GUIDING MISSION FOR TCD IMPLEMENTATION

ENHANCE HABITAT FOR NATIVE FISH (CHUB)

A RISK ASSESSMENT OF A TEMPERATURE CONTROL DEVICE ON GLEN CANYON DAM

BY

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OBJECTIVES

1. RISK ASSESSMENT OF TCD RESOURCE IMPACTS
2. CHARACTERIZE RISK IN FOUR AREAS
3. EVALUATE RISKS IN DIFFERING PHYSICAL ENVIRONMENTS
4. RESPOND TO AMWG IN AUGUST 2003

KEY ASSUMPTIONS

- FOUR MAJOR HABITAT CHANGE AGENTS EXIST; TEMPERATURE, BIOTIC RELATIONSHIPS, FLOW REGIME, SEDIMENT
- INCREASED TEMPERATURE REGIMES ENHANCE HBC HABITAT
- TCD CAN INCREASE RIVER TEMPERATURE
- RISKS ARE MULTIPLE, INTERACTIVE, WITH LIMITED KNOWLEDGE OF SOME IMPACTS
- QUALITATIVE CONCEPTUAL RISK ASSESSMENT MOST APPROPRIATE

EXPANDED ASSESSMENT OF RISKS

- IMPACTS OF TCD THROUGHOUT GRAND CANYON SYSTEM
- EFFECTS OF EXCEEDING THERMAL OPTIMA ON COLDWATER SPECIES
- ROLE OF INDIRECT ECOLOGICAL EFFECTS ON INCREASED UNCERTAINTY
- CONSIDERATION OF MULTILPE INTERACTIVE IMPACTS ON HBC

SUMMARY STATEMENT OF FINDINGS

- ALL RISKS CONSIDERED, THE PROPOSED TCD PROGRAM SHOULD BE IMPLEMENTED
- PILOT PROGRAM IS ENCOURAGED

INFORMATION CONSIDERED FOR RISK ASSESSMENT

- TCD WORKSHOPS: 1999, 2001, 2003
- INTERVIEWS OF SCIENTISTS, MANAGERS, TECHNICAL SPECIALISTS
- SCIENCE AND TECHNICAL REPORTS
- PLANNING DOCUMENTS (EA, EIS, RESEARCH PLAN, ETC.)
- SCIENCE ADVISOR INPUT

AREAS OF RISK CONSIDERED

- OPERATIONAL
- PHYSICAL/CHEMICAL
- BIOLOGICAL
- ECONOMIC

OPERATIONAL RISKS

- MECHANCIAL OUTAGES OF TURBINES
- TURBINE MAINTENANCE
- TURBINE COMMITMENTS (WATER)
- SAFETY FACTORS

PHYSICAL/CHEMICAL RISKS DOWNSTREAM

- TEMPERATURE
- DISSOLVED OXYGEN
- NUTRIENT CONCENTRATIONS
- POTENTIAL PRODUCTIVITY IMPACTS IN GLEN CANYON
- MINOR RISKS TO WATER DENSITY, TURBIDITY, SEDIMENT EXPORT

BIOLOGICAL RISKS

- CHANGE IN RATE OF PRIMARY PRODUCTION
- CHANGE TROUT SPAWNING HABITAT
- CHANGE IN COMPOSITION OF PERIPHYTON
- CHANGE NUTRIENTS, DISSOLVED OXYGEN, PARTICULATE CARBON TRANSPORT
- POTENTIAL CHANGE IN HBC VIGOR AND SPAWNING
- CHANGE MACROINVERTABRATE AND INVERTABRATE FOOD SUPPLY
- CHANGE OVERALL FOOD AVALIABILITY FOR NATIVE FISH
- CHANGE HBC YOUNG-OF-YEAR THERMAL SHOCK
- ENTRAINMENT AND RELEASE OF WARM WATER FISH INTO GLEN CANYON

BIOLOGICAL RISKS (CONTINUED)

- MOVEMENT OF NON-NATIVE WARM WATER FISH UPSTREAM AND INCREASE POPULATIONS
- ESTABLISHMENT OF EXOTIC SPECIES
- INCREASE WATER BORNE DISEASE
- INCREASE COLD WATER FISH THERMAL IMPACT DOWNSTREAM
- INCREASE COMPETITION FOR FOOD SUPPLY
- ENHANCE HBC SPAWNING AND REARING HABITAT AND POTENTIAL INCREASED RECRUITMENT
- POTENTIAL INCREASED PREDATION DOWNSTREAM FROM WARM WATER NON-NATIVES
- POTENTIAL DECREASED PREDATION DOWNSTREAM FROM RAINBOW TROUT
- POTENTIAL INCREASED PREDATION DOWNSTREAM FROM BROWN TROUT

ECONOMIC RISKS

- HIGH TCD CONSTRUCTION COSTS COULD IMPACT OTHER BOR PROGRAMS
- HIGHER GCD OPERATING, MAINTENANCE, MONITORING COSTS
- HIGHER GCMRC MONITORING COSTS COULD IMPACT OTHER GCMRC PROGRAMS
- INCREASED GLEN CANYON TROUT POPULATIONS, COULD INCREASE ECONOMIC VALUE

RISK ASSESSMENT HYPOTHESIZED RESOURCE RESPONSES

PRIMARY PRODUCERS: EXPECTED NET INCREASE; CLADOPHORA WOULD REMAIN THE DOMINENT MACRO ALGAE

PRIMARY CONSUMERS (INVERTEBRATES): EXPECTED TO INCREASE PRODUCTION RATES IN SOME IN PROPORTION TO TEMPERATURE INCREASES. MAY SEE SOME CHANGES IN SPECIES COMPOSITION

RISK ASSESSMENT: HYPOTHESIZED RESOURCE RESPONSES (continued)

HUMPBACK CHUB AND OTHER NATIVE FISHES: Spawning success and recruitment should increase; adaptive management of increased predation may be necessary.

TROUT AT LCR: Increased temperature should produce greater abundance and vigor. Could be mitigated by warm water fish migration, disease, or AMP. Monitoring necessary.

RAINBOW TROUT BELOW LCR: Effects of temperature, siltation, low dissolved oxygen, pathogens, will be negative

RISK ASSESSMENT: HYPOTHESIZED RESOURCE RESPONSES (continued)

- **BROWN TROUT AT LCR:** At optimum temperature. Increased abundance and vigor. Potential need for AMP mitigation. Monitoring and modeling critical.
- **NON-NATIVE WARM WATER FISHES:** Increased vigor and abundance. Significant potential impactor. Monitoring, modeling critical and AMP mitigative strategies possible.
- **PATHOGENS:** Tapeworm will likely increase; whirling disease and other pathogens could enter system.

PHYSICAL AREA RISK ASSESSMENTS

- MINOR RISKS TO LAKE POWELL THERMAL STRUCTURE, CHEMISTRY AND BIOLOGY
- MODERATE RISKS TO GCD OPERATIONS, MAINTENANCE, SCHEDULING, MONITORING, ECONOMICS
- SIGNIFICANT RISKS TO COLORADO RIVER CORRIDOR PHYSICAL AND BIOLOGICAL RESOURCES
- MINOR RISKS TO LAKE MEAD PHYSICAL AND BIOLOGICAL RESOURCES

SUMMARY

- TCD MUST BE PART OF COMPREHENSIVE PROGRAM PLAN
- SIGNIFICANT POSITIVE AND NEGATIVE RISKS EXIST
- INCOMPLETE KNOWLEDGE OF POTENTIAL RESOURCE INTERACTIONS PREVENT MEASURE OF ALL IMPACTS
- RESOURCE IMPACT MITIGATION CAN OCCUR WITH AMP
- ALL RISKS CONSIDERED, THE PROPOSED TCD PROGRAM SHOULD BE IMPLEMENTED TO FULLY UNDERSTAND AND MANAGE NET BENEFIT
- IMMEDIATE START UP ON PILOT PROGRAM IS ENCOURAGED