



Expanded Non-Native Aquatic Species Management Plan Environmental Assessment

U.S. Department of the Interior
National Park Service

Grand Canyon National Park
Glen Canyon National Recreation Area
Intermountain Region



Expanded Non-Native Aquatic Species Management Plan below Glen Canyon Dam

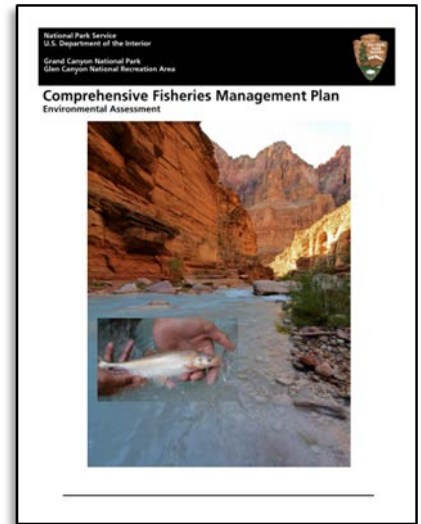
Presentation to TWG

April 2018



Background

- Threats posed by aquatic non-natives were identified in:
 - Comprehensive Fisheries Management Plan (2013 CFMP)
 - Long-Term Experimental and Management Plan (2016 LTEMP)
- Increases in potentially harmful non-native species (such as Green Sunfish and Brown Trout) have been documented since 2013.
 - Rapid Response options of existing compliance
 - Short term CEs
- Other species such as quagga mussels, etc. are also increasing
 - Other invasive fish may appear and increase over time
 - Other invasive organisms such as invertebrates and plants may also increase
- Non-native aquatic species control is needed to provide for long-term management of the native aquatic system





Purpose of and Need for Action

Purpose

- Provide additional tools beyond what is available under the CFMP and the LTEMP
- Prevent, control, minimize, or eradicate potentially harmful non-native aquatic species
- Reduce the risk associated with their presence or expansion in the action area

Identify adaptive approaches that will help manage these threats as they appear over time

Need

- Recent increases of green sunfish and brown trout
- Potential expansion or invasion of other harmful non-native aquatic species
- Non-native aquatic species threaten downstream native aquatic species and have become an increasing threat due to changing conditions since the completion of the 2013 CFMP and the 2016 LTEMP
- Species at risk include:
 - Listed species
 - Lees Ferry recreational rainbow trout fishery

Existing measures may be inadequate to address potentially harmful non-natives





Cooperating Agencies

- Arizona Game and Fish Department
- Bureau of Reclamation
- Colorado River Board of California
- Colorado River Commission of Nevada
- Pueblo of Zuni
- Southern Nevada Water Authority
- Upper Colorado River Commission
- U.S. Fish and Wildlife Service
- Utah Associated Municipal Power Systems
- Western Area Power Administration





What Are Potentially Harmful Non-Native Aquatic Species?

- Fish, amphibians, aquatic plants, or aquatic invertebrate species that are not native to the action area that may pose a threat to native species (including federally or state-listed species) or may pose a threat to the Lees Ferry recreational rainbow trout fishery

What non-natives are not considered potentially harmful for this project?

- Common carp would not be targeted, but may be removed incidentally as part of other removal or monitoring efforts. We are developing a threat level rating and other species may call in this low level as well.

Trout-specific approaches

- Rainbow trout management would be consistent with that described in the CFMP and LTEMP
- New actions would be designed to minimize negative effects to the recreational fishery and continue to be consistent with the LTEMP goal to maintain “a healthy high-quality recreational rainbow trout fishery in GCNRA and reduce or eliminate downstream trout migration consistent with NPS fish management and ESA compliance.”



Ranking of Potentially Harmful Non-Native Aquatic Species

DRAFT

Species	Category	GLCA	GRCA	Level of Threat
Smallmouth Bass (<i>Micropterus dolomieu</i>)	Fish	Present	Present	1- Very High
Walleye (<i>Sander vitreus</i>)	Fish	Present	Present	1-Very High
Brown Trout (<i>Salmo trutta</i>)	Fish	Present	Present	2-High
Northern Pike (<i>Esox lucius</i>)	Fish	Present	Potential	2-High
Striped Bass (<i>Morone saxatilis</i>)	Fish	Present	Present	2-High
Gizzard Shad (<i>Dorosoma cepedianum</i>)	Fish	Present	Present	6-Low
American Bullfrog (<i>Lithobates catesbeianus</i>)	Amphibians	Present	Potential	4-Medium
New Zealand Mudsail (<i>Potamopyrgus antipodarum</i>)	Invertebrates	Present	Present	4-Medium
Rusty Crayfish (<i>Orconectus rusticus</i>)	Invertebrates	Potential	Potential	4-Medium
Eurasian Water-milfoil (<i>Myriophyllum spicatum</i>)	Plants	Potential	Potential	6-Low
Hydrilla (<i>Hydrilla verticillata</i>)	Plants	Potential	Potential	6-Low
Didymo (Rocksnot) (<i>Didymosphenia geminata</i>)	Algae	Present	Potential	4-Medium



Elements Common to All Action Alternatives

- Identify when and where different control actions could be taken
 - Decision tree or matrix including condition trigger levels
 - Preferred sequence of control actions using a tiered approach
 - Control actions from multiple tiers could be applied at the same time
- Identify resources of concern that would be considered prior to determining action
- Monitoring and adaptive responses that would include:
 - Off-ramps that would be used to determine when control actions stop because of unacceptable adverse effects on resources
 - Mitigation actions that would be used to address adverse impacts on other resources
- All elements of the no-action alternative



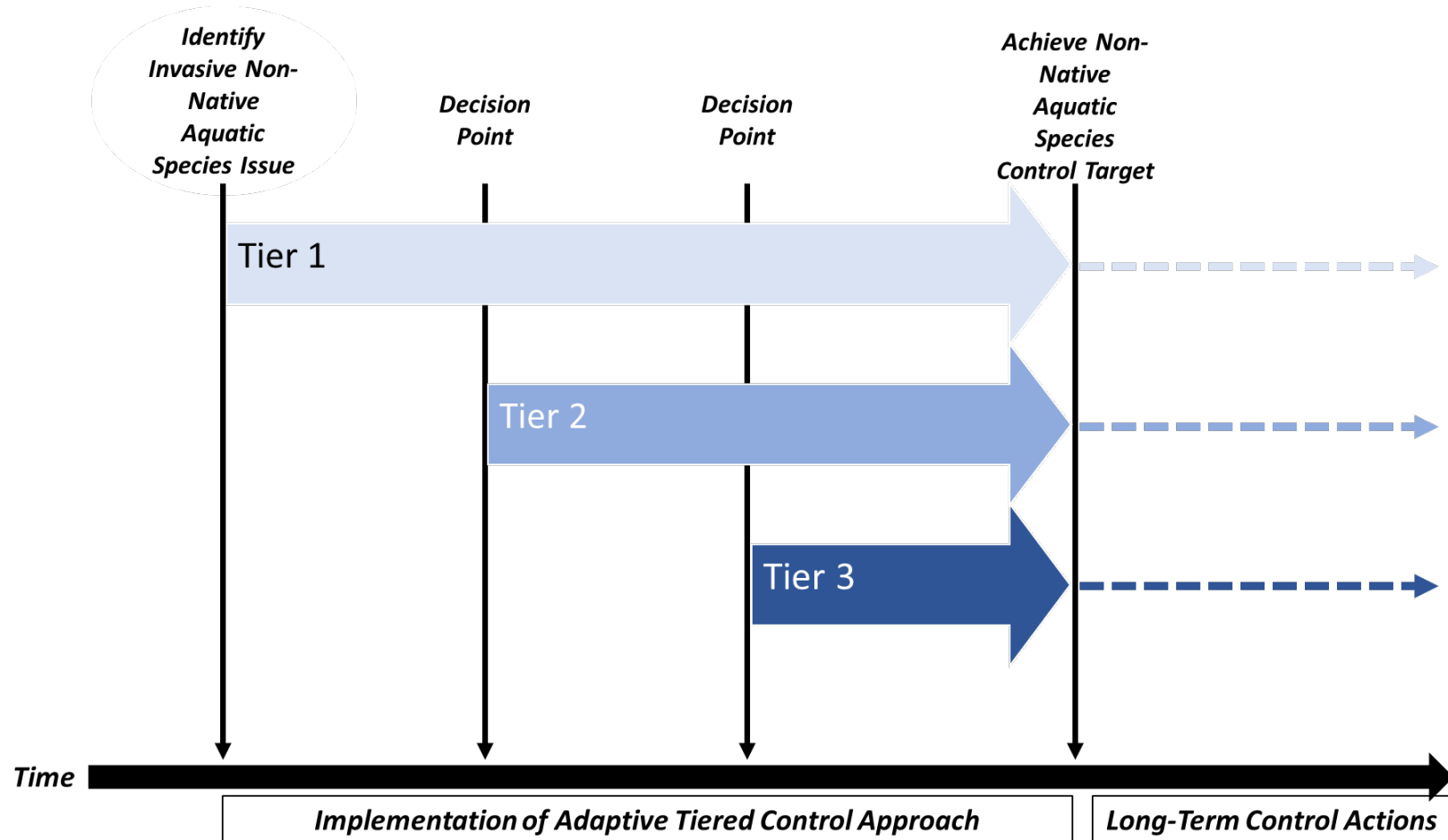
Adaptive Tiered Approach to Non-Native Aquatic Species Control

Control actions would be made in a stepwise fashion according to tiers

- **Tier 1 Actions**
 - Applied as a first step toward control
 - Have little if any impact on non-target species or resources of concern
 - Focuses on non-lethal approaches
 - Relatively low cost
- **Tier 2 Actions**
 - Applied only after Tier 1 actions are determined to be ineffective on their own (triggered)
 - Uses some non-lethal removal and some lethal methods in limited areas over short periods of time
 - Includes some habitat alteration in limited habitats or areas
- **Tier 3 Actions**
 - Applied only after Tier 1 and 2 actions are determined to be ineffective on their own or together (triggered)
 - Uses beneficial use with lethal removal when possible, applied over broader areas and for long-term control
- **Tier 4 Actions**
 - Applied only after Tier 1, 2 and 3 actions are determined to be ineffective on their own or together (triggered)
 - Includes major modification of limited areas to remove suitable habitat
 - Includes use of registered piscicides for long-term control
- Specific tiers for certain actions vary among alternatives
- Control actions and strategies would be modified as needed based on the effectiveness of actions taken



Conceptual Application of Tiered Actions





Refined Alternatives – Brown Trout in Glen Canyon NRA

- 4 tier levels
- Two action alternatives with some differences
- Cornerstone is incentivized harvest for brown trout in Lees Ferry (tier 1 action) under both alternatives
- Triggers are DRAFT – we have started talking through with cooperators and GCMRC – we intend for them to be tied to risk to humpback chub and other downstream natives
- Triggers may be re-evaluated annually (or every few years as needed) and discussed with the TWG. We will want to be able to adapt to new information.
- We are also identifying specific habitats where the actions apply, off-ramps, and mitigations, but those are not yet ready to present those



Controlling Brown Trout in Marble Canyon

- The CFMP EA allows for on-going mechanical removal of brown trout source populations in Grand Canyon NP. This Expanded EA will not change existing compliance, so that is why this action does not appear in the following slides describing action alternatives.
- However, for communication purposes, the conditions under which the NPS would consider electrofishing in Marble Canyon under existing compliance would be:
 - If large concentrations/congregations/spawning of brown trout were found in Marble Canyon (for instance down by 30-mile) we would consider a removal project there.
 - If the population in Lees Ferry was below a trigger level (probably below the 2015 population estimate), and large numbers were found in Marble Canyon, then we may only conduct the electrofishing in Marble and not in Lees Ferry.
 - If the Lees Ferry brown trout population does not decline or continues to increase, conducting control in Marble Canyon would not be expected to be a replacement for removal of adults in Lees Ferry given efficacy estimates from the 2011 BOR NNF EA and recent work from GCMRC (Brown Trout White Paper, and Bair et al. 2018)
- However, the first tier action (Tier 1) to remove adult brown trout would be through incentivized harvest in Lees Ferry . Electrofishing targeting brown trout in Lees Ferry would not be used until triggered (Tier 3 or 4).



Refined Alternatives – Brown Trout in Glen Canyon NRA

PRELIMINARY DRAFT	Draft Tiers* and Triggers	
Draft Control Actions**	Alternative 2	Alternative 3
GLCA: BROWN TROUT SPECIFIC		
Bounties/tournaments/prize fish/volunteer guided fishing and other incentivized harvest tools	Tier 1 Trigger: presence	Tier 1 Trigger: presence
Introduction of YY males	Trigger: Tier 1 actions ineffective, and brown trout population is < X fish (number above which cannot get enough YY males to be effective).	Tier 1 Trigger: presence
Mechanical disruption of early life stage habitats at specific spawning sites, including high-pressure water flushing and mechanical gravel displacement	Tier 2 Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 1 risk - e.g. 5,000] 8+ inches long	Tier 2 Trigger: same as Alternative 2
Selective electrofishing and trapping in spawning areas only	Tier 3 Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 2 risk - e.g. 10,000 8+ inches long	Tier 2 Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 1 risk - e.g. 5,000] 8+ inches long
Conditional species-specific electrofishing or trapping for long-term control	Tier 4 Trigger: 1) LCR triggers for HBC declines based on predators occur and trout removal has been initiated, 2) Brown trout are a significant proportion of the predators in the LCR area, 3) estimates for brown trout in Lees Ferry Reach are documented as being over X,000 8+ inches fish.	Tier 4 Trigger: same as Alternative 2



Refined Alternatives – Brown Trout in Glen Canyon NRA

- **Tier 1 - Bounties/tournaments/prize fish/volunteer guided fishing and other incentivized harvest tools**
 - Trigger – presence of brown trout in Lees Ferry
 - TBD – who administers and how (logistics, money levels), what agencies are willing to contribute to funding
- **Tier 1 or 2 (alt dependent) - Introduction of YY males**
 - Trigger: Tier 1 actions not effective alone, and brown trout population is $< X$ fish (number above which cannot get enough YY males to be effective).
 - Brood stock would not be available for 5-10 years.
 - Experimental – it is old technology (producing YY males has been in fish farming since 1920's, but has not been used for wild population management until recently). Currently we are not aware of any major side effect concerns – only that introduced YY fish could have high mortality and/or could migrate at a high rate downstream. But effects would disappear a few years after cessation.
 - Discussing with tribes and cooperating agencies



Refined Alternatives – Brown Trout in Glen Canyon NRA

- **Tier 2 or 3 - Mechanical disruption of early life stage habitats at specific spawning sites, including high-pressure water flushing and mechanical gravel displacement**
 - Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 1 risk - e.g. 5,000] 8+ inches long
 - Experimental
 - Analyzing efficacy and logistics – locations/depth of spawning beds
 - Design with GCMRC and cooperating agencies to minimize incidental take of rainbow trout and disruption of recreational fishing while achieving significant brown trout reduction
- **Tier 3 - Selective electrofishing and trapping in spawning areas only**
 - Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 2 risk - e.g. 10,000] 8+ inches long
 - Design with GCMRC and cooperating agencies to minimize incidental take of rainbow trout and disruption of recreational fishing while achieving significant brown trout reduction

Refined Alternatives – Brown Trout in Glen Canyon NRA

- **Tier 4 - Conditional species-specific electrofishing/trapping for long-term control**
 - Trigger: Initiate a multi-year electrofishing project if other tiers have proven ineffective and there is a population of brown trout in Lees Ferry and brown trout have increased in the LCR and tripped the mechanical removal trigger there, or specifically:
 - 1) When LTEMP triggers for mechanical removal at the LCR have been exceeded,
 - 2) Brown trout are a significant proportion of the predators in the LCR area,
 - 3) estimates for brown trout in Lees Ferry Reach are documented as being over X,000 8+ inches fish.
 - Design with GCMRC and cooperating agencies to minimize incidental take of rainbow trout and disruption of recreational fishing while achieving significant brown trout reduction





Refined Alternatives – Brown Trout in Glen Canyon NRA

PRELIMINARY DRAFT	Draft Tiers* and Triggers	
Draft Control Actions**	Alternative 2	Alternative 3
GLCA: BROWN TROUT SPECIFIC		
Bounties/tournaments/prize fish/volunteer guided fishing and other incentivized harvest tools	Tier 1 Trigger: presence	Tier 1 Trigger: presence
Introduction of YY males	Trigger: Tier 1 actions ineffective, and brown trout population is < X fish (number above which cannot get enough YY males to be effective).	Tier 1 Trigger: presence
Mechanical disruption of early life stage habitats at specific spawning sites, including high-pressure water flushing and mechanical gravel displacement	Tier 2 Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 1 risk - e.g. 5,000] 8+ inches long	Tier 2 Trigger: same as Alternative 2
Selective electrofishing and trapping in spawning areas only	Tier 3 Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 2 risk - e.g. 10,000 8+ inches long	Tier 2 Trigger: Estimates for brown trout in Glen Canyon reach now exceed [level 1 risk - e.g. 5,000] 8+ inches long
Conditional species-specific electrofishing or trapping for long-term control	Tier 4 Trigger: 1) LCR triggers for HBC declines based on predators occur and trout removal has been initiated, 2) Brown trout are a significant proportion of the predators in the LCR area, 3) estimates for brown trout in Lees Ferry Reach are documented as being over X,000 8+ inches fish.	Tier 4 Trigger: same as Alternative 2



Refined Alternatives – Glen Canyon Sloughs (RM-12)

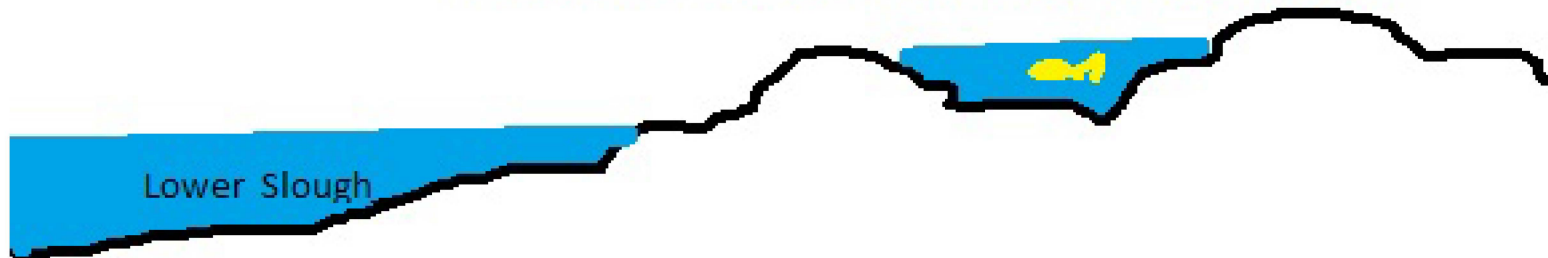
- Reclamation helped evaluate 7 options in this area (hydrology modeling and engineering advice) and NPS is evaluating two of those options:
- **Tier 1 – Barriers, Periodic Dewatering of Upper Slough and Non-Lethal Removal to the degree possible**
 - In the upper slough, following periods of water overtopping when non-natives could be appearing, NPS would pump out the upper slough within days of the drop and dewater for 1-2 weeks. The expectation is that this could remove a small number of adult non-native fish prior to reproduction. This would avoid having to treat or remove thousands of fish after reproduction and so would result in less taking of life.
 - In lower slough if non-native species are detected then we would consider using non-lethal electrofishing with relocation to Lake Powell as a tier 1 action if possible. This may depend on the numbers of fish, whether they are NEW to area, and the threat level of the species as to whether this would be appropriate and is also subject to state permits and testing.
 - We may also consider disruption of spawning beds in lower slough using high pressure wash to disrupt spawning (again may depend on threat rank of fish)

Overtopping Flows - circa 20-23k cfs

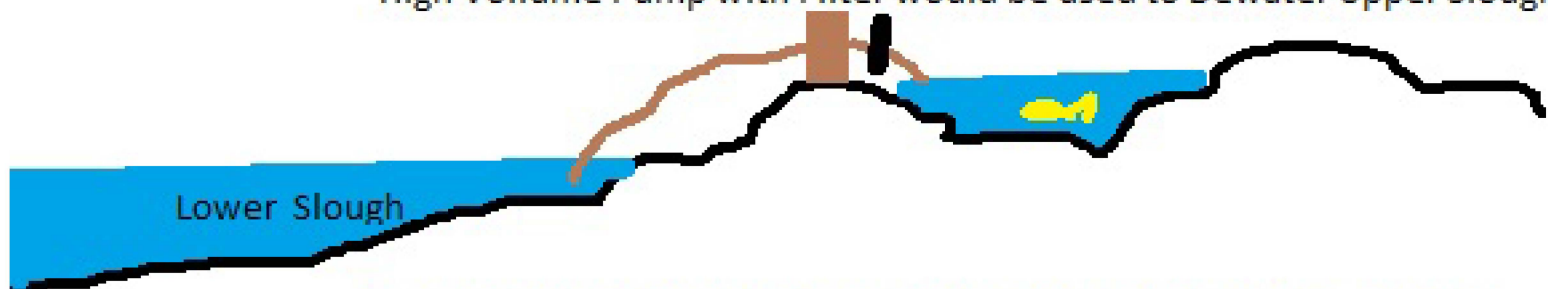
Environmental Assessment



After overtop, Non-natives could be left in Upper Slough



High Volume Pump with Filter would be used to Dewater Upper Slough



Non-native Fish would be captured in filter and could potentially be used for beneficial use



Not to scale - diagramtic only



Refined Alternatives – Glen Canyon Sloughs (RM-12)

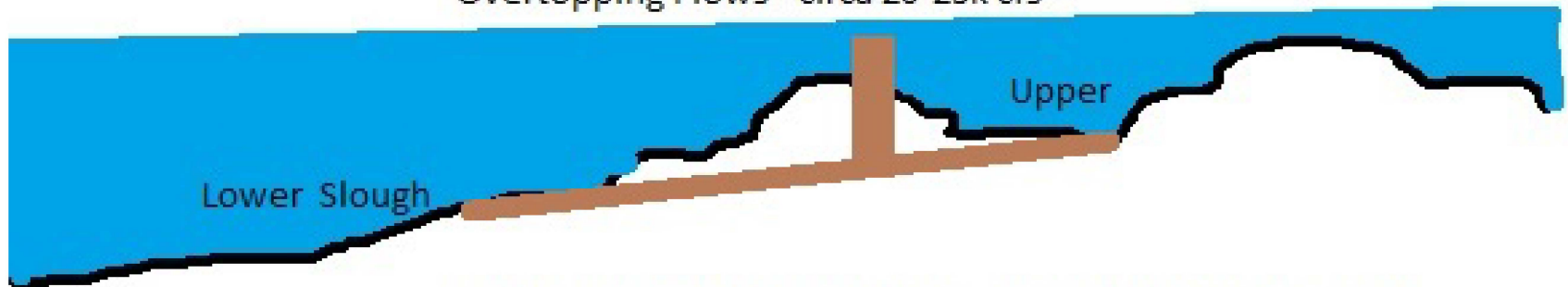
- **Tier 1 or 2 (alternative dependent) – Mechanical Removal**
 - In the upper slough, if Tier 1 actions prove ineffective or pools remain during dewatering of upper slough, or if non-lethal relocation was not possible, then lethal mechanical removal using electrofishing would be employed using beneficial use if possible.
 - In lower slough if NEW and higher risk non-native species are detected then we would consider using lethal electrofishing as a rapid response to prevent reproduction or dispersal (this is already permitted under the CFMP, so stated here only for communication purposes not for new compliance).
- **Tier 2 or 3 (alternative dependent) – Chemical Treatment**
 - In the upper slough, if Tier 1 and Tier 2 actions prove ineffective then we would consider using experimental treatment to overwhelm the ecosystem cycling (such as ammonia, carbon dioxide, oxygen, etc.)
 - In upper or lower slough if NEW and higher risk non-native species are detected and Tier 1 and 2 actions were not effective, then we would consider using chemical treatment as a rapid response to prevent reproduction or dispersal.



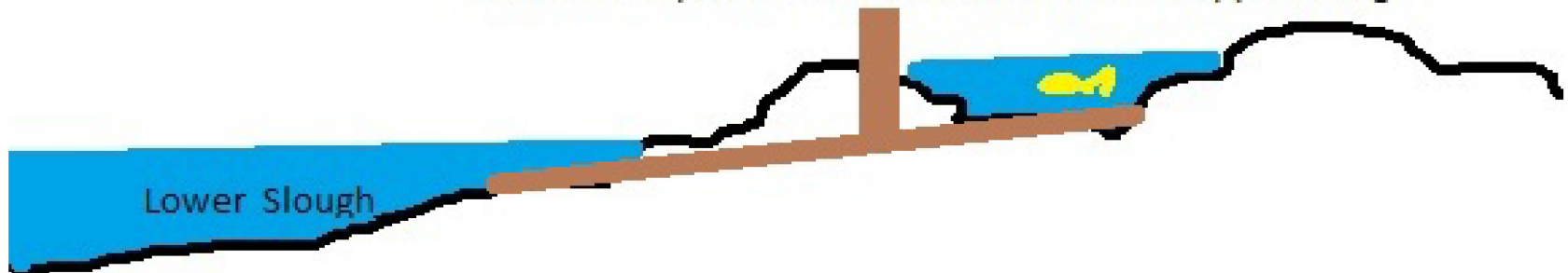
Refined Alternatives – Glen Canyon Sloughs (RM-12)

- **Tier 3 or 4 – Dredging Option**
 - If dewatering using pumps proved ineffective, then a dredging option would be consider to cut a channel between the upper and lower sloughs to better drain the upper slough. A headgate would be installed to control the dewatering and it would be deployed similarly to the pump option, dewatering after overtopping for a period about 2 weeks.
- **Tier 4 in alternative #2 only – Chemical Removal**
 - In upper or lower slough if higher risk non-native species are detected and Tier 1-3 actions were not effective, then we would consider using chemical treatment on an going basis as a last resort to prevent reproduction or dispersal.

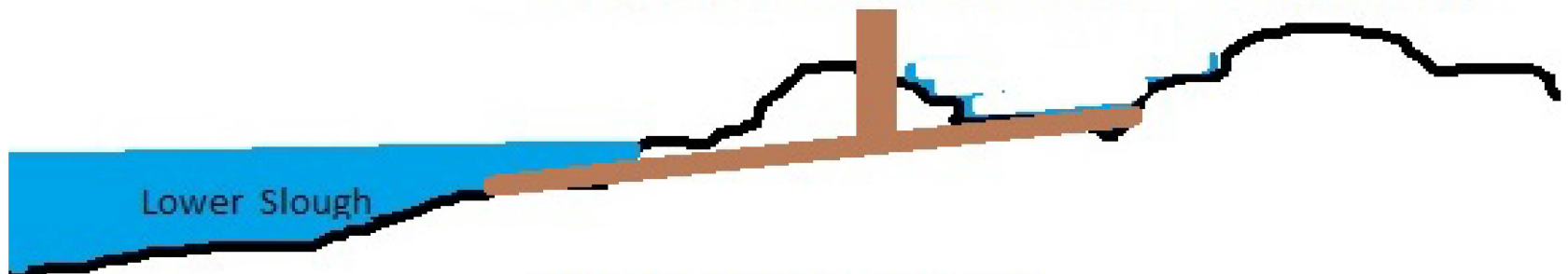
Overtopping Flows - circa 20-23k cfs



After overtop, Non-natives could be left in Upper Slough



Headgate would be opened to dewater the Upper Slough



Not to scale - diagramtic only



Refined Alternatives – Glen Canyon

Species other than brown trout, areas other than RM-12 sloughs

- The approach would be similar to that used at RM-12 with a few differences...
- **Similarities:**
 - Tier 1 – Barriers, Periodic Dewatering of backwaters and Non-Lethal Removal to the degree possible
 - Tier 1 or 2 (depending on alternative) – Lethal Mechanical Removal with beneficial use or Spawning Bed Disruption
 - Tier 3 or 4 (depending on alternative) – Chemical treatment using experimental treatment to overwhelm cycling or chemical treatment for rapid response of a NEW higher risk species.
- **Differences (alternative #3 only):**
 - YY males (tier 2) – would consider for Green Sunfish or other higher risk species (if brood stock available) if they were found to be reproducing in areas other than the upper slough and tier 1 actions were ineffective
 - Sonic Concussive devices (tier 4) – would consider in backwaters as tool when tiers x and x have proven ineffective in order to prevent reproduction and downstream dispersal of higher risk non-natives.
 - Chemical treatment of higher species for on-going basis is other tiers failed



Refined Alternatives – Grand Canyon Only (main and tribs)

- Similar approach to Glen Canyon with a few differences...
- **Similarities:**
 - Tier 1 – Barriers, Periodic Dewatering of backwaters
 - Tier 1 or 2 (depending on alternative) – Lethal Mechanical Removal with beneficial use or Spawning Bed Disruption
 - Tier 3 or 4 (depending on alternative) – experimental treatment to overwhelm cycling or chemical treatment for rapid response of a NEW higher risk species.
- **Differences:**
 - No incentivized harvest and no non-lethal electrofishing (logistics preclude)
 - Tier 1 (alternative #3 only) – small scale temperature alternation on tributaries to disadvantage coldwater species
 - Tier 1 or 2 (alt dependent)- Chemical treatment in tributaries with a natural barrier to removal non-natives for renovation (such as prior to translocation)
 - YY males (tier 1) – would consider for small scale brown trout test
 - Sonic Concussive devices (alternative #3 only tier 4) – would consider in backwaters as tool when tiers 1 actions have proven ineffective in order to prevent reproduction and downstream dispersal of higher risk non-natives.



Next Steps

- After the TWG, release materials to TWG members and provide opportunity to comment on draft alternatives, tiers and triggers as well as risk rating of species – April
- Release scoping report and comments - April
- Meet with AGFD regarding incentivized harvest and other concerns
- Consultation with tribes as needed
- Refine and finalize alternatives, tiers and triggers - May
- Conduct analysis – May/June
- Work with cooperating agencies on administrative draft of EA – May/June
- Release EA for public comment –July

