality assurance checks will be conducted periodically by designated staff. Results of inspections should be documented and submitted for review and any required follow up action sent to a responsible Manager/Supervisor.

AQUATIC INVASIVE SPECIES / WHIRLING DISEASE RISK MAPS

A 'Whirling Disease/Aquatic Invasive Species Risk Map' has been developed for the purpose of ensuring the correct decontamination protocols are used when working in the field. This map is not included in this manual as it is subject to change depending on whirling disease monitoring results and detections of other high risk fish disease or AIS. The current Protocol and Decontamination Risk Map can be found at: <http://aep.alberta.ca/fish-wildlife/wildlife-diseases/whirling-disease/stop-the-spread.aspx>.

The map is current to the status of whirling disease and high risk AIS confirmed locations in Alberta; this map reflects the distribution of only whirling disease in the Red Zone, given that there have been no detections of high risk AIS, such as Dreissenid mussels at the time of publication. The map will be updated if new positives are detected, or if other fish diseases or AIS are detected in Alberta waters. Field staff will have access to detailed maps in both digital and print forms.

The Decontamination Protocol is linked to the Decontamination Risk Map, which includes recent detections of 'suspect positives' not yet confirmed by the Canadian Food Inspection Agency (CFIA).

Given the intention of this decontamination protocol, Hydrologic Unit Code (HUC) watersheds were determined to be the most appropriate mapping system for developing the Risk Map. Hydrologic Unit Code (HUC) Watersheds of Alberta define hydrologic units that form a standardized baseline across Alberta. HUCs represent a collection of nested hierarchically structured drainage basins and consist of successively smaller hydrologic units that nest within larger hydrologic units.

NOTE: If other fish diseases (besides whirling disease) are detected in the province, alternate disinfection products would be required and the protocol would need to be modified to address these other fish disease mitigation measures.

OVERVIEW OF DECONTAMINATION METHODS

GENERAL PROTOCOL GUIDELINES

- The three risk zones in the province are as follows:
 - **Red Zone:** zone tested positive for whirling disease, AIS, and/or other fish disease;
 - **Yellow Zone:** zone that represents high risk waters for introduction/spread of AIS and fish disease due to one or more of the following criteria: whirling disease susceptible species, high recreational activity/use and access to water, and high population base;
 - **White Zone:** zone that does not have any whirling disease susceptible species, has no confirmed high profile AIS or whirling disease and represents lower risk due to lower population base and less activity/use.
- The principles of “Clean, Drain, and Dry” apply to all zones, regardless of activity or movement.
- It is recommended to use dedicated gear in the Red Zone whenever possible to avoid decontamination issues and/or concerns when working with sensitive equipment or gear. Level 2 and 3 decontamination protocols can be bypassed only if there are watercraft and/or equipment that is **ONLY USED** in the Red Zone and staff are working upstream to downstream.
- When working in a particular zone, please refer to that zone’s decontamination protocols for a detailed description on how to proceed.
- GOA staff cannot use felt-soled waders (unless they have removable felt soles) as they cannot be properly decontaminated.
- Items that cannot be decontaminated should not be used.

TABLE CATEGORIZATION OF PROTOCOLS

| WHITE ZONE PROTOCOLS | YELLOW ZONE PROTOCOLS | RED ZONE PROTOCOLS |
|------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------|
| Level 1: Streamside Clean, Drain, Dry | Level 1: Streamside Clean, Drain, Dry | Level 1: Streamside Clean, Drain, Dry |
| | Level 2: Streamside Clean, QUAT, Rinse | Level 2: Streamside Clean, QUAT, Rinse |
| | | Level 3: Decontamination Hub Hot water treatment Secondary QUAT treatment |

*See associated 'Fish Disease & Aquatic Invasive Species Risk Map' to determine Zone

Note: Quaternary Ammonium Compounds (QUAT) are common cleaning agents used in homes and hospitals, are safe for MOST gear and equipment when used at recommended concentrations and rinsed (See Appendix C for Chemical Treatments). The label of any chemical product must be followed at all times.

LEVEL 1 – CLEAN, DRAIN, DRY!

While on land, but before leaving any body of water, properly follow these protocols every time that watercraft or equipment are used, regardless of the zone. This is what we ask of the public, as well as GOA staff;

it is not only mandatory, but critical. Clean, drain, and dry all watercraft parts and equipment that came in contact with water. This is the 'level 1' protocol.

CLEAN

- Visibly inspect watercraft, trailers, and all equipment after each use. Remove any visible plant or plant fragments, as well as mud and other organic debris. Aquatic plants and mud routinely contain organisms or AIS. Check the trailer, including axle, bunks and wheel areas, and in and around the boat itself: anchor, propellers and jet engines, ropes, boat bumpers, and paddles. Take extra care to look in tight dark places, or where there are angles or edges for organics to get caught.
- Gear must be cleaned and rinsed on-site using lake/river water. For small items, a small nylon bristle-scrub brush (no wood), can be used to aid in the removal of organic debris or fish slime. All small field equipment that was in contact with stream or lake water, that can



CLEAN + DRAIN + DRY YOUR GEAR



be immersed, must be thoroughly cleaned by hand washing on-site. Large equipment (e.g., boats, trailers, quads) must be cleaned with a long handled nylon scrub brush.

Thorough cleaning is extremely important as the presence of organics can compromise the efficacy of disinfectants (required for Yellow and Red Zones).

DRAIN

- Drain all spaces or items that can hold water. At the conclusion of your field work, drain all containers, live wells, fish holding tanks, boat bilges, etc., that were filled with “native” water. Water should be drained on-site. Follow factory guidelines for eliminating water from engines. All engines hold water, but jet drives on personal watercraft and other specialized boats can hold extra water. Lower the motor prior to leaving the body of water to properly ensure all water is drained after each use. Remove the drain plug from boats (it is now required in Alberta to ‘Pull the Plug’ while in transport) and put the boat on an incline so that the water can drain out. Drain live-wells, bilges, ballast tanks, and transom wells. Empty water out of kayaks, canoes, rafts, etc. and towel dry if necessary.

DRY

- Whenever possible, allow everything to completely dry before launching into another body of water. A minimum of 24 hours is recommended, but the longer the dry time, the better between each use.



LEVEL 2 – STREAMSIDE QUAT TREATMENT

- After thorough cleaning a two-step treatment procedure must be used to disinfect wettable items at the sample site. Items do not need to be dry when moving from level 1 to level 2.

FIRST TREATMENT: QUAT

Submersible Items

- Use a rigid plastic container with a tight fitting lid (or if field work does not allow, an alternative product that serves the same purpose effectively, such as a dry bag). This treatment should contain 1500 ppm solution of Quaternary Ammonium Compounds (QUAT). Care should be taken to locate this container on high ground.
 - **Note:** If using QUAT Plus, 2 liters diluted with 62 L of water provides 64 L of solution which is a practical volume for immersing most field gear.
- Submersible items (e.g., sample measuring boards, waders, wader boots, floater coats, rain suits, PFD's, nets, electrofishing gloves, scrub brushes, etc.) must be immersed such that all surfaces which were in contact with potentially contaminated water, mud, or fish, are submerged for 10 minutes (quantity of equipment in the treatment is discretionary as it is concentration based). Care must be taken to ensure that any porous materials which may have absorbed potentially contaminated water are thoroughly soaked and physically agitated while submerged. Save this solution for later use on larger equipment (and check concentration level for efficacy).

Non-Submersible Items

- Non-submersible items (e.g., backpack electrofishing units, boat mounted electrofishing control boxes, probes, sensors, truck boxes, etc.) where surfaces have been in contact with potentially contaminated water can be surface disinfected by wiping wetted surfaces with a heavy duty type paper shop towel which has been soaked in 3000 ppm QUAT, or by using a hand-pump sprayer. Surfaces must be kept damp for 10 minutes. Any disposable items (i.e., shop towels, disposable gloves) used for this purpose must be double bagged until able to dispose of these materials in a safe location (i.e., garbage cans with lids) away from water.

Note: If using QUAT Plus, 0.25 liters (1 cup) diluted with 3.75 L of water provides 4 L of solution which is a practical volume for spraying or wiping most field gear.

- A 1500 ppm solution of QUAT disinfectant must be applied to boats, boat trailers, truck boxes, vehicle mats (if in contact with potentially contaminated boots), and other equipment (e.g., sampling poles) that can be sprayed down but not submerged, with special attention to areas that will not be exposed to direct sunlight. The QUAT solution can be applied using garden variety pump-up style sprayers which are labelled specifically for use with chlorine or other disinfectants. The QUAT solution from the dip tank can be used for this purpose. The solution should be liberally sprayed on both the outside and the inside of watercraft keeping surfaces moist for 10 minutes. Care should be taken to avoid non-wettable electronic components.



Note: It is important to specifically target the trailer “bunks” to ensure they are cleaned of organics and then thoroughly wetted with a 1500 ppm solution of QUAT. Furthermore, truck beds need to be sprayed down between watersheds and waterbodies as to not contaminate gear. It is difficult to target trailer bunks once the boat is on them. Staff should consider upgrading bunks to polyethylene plastic from the traditional non-wooden/carpeted options.

Note: Small quantities of QUAT solution (e.g., residual volume from a containment mat or both) can be reused but should be monitored using testing strips for effective (1500 ppm) concentration. They can be disposed through a sanitary sewer but should be diluted with an equal volume of water (See Disposal of Products Section). Local authorities responsible for operating municipal wastewater treatment facilities should be consulted before disposing of larger volumes of QUAT solutions down sanitary sewers.

SECOND TREATMENT: RINSE

- For rinse, use another hard plastic tub with lid (or equivalent) to contain “clean” water; this is typically obtained off-site prior to sampling or from a potable water source on-site if available. It must not be native water. Water can be transported to site as required in portable water containers (e.g., two 20 L containers). Small disinfected items, following the 10 minute submersion, should be rinsed in this tank. A quick dip is all that is required as some residual QUAT is not harmful to most gear. Gear that was wiped or sprayed with QUAT should be wiped down with clean water to remove any QUAT residue. Large equipment (e.g., boats and trailers) which are primarily metallic, do not need to be rinsed.

Note: If “clean” rinse water is not available, disinfected items should be secured in a designated container (e.g., hard totes preferred, dry bags, etc.) for transport back to the Level 3 decontamination location

THIRD TREATMENT: DRY

- Once treatment and rinse completed, allow items to dry as long as possible (24 hours minimum recommended).

LEVEL 3 – DECONTAMINATION HUB

All equipment leaving a Red Zone requires a level 3 decontamination in addition to levels 1 and 2. Once Level 2 decontamination has been completed, equipment and gear can be transported to a designated location (decontamination hub) for a final Level 3 decontamination. This step must be completed before gear goes back into the field for use at another sample site unless it is staying in the same Red Zone. Items do not need to be dry when moving from level 2 to level 3.

FIRST TREATMENT: HOT WATER WASH

- Care must be taken to ensure that any gear onboard a watercraft (e.g., rope, paddles, etc.) are removed, sorted and disinfected separately according to hot water and QUAT protocols prior to commencing hot water decontamination of watercraft. Some disassembly of watercraft may be required to ensure that all compartments are appropriately disinfected (e.g., removal of floorboards).
- Equipment to be decontaminated should be evaluated for tolerance to hot water, by contacting the distributor or manufacturer prior to treatment. Inflatable watercraft should not be subjected to more than warm water (e.g., Zodiac recommends temperatures not exceeding 38°C) to ensure that heat and glue welded seams on the pontoons do not rupture.
- Water should be applied using a high pressure unit which is capable of maintaining a continuous application of 90 C (195 F). Applied water must be in continuous contact with all surfaces, both external and internal for at least 10 minutes; however, manufacturer's recommendations should be followed to prevent catastrophic failure of the watercraft or equipment.
- For wettable and submersible equipment, a large bath of water should be heated to and maintained at 90°C and equipment should stay in the bath for 10 minutes.
- For sensitive equipment and gear that cannot be subjected to hot water, this step can be skipped. Move to level 3 second treatment (QUAT bath/spray) below.

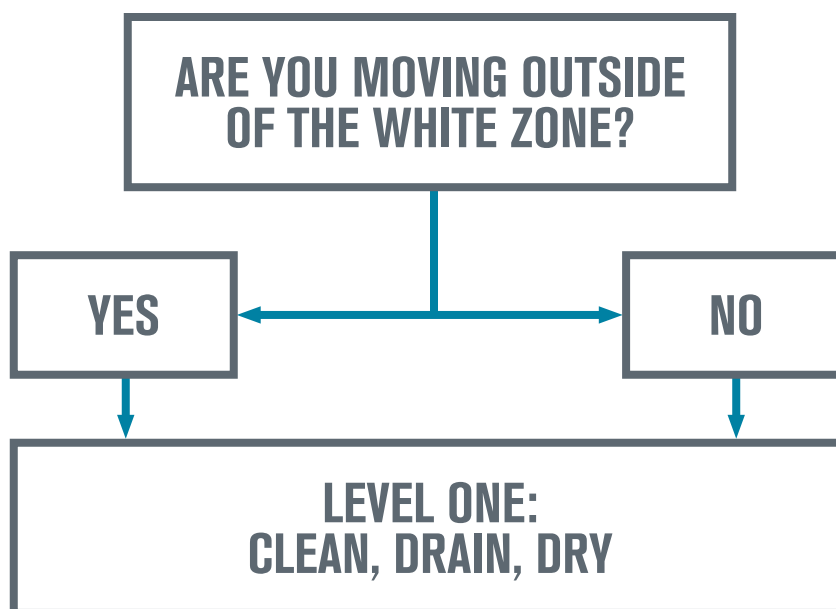


SECOND TREATMENT: QUAT

- Following hot water decontamination, all equipment and gear must receive a secondary decontamination with a 1500 ppm QUAT compound for 10 minutes. This is particularly important where water temperature has not been maintained at 90°C because of manufacturer's recommendations or where there is no assurance that internal or difficult to reach areas (e.g., under-hull compartments of a boat) were subjected to the hot water decontamination.

THIRD TREATMENT: DRY

- Once treatment and rinse completed, allow items to dry as long as possible (24 hours minimum recommended).



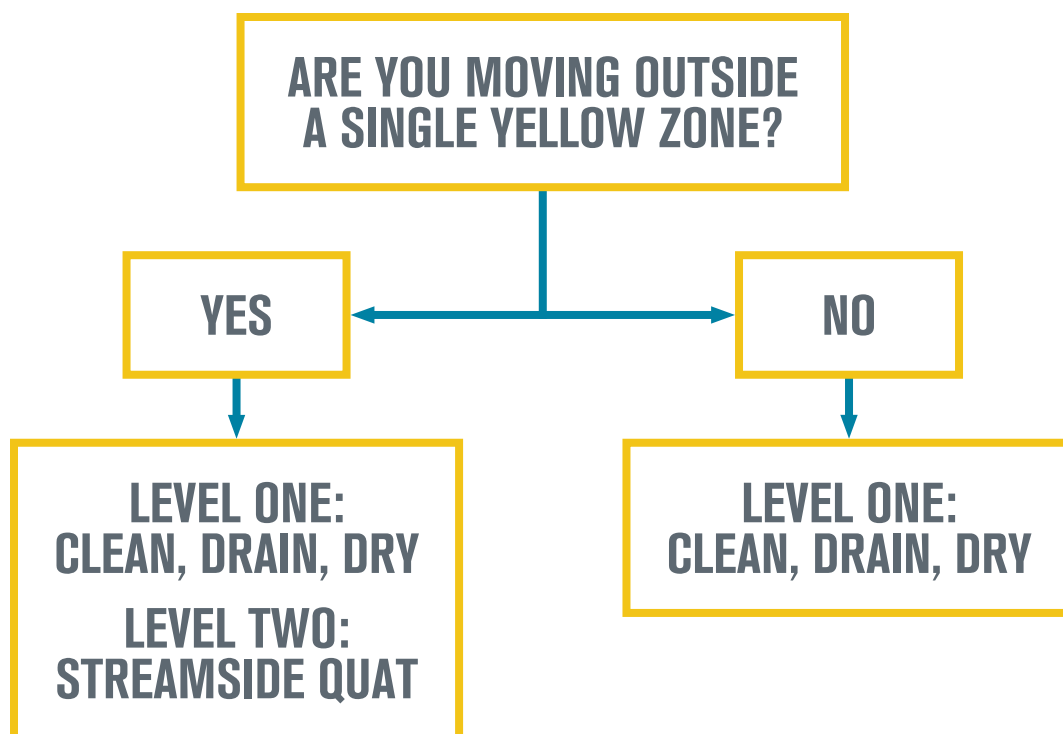
WHITE ZONE – GENERAL PRINCIPLES

WHITE ZONE = REDUCED RISK OF INTRODUCTION: WATERS WITH NO FISH SUSCEPTIBLE TO WHIRLING DISEASE; NO KNOWN HIGH PROFILE AIS OR FISH DISEASES PRESENT; OR LOW ACTIVITY/USE

- Level 1 (Clean, Drain, Dry protocols) are to be followed.
- Washing with hot water, high pressure and/or QUAT is NOT required as this zone does not have any confirmed cases of AIS or fish disease and represents low risk due to lower population and less activity.

DECONTAMINATION INSTRUCTIONS FOR WHITE ZONE

1. At the completion of work at a site, all equipment must be subjected to a thorough inspection (visually inspect equipment and/or watercraft for organic materials, mud and water).
2. Clean all organic debris, sediment, mud, fish slime, etc. off of watercraft, trailer and/or equipment using brushes, pump sprayer, and/or towels. Gear must be cleaned and rinsed on-site using lake/river water ('native').
3. Drain all residual standing water from the motor, bilge, live wells, boat bilges and ballast tanks. Water should be drained on-site.
4. At the completion of field activity, all items should be allowed to dry completely for 24 hours, ideally in direct sunlight, prior to being used again in the field.



YELLOW ZONE – GENERAL PRINCIPLES

YELLOW ZONE = MODERATE TO HIGH RISK: WATERS SUSCEPTIBLE TO AIS OR FISH DISEASE; HIGH ACTIVITY/USE; OR CLOSE TO HIGH POPULATION BASES

- Staff should avoid using leather, felt, wood, Styrofoam, Velcro or rope, as they cannot be easily decontaminated.
- When moving outside one Yellow Zone HUC boundary (or at the completion of the field season if staying in one HUC boundary), Level 1 and 2 decontamination must be completed.
- If you are not moving outside of a single Yellow Zone HUC boundary, only Level 1 protocols are required.
- As an alternative to conducting a Level 2 decontamination when leaving the Yellow Zone HUC boundary, the biological risk of spreading whirling disease can also be mitigated by achieving dry time (minimum of one year out of water) or freezing (minimum of 7 days in sub-zero temperatures)

DECONTAMINATION INSTRUCTIONS FOR YELLOW ZONE

1. Review equipment before heading into the field and remove any gear from trucks or boats which is not required for field sampling or decontamination. Any equipment that is exposed to potentially contaminated water must be decontaminated. Do not take what will not be needed.

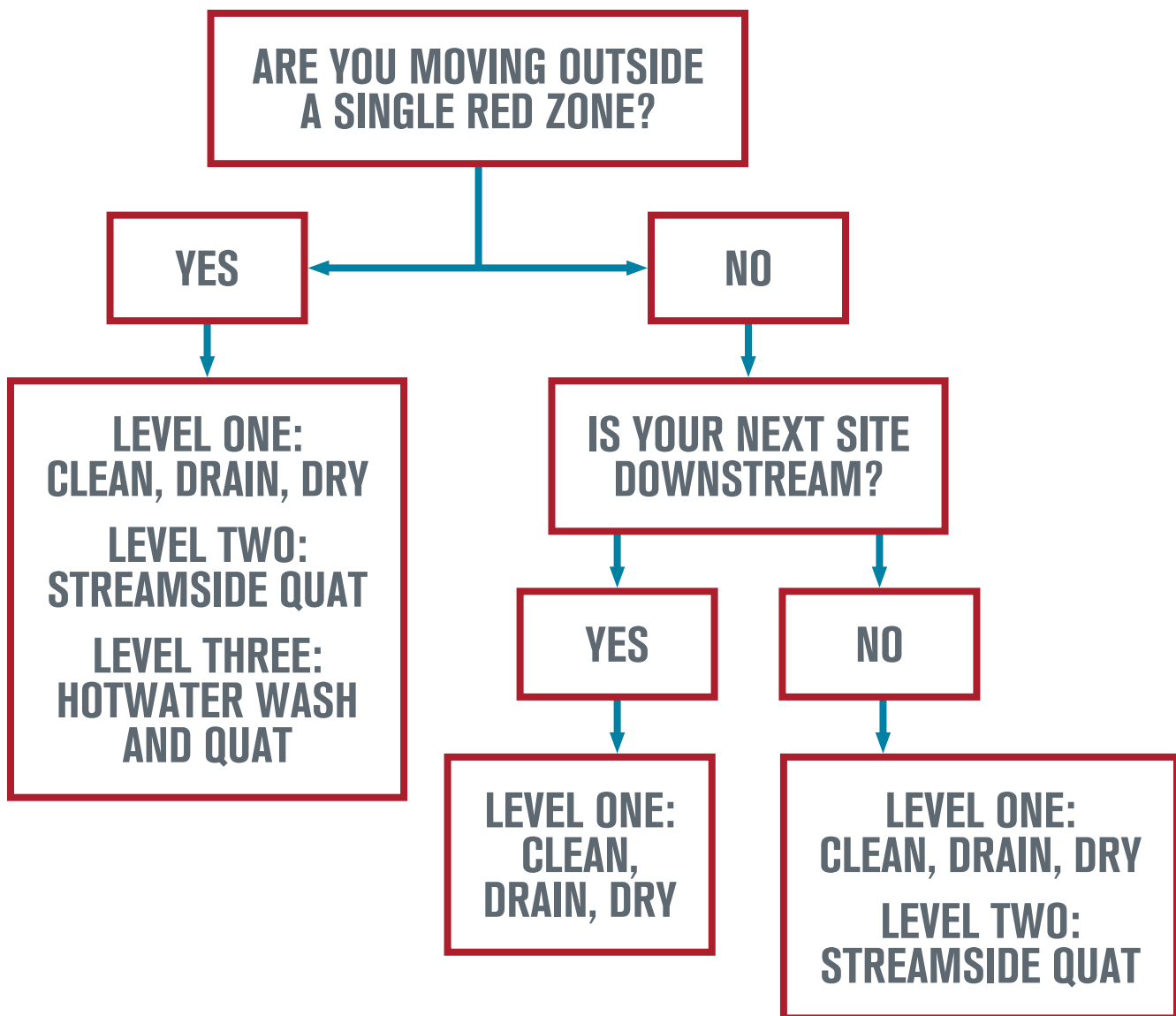
2. Equipment that cannot or will not be disinfected must be handled and disposed of in a bio secure manner (See Appendix D: Disposable Items Procedure).
3. Any essential non-disposable equipment which cannot be decontaminated without compromising its functionality, should be protected from contamination. For example, electronic items that cannot be sprayed with QUAT can be placed inside heavy duty baggies to protect them from contamination with whirling disease during use. The baggies can be removed on-site after sampling, taking care not to contaminate the “clean” item through contact with potentially contaminated materials.
4. Vehicles should be located on high, dry ground whenever practical and possible prior to unloading field equipment in order to limit exposure to potentially contaminated water or soil.
5. Change footwear on high, dry ground before sampling begins to avoid the need to disinfect personal footwear following sampling. Suitable options include changing into rubber boots immediately on egress from the vehicle, or the use of boot covers which can be pulled over waterproof footwear (e.g., rubber boots or waders). Boot covers should be considered single use, and should only be used at one sample site. Boots with deep treads or screw in cleats on wader boots require more time to get thoroughly clean and should not be used unless necessary for safety purposes.

Stop Aquatic Invasive Species

**Clean, Drain, Dry
Your Boat**

Inspections are Mandatory

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RED ZONE – GENERAL PRINCIPLES

RED ZONE = HIGH RISK: FISH DISEASE OR AIS PRESENT

- Have dedicated equipment for use in the Red Zone whenever possible.
- If gear is only used in a single Red Zone, and is properly labeled and stored, Level 3 decontamination is not necessary. Upon leaving a Red Zone, level 3 decontamination is required.
- Avoid the use of wood products, leather, Styrofoam, Velcro, or rope, in the Red Zone as these materials cannot easily be decontaminated or subjected to hot water decontamination.

Note: Felt-soled waders are not to be used anywhere in the province, unless the soles are removable and able to be properly decontaminated OR only used in a single Red Zone.

Note: Inflatable watercraft are not to be used in the Red Zone unless dedicated to that zone or can achieve level 3 decontamination. No exceptions.

- If the field work is exclusively happening inside a single Red Zone (from upstream to downstream), then Level 1 decontamination is sufficient.

Note: When working within a Red Zone, always select sites from upstream to downstream. If this cannot be accomplished, Level 1 and 2 decontamination is required between each site.

- If watercraft/equipment are going to be used anywhere outside of the Red Zone, then the Level 1, 2, and Level 3 Red Zone protocols must be completed prior to watercraft or equipment being used again.
- The Map denotes irrigation systems that are sourced from infected waters; Red Zone principles apply in the Irrigation District only when working in canals (see associated Decontamination Risk Map); the rest of the waterbodies within the delineated Irrigation District area may be considered the Yellow Zone.
- Avoid working in, or drawing water from the Red Zone whenever possible.

DECONTAMINATION INSTRUCTIONS FOR RED ZONE

- Review equipment before heading into the field and remove any gear from trucks or boats which is not required for field sampling or decontamination. Any equipment that is exposed to potentially contaminated water must be decontaminated. Do not take what will not be needed.
- Before using any equipment, including watercraft, in the Red Zone, ensure that equipment can be disinfected effectively without compromising its functionality (See associated 'Decontamination Equipment List').
- Equipment that cannot or will not be disinfected must be handled and disposed of in a bio secure manner (See Appendix E: Disposable Items Procedure). Any essential non-disposable equipment which cannot be decontaminated without compromising its functionality, should be protected from contamination in the Red Zone. For example, electronic sample scales should be placed inside heavy duty baggies to protect them from contamination with whirling disease during use. The baggies can be removed on-site after sampling, taking care not to contaminate the "clean" item through contact with potentially contaminated materials.
- Vehicles should be located on high, dry ground whenever practical and possible prior to unloading field equipment in order to limit exposure to potentially contaminated water or soil.
- Change footwear on high, dry ground before sampling begins to avoid the need to disinfect personal footwear following sampling. Suitable options include changing into rubber boots immediately on egress from the vehicle or the use of boot covers which can be pulled over waterproof footwear (e.g., rubber boots or waders). Boot covers should be considered single use and should only be used at one sample site or exclusively in the Red Zone. Boots with deep treads or screw in cleats on wader boots require more time to get thoroughly clean and should not be used unless necessary for safety purposes.
- As an alternative to conducting a Level 3 decontamination when leaving the Red Zone, the biological risk of spreading whirling disease can also be mitigated by achieving dry time (minimum of one year out of water) or freezing (minimum of 7 days in sub-zero temperatures).



GUIDELINES FOR DECONTAMINATION HUBS

Decontamination hubs will be established within or near Red Zones, and will be equipped with hot water wash units, QUAT products and equipment necessary to decontaminate watercraft and equipment. In the event that a decontamination hub is not available, the following criteria are required for level 3 decontamination:

- Be large enough to safely turn around a truck and 20 foot boat/trailer unit, and preferably with exposure to natural sunlight. Asphalt or concrete surfaces are preferred, as water will evaporate following decontamination of equipment due to direct or reflected sunlight.
- Vegetated or graveled areas that allow for filtration are sufficient as well. Dirt surfaces should be avoided for decontamination hubs as they are prone to collecting water or becoming muddy.
- No conveyed drainage to surface waterbodies, wetlands, or adjacent flowing water can be permitted; similarly, no potential for overland drainage to surface waterbodies in the event of large rain events is permissible.
- Controlled, secure access to the site (i.e., no access to vehicles other than those dedicated to the decontamination protocol) is highly desirable. Multi-purpose (e.g., Fish and Wildlife warehouses) and/or permanent locations housing watercraft or other aquatic equipment should only be used when other suitable locations cannot be found. If site does not meet all requirements, containment mats must be used.
- If using containment mats, contained water must be treated as required to ensure safe disposal (See Disposal of Products, Level 3 Decontamination QUAT Disposal Section). This is particularly important if there are concerns that waste water from the decontamination procedure may still be potentially contaminated (e.g., 90°C was not maintained for 10 minutes, or some wetted parts of watercraft were potentially not decontaminated completely due to equipment intricacies or manufacturer's considerations). In the event of contaminated water, consider allowing dumping of water in a safe location (i.e., vegetated area, on gravel, etc. as it allows for slow percolation and/or evaporation of waste water).



CONSIDERATIONS FOR DECONTAMINATION BY ACTIVITY TYPE

Fisheries/Enforcement/Aquatic Invasive Species Control

Fisheries field staff includes those managing fisheries, stocking fish, or enforcing legislation and regulations related to fishing.

General Prevention

- Handling/movement of fish (e.g., live, dead, parts) is the greatest risk for spreading fish disease, so your work generally is higher risk than most of the other program areas.
- Currently, there is very limited monitoring for AIS and fish disease in the province. You can never be certain that AIS are not present, so make sure that your practices are not going to spread what may be there.
- Avoid transferring water between watersheds or between unconnected waters within the same drainage. Do not dump water from one waterbody (e.g., stream, lake, reservoir) into another waterbody. Dispose of excess water over uplands.
- Watercraft and trailers can be a primary source of spread of AIS and fish disease. They must be washed according to the protocols outlined in this guide, and where they were used according to the most up-to-date risk maps between each use (unless using in same waterbody, river drainage, or HUC according to the protocols of that particular Zone).
- When working within a Red Zone, always sample from upstream to downstream, and from unaffected zones to infected zones. If this cannot be accomplished, Level 1 and 2 decontamination is required in between each site .
- When working in the Red Zone, a Level 1, 2, and 3 decontamination is required, unless you are working only in the Red Zone, in which case only a Level 1 decontamination is needed until you are leaving to work any other Zone, or plan to store the equipment for a longer term. **THIS IS VERY IMPORTANT.** Movement of any fish, fish parts, sediment, and water from the Red Zone to the Yellow Zone constitutes the highest risk of spread.



- When working in the Yellow Zone a Level 1 and 2 decontamination protocols must be used when moving between HUC 6 boundaries.
- If you are working within one Yellow Zone HUC 6 boundary, you may conduct the level 2 decontamination at the end of your field season at the warehouse (instead of streamside), so long as care is taken to avoid potential cross-contamination and the (warehouse) site is appropriate for decontamination activities.

Notes on Fish Sampling in Red Zone

- All fish must be processed (i.e., weighed and bagged on site), unless specific procedures are in place to quarantine these fish.
- Fish must be processed on non-porous surfaces that can be hot water washed and disinfected with QUAT.
- Fish samples should be double bagged to reduce potential leakage of contaminated fluids.
- The outside of sample bags must be cleaned to remove any blood or organic matter with a 3000 ppm QUAT solution (a higher concentration is specified for these materials given the potential for contamination from direct contact with potentially infected fish) before placing samples on ice within a clean and disinfected cooler.
- The outside of fish aren't likely any more 'infectious' than is the water they've been taken out of. If TAMs are on the outside of the fish, they're in the water too.
 - The biggest risk is if staff are cutting off heads in the field with potential for myxospore release from bones/cartilage lesions and subsequent contamination of equipment and cross-over from one sample to another.
- Unless you've been in contact with the lab to ship fresh fish, transfer samples to -80 C freezer and disinfect coolers. Coolers should be hot water cleaned, sprayed with a 3000 ppm QUAT solution and dried completely.
 - All surface water and QUAT solution should be collected in the cooler and disposed of in accordance with approved procedures (in accordance with previous procedures).

Disposal of Fish within the Red Zone

When disposing of fish in the Red Zone (re: fish toxicant and fish salvage operations) the appropriate disposal method for potentially infected fish includes:

- Non-salmonids may be disposed of in landfill (no risk of spreading whirling disease).
- Salmonids must be disposed of in a secure manner, either by making special arrangements with the landfill (deep burial) or incineration.
 - Landfill considerations: Per the Waste Control Regulation (AR 192/96), fish are not biomedical waste and there is no limitation to Class II Landfill disposal, unless the EPEA approval specifically limits pathogenic animal waste or bio-hazardous or infectious waste. These limitations are generally not listed in the landfill approvals, however this stresses the need to make arrangements with the landfills prior to disposal. The landfill run-off control system should be isolated so there is no run-off from the disposal areas at the time of disposal. Isolation burial is required to ensure the risk remains with the landfill. A pre-arranged haul into the landfill for all special waste is advised; working with the landfill owner/operator is key to the successful burial.
- Transport Considerations: If there is risk of transmission to organisms other than fish, the infected fish may be considered a risk to animals, but not to humans. The waste material could be classified under the transportation of dangerous goods as an infectious substance (UN2900, INFECTIOUS SUBSTANCE, AFFECTING ANIMALS). CFIA should be able to provide more clarity here.
- Incineration is also an option.
- Salmonid (including parts) should not be used for bear bait in the Red Zone as the range of bears is too great not to produce a risk of spreading whirling disease. However this can still be conducted in the Yellow Zone.



Monitoring/Research/Flood & Drought Mitigation

Field staff monitoring, managing, and/or researching surface water.

General Prevention

- While the movement of water is not considered the highest risk activity for whirling disease, standing water can be a host to a number of fish diseases and AIS. Care must be taken to avoid inadvertently spreading non-native species in water or on equipment.
- We have very limited monitoring for AIS and fish disease in the province. You can never be certain that AIS are not present, so make sure that your practices are not going to spread what may be there.
- Avoid transferring water between watersheds or between unconnected waters within the same drainage. Do not dump water from one waterbody (e.g., stream, lake, reservoir) into another waterbody. Dispose of excess water over uplands.
- Watercraft and trailers can be a primary source of spread of AIS and fish disease. They must be decontaminated between each use (unless using in the same waterbody or river drainage).
- When working within a Red Zone, always sample from upstream to downstream, and from unaffected zones to infected zones. If this cannot be accomplished, Level 1 and 2 decontamination is required in between each site (to avoid spreading whirling disease from an infected downstream area to a unaffected upstream area).
- When working in the Red Zone, a Level 1, 2, and 3 decontamination is required, unless you are working only in the Red Zone, in which case only a Level 1 decontamination is required. **THIS IS VERY IMPORTANT.** Movement of fish, fish parts, sediment and water from the Red Zone to other Zones constitutes the highest risk of spread.
- Isolate water samples within separate bags until sampling is complete, then place in a single cooler.
- Sonde probes and calibration cups should be treated with QUAT and carefully cleaned using a brush and triple-rinsed with clean water.



- Teflon coated sensors in the M9, FlowTracker, StreamPro and ADCP are able to receive the QUAT spray.

Sampling of Irrigation Districts

- Portions of the Western Irrigation District (WID) fall within the Risk Map.
- When sampling within an Irrigation district always sample from upstream to downstream, and from unaffected zones to infected zones (if known).
- Irrigation districts have canals which routinely cross watershed lines and as such require special zones for decontamination. Decontamination zones are to be defined based upon shared source water, returning river basins, and susceptible reservoirs. (See Table 1 below)
- For specific zone boundaries, please consult irrigation infrastructure schematics and flow patterns.
- Level 1 and 2 decontamination should be completed when leaving one Zone for work in another. Level 3 decontamination should be completed when leaving a Bow River or Crowsnest zone and prior to working elsewhere.

Table 1: Irrigation District Decontamination Zones

| ZONE | RETURNING RIVER BASIN | DESCRIPTION |
|----------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------|
| Bow River Irrigation District (BRID) | | |
| 1 | Bow River | All infrastructure sourcing from the Little Bow Reservoir and returning to the Bow River |
| 2 | Oldman River | All infrastructure sourcing from the Little Bow Reservoir and returning to the Oldman River |
| Eastern Irrigation District (EID) | | |
| 3 | Headworks/Bow River | All infrastructure sourcing from the Bassano Dam and returning to Crawling Valley Reservoir |
| 4 | Red Deer River | All infrastructure sourcing from Crawling Valley Reservoir and returning to the Red Deer River. |
| 5 | Red Deer River | All infrastructure sourcing from the Bassano Dam and returning to the Red Deer River |
| 6 | Bow River | All infrastructure sourcing from the Bassano Dam and returning to the Bow River |
| 7 | Lake Newell/Rolling Hills Reservoir | Any infrastructure within Lake Newell or Rolling Hills Reservoir |
| 8 | Bow River | All infrastructure sourcing from Lake Newell or Rolling Hills Reservoir and returning to the Bow River |
| Lethbridge North Irrigation District (LNID) | | |
| 9 | Oldman River | All LNID infrastructure |

| | | |
|---------------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Magrath Irrigation District (MID) | | |
| 10 | St. Mary River | All MID infrastructure |
| Mountain View, Leavitt, and Aetna Irrigation Districts | | |
| 11 | Belly/St. Mary River | All infrastructure within these districts |
| Raymond Irrigation District (RID) | | |
| 12 | St. Mary River | All RID infrastructure |
| Ross Creek Irrigation District | | |
| 13 | Ross Creek | All Ross Creek Irrigation District infrastructure |
| St. Mary River Irrigation District (SMRID) | | |
| 14 | Oldman River | All SMRID infrastructure west of Taber Irrigation District |
| 15 | Oldman River | All SMRID infrastructure east of Taber Irrigation District to Sauder (Rattlesnake) Reservoir |
| 16 | South Saskatchewan River | All SMRID infrastructure east of Sauder (Rattlesnake) Reservoir |
| Taber Irrigation District (TID) | | |
| 17 | Oldman River | All TID Infrastructure |
| United Irrigation District (UID) | | |
| 18 | Waterton River/Belly River | All UID Infrastructure |
| Western Irrigation District (WID) | | |
| 19 | Headworks/Bow River | AEP main canal from Harvey Passage to Chestermere Lake |
| 20 | Red Deer River | All infrastructure sourcing from Chestermere Lake and returning to the Red Deer River |
| 21 | Bow River | All infrastructure sourcing from Chestermere Lake and returning to the Bow River |
| Other Infrastructure | | |
| 22 | McGregor Lake | AEP main canal sourcing from the Bow River and returning to McGregor Lake |
| 23 | McGregor Lake/Travers Reservoir/Little Bow Reservoir | Any infrastructure within and connecting McGregor Lake, Travers Reservoir, and Little Bow Reservoir |
| 24 | Little Bow River | Any infrastructure within the Mosquito Creek or Little Bow River Basins |

*To be updated as monitoring results become available, as needed.

Disposal of Water Samples from Red Zone

For water quality monitoring, analytical labs should be directed to treat the water with QUAT or bleach prior to disposal.

- Decontamination: use a QAC compound like “QUAT Plus” at a concentration of 1500 mg/L (active ingredient) for a minimum of 10 minutes. The alkalinity of the solution can be neutralized prior to disposal.
- Heating: 90° for a minimum of 10 minutes
- Freezing: -20°C for a minimum of 1 week
- Chlorine Bleach: added to sample to achieve a final concentration of **5000** ppm of available chlorine (= 1:10 dilution of household bleach) held for a minimum of 15 min. before disposal. Bleach can be neutralized by adding sodium thiosulphate prior to release.

Off Highway Vehicles

Human activity is a known vector for transferring fish disease and AIS. While it is difficult to demonstrate the specific potential of Off-Highway-Vehicles (OHV) for introducing and spreading fish disease and AIS, these vehicles are a cause for concern if they are crossing bodies of water (particularly between water courses). **Whirling disease can be spread through contact with water, mud, and organic debris, particularly if OHVs are travelling through multiple watercourses.**

OHV use in water courses has been an issue for public lands management in the province, and as such, it is important that staff set a positive example for the public and reduce their risk of spreading fish disease and AIS. Under the Public Lands Act, it is against the law to use OHVs in public waters. It is recommended that the following actions be taken each time staff use OHVs for field work.



General Prevention

- Keep Wheels out of Water! We ask the public to follow these guidelines, so staff should be mindful of setting an example. Avoid contact with water when possible and clean OHVs as best as possible before transporting them from the field site.
- Plan before you go. Avoid crossing water courses where there is no infrastructure or measures in place to mitigate the impact to the water bodies. Use bridges or built-up crossings whenever possible.
- If contact with water is unavoidable, remove mud and organic debris from the OHV between water courses.
- Know where your field work is occurring within the 'Decontamination Risk Map,' and avoid OHV contact with water in the Red Zone.
- Avoid taking an OHV from the red zone to the yellow zone.
- Use a high pressure wash unit to clean all equipment at the end of the field activity.

Notes on OHV Use in the Red Zone

- Use Red Zone dedicated equipment (e.g. OHV) where possible as OHVs are difficult to decontaminate (particularly in the field).
- Use a high pressure wash unit to clean all mud and organic debris from OHV when returning from field activities.
- In Red Zones, contact with water should be avoided at all times unless it is critical and the OHV is dedicated for use in the whirling disease positive zone (see Risk Map).
- Plan your trip to allow for crossing at a bridge to minimize contact with water.
- QUAT can be applied via sprayer as part of the decontamination procedures, but all mud and organic debris must be removed prior to application to ensure efficacy.

Float Planes and Aviation

Many AIS, such as zebra mussels and Eurasian watermilfoil, can be unintentionally transported from one waterbody to another on the floats of float planes. Therefore, it is always important to clean aircraft of any AIS, organic debris, mud and standing water before traveling rather than after landing at new locations and incorporate these procedures into the operation of the float plane.

Recommended Actions

BEFORE ENTERING THE AIRCRAFT:

- Inspect and remove aquatic plants from the floats, wires or cables, and water rudders;
- Pump floats (which may contain infested water);
- If moored in zebra mussel infested waters for extended periods: check the transom, chine, bottom, wheel wells, and the step area of floats (see diagram). If zebra mussels are present on the floats, use the following options to remove or kill them:
 - wash with hot water; or
 - spray with high-pressure water; and/or
 - dry all parts of the floats in the sun for at least 5 days.

PRE TAKE-OFF CHECK:

- Avoid taxiing through heavy surface growths of aquatic plants before takeoff;
- Raise and lower water rudders several times to clear off plants;

AFTER TAKE-OFF:

- Raise and lower water rudders several times to free aquatic plant fragments;
- If aquatic plants are visible on floats or water rudders, return to the lake you left and remove plant fragments

STORAGE/MOORING:

- Remove aircraft from the water (as is often done at float plane bases) and allow all parts of the floats to dry. During hot summer temperatures, a few days will kill adult zebra mussels (longer drying times are required to kill adult mussels during cool, humid weather);
- Aircraft moored for extended periods in zebra mussel infested waters may have zebra mussels attached to the floats and should be cleaned regularly. In remote locations where zebra mussels are present, but where there are no provisions for drying, spraying, or treating the floats with hot water, hand-clean the submerged portions of floats with a scrub brush and physically removing organic debris and organisms.



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APPENDIX A: DEFINITION OF TERMS

- 1. Infected Zone:** Zone that immediately surrounds a location that has tested positive for whirling disease.
- 2. HUC:** Hydrologic Unit Code (HUC) Watersheds of Alberta define hydrologic units that form a standardized baseline across Alberta. HUCs represent a collection of nested hierarchically structured drainage basins and consist of successively smaller hydrologic units that nest within larger hydrologic units. There are currently individual feature classes for HUC 2 (coarsest level), HUC 4, HUC 6, HUC 8 and HUC 10 (finest level). The HUC 6 Watersheds of Alberta represent a seamless basin-wide coverage that falls completely within the Hydrologic Unit Code 4 Watersheds of Alberta.
- 3. Native water:** Water which has been collected from a potentially contaminated watercourse to be used at a sample site.
- 4. Clean water:** Water not likely to be contaminated with whirling disease, which has typically been obtained off-site from a potable water supply.
- 5. Hot water:** Water being used for decontamination purposes which is 90°C or hotter.
- 6. Containment Mat:** A waterproof, chemically resistant ground cover which is designed to hold the hot water and QUAT solutions used to disinfect watercraft. Mats are usually portable, leak proof, one piece systems large enough to accommodate a boat on trailer with self-supporting sides to capture treatment water. Typically, two containment mats are utilized during watercraft decontamination: one mat for hot water decontamination and a second mat for chemical decontamination. A two mat system provides for the separation of hot wash water from chemical decontamination solutions for ease of containment and eventual disposal. Specifications: impervious containment mat material with lip height appropriate to items being decontaminated on mat (i.e., drive on/off ability for vehicles and trailers), drain protector – impervious (urethane) drain protector/seal, impervious dykes/pads (not filter socks)
- 7. Waterbody:** Any location where water flows or is present, whether or not the flow or the presence of water is continuous, intermittent or occurs only during a flood, and includes but is not limited to wetlands and aquifers but does not include except for clause (nn) and section 99 “water body” that is part of an irrigation works if the irrigation works is subject to a licence and the irrigation works is owned by the licensee, unless the regulations specify that the location is included in the definition of water body (per the Water Act).

NOTE: Self-contained, non-fish bearing, dugouts/wetlands that are not hydraulically connected to a flowing waterbody (creek, irrigation canal, etc) are not included in this definition, but still require Level 1 decontamination.

APPENDIX B: BEST MANAGEMENT PRACTICES FOR WILDFIRE MANAGEMENT EQUIPMENT DECONTAMINATION

Activities associated with field staff preventing and managing wildfire is a possible source of aquatic invasive species (AIS) and fish disease introductions and spread. Firefighter and public safety is still the number one priority, but whirling disease and AIS pose a significant risk to the environment. Avoidance and decontamination can prevent the spread of these organisms. Given that wildfire management and mitigation are considered emergency activities, the non-traditional types of equipment used for wildfire management, as well as the complexity and scope of the work, it was deemed most appropriate to adopt them as Best Management Practices, to be implemented whenever possible, instead of including them in the mandatory protocols for other GOA field staff. Mud and standing water are known vectors of spread for AIS and fish disease, so care should be taken during each use to minimize the risk of transfer.

The Risk Map shows the distribution of known whirling disease or AIS positive watersheds in Alberta (red zone), as well as those that are considered high risk or susceptible to whirling disease or AIS (yellow zone). While the white zone captures watersheds that are considered a lower risk than other locations in Alberta, care should always be taken to prevent the spread of AIS and fish diseases by ensuring equipment is CLEAN, DRAINED and DRY after each use.

PREVENTION PROTOCOLS

GROUND OPERATIONS

ALL ZONES

- CLEAN (remove organic material and mud as best as you can), DRAIN (drain all lake/river/stream standing water from tanks and equipment after each use), and DRY (a minimum of 24 hours is ideal) all equipment that came into contact with water between each use.



- Avoid transferring water between watersheds or between unconnected waters within the same drainage. Do not dump water from one waterbody (e.g., stream, lake, and reservoir) into another waterbody. Dispose of excess water over uplands.
- Use proper drafting and water handling procedures:
 - When possible, fill engines from a municipal hydrant, a water tender, or from a pump assigned to a single drafting source
 - To minimize the potential for engine water leakage through the foot valve, prime with water from the drafting source rather than water from the engine tank. Unit should carry a spare foot valve in case one leaks.
 - When priming by filling the drafting hose with a bucket, first make sure that the bucket is clean so that it does not transfer AIS or fish disease.
 - During drafting and water tending operations, don't leave draft hose full with foot valve engaged and submerged in water source when not pumping.
 - When filling the engine tank, avoid tank overflow into the water source.
- Use proper pumping and water handling procedures:
 - Elevate foot valves above the bottom of the waterbody for clean, sediment-free operation—for example, duct tape foot valve to a shovel or place the valve in a hard hat or bucket.
 - Remove water drain plug/s from self-priming pumps (e.g., trash pumps) to empty pump housing before moving to a new waterbody.
 - When done using pump, remove all mud and organic debris before subsequent use. This may be done by entering deeper water and cleaning mud off of pump and foot valve. In particular mud should be removed from equipment before it is used at any other site.
- When spraying water to suppress a fire, avoid application of untreated water into local water bodies (ponds, lakes, rivers, streams, wetlands, seeps, or springs), especially if the hose water came from a different watershed.
- Avoid drafting from known whirling disease/AIS positive waterbodies.
- Avoid training (pump, engine, airtanker/helitanker practices) in whirling disease/AIS positive waterbodies.

RED ZONE

- If collapsible tanks can be filled with municipal water, draft from those tanks instead of untreated water sources.
- Avoid obtaining water from multiple sources during a single operational period unless drafting/dipping equipment is decontaminated or changed out with clean equipment between sources.
- Use green 'Aquatic Invasive Species Risk' flagging tape to mark any ground equipment used in the 'Red Zone.'

YELLOW/WHITE ZONE

- "CLEAN, DRAIN, DRY" principles are strongly encouraged in both yellow and white zones.

AIR OPERATIONS

ALL ZONES

- Whenever possible, avoid operating from whirling disease/AIS positive waterbodies.

RED ZONE

- If possible, avoid dipping or scooping water from multiple water sources minimize cross-contamination of water sources.
- Whenever possible, use water dipped from the same watershed that it will be dropped
- Use deeper (blue) water whenever possible. Avoid areas that will intake mud or plants.
- Switch out a contaminated helicopter bucket with a clean bucket before moving to a new water source. Alternating used (possibly contaminated) helicopter buckets with spare (clean) buckets can save time and increase efficiency, as the first bucket can be decontaminated while the second bucket is being used.
- Snorkel ends and foot valves that encounter untreated water must be decontaminated.
- Pumps, suction hoses, and foot valves must be decontaminated prior to being used outside of the Red Zone.

YELLOW/WHITE ZONE

- “CLEAN, DRAIN, DRY” principles are strongly encouraged in both yellow and white zones.

DECONTAMINATION PROTOCOLS

GROUND OPERATIONS

RED ZONE

- At the end of operations within the red zone, decontaminate all equipment (eg. Foot valves, suction hose, hand tools etc). Three options are:
 - Dry the gear until dry to the touch (sunlight accelerates the process).
 - Use hot water (³90°C), allow spray to contact surface for 5 to 10 seconds (up to 5 minutes preferred).
 - Use a chemical solution (Quaternary Ammonium Compounds (QUATs). Surfaces of the can be decontaminated by submerging in a bucket for ten minutes filled with QUAT.
- Consider carrying spare, clean dry draft hoses and foot valves to switch out with used ones when moving to a new water source.
- Hose gets melon rolled, flagged with green flagging tape and sent to the Provincial Warehouse

YELLOW/WHITE ZONE

- “CLEAN, DRAIN, DRY” principles are strongly encouraged in both yellow and white zones.

AVIATION

Out of province import aircraft

- When importing helitankers, helicopters with buckets, or skimmer airtankers, from out of province, or when these aircraft are returning to Alberta, they must be thoroughly decontaminated (steaming) and dried prior to being utilized in Alberta waterbodies.
- Decontamination of these aircraft is not required for quick strikes into neighboring jurisdictions unless directed by the provincial aircraft coordinator.
- For skimmer airtankers, the Forest Area Duty Officer, with guidance from the Provincial Aircraft Coordinator, will arrange for a steam truck to be on-site upon the aircraft's arrival.
- Helicopter companies are responsible for decontaminating their tanks and buckets prior to being utilized in Alberta waterbodies.

RED ZONE

- Chemicals such as bleach and Quaternary Ammonium Compounds (QUAT) do not meet corrosion requirements for aluminum and **shall not be used on aircraft fuselages or water delivery components such as helicopter buckets and foot valves.**
- When contact with untreated water has occurred or is suspected, decontamination is needed.
 - Flush with uncontaminated water and dry the gear until dry to the touch (sunlight accelerates the process).
 - Use hot water ($\geq 90^{\circ}\text{C}$), allow spray to contact surface for 5 to 10 seconds (up to 5 minutes preferred).
- Decontaminate internal tanks by spraying the internal surface with hot water ($\geq 90^{\circ}\text{C}$). Allow spray to contact surface for 5 to 10 seconds (up to 5 minutes preferred). This method is recommended for scooper and Fire Boss aircraft. Tanked helicopters have tank doors that open widely from below for easy tank access and draining. Hot water spray or thoroughly dry these surfaces. A steam truck may also be used.

YELLOW/WHITE ZONE

- "CLEAN, DRAIN, DRY" principles are strongly encouraged in both yellow and white zones.

APPENDIX C: BEST MANAGEMENT PRACTICES FOR AGRICULTURE AND FORESTRY WATER PUMPING PROGRAM EQUIPMENT DECONTAMINATION

Water pumping activities associated with drought mitigation and emergency response (flood, fire, drought, etc) is a possible source of aquatic invasive species (AIS) and fish disease introductions and spread. Emergency response personnel and public safety is still the number one priority, but whirling disease and AIS pose a significant risk to the environment. Avoidance and decontamination can prevent the spread of these organisms. Given that water pumping equipment is often used in emergency situations, the large-scale equipment used, as well as the scope of the work, it was deemed most appropriate to adopt them as Best Management Practices, to be implemented whenever possible, instead of including them in the mandatory protocols for other GOA field staff. Mud and standing water are known vectors of spread for AIS and fish disease, so care should be taken during each use to minimize the risk of transfer.

The Risk Map shows the distribution of known whirling disease or AIS positive watersheds in Alberta (red zone), as well as those that are considered high risk or susceptible to whirling disease or AIS (yellow zone). While the white zone captures watersheds that are considered a lower risk than other locations in Alberta, care should always be taken to prevent the spread of AIS and fish diseases by ensuring equipment is CLEAN, DRAINED and DRY after each use.

PREVENTION PROTOCOLS

NON-EMERGENCY OPERATIONS (INCLUDES FILLING OF DUGOUTS FOR AGRICULTURAL USE)

ALL ZONES

- CLEAN (remove organic material and mud as best as you can), DRAIN (drain all lake/river/stream/dugout standing water from pump, pipe and equipment after each use), and DRY (a minimum of 24 hours is ideal) all equipment that came into contact with water between each use.
- Avoid transferring water between watersheds or between unconnected waters within the same drainage. Do not transfer water from one natural waterbody (e.g., stream, lake, and reservoir) or irrigation canal into another natural waterbody or irrigation canal.
 - Dispose of excess water over uplands where the runoff doesn't directly drain into a waterbody; it either evaporates or seeps into the ground.
- When transferring water between natural waterbodies or irrigation canals and dugouts/reservoirs containing fish, ensure all equipment (intake, hose, pump, pipe, etc) has not been used in a red zone
 - If equipment has been used in a red zone, it must be decontaminated before use
- Use proper pumping and water handling procedures:



- Drain water from primer and drain pump housing before moving to a new waterbody.

When done using equipment, remove all mud and organic debris before subsequent use. This may be done by entering deeper water and cleaning mud off of intake screen and intake pipe. In particular mud should be removed from equipment before it is used at any other site.

RED ZONE

- Avoid obtaining water from multiple sources during a single operational period unless intake pipe and hose is decontaminated or changed out with clean equipment between sources.
- All equipment must be decontaminated prior to being used outside of the Red Zone.
 - Consider segregating equipment that has been used in the Red Zone to only be used in Red Zone areas for the remainder of the season

YELLOW/WHITE ZONE

- “CLEAN, DRAIN, DRY” principles are strongly encouraged in both yellow and white zones.

EMERGENCY OPERATIONS (FLOOD, FIRE, DROUGHT)

ALL ZONES

- Whenever possible, avoid operating from whirling disease/AIS positive waterbodies.
- Change footwear, hipwaders, etc on high ground
- Use proper pumping and water handling procedures:
 - Drain water from primer and drain pump housing before moving to a new waterbody.
 - When done using equipment, remove all mud and organic debris before subsequent use. This may be done by entering deeper water and cleaning mud off of intake screen and intake pipe. In particular mud should be removed from equipment before it is used at any other site.

RED ZONE

- If possible, avoid pumping water from multiple water sources to minimize cross-contamination of water sources.
- Use deeper water whenever possible. Avoid areas that will intake mud or plants.
- If possible, switch out a contaminated intake pipe and hose with a clean intake before moving to a new water source. Alternating used (possibly contaminated) intakes with spare (clean) intakes can save time and increase efficiency, as the first intake can be decontaminated while the second intake is being used.

YELLOW/WHITE ZONE

- “CLEAN, DRAIN, DRY” principles are strongly encouraged in both yellow and white zones.

DECONTAMINATION PROTOCOLS

NON-EMERGENCY OPERATIONS (INCLUDES FILLING OF DUGOUTS FOR AGRICULTURAL USE)

RED ZONE

- At the end of a pump job within the red zone, before leaving the site:
 - Clean off all mud and debris and drain all equipment (pumping and personal)
 - Spray down any surfaces that were in contact with mud or water (intake pipe, hose, pump,) from contaminated waterbody with QUAT solution using a handpump/backpack sprayer
 - Surfaces of small equipment (boots, etc) can be decontaminated by submerging in a bucket/ container filled with QUAT solution for ten minutes.
- After completion of a pump job, decontaminate all equipment (either at site or after transferring to regional storage location)
 - For pumping equipment (eg. intake pipe, hose, pump, pipe etc), leave out until dry to the touch (sunlight accelerates the process.).
 - Launder all clothing that was in contact with contaminated water in hot water
- Consider keeping spare, clean dry intake pipe and hose on hand to switch out with used ones when moving to a new water source.
- Consider segregating equipment that has been used in the Red Zone to only be used in Red Zone areas for the remainder of the season
- After pumping season is complete (fall/winter), all pumping equipment must be decontaminated by complete drying and exposure to freezing (ie outside winter storage)
- Before leaving red zone (and entering yellow/white):
 - Remove gaskets to allow for decontamination either by submerging in a bucket/container filled with QUAT solution for ten minutes, or
 - Complete drying (sunlight accelerates the process).

YELLOW/WHITE ZONE

- “CLEAN, DRAIN, DRY” principles are strongly encouraged in both yellow and white zones.
- After pumping season is complete (fall/winter), all pumping equipment must be decontaminated by complete drying and exposure to freezing (ie outside winter storage)

EMERGENCY OPERATIONS (FLOOD, FIRE, DROUGHT)

RED ZONE

- If possible, clean off all mud and debris and drain all equipment before leaving the site.
- If possible, dry all equipment (sunlight accelerates the process) before moving to another site.

YELLOW/WHITE ZONE

- “CLEAN, DRAIN, DRY” principles are strongly encouraged in both yellow and white zones.

APPENDIX D: CHEMICAL TREATMENTS

- Quaternary Ammonium Compounds (QUAT) are common cleaning agents used in homes and hospitals, and are safe for MOST gear and equipment when used at recommended concentrations and rinsed.

NOTE: QUAT products can cause corrosion when used on aluminum. Alternate cleaning methods should be utilized for aluminum equipment.

- Chlorine products are not recommended for use in these protocols because of their corrosiveness to fabrics, plastics, rubber, and metal and their limited effectiveness against snails.

Approved Products

- Of the Quaternary Ammonium Compounds (QUAT) available, 'QUAT Plus' (Dustbane) has been found to be most effective against whirling disease and a variety of AIS, at concentrations no lower than 1500 ppm. This is the product recommended for use in Alberta by GOA staff and all contractors.
- QUAT compounds are toxic to aquatic organisms but are immobile in soil.
- Keep effluent containing this product at least 30m from lakes, ponds, streams or other waters.

Table 1: Available QUAT's and Manufacturer's Concentrations

| BRAND NAME | MANUFACTURER | QUAT ACTIVE INGREDIENT(S) | QUAT CONCENTRATION (AS SUPPLIED) |
|--------------|------------------|----------------------------------------------------------------------------------|----------------------------------|
| QUAT Plus* | Dustbane | n,n-dialkyl –n, n-dimethyl ammonium chloride | 4.8% |
| QUAT Plus M5 | Dustbane | n,n-dialkyl –n, n-dimethyl ammonium chloride | 7.7% |
| Vanguard | Dustbane | Didecyl dimethyl ammonium chloride n-alkyl; dimethyl benzyl ammonium chloride | 2.88% 1.92% |
| Pinosan | Dustbane | Didecyl dimethyl ammonium chloride n-alkyl; dimethyl benzyl ammonium chloride | 1.44% 0.96% |
| QUAT 128 | Sanicare | Didecyl dimethyl ammonium chloride Dimethyl benzyl ammonium chloride | 5.07% 3.38% |
| SparQUAT 256 | Spartan Chemical | Dialkyl dimethyl ammonium chloride Alkyl dimethyl benzyl ammonium chloride | 5-10% 5-10% |

*Recommended Product (AEP)

Recommended Application Concentration and Dilutions

The recommended concentration of active ingredient for QUAT compounds (above) is 1500 ppm. The dilution rate for QUAT compounds will be specific to the brand name and the concentration of active ingredient in that product.

The dilution rate can be calculated by:

- Convert the percent active ingredient identified from the label or MSDS sheet for the product into ppm by multiplying the % times 10,000 (e.g., QUAT Plus: 4.8% active ingredient X 10,000 = 48,000 ppm).
- To determine the dilution rate to obtain the desired concentration of 1500 ppm of active ingredient, divide the ppm obtained above by 1500 ppm. Using QUAT Plus as the product of choice this would result in a dilution rate of 32 (i.e., 48,000 divided by 1500 = 32). To make up a stock solution this would require diluting one liter of QUAT Plus with 31 liters of clean water to yield 32 liters of stock solution at a concentration of 1500 ppm.

Note: These calculations assume no organics present and no interference(s) from other chemicals/minerals in the dilution water. Solutions should be tested with QUAT test strips initially to confirm concentrations and dilution rates.

APPENDIX E: DISPOSAL OF PRODUCTS AND ITEMS

Disposal Of Items

A number of items that are used in these protocols are considered disposable either due to the difficulty in adequately disinfecting them or because of their insignificant purchase cost. These items include:

- Boot covers and single-use laboratory coveralls
- Wet wipes, or paper “shop towels”
- Bags for contaminated gear

This material must be secure and double bagged in heavy duty garbage bags (leak and tear resistant) and dispose of these materials in a safe location (i.e., garbage cans with lids, GOA warehouse, etc.) away from water.

Incineration is also an option for disposal.

Disposal Of Chemical Products

- Small quantities of diluted QUAT products may be disposed of in a sanitary sewer as allowed by the product label.
- Always consult the product label in determining the appropriate Personal Protective Equipment (PPE) necessary for the mixing and use of these chemicals, and for final direction on a given products use and disposal.
- Do NOT allow these products to enter storm drains, lakes, streams, or other waterbodies.
- May flush into waste systems in accordance to municipal, provincial, and federal regulations (See Appendix G – MSDS).

On-Site Product Disposal (Level 2)

The disposal of QUAT used for Level 2 for on-site decontaminations.

- Volume limitations: Follow label rate, mixing instructions and dilution rate of product (See Appendix D, Table 1: Dilution rates.) Use care in applying decontamination solution to minimize runoff.
- Large equipment decontamination runoff concerns: applied to equipment in the following areas over dry bare ground such as concrete or asphalt surfaces, or gravel or vegetated areas away from surface water, ditches, or storm drains. No containment mats are necessary if no surface drains are present.
 - Prevent off-site runoff using containment mats and surface drain protection, when the above criteria cannot be met.
 - Water body proximity buffers—decontamination not to be conducted on boat ramp or ramp approach/setup areas—flat, level area a minimum of 30 m from water and with no slope towards water
 - Restricted/sensitive areas—Avoid decontamination activities in these areas: low-lying, non-level, surface drainage present to water body, standing water present, and sandy soils.
 - Containment mats – when using, collect water for transport back to warehouse for consolidation and disposal.

- Streamside equipment decontamination soak – tubs/ pails: not to be disposed of on-site.
 - Return to warehouse/operations facility for consolidation and disposal. These larger quantities must be disposed of properly.
 - Do not allow decontamination solution to enter storm water drains or floor drains.
 - Contact local wastewater treatment facility for disposal authorization for used decontamination solution (volumes, concentrations, and point of disposal information likely required). Determine disposal for larger volumes of decontamination solution which must be determined on a site-by-site basis depending on location and wastewater treatment options.

Off-Site Product Disposal (Level 3)

It is the responsibility of the generator of the wastewater to ensure proper disposal of their wastewater. This would include receiving consent of the ultimate wastewater treatment provider. Individual wastewater treatment plants are responsible for ensuring that what gets discharged to their system can be appropriately treated – they can restrict what enters the wastewater system through municipal sewer bylaws. The wastewater treatment providers are also in better position to investigate and determine if a particular waste can be managed/treated by their system or not.

Regarding smaller municipalities who may not have the same wastewater expertise as a large municipality—the generator should err on the side of caution and should not assume that smaller municipal wastewater systems can treat their waste appropriately.

APPENDIX F: LEVEL 2 DECONTAMINATION KIT – RECOMMENDED CONTENTS

FIELD SUPPLIES

1. Two plastic (no wooden components), nylon stiff bristle brushes (two sizes, one small hand scrub brush, a second larger, long handled brush for exterior/interior of watercraft, trailers and trucks);
2. Three 100 L rigid plastic totes with tight fitting lids (or equivalent) to be used as follows: disinfectant tub for small gear; rinse tub, and bio-secure container for non-decontaminated, disposable items;
3. Pump-style liquid sprayers (two sizes, one approximately 10 L, a second smaller (e.g., 1 L) , suitable for chemical use (typically labelled as suitable for use with chlorine);
4. Zepp® instant hand sanitizer (or equivalent);
5. QUAT Plus (preferably a 4 L container);
6. Test strips for measuring concentration of QUAT in the field;
7. Measuring container marked out in liter increments for use with QUAT Plus;
8. Pail marked out in liter increments for filling plastic disinfecting containers.

PERSONAL PROTECTIVE EQUIPMENT (SPECIFICALLY FOR USE WITH QUAT PLUS)

■ **Note:** please refer to product specific MSDS sheets, and Appendix D

1. Mid-forearm length, “gauntlet style” chemical resistant gloves (disposable preferred): Neoprene, rubber, polyvinyl chloride, Vitron or nitrile;
2. Chemical resistant apron, in case of spill;
3. Waterproof, chemical resistant foot wear (rubber boots);
4. Eye protection: safety glasses with side shields, which protect from splash.

APPENDIX G: MSDS AND LABEL FOR QUAT PLUS

NOTE: Comprehensive Safety Data Sheet for QUAT PLUS can be found at: <http://www.dustbane.ca/sds/Quat-Plus.pdf>



MATERIAL SAFETY DATA SHEET (MSDS)

Quat Plus
Liquid Disinfectant
Germicides

Effective against influenza A (H1N1)



| SECTION I ▶ PRODUCT IDENTIFICATION | | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------|----------------------------|
| Product Name | | Product Type | | WHMIS Classification | |
| Quat Plus | | Liquid Disinfectant | | Exempt | |
| SECTION II ▶ HAZARDOUS INGREDIENTS | | | | | |
| Chemical Name | | Cas Registry No. | % | Toxicity | |
| N,N-DIALKYL-N,N-dimethyl ammonium chloride | | 68424-95-3 | 1-5 | LD ₅₀ ORAL (RAT) 455 mg/kg | |
| SECTION III ▶ PHYSICAL DATA | | | | | |
| Appearance | Odour | pH | Boiling Point | Specific Gravity | Solubility in Water |
| Clear colourless liquid | Unscented | 10.5 | 100 °C | 1.0 | 100 % |
| SECTION IV ▶ FIRE AND EXPLOSION HAZARD DATA | | | | | |
| Flash Point (°C): None | | Extinguishing media: Not Applicable | | | |
| Special fire fighting procedures: None | | | | | |
| Unusual fire and explosion hazards: None | | | | | |
| SECTION V ▶ TOXICOLOGICAL PROPERTIES | | | | | |
| HAZARD RATING: Health = 1 Flammability = 0 Reactivity = 0 | | Rating System 0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme | | | |
| Swallowing: Slightly Toxic | | | | | |
| Inhalation: Not Applicable | | | | | |
| Skin Absorption: Unknown | | | | | |
| Skin Contact: May cause irritation | | | | | |
| Eye Contact: Irritant | | | | | |
| Special Warning: None | | | | | |
| SECTION VI ▶ FIRST AID MEASURES | | | | | |
| Ingestion: Promptly drink large quantities of milk, egg whites, gelatin or water. Avoid alcohol. Call a physician immediately. | | | | | |
| Inhalation: Not Applicable | | | | | |
| Skin: Flush thoroughly with water for at least 15 minutes. Remove and wash contaminated clothing. | | | | | |
| Eyes: Flush thoroughly with water for at least 15 minutes. Call a physician. | | | | | |
| SECTION VII ▶ REACTIVITY DATA | | | | | |
| Stable: Yes | | | | | |
| Conditions to avoid: None | | | | | |
| Incompatibility with other materials: None | | | | | |
| Hazardous decomposition products: None | | | | | |
| Hazardous polymerization: Will not occur. | | | | | |
| SECTION VIII ▶ PREVENTIVE MEASURES | | | | | |
| Hand protection: Gloves made of neoprene, rubber, polyvinyl chloride, Viton or nitrile. | | | | | |
| Eye protection: Safety glasses with side shields. | | | | | |
| Ventilation: General | | | | | |
| Respiratory protection: None | | | | | |
| Other protective equipment: In case of spills, wear chemical resistant apron and boots. | | | | | |
| Steps to be taken in case material is released or spilled: Mop up spillage. Rinse spill area with water and allow to dry. | | | | | |
| Waste disposal method: Flush with water into waste systems in accordance with municipal, provincial and federal regulations. | | | | | |
| Precautions to be taken in handling and storage: Normal handling processes. Inside storage at 4-40 °C recommended. | | | | | |
| Other precautions: Follow label use instructions. | | | | | |
| UN: Not Applicable | | TDG Class: None | | Packing Group: Not Applicable | |
| TDG Emergency Telephone Number: 613-996-6666 (COLLECT) | | | | | |
| SECTION IX ▶ PREPARATION DATA | | | | | |
| Prepared by: D.R. Dunlop | | | Last updated: June 1, 2014 | | |
| Location: Dustbane Products Limited, 25 Pickering Place, Ottawa, Ontario, K1G 5P4 – 613-745-6861 | | | | | |

Quat Plus

Liquid Disinfectant

“This quat-based disinfectant cleaner kills a broad spectrum of bacteria, virus and fungi without the harsh smell of chemicals.”

| FEATURES AND BENEFITS |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reduced environmental impact: ECOLOGO Certified UL 2794 - Disinfectants and Disinfectant Cleaners. |
| Multiple Claims: effectively destroys a broad range of bacteria, fungi and viruses including: Pseudomonas aeruginosa, Salmonella choleraesuis, Staphylococcus aureus, HIV-1 and Trichophyton mentagrophytes. |
| Dual Purpose: Cleans and disinfects. |
| WHERE TO USE |
| Formulated for use in health care, food processing facilities, schools, offices and public areas. It may be used to disinfect all hard, non-porous surfaces including walls, floors, tubs, sinks, counter tops, garbage pails, furniture etc. |
| HOW TO USE |
| Pre-clean heavily soiled surfaces before using Quat Plus. Dilute with unheated tap water according to the dilution rates listed below. Apply the solution with a sponge, mop or cloth. Allow 10 minutes contact time for complete disinfection. |
| Dilution Rates: |
| Disinfection/ECOLOGO (Certified UL 2794) 1:80 |
| All purpose 1:120 |
| Regular cleaning 1:256 |
| Heavy cleaning 1:40 |
| Auto-scrubber 1:256 |
| <i>Note: Adjust dilution rates to suit your cleaning needs.</i> |
| MOLD AND MILDEW: When mixed at a rate of 1:80, QUAT PLUS effectively inhibits the growth of odour-causing mold and mildew. Apply the solution and allow it to dry on the treated surface. Repeat treatment when mold or mildew returns. |
| DISINFECTING: Allow a minimum contact time of 10 minutes in a single application. Surfaces subject to direct food contact should be adequately rinsed with potable water. Heavily soiled surfaces must be pre-cleaned. |
| HIV-1: When mixed at a rate of 1:80, QUAT PLUS may be used to disinfect and decontaminate hard surfaces exposed to blood or other body fluids that contain the HIV-1 virus. Thoroughly clean all hard surfaces removing blood and body fluids prior to disinfection. Allow surfaces to remain wet for a minimum of 4 minutes. Wear protective clothing including latex gloves, gown, mask and eye goggles. Blood, body fluids, cleaning materials and clothing should be autoclaved and disposed of according to local regulations. [Note: efficacy testing was done in the presence of hard water (400 ppm as CaCO ₃) and a soil load (5% blood serum)]. |
| SPECIFICATIONS |
| N,N-DIALKYL-N,N-dimethyl ammonium chloride: 4.8% |
| Inert Ingredients: 95.2% |
| pH, concentrate @ 25°C: 10.5 |
| pH, at 1:80 @ 25°C: 9.0-9.5 |
| Colour: Colourless |
| Odour: Unscented |
| DIN#: 02298694 |
| CFIA: Yes |

Quat Plus is an effective bactericide, fungicide and virucide as demonstrated by the following support data:

- a) CLAIM - DISINFECTANT - AOAC USE - DILUTION TEST AT 600 ppm (dilution ratio of 1:80 in 250 ppm hard water).

| | | | |
|------------------------|--------------|----|------|
| Pseudomonas aeruginosa | ATTC # 15542 | 10 | 0/10 |
| Staphylococcus aureus | ATTC # 6538 | 10 | 0/10 |
- b) CLAIM - DISINFECTANT - AOAC USE - DILUTION TEST AT 600 ppm (dilution ratio of 1:80 in 250 ppm hard water and 5% organic soil).

| | | | |
|---------------------|--------------|----|------|
| Salmonella enterica | ATTC # 10708 | 10 | 0/10 |
|---------------------|--------------|----|------|
- c) CLAIM - FUNGICIDE - AOAC FUNGICIDAL USE - DILUTION TEST AT 600 ppm (dilution ratio of 1:80 in 250 ppm hard water and 5% organic soil).

| | | | |
|-----------------------------|-------------|----|------|
| Trichophyton mentagrophytes | ATTC # 9533 | 10 | 0/10 |
|-----------------------------|-------------|----|------|
- d) CLAIM - VIRUCIDE - EPA VIRUCIDAL EFFICACY OF A DISINFECTANT FOR USE ON INANIMATE ENVIRONMENTAL SURFACES AT 600 ppm (dilution ratio of 1:80 in 250 ppm hard water and 5% organic soil).

| | | | |
|------------|-----------------|-----------------|-------------------------|
| HIV type 1 | Strain HTLV III | Titer reduction | ≥ 3.5 log ₁₀ |
|------------|-----------------|-----------------|-------------------------|
- e) CLAIM - INFLUENZA A H1N1 - EPA VIRUCIDAL EFFICACY OF A DISINFECTANT FOR USE ON INANIMATE ENVIRONMENTAL SURFACES AT 600 ppm (dilution ratio of 1:80 in 250 ppm hard water and 5% organic soil).

| | | | |
|------------|-----------------|-----------------|-------------------------|
| HIV type 1 | Strain HTLV III | Titer reduction | ≥ 3.5 log ₁₀ |
|------------|-----------------|-----------------|-------------------------|

APPENDIX H: SAMPLE WATERCRAFT AND EQUIPMENT TRACKING SHEET

WATERCRAFT AND EQUIPMENT DECONTAMINATION TRACKING SHEET/DATA LOG

| DESCRIPTION OF WATERCRAFT OR EQUIPMENT | DATE USED | WATERBODY | ZONE | DECONTAMINATED (YES/NO, DATE) | NOTES |
|----------------------------------------|-----------|-----------|------|-------------------------------|-------|
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