

DESIRED FUTURE CONDITIONS FOR THE COLORADO RIVER ECOSYSTEM IN RELATION TO GLEN CANYON DAM: DFC AD HOC COMMITTEE REVIEW 23 JANUARY 2012

PREFACE

Purpose

The following Desired Future Conditions (DFCs) are intended to be used within the Adaptive Management Program (AMP), including by the Adaptive Management Work Group (AMWG), to help guide the development of recommendations concerning management of Glen Canyon Dam operations and related activities, and dam impacts on Grand Canyon National Park (Grand Canyon) and Glen Canyon National Recreation Area (Glen Canyon). The focus of this document is to identify DFCs that can be accomplished through dam operations. However, for the sake of completeness, this document also includes DFCs that might be achieved through non-operational measures.

Justification

The Secretary is authorized to consider and implement both operational and non-operational measures to address downstream effects of Glen Canyon Dam if those measures meet the Grand Canyon Protection Act's goal of protecting, mitigating adverse impacts to, and improving the resources downstream of the dam. Section 1802 of the Grand Canyon Protection Act provides:

- a) In General.—The Secretary shall operate Glen Canyon Dam in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use.
- b) Compliance With Existing Law.—The Secretary shall implement this section in a manner fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River basin.
- c) Rule of Construction.—Nothing in this title alters the purposes for which the Grand Canyon National Park or the Glen Canyon National Recreation Area were established or affects the authority and responsibility of the Secretary with respect to the management and administration of the Grand Canyon National Park and Glen Canyon National Recreation Area, including natural and cultural resources and visitor use, under laws applicable to those areas, including, but not limited to, the Act of August 25, 1916 (39 Stat. 535) as amended and supplemented.

Reclamation is charged with balancing a complex set of interests in operating the dam. Those interests include not only the endangered species below the Dam, but also tribes in the region, the seven Colorado River basin states, large municipalities that depend on water and power from Glen Canyon Dam, agricultural interests, Grand Canyon National Park, and national energy

needs at a time when clean energy production is becoming increasingly important. The DFCs will assist the AMWG in providing recommendations to the Secretary of the Interior for future decision-making. The DFCs have evolved from discussions during the entire sixteen year history of the AMWG, and were generated in the following form from the concerted work of the DFC Ad Hoc Group and the federal agency regional leadership during 2010 and 2011.

The vision and mission of the AMWG (adopted on July 21, 1999) was developed to guide adaptive management of Glen Canyon Dam, and helps explain how and why definition of desired conditions is important.

“The Grand Canyon is a homeland for some, sacred to many, and a national treasure for all. In honor of past generations, and on behalf of those of the present and future, we envision an ecosystem where the resources and natural processes are in harmony under a stewardship worthy of the Grand Canyon. We advise the Secretary of the Interior on how best to protect, mitigate adverse impacts to, and improve the integrity of the Colorado River ecosystem affected by Glen Canyon Dam, including natural biological diversity (emphasizing native biodiversity), traditional cultural properties, spiritual values, and cultural, physical, and recreational resources through the operation of Glen Canyon Dam and other means.

We do so in keeping with the federal trust responsibilities to Indian tribes, in compliance with applicable federal, state, and tribal laws, including the water delivery obligations of the Law of the River, and with due consideration to the economic value of power resources.

This will be accomplished through our long-term partnership utilizing the best available scientific and other information through an adaptive ecosystem management process.”

These DFCs are intended to be statements of qualitative goals and objectives for the AMP, realistic and achievable through the operation of Glen Canyon Dam and related activities, subject to the Law of the River and other laws and authorities and consistent with the Grand Canyon Protection Act. These DFCs may not be entirely or collectively achievable – there will be tradeoffs and inherent limitations. This fact does not diminish their value. These desired future conditions of the affected resources have been identified by the stakeholders as appropriate goals for the AMP and are based on information available at this time. As new information develops, the DFCs may need further revision and refinement. Therefore, these DFCs are neither fixed nor final. This is intended to be a “living document” that reflects advances in learning and understanding. This is consistent with the process – and application -- of adaptive management.

Scope of the DFCs

The Colorado River ecosystem (CRE) which is defined as the Colorado River mainstream corridor and interacting resources in associated riparian and terrace zones, located primarily from the fore bay of Glen Canyon Dam to the western boundary of Grand Canyon National Park. It includes the area where the dam operations impact physical, biological, recreational, cultural,

and other resources. The scope of GCDAMP activities may include limited investigations into some tributaries (e.g. the Little Colorado and Paria Rivers).

The CRE is a human-dominated ecosystem, one whose aesthetic appeal, goods and services, and spiritual services are widely used and appreciated and needed by a broad cross-section of society. Adaptive management of the CRE has been adopted to ensure the sustainability of the natural environment with the least impact to goods and services provided by the CRE to society. As such, and as information about the CRE has increased, its stewardship is moving towards an ecosystem perspective, fully recognizing the role of humans, and this approach is reflected in the structure of this document.

DFC Organization

These DFCs are divided into four categories, including the Colorado River Ecosystem, Power, Cultural Resources, and Recreation. There are many direct and indirect, short-term and long-term ecosystem responses to dam existence and operations. These DFCs are directly or indirectly linked on short and long-term bases through dam-related flows, sediment retention and distribution, hydropower production, fish and wildlife populations, recreation, and visitor experience.

DESIRED FUTURE CONDITIONS (DFCs): COLORADO RIVER ECOSYSTEM

DFC DESCRIPTION

Ecosystem Definition

The term **ecosystem** refers to the combined physical and biological components of an environment. An ecosystem is generally an area within the natural environment in which physical (abiotic) factors and processes of the environment, such as geology, climate, and soil development, function along with interdependent (biotic) organisms, such as plants and animals, in the same habitat and create a dynamic and interconnected system. Ecosystems usually encompass a number of food webs. An ecosystem is a functional unit within a given area consisting of living things and the non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow.

DFC Background and Legislation

Glen Canyon Dam has had a profound impact on the aquatic and terrestrial domains of the Colorado River ecosystem from lower Lake Powell downstream to Lake Mead. The CRE DFCs are designed to be consistent with the 1992 Grand Canyon Protection Act, Law of the River, and other appropriate laws and mandates. The CRE DFCs apply the requirements of the Grand Canyon Protection Act, and are the goals that AMWG members will consider when making recommendations to the Secretary.

Why the CRE DFCs are Important

These CRE DFCs address the natural resource values for which the GCNP and the GCNRA were established. The DFCs aim to comply with the GCPA and describe the individual resource objectives sought with the realization that they may not be achievable in the process of finding the most desirable mix of resources in the CRE and the natural habitats, and natural ecosystem processes. Native and non-native species are to be managed in accord with Federal regulations, policies, and guidelines. The CRE described herein includes most of the native natural resources found in the Colorado River. Those resources are managed, consistent with the “Law of the River” (described in part in Section 1802(b) of the GCPA”, under the National Park Service (NPS) Organic Act, the Redwoods Amendment, NPS 2006 Management Policies, the Wilderness Act, the Antiquities Act, the Endangered Species Act, the Grand Canyon Protection Act, the Fish and Wildlife Coordination Act, and other Federal legislation. The health of the river ecosystem and the protection of the resource values of GCNP and GCNRA are important to the nation, many Native American Tribes, the economy of the Southwest, and the millions of visitors to the parks and the region.

The CRE DFCs will provide a foundation for and help define the components of the Core Monitoring Program under development by the Grand Canyon Monitoring and Research Center (GCMRC). The Core Monitoring Program will be essential to ultimately quantifying, measuring, and reporting the status of the natural resources, allowing the Secretary and the AMP to track progress toward desired outcomes. DFCs will also provide foundation support in the development of other planning and management assignments associated with the GCDAMP.

CRE DFCs

Sediment-related Resources

High elevation open riparian sediment deposits along the Colorado River in sufficient volume, area, and distribution so as to provide habitat to sustain native biota and desired ecosystem processes

- Nearshore habitats for native fish
- Marsh and riparian habitat for fish (food chain maintenance)
- Cultural resource preservation
- Maintenance of camping beaches

Water Quality

- Water quality with regards to dissolved oxygen, nutrient concentrations and cycling, turbidity, temperature, etc., is sufficient to support natural ecosystem functions, visitor safety and visitor experience to the extent feasible and consistent with the life history requirements of focal aquatic species
 - Ecosystem-sustaining nutrient distribution, flux, and cycling.
 - Hydro-physical conditions and characteristics of the CRE necessary to sustain aquatic biota.
 - Acceptable water quality for human health and visitor experience.

CRE Aquatic Domain

- The aquatic food base will sustainably support viable populations of desired species at all trophic levels.
- Assure that an adequate, diverse, productive aquatic foodbase exists for fish and other aquatic and terrestrial species that depend on those food resources.

Native Species:

- Native fish species and their habitats (including critical habitats) sustainably maintained throughout in each species' natural ranges in the CRE.
 - A healthy, self-sustaining populations of other remaining native fish with appropriate distribution (flannelmouth sucker, bluehead sucker, speckled dace, so that listing under the ESA is not needed.
- Humpback chub
 - Achieve HBC recovery in accord with the Endangered Species Act (ESA), , the HBC comprehensive management plan, and with the assistance of collaborators within and external to the AMP.
 - A self-sustaining humpback chub (HBC) population in its natural range in the CRE.
 - An ecologically appropriate habitat for the HBC in the mainstem.
 - Spawning habitat for HBC in the Lower Little Colorado.
 - Establish additional HBC spawning habitat and spawning aggregations within the CRE, where feasible.
 - Adequate survival of young-of-year or juvenile HBC that enter the mainstem to maintain reproductive potential of the population and achieve population sizes consistent with recovery goals.

Rainbow trout:

- A high quality trout fishery in GCNRA, as further described in the Recreation DFC that does not adversely affect the native aquatic community in GCNP.
 - Minimize emigration of non-native fish from the Lees Ferry reach in Glen Canyon National Recreation Area to downstream locations.
 - Minimize emigration of non-native warm water fish to the mainstem Colorado River.

Extirpated Species:

- Re-establish fishes extirpated from Grand Canyon, where feasible and consistent with recovery goals for HBC and the recovery goals of those extirpated fishes. See the linkages that follow for further information.

Nonfish Biotic Communities:

- Native non-fish aquatic biota and their habitats are sustainably maintained with ecologically appropriate distributions.
 - Populations of native non-fish species (invertebrates and vertebrates, including Northern Leopard Frog).
 - AMP Support, actions and funding are limited to incorporation of dam operations which are conducive to restoration of extirpated species.
 - Minimize the abundance and distribution of non-native species in the CRE.
 - Sustainable dam-influenced aquatic, wetland, and springs plant communities and associated biological processes, including those supporting threatened and endangered species and their habitats.

CRE Riparian Domain

- Native riparian systems, in various stages of maturity, are diverse, healthy, productive, self-sustaining, and ecologically appropriate.
 - Native, self-sustaining riverine wetlands, and riparian vegetation and habitat, with appropriate mixture of age classes.
 - Healthy, self-sustaining populations of native riparian fauna (both resident and migratory).
 - Habitat for sensitive species within the CRE
 - Encourage the resolution of the taxonomic status of the Kanab ambersnail (e.g., completely describe the taxa and subspecies).
 - Habitat for neotropical migratory birds, waterfowl, and other appropriate native bird species.
 - Ecological functions of tributary mouths and riverside springs, including habitat for native species.

CRE DFCs ADDITIONAL INFORMATION

Linkages

Ecosystem Structure: Physical characteristics, including climate, site-specific geomorphology, dam-related discharge and flow, and tributary flows, generally predominate over biological processes. The aquatic and riparian components of the CRE are linked to fluvial habitat distribution and the collection, composition, structure, and population dynamics of living

organisms. “Lateral” bio-ecological processes, such as competition, and “top-down” processes, such as predation, parasitism, and decomposition, can influence some elements of these linkages over time.

In addition to physical and biological interactions, the CRE is linked to Native American cultural resources such as archeological and cultural properties. Recreation benefits have resulted from both dam operations and healthy ecosystem conditions.

Metrics

These DFCs are intended to guide the gathering and analysis of data pertinent to the CRE in Grand Canyon National Park and Glen Canyon National Recreation Area. The CRE DFCs and the related documents will be used to provide direction towards development of the core monitoring program under development by the Grand Canyon Monitoring and Research Center (GCMRC). Through diligent and consistent monitoring, GCMRC may inform the Secretary as to whether as to what degree these DFCs are being achieved.

- Percentage of critical habitat lost or gained
- Condition of species variability (native population, abundance, distribution)
- Carrying capacity thresholds
- Population estimates

POWER DESIRED FUTURE CONDITIONS

DFC DESCRIPTION

Power Definition

Hydroelectric power is generated by the release of stored water through Glen Canyon Dam. The dam's eight generators can produce up to 1,320 megawatts: enough electricity to serve 1.3 million residential customers. The integration of hydropower and other resources provides an efficient and flexible operation of this region's electrical resources. Releases of water from Glen Canyon Dam are adjusted in part to follow customer loads.

DFC Background and Legislation

Glen Canyon Dam is an important component of the Colorado River Storage Project (CRSP) which stores water, the West's most vital resource, during wet years for use in times of drought, much like a bank account. As part of the nation's critical infrastructure, the water stored by Glen Canyon Dam is vital to the growing water needs of the Western United States. Over 30 million people depend on the water stored behind the dam for drinking, irrigation, and other municipal and industrial uses.

Revenues from the sale of Glen Canyon hydropower generation and other CRSP facilities are used to repay the reimbursable costs, and interest on the interest-bearing costs of the Federal investment in the CRSP, and are also used to repay over 85 percent of the irrigation costs of the CRSP Federal irrigation projects. These revenues are also used, instead of annual Federal appropriations, to pay for the yearly operation, maintenance and replacement costs of Glen Canyon Dam and other CRSP facilities.

The Reclamation Project Act of 1939 provides that hydropower produced by Glen Canyon Dam and other CRSP facilities be offered for sale first to municipalities and other public corporation and cooperatives and other nonprofit organizations financed in whole or in part by loans made pursuant to the Rural Electrification Act of 1936. Customers include rural electric associations, Federal facilities, state agencies, universities, and 57 Native American entities.

Why the Power DFC is Important

- Hydropower is an authorized purpose of Glen Canyon Dam.
- Hydropower produced by Glen Canyon Dam is under long-term contract to not-for-profit entities and 57 tribal entities.
- Power revenues are a significant funding source (est. \$20 million/year) for the AMP, Upper Colorado River and San Juan River Endangered Fish Recovery Programs, and the Colorado River Salinity Control Program.
- Hydropower is a renewable resource that is an important component in the Western Electricity Coordinating Council (WECC). Hydropower production is a national objective to help meet the Nation's needs for reliable, affordable, and environmentally sustainable electricity.
- Glen Canyon generation has the ability to "ramp up" to meet system reliability obligations that are important when regional power shortages or power/transmission system disruptions occur.

DFC GOALS AND OBJECTIVES

- Glen Canyon Dam capacity and energy generation is maintained and increased, so as to produce the greatest practicable amount of power and energy, consistent with the other DFCs.
- Ensure continued delivery of Glen Canyon Dam hydropower to the existing customers who have entered into long-term firm power contracts with WAPA.
- Ensure sufficient and efficient production of Glen Canyon Dam hydropower in order to provide the revenues to support the CRSP facilities and purposes.
- Maintain the operational flexibility (including but not limited to load following capability, ramp rates, and emergency operations allowances) that enable Reclamation and WAPA to meet the system operating and other regulatory requirements of WECC, North American Electric Reliability Corporation and the Federal Energy Regulatory Commission, as well as emergency operating criteria for safety and human health situations.
- Maximize the environmental benefits of hydropower generation at Glen Canyon Dam.
- Minimize carbon emissions through hydropower generation at Glen Canyon Dam.

POWER DFC ADDITIONAL INFORMATION

Linkages

- Operational changes, including experimentation and management actions, which include changes to volumes, release limitations (minimum and maximum), ramp rates, hourly, daily, monthly and seasonal variability, all potentially impact this resource.
- The above-identified parameters could have impacts to the CRE resources as well as recreational and cultural resources, depending on the operational design.

Metrics

- Valuation (measurement characterization for an average year)
 - Electric generating capacity (MW)
 - Electric generating energy (MWH)
 - Load following capability MW/hr
 - Ramp rate capability (MW/hr)
 - CO₂, SO₂ and NO_X emissions (tons)
 - Power plant water consumption (acre-feet)
 - Costs (\$ millions)

CULTURAL RESOURCES DESIRED FUTURE CONDITIONS

DFC DESCRIPTION

Cultural Resources Definition

Preservation and appropriate management of cultural resources are vital at many levels. At the most basic level, cultural resources are our history; they define and reaffirm us, and provide a tangible record of who we are and where we have been. Their importance may be to the nation as a whole, to a local community, or to a group traditionally associated with the area. This includes resources within the Grand Canyon region, including resources along the river corridor in Glen and Grand Canyons.

DFC Background and Legislation

Recognition of the importance of cultural resources is codified through numerous statutes and executive orders that mandate protection, consideration, and preservation of cultural resources. Because of the structure of federal law, particularly the National Historic Preservation Act of 1966 (NHPA), cultural resources will be considered below in two broad groupings: 1) those that fall within the purview of the NHPA (National Register Eligible historic properties); and 2) all other resources of traditional cultural importance. This is done for purely pragmatic reasons; there are specific legal requirements for cultural resources that fall under the NHPA umbrella that do not apply to the second class of cultural resources. The Cultural Resources DFCs apply the requirements of the Grand Canyon Projection Act to “protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park (GCNP) and Grand Canyon National Recreation Area (GCNRA) were established,” including cultural resources, and are the goals that AMWG members will consider when making recommendations to the Secretary.

Why the Cultural Resources DFCs are Important

The cultural resources of the Grand Canyon provide a record of human history in the area. They also encompass the traditional cultural use and significance of the Grand Canyon. Maintaining these resources is important to the nation as a whole so we can better understand the long history of the people who came before us and to the traditional groups that consider this area to have traditional significance to them. A number of Native American groups believe the Grand Canyon is their place of origin. These DFCs will help: maintain compliance with relevant cultural resource laws; maintain traditional cultural linkage with the Grand Canyon; and maintain traditional cultural access to and use of resources in the Grand Canyon in accordance with applicable law.

DFC NHPA ELIGIBLE (OR POTENTIALLY ELIGIBLE) HISTORIC PROPERTIES

Description

These resources are historic properties that are eligible or potentially eligible for inclusion in the National Register of Historic Places. The criteria for inclusion are defined in the NHPA, and are described in more detail in National Register Bulletins 15 and 38. Resources in the Grand Canyon include:

- Prehistoric archaeological sites (including trails, petroglyphs and pictographs)
- Historic sites (boats, mining, European exploration, river running)
- Traditional Cultural Properties - for the Grand Canyon, these include:
 - Archaeological sites
 - Traditional resource use areas

- Sacred sites
- Landmarks/geographic features
- Springs
- The Colorado River
- Ethnoecological resources
- Significant event locations
- The Grand Canyon itself

Prehistoric Archaeological Sites and Historic Sites:

- To the extent feasible, maintain significance and integrity through preservation in place.
 - If preservation in place is not feasible or reasonable, then implementation of appropriate preservation treatments will be implemented to ensure reduction or elimination of threats consistent with NPS management policies, tribal traditional values and historic preservation law.
 - Public access to historic properties on tribal lands is managed by the respective tribes. On lands administered by the NPS, access to some sites for users of the river corridor is maintained as long as integrity of the sites is not compromised.

Traditional Cultural Properties (TCPs):

- Attributes are maintained such as National Register eligibility is not compromised. These attributes will be specific to the traditionally associated peoples and will need to be identified by the federal agencies in consultation with those groups. Attributes may include aspects of location or physical integrity, as well as be intangible elements that link the resource to ongoing traditional cultural practices.
- The ability of traditionally associated people to maintain access to and use of the resources is preserved, in accordance with applicable law.
- Culturally appropriate conditions of resources are maintained based on traditional ecological knowledge; integration of the desired condition is included in relevant monitoring and management programs.
- Maintain ongoing consultation with the groups for whom the resource has traditional value. Because the desired condition of a TCP needs to be determined by the group for whom it has the traditional value, ongoing consultation is necessary to assess the condition of the resource.
- Mitigate impacts that affect the integrity of the TCPs. How and if effects can be mitigated will need to be developed in conjunction with the traditionally associated peoples for whom the resource holds value.

Linkages

The goals for the following all have the potential to directly or indirectly affect the condition of the National Register eligible properties (including some examples of effects):

- Flow
 - Direct inundation
 - Levels of sediment deposition
 - Fluctuation frequency and range
- Sediment
 - Distribution (laterally and vertically)

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- Vegetation
 - Species composition
 - Density
- Recreation
 - Camping locations
 - Recreational visitation
 - Trailing

Additionally, management and research actions have the potential to directly or indirectly impact these resources.

Metrics

- Erosion (or deposition) rates of substrates in which the sites are contained
- Impacts at sites that will affect eligibility

RESOURCES OF TRADITIONAL CULTURAL SIGNIFICANCE BUT NOT NRHP ELIGIBLE

Description

These are resources of cultural significance to traditional peoples, often Native American Tribes which do not meet some aspect for eligibility for inclusion in the National Register of Historic Places. A common reason that a resource does not meet National Register eligibility is that the resource lacks a clearly defined boundary or does not remain in a fixed location.

Resources that have the potential to be considered of traditional cultural significance in the Grand Canyon include:

- Animal resources
- Geologic materials
- Landscapes
- Plant resources
- Soundscapes
- Viewscapes
- Water

Objectives

- Maintain the ability of traditionally associated peoples to access and use the resource in accordance with applicable law.
- Maintain culturally appropriate resource conditions based on traditional ecological knowledge, and integrate this desired condition into monitoring and management programs.
- Maintain effective consultation with the groups for whom the resource has traditional cultural significance.

Linkages

The goals for the following resources all directly or indirectly affect the condition of resources with traditional cultural significance:

- Flow
- Sediment

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- Vegetation
- Recreation

Also, management and research actions have the potential to directly impact these resources.

Metrics

Because culture defines the roles that resources play in that culture, only members of that culture can assess the status or health of the resources. Therefore, measures for resource status or health and appropriate management will need to be determined individually by the federal agencies in consultation with the traditionally associated peoples.

RECREATION DESIRED FUTURE CONDITIONS

DFC DESCRIPTION

Definition

The Recreation DFCs are meant to describe goals and objectives for human use of the Colorado River Ecosystem (CRE) through GCNRA and the GCNP. They are intended to include not only traditional recreational activities such as whitewater rafting, camping, and fishing, but also such things as educational activities, spiritual engagement, and other appropriate activities and values. Grand Canyon and Glen Canyon offer many ways for people to experience, appreciate, and learn from them, even to those who never visit in person.

DFC Background and Legislation

Recreational use began before there were any dams on the Colorado River, though the exact beginnings are unknown. Recreational and other activities and values in the Grand Canyon and Glen Canyon have increased greatly since the time of the construction of Glen Canyon Dam. The Recreation DFC applies the requirements of the Grand Canyon Projection Act to “protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park (GCNP) and Grand Canyon National Recreation Area (GCNRA) were established,” including visitor use/recreation, and the goals that AMWG members will consider when making recommendations to the Secretary.

Why the Recreation DFC is Important

Grand Canyon National Park: The Grand Canyon is a unique place in this world. Its natural beauty, challenging environment, fascinating history, wilderness character, biodiversity and sheer size offer a rare and valuable experience. The river corridor is at the heart of the Grand Canyon. The river corridor and the canyon are worthy of the greatest possible respect, treatment, and protection that we can afford them. They must be kept vital and intact for future generations.

Glen Canyon National Recreation Area: The river corridor through the GCNRA provides opportunity to enjoy outdoor beauty with relatively easy access. It supports a valuable and high quality trout fishery and offers excellent outdoor opportunities that are more accessible and less demanding than those of the Grand Canyon. It is deserving of our respect and protection, while also providing the recreational opportunities for which it was established.

DFC GOALS AND OBJECTIVES

DFC Objectives

The Recreation DFCs have been divided in to four subcategories, each corresponding to a different section of the overall ecosystem or type of use:

River Recreation in Grand Canyon National Park

- Stewardship worthy of the Grand Canyon so that it can be passed from generation to generation in as natural condition as possible.
- Provide maximum opportunity to experience the wilderness character of the canyon.
- Wilderness experiences and benefits available in the canyon include solitude, connection to nature, personal contemplation, joy, excitement, the natural sounds and quiet of the desert

and river, and extended time periods in a unique environment outside the trappings of civilization.

- A river corridor landscape that matches natural conditions as closely as possible, including extensive beaches and abundant driftwood.
- A river corridor ecosystem that matches the natural conditions as closely as possible, including a biotic community dominated in most instances by native species.
- A dynamic river ecosystem characterized by ecological patterns and processes within their range of natural variability.
- Numerous campable sand bars distributed throughout the canyon.
- Recreational and wilderness experiences minimally affected by research and management activities.
- River flows that continue to be within a range that is reasonably safe, given the inherent risks involved in river recreation.

River Recreation in Glen Canyon National Recreation Area

- A quality recreation experience in Glen Canyon.
- Camping beaches suitable for recreational use.
- A setting and ecosystem that is as close to natural conditions as possible.
- Quality river running and angling recreation opportunities.

Blue Ribbon Trout Fishery in Glen Canyon National Recreation Area

- A high-quality sustainable recreational trout fishery in the river corridor in GCNRA, while minimizing emigration of non-native fishes.
- Operate Glen Canyon Dam to achieve the greatest benefit to the trout fishery in GCNRA without causing excessive detriment to other resources.

River Corridor Stewardship

- Management of Glen Canyon Dam that is significantly driven by concern for the cultural values and ecological integrity of the river corridor through the Grand Canyon, with preservation and protection considered over the long term (multiple generations).
- A well-informed public, confident that high quality scientific information is being used for best stewardship practices in the CRE.

DFC ADDITIONAL INFORMATION

Linkages

- A natural, healthy, and protected ecosystem is a fundamentally key element to the recreation experience and wilderness character of the river corridor.
- Cultural resources within and near the river corridor:
- The history of human habitation and use is an important part of the recreation experience. Individual sites are valuable whether they are open for visitation or designated off-limits.
- Outfitters and guiding opportunities
- Local businesses

Metrics

- Socio-economic value of river recreation in GCNP.

- Socio-economic value of the river corridor visitation and the Grand Canyon itself, as a whole.
- Economic effects of Grand Canyon tourism.
- Factors that make up the "wilderness character" of the river corridor.
- Number and size of campable beaches, safe flows for an optimal recreation experience
- Socio-economic value of river recreation in GCNRA.
- Socio-economic value of the river corridor itself in GCNRA.
- Socio-economic value of the fishery in GCNRA.
- Effect of the trout on the ecosystem in GCNP and the social and economic costs of mitigation.
- Characteristics most valued for the fishery; for example, the number, condition, and size of fish, and the ease or challenge of catching them.
- River running visitation metrics
- Water quality variables that influence river recreation
- Other river running safety issues

ATTACHMENT A: DFC BACKGROUND

GENERAL COMMENTS REGARDING PHASE 1 PROCESS

Dam Operations, Limitations, and Constraints

The process to complete the DFCs generated a number of comments and discussion that may clarify or augment the DFCs, and are here documented as background information.

Almost every means or fundamental DFC resource or process in the Colorado River ecosystem (CRE) in Glen and Grand Canyons has some nexus to the operations of Glen Canyon Dam, and the existence of the dam is a given. The Grand Canyon Protection Act (GCPA) and the Adaptive Management Work Group (AMWG) Charter frame the discussion of system limitations and constraints accepting the existence of Glen Canyon Dam as a given. Pursuant to your direction, our DFCs Phase 1 discussions focused on the definition of reasonableness and achievability of the DFCs proposed; however, many uncertainties exist over the nature and extent of dam operations and their impacts. Some resources, such as power, are clearly affected by Glen Canyon Dam operations, while the impacts of dam operations on other resources (e.g., water quality) are less clear.

The DAHC engaged in a rigorous discussion over what could be managed with dam operations and which resources and processes were not affected, or were only partially affected, by dam operations. Teasing apart the ecosystem impacts of dam existence versus dam operations remains a challenge, both in terms of science and agency policy dynamics. For example, dam construction greatly reduced annual flow variability, and the potential ecological benefits and policy implications of Modified Low Fluctuating Flows (MLFF) flows with relatively small (45,000 cfs) high flow experiments are still being evaluated. It was agreed that additional direction and science are needed to help improve understanding of these relationships, limitations, and operational constraints, and that those topics should be key components of Phase 2 DFCs discussions.

The GCPA provides for management actions other than dam operations, and therefore may expand river ecosystem management tools. The AMWG charter states, “the AMWG may recommend research and monitoring proposals outside the Act, which complement the Glen Canyon Dam Adaptive Management (AMP) process, but such proposals will be funded separately, and do not deter from the focus of the Act.” Phase 2 DFCs discussions will need to distinguish between dam operations and non-flow management responsibilities and actions. The DAHC will forward to the AMWG for considerations recommendations to the Secretary for appropriate long-term flow and non-flow management actions for implementation, addressing the funding for non-flow actions.

Science and Monitoring

A rigorous, credible science program is essential for all aspects of DFCs monitoring, research, and reporting, for development of AMP advice to the Secretary (Schmidt et al. 1998). At present, science services are provided to the AMP primarily by the U.S. Geological Survey through the Grand Canyon Monitoring and Research Center (GCMRC). While a DFC specifically for science integrity was considered by the DAHC, we view the need for AMP science and

monitoring as programmatic, extending to all elements of the AMP. Therefore, achieving DFCs as well as AMP goals requires the following from its science program(s).

1) Scientific information used for the AMP process must be reliable, of high quality, and rigorously reviewed. At present, the AMP relies on dialogue between stakeholders and the GCMRC to establish research and monitoring tasks and priorities. Continued and even more rigorous review of scientific research plans and projects should be performed by the independent Science Advisors, and their recommendations should be seriously considered and implemented where appropriate.

2) Peer-reviewed publication of scientific findings in major scientific journals is the gold standard for scientific credibility, and peer-reviewed publication amplifies the credibility of the overall AMP to the scientific community and to the public. Peer-reviewed publication is the norm for all scientific organizations; and we strongly recommend that all major AMP projects undertaken by the USGS be prepared and submitted for peer-review publication, rather than being left in report form.

3) AMP data, reports, hard copy field notes and maps, meeting documentation, and other information should continue to be compiled and archived in a fashion that makes it easy to access and easy to relate to contemporary and emerging issues. AMP information management, through both GCMRC and Reclamation, occasionally should be reviewed by the Science Advisors or by external information management experts, and recommendations from those reviews should be followed. A summary of findings and conclusions to date should be developed, maintained, and modified as appropriate to further guide the AMP process (e.g., Gloss and Kennedy 2005 is an excellent example). An annotated, searchable administrative history of the AMP would be useful and improve information availability, project completion, AMP progress, and education of new AMWG members, and should help prevent duplication of effort over time.

4) Uncertainties, unrecognized linkages, unanticipated ecosystem events and processes, changing policies, and biases are abundant and affect our understanding of the CRE and its dynamic character. Consequently, much uncertainty exists over CRE management appropriateness and effectiveness, particularly involving direct and indirect impacts of dam operations on biota, processes, and interactions. The implications of uncertainty often are not clearly acknowledged or embraced in science planning. The extent, impacts, and risks of scientific uncertainty on monitoring, research, and management program success should be more clearly identified, assessed, and communicated to the AMWG.

DFC REVISION AUGUST 2011 TO JANUARY 2012

Process

The Department of the Interior reviewed the DFCs submitted by AMWG on 8 November 2010, with a transmittal memo from George Caan and Larry Stevens. The 8 November 2010 DFCs memo noted: "We expect that the DFC document presented here will be carefully reviewed and considered by DOI for consistency with existing laws and policies. However, the advice provided is the Secretary's to do with as he sees fit, and may or may not be incorporated into DOI management. Consequently...we consider the DAHG presentation of this final DFC

document to be an appropriate use of Secretarial engagement of his Federal Advisory Committee."

AMWG 24 August 2011 Charge

The Secretary's Designee coordinated the expected review of the DFC document, and graciously returned the reviewed draft to AMWG for consideration. The DFC Review Ad Hoc Committee was charged on 24 August 2011: "To reconstitute the DFCs Ad Hoc Group, with Larry Stevens and Perri Benemelis as co-chairs, with participation from federal agencies, with members who volunteer in the spirit of full participation, to provide a final review of the DFCs, focusing on changes made to the DFCs by the federal agencies, and submit the final draft DFC document for consideration by the AMWG."

The scope of the DFC Ad Hoc review process focused on changes to the DFC's by DOI but was not strictly limited to reconciling the DOI document with the final recommendation from the Ad Hoc. , In those instances where substantive changes to the AMWG recommendation were made, discussion focused upon existing information, laws and policies that led to modification of the AMWG recommendation.

The Review Process

Before discussing non-consensus issues that arose at these meetings, the DFCAHC recommends that the AMWG examine the process used to develop its Phase I narrative (qualitative) DFCs document. The AMP program employs adaptive ecosystem management to pursue improvement of the science-based aspects of the program. The DFCAHC believes that it is also worthwhile to review the process utilized to develop DFCs so that it can learn from, and improve its process in the future to benefit the Program and the valued resources of the Colorado River Ecosystem.

- In August, 2010, the AMWG recommended the narrative DFCs to the Secretary for consideration, revision, and approval, subsequent to comments received by the DFC Ad Hoc group. This recommendation initiated a process in which individual Ad Hoc members and others suggested additional changes to the document. While the development of the August 2010 document was largely accomplished with in-person meetings, the subsequent comment process was handled in a less direct manner. The co-chairs were responsible for reconciling comments (provided to the Ad Hoc via mail, e-mail or by phone communication) and appropriately modifying the document. The resulting document was issued in November 2010.
- The two-step process (described above) to develop the November 2010 DFC recommendation led to confusion. The first part of the process was accomplished mostly through in-person meetings. The second part of the process was accomplished mostly via e-mail. The November 2010 recommendation inadvertently omitted provisions of the August recommendation. Omissions from the November 2010 document were not identified until the reconstituted DFC Ad Hoc 2 process began.
- The Interior agencies subsequently initiated a review of the November 2010 document for consistency with existing law and policy. The resulting document was reformatted, reorganized and rewritten. The undated DOI document and table of changes was included with the AMWG materials for the August 2011 meeting. We note some confusion over interpretation of the formatting of the November 2010 document, which resulted in additional confusion in the August 2011 document.

- The shift from the in-person process to the e-mail communication process may have resulted in unintended changes to the AMWG recommendations. These omissions were not identified until much later. The Interior agencies changes resulted in additional confusion.
- The Ad Hoc was under significant time pressure to complete its work by the identified deadline.

The DFCAHC Review members and co-chairs devoted considerable time and effort to this process, and intend that their efforts result in a positive outcome for the program. Future Ad Hoc efforts could benefit from recognition of the role of the public deliberation part of the process. Both the Ad Hoc group and the greater advisory council benefit from open, frank and respectful communication between the stakeholder representatives. Although the stakeholders represent varied and sometimes competing interests, all have a responsibility to clearly communicate issues and concerns and to openly deliberate with the goal to reach a reasonably balanced and workable solution or recommendation.

Non-Consensus DFC Issues

At the November 22 2011 meeting, these non-consensus issues were identified. This list follows the order of presentation in the DFC Reviewed document, and does not imply priority or importance.

1. Resolution of Kanab ambersnail taxonomy
2. Additional CRE information text to add
3. Funding responsibility for extirpated species
4. Use of the term “balance” with respect to hydropower and environmental management
5. The scope of cultural concerns is broader than just archeology
6. The use of the term ‘unimpaired’
7. Use of the phrase “blue ribbon trout fishery”
8. Additional CRE issues in GLCA
9. A Recreation DFC for a well-informed visiting public

All topics except 2 and 3 (above) were resolved with further discussion during the 10 January 2012 meeting. Following is a summary of the non-consensus issues discussion. Text associated with the two remaining non-consensus issues is highlighted in red. The following non-consensus issues summaries are provided for informational purposes.

1. P. 6: Resolution of Kanab ambersnail (KAS) taxonomy involves peer-reviewed publication of genetics findings, which indicate that KAS as *Oxyloma haydeni kanabensis* should be subsumed into the taxon known as the Niobrara ambersnail (*O h. haydeni*), thus eliminating KAS as a taxonomic entity. Failure of AMWG to continue funding this process after more than a decade of research means that KAS will continue to impact flow management options in the CRE.

In the December 23, 2011 Biological Opinion entitled *High Flow Experimental Releases, Non-native Fish Control Downstream, and the Modified Low Fluctuating Flow from Glen Canyon Dam for 10 years through 2020*, the Service addressed the Kanab ambersnail (KAS)

taxonomy discrepancy. Due to the pending taxonomic evaluation the conservation measure for KAS was revised to study the effect of the HFE Protocol on the population of Kanab ambersnail at Vasey's Paradise through continued monitoring but not continue removal and replacement of habitat for HFEs. FWS has analyzed the effect of the potential loss of habitat over the life of the proposed action and concluded that the conservation measure is not necessary to maintain a healthy population of Kanab ambersnail at Vasey's Paradise because the amount of habitat and snails that will be unaffected by the proposed action is sufficient to maintain the population. FWS recommended that Reclamation should consider supporting the recommendations in the Kanab ambersnail 5-year review including convening a team of snail, taxonomy, and genetics experts to conduct a Structured Decision Making exercise focused on reviewing or revising the current taxonomic status of the *Oxyloma* genus.

2. P. 7: Modification of the text of the CRE Additional Information Linkages section was suggested by the State of Colorado, but was not resolved and requires more discussion. The suggested additional text reads:

“In addition to physical and biological interactions, the CRE is linked to Native American cultural resources such as archeological and cultural properties. Recreation benefits have resulted from both dam operations and healthy ecosystem conditions. **It is critical to recognize the linkage between the body of law known as the “Law of the River,” the 1992 GCPA, laws pertaining to the NPS, and these DFC’s. The “Law of the River” defines how the Secretary of Interior must operate Glen Canyon Dam for water storage, water management, river regulation and hydropower. The ability to achieve the DFC’s identified herein depends in large part on the ability of the Secretary of Interior to find an appropriate balance given the competing legal mandates within the operational flexibility those laws provide.”**

3. P. 7: Disagreement among stakeholders exists over responsibility for funding the restoration of extirpated native fish and non-fish species (Colorado, Arizona, Western; contested by GCT, GCWC). The following text on this subject was originally agreed to by AMWG and included in the AMP Strategic Plan was inadvertently omitted and did not appear in the final November 2010 DFCs passed along to the Secretary:

“Achieve the balance of resource benefits envisioned by the Grand Canyon Protection Act, GCD EIS Preferred Alternative, and NPS 2006 Management Policies; maintaining, enhancing and where practical, restoring native species, natural habitats, and natural ecosystem processes. Native and non-native species are to be managed in accord with federal regulations, policies, and guidelines. Goal 3 in the AMP Strategic Plan ("Restoring populations of extirpated species as feasible and advisable") is to be achieved in accord with the direction in RIN 3.1.1, which states:

‘RIN 2.1.1 What information (including technical, legal, economic, and policy issues) should be considered in determining the feasibility and advisability of restoring pikeminnow, bonytail, roundtail chub, river otter, or other extirpated species? (Category C)’

A Category C Information Need is defined in the Strategic Plan as: ‘Information Needs that are funded and accomplished under authority of an entity other than GCMRC.’

Restoration of extirpated species should be guided by Goal 3 of the GCD AMP Strategic Plan and AMWG agreements from its August 2003 meeting, and such activities are not to be funded by the Adaptive Management Program. While AMP funding may not be used for such activities, AMWG may still advise the Secretary about the feasibility of reintroduction activities, and may request monitoring and information integration about such reintroduction activities.”

The above text was requested for inclusion in the CRE Extirpated Species DFC by some stakeholders but it was agreed to identify and move the issue here in Appendix for discussion by AMWG at a more appropriate time in the future. This issue pertains primarily to cases in which the construction or operations of Glen Canyon Dam have been clearly identified as contributing to the extirpation or precipitous decline of a native species in the CRE. The issue of actions outside the scope of the AMP and the funding of those actions was initially addressed in a January 2000 informal opinion by Scott Loveless, legal counsel for Interior and Reclamation. The argument of whether or not the reintroduction of extirpated species was within or outside the AMP lead to the above language.

AMP assumption of funding responsibility for extirpated species may affect the funding available for other AMP activities as well as having impacts on power marketing both from costs accrued from the conduct of restoration activities as well as potential limitation of flows to accommodate restored populations. However, NPS and FWS missions oblige Interior to engage in restoration, and some AMWG stakeholders are committed to the restoration of native extirpated and declining species. The DFC AHC noted that positive benefits may accrue from AMWG advice on such actions and resolution of conservation issues that limit flow management (e.g., humpback chub management, Kanab ambersnail taxonomic status). The consequences of an AMWG recommendation to the Secretary at this time that does not address responsibility for extirpated species management simply means extirpated species management continues under existing federal laws. Nothing prohibits AMWG offering advice to Secretary at a later date through the Adaptive Management Program.

4. P. 9 (top): There has been significant discussion regarding achieving a balance among GCDAMP resources. Language reflecting the relationship of the hydropower DFC to the other DFCs was proposed and included.
5. Pp. 10, 12: At least one and likely other Tribes contend that the DFC treatment of cultural issues fails to recognize Grand Canyon as a vital, living landscape, one whose care is central to the cultural well-being of several Tribes. Also of central concern are aquatic and wetland species, which hold special significance to several Tribes. The cultural DFC focuses principally on archeological and historical resources and fails to take into full account both fine-scale and Canyon-wide distribution of cultural sites.

6. The term “unimpaired” is used several times in the CRE DFC. Management of the CRE for a DFC of an unimpaired condition is philosophically misleading, unrealistic, and may limit management options (State of Colorado; Zuni Tribe).
7. P. 15: The phrase “blue-ribbon trout fishery” is retained as a header for the trout fishery section of the CRE, and has economic implications for the angling community. Should the phrase be used more frequently in the text?

Wikipedia (http://en.wikipedia.org/wiki/Blue_Ribbon_fishery) defines a blue ribbon trout fishery as:

“... a designation made in the United States by government and other authorities to identify recreational fisheries of extremely high quality. Official *Blue Ribbon* status is generally based on a set of established criteria which typically addresses the following elements:

- *Water quality and quantity*: A body of water, warm or cold, flowing or flat, will be considered for Blue Ribbon status if it has sufficient water quality and quantity to sustain a viable fishery.
- *Water accessibility*: The water must be accessible to the public.
- *Natural reproduction capacity*: The body of water should possess a natural capacity to produce and maintain a sustainable recreational fishery. There must be management strategies that will consistently produce fish of significant size and/or numbers to provide a quality angling experience.
- *Angling pressure*: The water must be able to withstand angling pressure.
- *Specific species*: Selection may be based on a specific species.

...Many quality recreational fisheries are informally referred to as *Blue Ribbon* by government agencies, tourist, media, environmental, sportsman organizations and writers, but are not officially designated as such by established criteria.”

8. P. 15: Recreation issues within Glen Canyon National Recreation Area not recognized in the DFCs include: a) the economic significance of river running and trout fishing (recreation); b) limiting the undesired impacts of recreation on the viewshed (CRE); and c) the loss of driftwood as a natural resource, primarily as habitat in the CRE DFC. Text on these topics were added to the Recreation DFCs for Glen Canyon.
9. P. 15: A Recreation DFC issue not included in the document involves outreach of scientific information to the visiting public in GLCA and GRCA. A primary resource for enhancing visitor experience is information on the high quality of scientific information available for Grand Canyon, and public trust that such information is being used to support best management practices. Such a Recreation DFC for both NPS units might read:

“A well-informed public, confident that high quality scientific information is being used for best stewardship practices in the CRE.”

This DFC was added to the Recreation DFCs in the River Corridor Stewardship section.

23 January 2012

The 10 January 2012 Meeting, Conference Call, and Final Wrap-up

A conference call held on 10 January 2012 clarified many points of disagreement in the December 2011 draft documents. The 13 January draft DFC review, cover letter to AMWG, and table of comments were circulated to the DFCAHC for a final review. That meeting and further discussion during the following week resolved the non-consensus issues, except for points 2 and 3 (above). The non-consensus issues are described in the final DFC AHC Background and the two unresolved issues are highlighted in red (above) for discussion and development of recommendations to the Secretary by AMWG. The documents were forwarded to Reclamation on 23 January 2012 for inclusion in the February 22-23 AMWG meeting package.

DFC PHASE 2 RECOMMENDATIONS: HOW TO MOVE FORWARD

DFC Phase 2 Challenges

Phase 1 DFCs clarify the DAHC vision for the Colorado River socio-ecosystem. Further DOI review of these DFCs helps focus the AMP. Several conflicts and assumptions over AMP direction challenged the development of Phase 1 DFCs and remained unresolved.

General programmatic conflicts are listed in the 2009 Policy Issues Ad Hoc Committee report and primarily involve conflicts among mandates and establishment of clear priorities. It would be advantageous for the DOI to resolve intra-departmental conflicts, and to identify a resolution strategy for inter-departmental conflicts that would help the AMP find a balance among competing laws and mandates.

An assumption that perpetuates conflicts in development of the DFCs appears to be the direction and magnitude of the AMP: if environmental impacts stemming from dam operations can be successfully addressed, and other problems can be solved or mitigated outside the AMP, will the size and cost of the AMP program decrease?

Phase 2 DFCs quantification will require clarification of the scope of the AMP. Previous efforts have attempted to identify which elements lie within or outside the scope of AMP, but all issues have not been resolved or agreed to and they perpetuate controversy within the AMP. For example, how can the AMP be limited to dam operations if a fisheries recovery program addresses non-flow management activities? To what extent should AMWG consider restoration of missing species? The scope of AMP activities needs to be addressed through further discussion between the AMWG and the DOI.

Phase 2 should be structured to prioritize “fundamental resource” over “means” DFCs or to identify obstacles (including uncertainties) to that prioritization where possible. A prioritized approach will help define and clarify the supporting ecological and sociological linkages needed to achieve DFCs, and move towards those goals through appropriate scientific endeavors.

The relationship among federal and state responsibilities and the AMP should be clarified. It can be argued that the NPS has full jurisdiction over all DFCs, except those for hydropower and the Tribal and joint-use lands in the river corridor. For example, there is shared responsibility for some cultural and natural resources in the river corridor (e.g., Tribal responsibilities for cultural resources, Arizona’s responsibilities for fish and wildlife). Reclamation, in full cooperation with the Colorado River Basin States and other stakeholders, has responsibility for water storage, delivery, and dam operations. NPS has responsibility for GCNRA and GLNRA. (need correct acronyms). Clarification and balancing of jurisdictional responsibilities will help improve the overall adaptive management process.

In relation to the above, discussion on establishing a reference condition for management of the CRE has been a persistently divisive and controversial issue within AMWG.

Should the reference point be the pre-dam condition, or is it one or more post-dam reference years (e.g., 1984 or the initiation of the AMP in 1997), varying among resources? Resolution of this issue is needed for DFCs quantification in Phase 2.

Many of these issues are controversial. Therefore, we recommend that the Phase 2 DFC discussion be facilitated to identify, define, and resolve or clarify these and other conflicts prior to, and during, the Phase 2 DFCs quantification process.

PHASE 2 DFCs PROCESS RECOMMENDATIONS

We believe a number of steps should be taken as part of the Phase 2 process. The following is a list of some steps that might be considered.

- Design and conduct a facilitated AMP policy issues discussion process—perhaps as a workshop—to clearly identify, define, discuss, and, where possible, promote resolution of key issues of conflict among agencies. This process should focus initially on contentious issues among DOI agencies, such as NPS management for the natural (predam) condition of the CRE and Reclamation’s dam management policies and consequences. Progress on DFCs quantification in Phase 2 also will require determining whether and how inter-agency conflicts may limit achievement of DFCs and how to resolve those conflicts.
- Establish priorities among fundamental and means DFC elements by considering ranking and weighting by: perceived importance, certainty of beneficial impact, agreement on methods and metrics to be used (standardized metrics may be most useful), legal requirements, compliance/acceptability, cost, time frame, and linkage to other prioritized actions (i.e., implications for quantification of some DFC variables that affect quantification of other variables). Towards this end, completion and utilization of the comprehensive, long-term planning process would likely prove beneficial.
- Determine how Phase 2 DFCs priorities relate to AMP and GCMRC strategic plans and readjust monitoring priorities if necessary.

After the development of the quantified Phase 2 DFCs, Interior should propose or develop a draft Phase 2 DFCs implementation plan and funding strategy for review by all stakeholders, GCMRC and the Science Advisors. A final Phase 2 DFCs implementation plan should be provided to the AMWG by the Secretary for guidance.

COMPLIANCE RESPONSIBILITIES, LAWS, AND REGULATIONS

Each DFC has associated laws, regulations, and compliance responsibilities. A section was included in the DFC template to identify specific legal and compliance issues in each DFC. Many of these regulations are common to all DFCs but may be interpreted and applied differently, creating challenges in understanding linkages. We have provided a list of these laws and regulations below in order to facilitate the discussions that will occur during later phases of the project.

Partial List of Authorities (chronological if noted)

- Reclamation Act (1902)
- Grand Canyon National Monument (1908)
- National Park Service Organic Act (1916)
- Migratory Bird Treaty Act and Bald Eagle (1918)
- Grand Canyon National Park (1919)
- The Colorado River Compact- Law of the River (1922 and ongoing)
- Fish and Wildlife Coordination Act (1934)
- Bald and Golden Eagle Protection Act (1940)
- Upper Colorado River Basin Compact (1948)
- Colorado River Storage Project Act of (1956)
- Wilderness Act (1964)
- National Historic Preservation Act (1966) Sections 106 and 110
- Colorado River Basin Project Act (1968)
- National Environmental Policy Act (1969)
- Endangered Species Act (1973)
- Grand Canyon Enlargement Act (1975)
- DOE Organization Act (1977)
- Redwoods Act (1978)
- Archeological Resource Protection Act (1979)
- Native American Graves Protection and Repatriation Act (1990)
- Grand Canyon Protection Act (1992)
- Religious Freedom Restoration Act (1993)
- GCNP General Management Plan (1995)
- Record of Decision, Operation of Glen Canyon Dam Final Environmental Impact Statement (1997)
- Grand Canyon National Park Resource Management Plan (1997)
- Energy Policy Act (2005)
- Colorado River Management Plan (2006)
- NPS Management Policies (2006)
- Natural Environment Research Council NERC/WECC Standards (2007)
- NPS management statutory authorities for Glen Canyon National Recreation Area and Grand Canyon National Park
- Executive Order 11593-Protection and Enhancement of the Cultural Environment
- Executive Order 13007-Indian Sacred Sites
- Executive Order 13175-Consultation and Coordination with Indian Tribal Governments
- Secretary Order 3206-American Indian Tribal Rights, Federal-Tribal Responsibilities and the Endangered Species Act
- Arizona Revised Statutes Title 49
- Arizona Revised Statutes Title 17

CRE Relationship to Dam Operations

There are many direct and indirect, short-term and long-term ecosystem responses to dam existence and operations. Many of these are discussed in the SCORE Report (Gloss et al. 2005; Fig. 1). This and the other three proposed DFCs are directly or indirectly linked on short and long-term bases through dam-related flows, sediment retention and distribution, hydropower

production, fish and wildlife populations, recreation, and visitor experience. Figure 1 illustrates the complicated linkage among the dam operations and natural as well as socio-cultural resources in the CRE, and the extent of coverage of the proposed DFCs described in this document.

REFERENCES CITED

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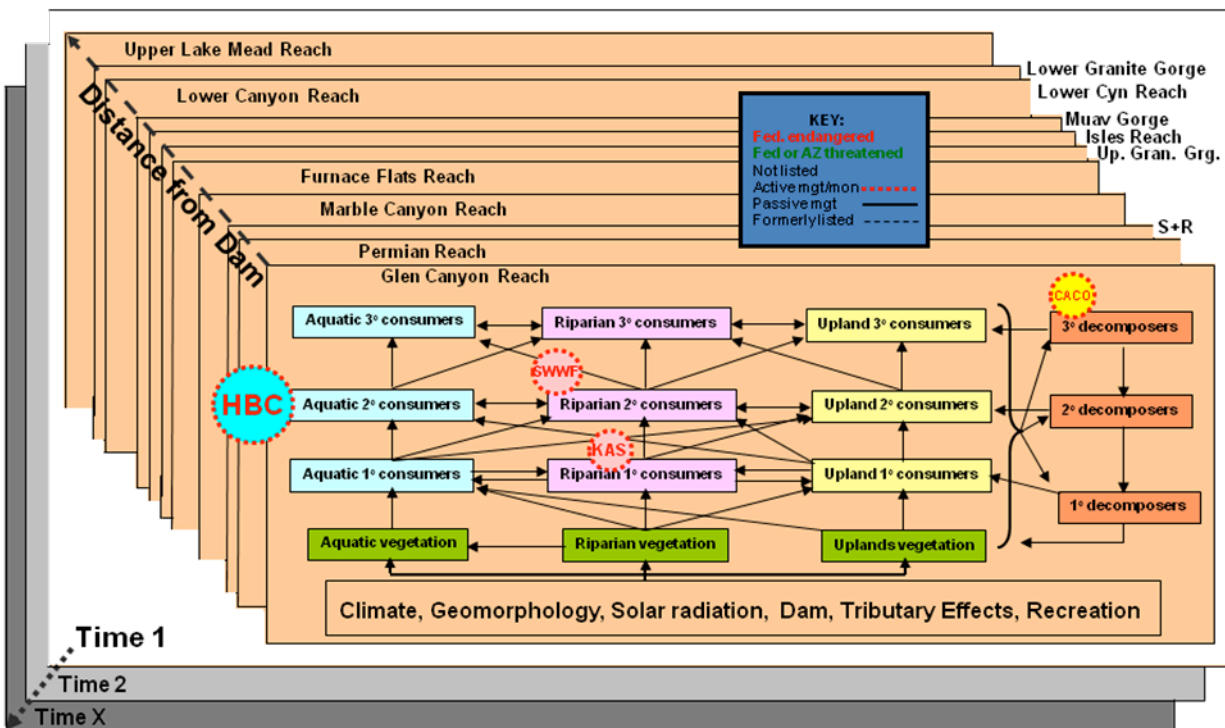


Figure 1: A schematic of the Colorado River ecosystem in relation to Glen Canyon Dam. The trophic position of species of management concern about which the AMP has devoted significant attention are indicated in circles: CACO – California Condor, HBC – Humpback Chub, KAS – Kanab ambersnail, SWWF – Southwestern Willow Flycatcher. Figure courtesy of Grand Canyon Wildlands Council, Inc., Flagstaff, AZ.