HACCP Step 1 – Activity Description

Activity Description				
Facility: BIO-WEST, Inc.	Site: Reaches 5 and 6 of Lower Colorado			
	River Multi-Species Conservation Plan			
	planning area (Imperial NWR downstream to			
	Mexico border).			
Project	Activity/Management Objective:			
Coordinator: Mike Robertson				
Site	Survey and evaluation of potential			
Manager: Mike Robertson	restoration habitats in the Lower Colorado			
Address: 1063 West 1400 North	sucker and bonytail.			
Logan, UT 84341				
Phone: 435-752-4202				
Project Description				
(i.e., Who, What, Where, When, How, Why)				

Who: BIO-WEST personnel

<u>What:</u> We wish to prevent transfer of non-target organisms between Lake Mead and downstream locations (and among downstream locations) in the Lower Colorado River during water quality and fisheries surveys in potential restoration sites.

<u>Where:</u> Equipment used on Lake Mead during seasonal monitoring of its razorback sucker population will also be used to sample 25 backwaters downstream of Imperial NWR (over approximately 25 river miles) for fish and water quality samples.

<u>When:</u> Surveys are to be conducted between June 15, 2007, and August 31, 2007; monitoring efforts on Lake Mead will be complete during early May.

How: The boat used to conduct monitoring efforts on Lake Mead may be trailered and launched in the Colorado River near Imperial Dam to access some survey sites from the river. In addition, some equipment used in Lake Mead (e.g., trammel nets) may also be used in sampling the potential survey sites. Risk of transporting non-target species will be reduced or eliminated from the surveys by a couple of means: First, the boat and any equipment used in Lake Mead monitoring will be treated according to the recommended approach (Attachments A and B); second, bodies of water in the Lower Colorado River will be sampled so that the locations with the least probability of holding nuisance species are surveyed first, while those with greatest probability are surveyed last. Any areas that have, or may have giant salvinia will be surveyed last. Third, when the boat is removed and moved to new launch site the boat and trailer will be pressured washed at a cleaning station when available.

Project Description (Continued)

(i.e., Who, What, Where, When, How, Why)

How (cont'd): Specific actions to be taken to treat the boat will include dry storage of the boat for as long as possible in the heat of Boulder City in May-June prior to sampling. We will also power wash the boat and trailer, and visually inspect each (especially the carpeted rails) and scrape off any mussels or aquatic vegetation between boat launch locations. The live well will be emptied of all water and live material when moving between boat launch locations and allowed to air dry completely. The bilge will be drained after each survey on the inclined ramp at the survey location. Sampling gear, including nets, measuring boards, scales, etc., which have been used in Lake Mead and will be used in the Lower Colorado River will be soaked in a solution of 5-12% chlorine bleach for at least 30-60 minutes.

<u>Why:</u> To complete contact obligation for BOR contract to conduct LCR MSCP Backwater Inventory Site Visits in Reaches 5 & 6.

HACCP Step 2 – Identify Potential Hazards

(to be transferred to column 2 of HACCP Step 4 – Hazard Analysis Worksheet)

Hazards: Species or Contaminants That May Potentially Be Moved/Introduced

Vertebrates:

Fish

Invertebrates:

Aquatic invertebrates and zooplankton (such as quagga mussels, New Zealand mudsnails, apple snails, crayfish, and undesirable zooplankton)

Plants:

Aquatic macrophytes (such as giant salvinia, Hydrilla, watermilfoils [Eurasian and Parrot feather], pondweeds, naiads, coontail) and phytoplankton (such as golden algae, filamentous and blue-green algae)

Other Biologics (e.g., genetics, disease, pathogen, parasite, or non-pathogens):

Fish parasites (e.g., Eurasian tapeworm, leeches and flukes, anchorworms)

Others (non-biological contaminants [e.g., pesticide residue, oil products, and harborage via packing or construction materials]):

Gas, oil

HACCP Step 3 – Flow Diagram

Flow Diagram Outlining Sequential Tasks to Complete Activity/Project Described in HACCP Step 1 – Activity Description (to be transferred to column 1 of the HACCP Step 4 – Hazard Analysis Worksheet)

Task	Inspection and cleaning of equipment, boat, and trailer when removed from
1	Lake Mead after final razorback sucker monitoring efforts there and prior to dry
	storage.
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Task 2	Transfer to Lower Colorado River to access survey sites.

Task	Conduct surveys at multiple sites that are accessed via the river from the same
3	boat launch.

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Task	Visual inspection upon leaving the ramp following the survey (boat, trailer,
4	truck, drain bilge, live well, and survey equipment). Remove fragments of
	vegetation and other organic materials.
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Task 5	Complete cleaning of equipment before deploying from a different boat launch.

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Task 6	
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HACCP Step 4 - Hazard Analysis Worksheet

	IIAOO		Interior Analysis WorkSheet		
1	2	3	4	5	6
Tasks	Potential hazards	Are any	Justify evaluation for column	What control measures	Is this task
(from HACCP Step 3 -	identified in HACCP	potential	3	can be applied to	a critical
Flow Diagram)	Step 2	hazards		prevent undesirable	control
		significant		results?	point?
		_			
Task 1	Vertebrates	No	Desiccation, heat, and		N/A
	Fish		removal of all standing water		
Inspection and			eliminate likelihood of		
cleaning of equipment,			survival; large organisms are		
boat, and trailer when			easy to detect and remove.		
removed from Lake	Invertebrates	Yes	Mollusks and zooplankton	Visually inspect for	Yes
Mead after final	Aquatic invertebrates		cysts may survive periods of	organisms and remove,	
razorback sucker	(quagga mussels,		desiccation.	ensure equipment is dry.	
monitoring efforts	New Zealand				
there and prior to dry	mudsnails, apple				
storage.	snails, crayfish) and				
	zooplankton				
	Plants	Yes	Plant materials, seeds, and	Visually inspect for	Yes
	Aquatic macrophytes		spores may survive periods	organisms and remove,	
	(giant salvinia,		of desiccation.	ensure equipment is dry.	
	Hydrilla, watermilfoils				
	(Eurasian and parrot				
	feather), pondweeds,				
	naiads, coontail,				
	algae and				
	phytoplankton				
	(golden algae,				
	filamentous and blue-				
	green algae)				
	Others Biologics	No	Desiccation, heat, and		N/A
	Aquatic parasites		removal of all standing water		
	(Eurasian tapeworm,		and obligate hosts eliminate		
	leeches and flukes,		likelihood of survival.		
	anchorworms)				
	Others	No	Equipment is well		N/A
	Gas, oil		maintained and cleaned.		

Task 2	Vertebrates	No	Likelihood of re-infection	N/A
	Fish		during transit is remote.	
Transfer to Lower	Invertebrates	No	Likelihood of re-infection	N/A
Colorado River to	Aquatic invertebrates		during transit is remote.	
access survey sites.	(quagga mussels,			
	New Zealand			
	mudsnails, apple			
	snails, crayfish) and			
	zooplankton			
	Plants	No	Likelihood of re-infection	N/A
	Aquatic macrophytes		during transit is remote.	
	(giant salvinia,			
	Hydrilla, watermilfoils			
	(Eurasian and parrot			
	reather), pondweeds,			
	nalaus, coontail,			
	alyae allu			
	(goldon algao			
	filamentous and blue-			
	areen alaae)			
	Others Biologics	No	Likelihood of re-infection	Ν/Δ
	Aquatic parasites		during transit is remote	14/7 (
	(Eurasian tapeworm			
	leeches and flukes			
	anchorworms)			
	Others	No	Likelihood of re-infection	N/A
	Gas, oil		during transit is remote.	

HACCP Step 4 - Hazard Analysis Worksheet (continued)

1	2	3	4	5	6
Tasks	Potential hazards	Are any	Justify evaluation for column	What control measures	Is this task
(from HACCP Step 3 -	identified in HACCP	potential	3	can be applied to	a critical
Flow Diagram)	Step 2	hazards		prevent undesirable	control
		significant		results?	point?
		_			
Tool: 2	Vertebrotoo	Vaa	Dept live well note and	Conduct "field" clooping:	No
Task 3		res	Boat, live well, nets, and	Viewelly increases heat and	INO
	FISH		equipment may narbor	visually inspect boat and	
Conduct surveys at			of the output	detected metericle drain	
multiple sites that are			of the survey.		
from the same best	Invertebrates	Vaa	Deet live well note and	IVE WEII	No
		res	Boat, live well, nets, and		INO
launch.	Aquatic invertebrates		equipment may narbor	visually inspect boat and	
	(quagga mussels,		nuisance species as a result	equipment, remove	
	New Zealand		of the survey.	detected materials, drain	
	mudshalls, apple			live well	
	snalls, crayfisn) and				
		Maa	Dest live well water and		NL-
	Plants	Yes	Boat, live well, nets, and	Conduct "field" cleaning:	NO
	Aquatic macrophytes		equipment may narbor	visually inspect boat and	
	(giant salvinia,		nuisance species as a result	equipment, remove	
	Hydrilla, watermilfoils		of the survey.	detected materials, drain	
	(Eurasian and parrot			live well. Identify sites in	
	feather), pondweeds,			advance that may	
	nalads, coontail,			contain Giant salvinia	
	algae and			and conduct sampling	
	phytoplankton			among sites in a manner	
	(golden algae,			to reduce likelihood of	
	filamentous and blue-			inadvertent transport	
	green algae)			between sites.	
	Others Biologics	Yes	Boat, live well, nets, and	Conduct "field" cleaning:	No
	Aquatic parasites		equipment may harbor	Visually inspect boat and	
	(Eurasian tapeworm,		nuisance species as a result	equipment, remove	
	leeches and flukes,		of the survey.	detected materials, drain	
	anchorworms)			live well	
	Others	No	Equipment well maintained		N/A
	Gas, oil				

1	2	3	4	5	6				
Tasks (from HACCP Step 3 - Flow Diagram)	Potential hazards identified in HACCP Step 2	Are any potential hazards significant	Justify evaluation for column 3	What control measures can be applied to prevent undesirable results?	Is this task a critical control point?				
Task 4 Visual inspection upon leaving the ramp following the survey (boat, trailer, truck; drain	Vertebrates Fish	Yes	Boat, trailer, truck, live well, nets, and equipment may harbor nuisance species as a result of the survey.	Conduct "field" cleaning: visually inspect boat, trailer, truck and survey equipment; remove detected materials; drain bilge and live well; rinse and dry equipment.	No				
bilge and live well, and inspect survey equipment). Remove fragments of vegetation and other organic materials.	Invertebrates Aquatic invertebrates (quagga mussels, New Zealand mudsnails, apple snails, crayfish) and zooplankton	Yes	Boat, trailer, truck, live well, nets, and equipment may harbor nuisance species as a result of the survey.	Conduct "field" cleaning: visually inspect boat, trailer, truck and survey equipment; remove detected materials; drain bilge and live well; rinse and dry equipment. Power wash boat and trailer between boat launches.	Yes				
	Plants Aquatic macrophytes (giant salvinia, Hydrilla, watermilfoils (Eurasian and parrot feather), pondweeds, naiads, coontail, algae and phytoplankton (golden algae, filamentous and blue-green algae)	Yes	Boat, trailer, truck, live well, nets, and equipment may harbor nuisance species as a result of the survey.	Conduct "field" cleaning: visually inspect boat, trailer, truck and survey equipment; remove detected materials; drain bilge and live well; rinse and dry equipment. Power wash boat and trailer between boat launches.	Yes				
	Others Biologics Aquatic parasites (Eurasian tapeworm, leeches and flukes, anchorworms)	Yes	Boat, trailer, truck, live well, nets, and equipment may harbor nuisance species as a result of the survey.	Conduct "field" cleaning: visually inspect boat, trailer, truck and survey equipment; remove detected materials; drain bilge and live well; rinse and dry equipment. Power wash boat and trailer between boat launches.	Yes				
	Others Gas, oil	No	Equipment well maintained		N/A				

1 2 3 4 5 6								
Tasks Potential hazards Are any Justify evaluation for What control measures Is this t	ask							
(from HACCP Step 3 - identified in HACCP potential column 3 can be applied to prevent a critic	cal							
Flow Diagram) Step 2 hazards undesirable results? contre	ol							
point	?							
Task 5VertebratesNoDesiccation, heat, andN/A								
Fish removal of all standing								
Storage of boat, water eliminate likelihood								
trailer, and equipment of survival; large								
between sample trips.								
detect and remove.								
Invertebrates Yes Mollusks and zooplankton Visually inspect for Yes								
Aquatic invertebrates								
(quagea mussels of designation ensure equipment is dry								
New Zealand								
Industrialis, apple								
Silalis, Cidylisii) allu								
Zoopiankion Planta Van Diantantaisia anada Visualkainanattan Van								
Plants Yes Plant materials, seeds, Visually inspect for Yes								
Aquatic macrophytes and spores may survive organisms and remove,								
(giant salvinia, periods of desiccation. ensure equipment is dry,								
Hydrilla, watermilfoils use power washer.								
(Eurasian and parrot								
feather), pondweeds,								
naiads, coontail,								
algae and								
phytoplankton								
(golden algae,								
filamentous and blue-								
green algae)								
Others Biologics No Desiccation, heat, and N/A								
Aquatic parasites removal of all standing								
(Eurasian tapeworm. water eliminate likelihood								
leeches and flukes.								
anchorworms)								
Others No Equipment is well N/A								
Gas oil maintained and cleaned								

HACCP Plan Form			
(all CCPs or "yeses" from column 6 of HACCP Step 4 – Hazard Analysis Worksheet)			
(1) Critical Control Point: Task		k 1: Inspection and cleaning of equipment, boat, and trailer	
	whe	n removed from Lake Mead after final razorback sucker	
	mor	nitoring efforts there and prior to dry storage.	
Significant Hazard	(s): Aqu	atic invertebrates and plants	
Limits for Each Co	ontrol Measure:	Size, visibility, detectability of nuisance organisms. Ability to	
		completely dry equipment (length of time between surveys).	
What:		Survey equipment, vehicles, trailers, and boats	
	How:	Visual inspection and manual removal of nuisance materials, make	
		sure equipment has dried sufficiently. Power wash boat, trailer,	
Monitoring		towing vehicle, survey equipment. Soak nets and other field gear	
		in a 5-12% solution of chlorine bleach.	
	Frequency:	Prior to each survey event	
	Who:	BIO-WEST field crew	
Evaluation & Corre	ective Action(s)	Complete thorough second cleaning including power washing and	
(if needed):		soaking nets and other field gear in a 5-12% solution of chlorine	
		bleach.	
Supporting Docum	nents (if any):	HACCP plan; field equipment treatment for Quagga mussels	
		(recommendations from AZDGF); boat treatment for Quagga	
		mussels (recommendations from AZDGF).	
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	
(2) Critical Contro	ol Point: Tas	k 4 Visual inspection upon leaving the ramp following the	
	surv	vev (boat, trailer, truck, drain bilge and live well, and survey	
	ean	ipment). Remove fragments of vegetation and other organic	
	mat	erials	
Significant Hazard	(s): Aqu	atic invertebrates and plants	
Limits for Each Co	ontrol Measure:	Size, visibility, detectability of nuisance organisms. Ability to	
		completely dry equipment (length of time between surveys).	
	What:	Survey equipment, vehicles, trailers, and boats	
	How:	Visual inspection and manual removal of nuisance material: make	
		sure equipment has dried sufficiently. Power wash between boat-	
Monitoring		launch locations.	
	Frequency:	Between each boat-launch location	
	Who:	BIO-WEST field crew	
Evaluation & Corrective Action(s)		Complete additional thorough cleaning including additional power	
(if needed):		washing.	
Supporting Docum	nents (if any):	HACCP plan; field equipment treatment for Quagga mussels	
		(recommendations from AZDGF); boat treatment for Quagga	
		mussels (recommendations from AZDGF).	

HACCP Step 5 – HACCP Plan Form

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>			
(3) Critical Control Point: Task		sk 5: Complete cleaning of equipment before deploying on a	
	diffe	erent body of water (either field approach or full facility office	
	арр	proach)	
Significant Hazard	l(s): Aqu	atic invertebrates and plants	
Limits for Each Co	ontrol Measure:	Size, visibility, detectability of nuisance organisms. Ability to	
	1	completely dry equipment (length of time between surveys).	
	What:	Survey equipment, vehicles, trailers, and boats.	
	How:	Visual inspection and manual removal of nuisance materials, make	
Manitarina		sure equipment has dried sufficiently. Power wash boat, trailer,	
wonitoring		towing vehicle, survey equipment. Soak nets and other field gear	
	Fraguanavi	Drier to moving to different body of water	
	Mbo:	Prior to moving to different body of water Pogional fisherios staff	
Evaluation & Corr	active Action(s)	Complete thorough second cleaning including nower washing and	
(if needed).		soaking nets and other field gear in a 5-12% solution of chlorine	
(in needed).		bleach.	
Supporting Documents (if any):		HACCP plan; field equipment treatment for Quagga mussels	
		(recommendations from AZDGF); boat treatment for Quagga	
		mussels (recommendations from AZDGF).	
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	
Facility:		Activity/Management Objective:	
Address:			
Signature:		Date:	
	followed		
TACCE FIAIT Was	s ionoweu.		

Attachment A: Field Equipment Treatment for Quagga Mussels

Quagga mussels (an invasive species) were identified as being present in Lake Mead on January 6, 2007. Subsequent surveys have been identified Quagga mussels as far south as the Central Arizona Project and Metropolitan Water District withdrawal intake structures in Lake Havasu. At this time the Department is considering all of the Colorado River and Colorado River lakes downstream of Lake Mead as being positive for the mussels. The spread of Quagga mussels is due to their naturally high fecundity and dispersal capacity by a microscopic larval stage called a veliger. The Department will immediately begin treating all of its field equipment that has contact with the Colorado River and river lakes for Quagga mussel control using the following procedures when moving to non-infected areas.

There are numerous recommendations from various Agencies on how to treat equipment and boats reducing the risk of facilitating the spread of zebra or Quagga mussels. Some of the recommended processes are lacking scientific data supporting the action. All of the recommendations are considered to be better than no action. First and foremost take advantage and incorporate ambient environmental conditions (heat, dryness, freezing) with recommended protocols. The immature stage (veligers) is particularly sensitive to heat or dryness.

This approach is multi phased with general recommendations for equipment and boat storage between uses, treatment recommendations for low risk situations, and treatment recommendations for higher risk situations.

If the equipment has been in dry storage for 30 days or more prior to movement to waters considered non-infected then consider the risk transfer minimal.

Precautionary Mussels Avoidance Procedures

There are numerous procedures used and recommended by various agencies that are reflective of each other and those recommend in this document. There is a general lack of scientific data actually supporting efficacy with the compounds, contact times, and processes. It is essential that additional precautions be instituted to increase the likelihood that a toxic environment is created for the mussels. These are simple procedural maters.

- Never transfer water between sites. Insure that equipment have been dried or treated prior to movement.
- Store equipment dry whenever possible. Flush motor lower end with fresh water before storage.
- Pressure wash equipment at coin operated washer after use in infected waters
- Inspect equipment immediately upon leaving the water. Scrape off any mussels or aquatic vegetation found.
- Ensure that the requisite materials and supplies for treatment are available when activity at the water is completed.
- Plan work activities so that the gradation of work sites is from least infected to most infected areas.

Mussel Decontamination Procedures

This is to be used every time equipment is exposed to water body that is confirmed or suspect (not detected yet) to have invasive mussels. Even short duration exposures can create a pathway for movement.

Field Equipment

Plan work activities to accommodate a gradation ranging no exposure (clean) to areas of greater exposure (positive).

- Inspect all field equipment before an after use to remove all visible mussels.
- All field equipment must be cleaned using appropriate methods with disinfectant materials.
- Care should be taken to match disinfectant technique with equipment and material type.
- Consideration of having equipment designated for sensitive areas (contaminated waters or water considered critical for sensitive species) area should be considered.
- Equipment should be marked as to be used in specific areas and tagged to indicate that it has been cleaned and ready for new use.

Long term exposure in contaminated waters

It is preferable not to have equipment and materials stored in waters that are known to be positive for invasive mussels. As exposure time increases the probability of mussels attaching to or veligers surviving in the wet areas increases. The decontamination procedures are the same with increased sensitivity to completing the process correctly and follow up inspections.

When possible, field equipment dedicated for use in infested waters should be considered. Typically these items may not be durable and are susceptible to accelerated degradation from recommended chemical decontaminates. Items should be cleaned and stored in marked containers designating areas of use.

- Field equipment should be washed in disinfectant solution from recommended list. Hard surfaces should be scrubbed.
- After disinfecting the items should be stored dry for not less then 7 days if temperatures of 91° F or freezing can not be attained for 2 days.

Recommended Disinfectants

Chemicals and procedures are intended to create a toxic environment for the mussels various life stages which can also deteriorate components of boats, trailers, motors, and field equipment. This impact should be considered when developing individual decontamination protocols. It is recommended to take advantage of environmental conditions (heat and dryness) as a process tool.

Chemical and Procedure Treatments

Chemical	Concentration	Contact Time
Chlorine Bleach	5% to 12 %	30 to 60 minutes
Potassium Chloride	750 ppm	60 minutes
Vinegar (5% acetic acid)	As sold	20 minutes
(ROCCAL [™])	250 ppm	15 minutes
Procedure		Contact Time
Desiccation (general)	> 91° F	48 hours
Desiccation (general)	< 91° F	5 to 30 days
Power washing	2000 to 3000 psi	<1 minute
Hot Water	140 ° F	23 minutes

Temperature and Humidity Chart

Relative %	Days to 100 % Mortality at Air Temperature			
Humidity	5° C, 41° F	15° C, 59° F	25° C, 77° F	
95	26.6	11.7	5.2	
50	16.9	7.5	3.3	
5	10.8	4.8	2.1	
Zebra Mussel research Program, US Army Engineer Waterways Experiment				
Station, Technical Note ZMR-2-10, 1992				

Attachment B: Boat Treatment for Quagga Mussels

Quagga Mussels (an invasive species) were identified as being present in Lake Mead on January 6, 2007. Subsequent surveys have identified Quagga mussels as far south as the Central Arizona Project and Metropolitan Water District withdrawal intake structures in Lake Havasu. At this time the Department is considering all of the Colorado River and Colorado River Lakes downstream of Lake Mead as being positive for the mussels. The spread of Quagga mussels is due to their naturally high fecundity and dispersal capacity by a microscopic larval stage called a veliger. The Department will immediately begin treating all of our watercraft that have contact with the Colorado River and river Lakes for adult Quagga mussel and veliger control using the following procedures when moving to non-infected areas.

There are numerous recommendations from various Agencies on how to treat boats, motors, and trailers reducing the risk of facilitating the spread of zebra or Quagga mussels. Some of the recommended processes are lacking scientific data supporting the action. All of the recommendations are preferred to no action. First and foremost take advantage and incorporate ambient environmental conditions (heat, dryness, freezing) with recommended protocols. The immature stage (veligers) is particularly sensitive to heat or dryness.

This approach is multi-phased with general recommendations for equipment and boat storage between uses, treatment recommendations for low risk situations, and treatment recommendations for higher risk situations.

If the watercraft has been in dry storage for 30 days or more prior to movement to waters considered non-infected then consider the risk transfer minimal.

Precautionary Mussels Avoidance Procedures

There are numerous procedures used and recommended by various agencies that are reflective of each other and those recommend in this document. There is a general lack of scientific data actually supporting efficacy with the compounds, contact times, and processes. It is essential that additional precautions be instituted to increase the likelihood that a toxic environment is created for the mussels. These are simple procedural maters.

- Never transfer water between sites. Insure that boats have been dried or treated prior to movement.
- Store boat dry and drained whenever possible. Pull drain plugs to drain bilge water and live wells.
- Flush motor lower end with fresh water before storage.
- Pressure wash outside of hull and trailer at coin operated washer prior to transport or after use in infected waters
- Inspect the boat and trailer immediately upon leaving the water. Scrape off any mussels or aquatic vegetation found.
- Ensure that the requisite materials and supplies are available for treatment when activity at the lake is completed.
- Plan work activities so that the gradation of work sites is from lest infected to most infected.

Mussel Decontamination Procedures

This is to be used every time a boat, motor, or trailer is exposed to water body that is confirmed or suspect (not detected yet) to have invasive mussels. Even short duration exposures can create a pathway for movement.

Boats/ motors/ trailers

- Drain the bilges, live wells, and compartments that can hold water from before leaving the water body. If possible the water is drained back into the originating water body.
- Inspect the boat, trailer, and motor removing all observed biological contaminants. Pay particular attention to trailer bunks (carpeted), hull cracks or crevices, and areas where moisture and mussels may be retained.
- Clean the boat, trailer, anchors, and compartments that held water should be pressured washed. This is easily accomplished at a self-service car wash. Pay attention while cleaning to cooling water intakes on lower units and trailer bunks.
- If bilge pumps can not be drained then re-plug the boat prior to transport and pour 2 gallons of vinegar into the bilge. Retain vinegar in the bilge for minimum of 30 minutes (transport during this phase will help wash bilge area).
- After washing is completed, including bilge wash with vinegar, pull brain plugs to dry before next usage.
- A visual inspection must be completed before and after each decontamination event.

Long term exposure in contaminated waters

It is preferable not to have equipment and materials stored in waters that are known to be positive for invasive mussels. As exposure time increases the probability of mussels attaching to or veligers surviving in the wet areas increases. The decontamination procedures are the same with increased sensitivity to completing the process correctly and follow up inspections.

If there are periods during the annual work cycle that equipment is not being used then the equipment should be removed from water for long term dry storage. Depending on environmental conditions it may require up to 30 days of storage to kill adult mussels that have become attached.

- Follow the same procedures recommended previously for decontamination.
- Incorporate a heating/drying period of not less then 7 days if temperatures of 91° F or freezing can not be attained for 2 days. These 2 temperatures are the extremes at which mussels survive in the wild and should be sufficient to kill all adults when in dry conditions. It is quite easy during most months in Arizona to attain the upper thresh hold temperature.

Recommended Disinfectants

Chemicals and procedures are intended to create a toxic environment for the mussels various life stages which can also deteriorate components of boats, trailers, motors, and field equipment. This impact should be considered when developing individual decontamination protocols. It is recommended to take advantage of environmental conditions (heat and dryness) as a process tool. The following charts summarize chemicals and treatments for Quagga mussel control:

Chemical	Concentration	Contact Time
Chlorine Bleach	5% to 12 %	30 to 60 minutes
Potassium Chloride	750 ppm	60 minutes
Vinegar (5% acetic acid)	As sold	20 minutes
(ROCCAL™)	250 ppm	15 minutes
Procedure		Contact Time
Desiccation (general)	> 91° F	48 hours
Desiccation (general)	< 91° F	5 to 30 days
Power washing	2000 to 3000 psi	<1 minute
Hot Water	140 ° F	23 minutes

Chemical and Procedure Treatments

Temperature and Humidity Chart

Relative %	Days to 100% Mortality at Air Temperature			
Humidity	5° C, 41° F	15° C, 59° F	25° C, 77° F	
95	26.6	11.7	5.2	
50	16.9	7.5	3.3	
5	10.8	4.8	2.1	
Zebra Mussel	research Program,	U.S. Army Eng	gineer Waterways	
Experiment Station, Technical Note ZMR-2-10, 1992				