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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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GENERAL COUNSEL

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June 30, 1999

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In the Matter of
ATLAS CORPORATION
(Moab, Utah)
Docket No. 40-3452-MLA-3

Dear Administrative Judges:

Pursuant to the Order of June 24, 1999, enclosed are the Final Technical Evaluation Report for the Proposed Revised Reclamation Plan for the Atlas Corporation Moab Mill and the Final Environmental Impact Statement Related to Reclamation and the Uranium Mill Tailings at the Atlas Site, Moab, Utah, both dated March 1997, and the Final Biological Opinion for the Proposed Reclamation of the Atlas Mill Tailing Site in Moab, Utah, dated July 29, 1998. The Nuclear Regulatory Commission Staff (Staff) has also explored the steps that would be necessary to obtain the entire license amendment application, both proposed and modified. The Staff has determined that the documents which comprise the amendment application are numerous and span a number of years. The Staff does not have the documents compiled together, but estimates that they would span thousands of pages. For these reasons, the Staff

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is not providing that information to the Presiding Officer at this time. However, the Staff will provide discrete documents pertinent to the application that are relevant to the issues before the Presiding Officer.

Sincerely,

Lisa Clark

Lisa Clark
Counsel for NRC Staff

Enclosures: As stated

cc w/out encls:
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Office of the Secretary
ATTN: Docketing and Service
Office of the Commission Appellate Adjudication
Atomic Safety and Licensing Board Panel
Adjudicatory File

FINAL BIOLOGICAL OPINION FOR THE PROPOSED RECLAMATION OF THE ATLAS MILL TAILINGS SITE IN MOAB, UTAH

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Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguard
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Holonich:

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act), and the Interagency Cooperation Regulations (50 CFR 402), this transmits the Fish and Wildlife Service's final biological opinion for impacts to federally listed endangered species from the proposed reclamation of the Atlas Mill Tailings Site in Moab, Utah. The Reclamation Plan includes the capping of the mill tailings and the relocation of Moab Wash. Interrelated to and an indirect effect of the Reclamation Plan is a groundwater corrective action plan. This opinion is provided to you as the lead Federal Agency regarding section 7 consultation for this project. Copies of this opinion should be provided to the applicant because the Service has incorporated reasonable and prudent alternatives that should be included as conditions of any permits issued by the Nuclear Regulatory Commission for this project.

This biological opinion is based on information provided in: the biological assessment; supplemental biological assessment; draft environmental impact statement; preliminary final environmental impact statement; supplemental information provided by Atlas Corporation, the Nuclear Regulatory Commission, and other public information sources; various reports detailing the results of sampling conducted for contaminant analyses of the tailings pile and the Colorado River adjacent to the pile including the most recent reports provided to the Service on January 9, January 23, and February 5 from Oak Ridge National Laboratory in Grand Junction, Colorado, and Atlas Corporation. Additional data was taken from information on file with the Service. A

complete administrative record of this consultation is on file in the Service's Utah Field Office, Salt Lake City, Utah.

The biological assessment and supplemental biological assessment for the project have concluded that, with the exception of ammonia, the proposal for onsite reclamation does not have an adverse impact on endangered species. The Service concurs that the level of ammonia in the discharge associated with leaching of the tailings pile may affect endangered species, in particular, the endangered Colorado squawfish (*Ptychocheilus lucius*) razorback sucker (*Xyrauchen texanus*). The Service also concluded that the leaching of additional constituents of the tailings pile may affect the Colorado squawfish and the razorback sucker; that the depletion of water from the Colorado River for dust control, decontamination, construction, and other uses, may affect the bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), razorback sucker, and Colorado squawfish; and that construction activities associated with reclamation of the site may affect the southwestern willow flycatcher (Empidonax traillii extimus). Therefore, this biological opinion covers impacts to the following species; razorback sucker, Colorado squawfish, humpback chub, bonytail chub, and southwestern willow flycatcher.

The Service has previously issued two drafts of this opinion. Extensive discussions have resulted in significant modifications to the opinion. The first draft that was issued in June 1997 identified a reasonable and prudent alternative for the Nuclear Regulatory Commission to require Atlas Corporation to move the tailings pile out of the floodplain. Although this course of action would provide the greatest environmental safeguards, the Service determined that requiring Atlas to move the tailings pile was outside of the present legal authority of the Nuclear Regulatory Commission, and, therefore, Service regulations would not allow its inclusion as a reasonable and prudent alternative.

SCOPE OF THE BIOLOGICAL OPINION

Interrelated Actions and Indirect Effects. The Biological Assessment and Supplemental Biological Assessment prepared by the Nuclear Regulatory Commission both state that formal consultation was initiated with the Service on the proposed reclamation of the Atlas mill tailings site in Moab, Utah, not simply on the capping of the pile in place. The Biological Assessment further states that to achieve reclamation of the site Atlas Corporation has applied for a license amendment to the Nuclear Regulatory Commission that would allow Atlas to (1) stabilize the tailings pile for permanent disposal at its current location on the floodplain of the Colorado River at the Moab site; (2) prepare the 162 ha (400 acre) site for closure; and (3) upon satisfactory

stabilization of the tailings pile and site closure, discontinue its responsibility for the tailings, which would then be transferred for long-term custodial care to a government agency.

The Service concluded, in its June 1997 Draft Biological Opinion, April 1998 Revised Draft Biological Opinion, as well as in additional verbal and written correspondence, that the actions of capping and Groundwater Corrective Action cannot be separated from the complete reclamation of the site. The Service recognizes that elements of groundwater corrective action, including dewatering the tailings pile through pumping of pore water to the surface of the pile for evaporation, have previously been accepted or approved by the Nuclear Regulatory Commission,.

The Nuclear Regulatory Commission, in their comments on the Services Draft and Revised Draft Biological Opinion, stated that they recognize that the current Corrective Action Plan must be revisited and needs to be expedited. To avoid future leaching of contaminated groundwater into the Colorado River jeopardizing the endangered Colorado squawfish and razorback sucker, the Service has identified in the following biological opinion, the need for expedited implementation of a revised Groundwater Corrective Action Plan. The Nuclear Regulatory Commission states that this new Action Plan "will involve modification to the already existing Corrective Action Plan".

Endangered Species Act regulations require that a section 7 consultation assess the direct or immediate effects and indirect effects of the project on the species or its habitat, as well as the impact of State or private actions which are contemporaneous with the consultation in process. Direct effects result from the agency action including the effects of interrelated and interdependent actions. Indirect effects are those that are caused by or will result from the proposed action and are later in time, but still are reasonably certain to occur. To cap the pile as proposed, the tailings must be dewatered to achieve certain compaction criteria per Nuclear Regulatory Commission regulations. The dewatering of the tailings pile will directly affect the leaching of contaminants from the pile because some of the water from the tailings will become contaminated and leave the pile as a component of the ground water. Ultimately, the ground water will carry the contaminants into the Colorado River. Therefore, the Service believes that the specific action of capping the pile has an indirect effect on the listed fish species.

Interrelated actions are defined as those activities that are part of the proposed action and depend on the proposed action for their justification. Interdependent actions are defined as those actions having no significant independent utility apart from the action that is under consideration. The

Service's consultation handbook further clarifies the use of the interrelated argument by stating that, "As a practical matter, the analysis of whether other activities are interrelated to, or interdependent with, the proposed action under consultation should be conducted by applying a "but for" test". In other words, would another activity in question occur "but for" the proposed action under consideration. The Service's regulations further support the interrelated argument by stating that the action in question, in this case a groundwater corrective action plan, should be measured against the proposed action. In other words, is the groundwater corrective action interrelated to the capping of the tailings pile? The Service believes that the Groundwater Corrective Action Plan is interrelated to the proposed action of capping the pile in place for the following reasons:

1.) The purpose of the action, as identified in the Preliminary Final Environmental Impact Statement (page 1-7) is "to minimize the potential for environmental and public health impacts posed by the existing tailings pile". The purpose of the Biological Assessment is further stated as evaluating the environmental impacts from the proposed reclamation of the Atlas mill tailings site. Given that stated purpose of completing reclamation of the pile and closure of the site by the Nuclear Regulatory Commission, groundwater cleanup must be considered an action interrelated with the capping of the pile and the relocation of Moab Wash. It is part of the proposed action, as it is identified in both the Preliminary Final Environmental Impact Statement and the Biological Assessment. Justification of the groundwater cleanup is dependent upon the proposed action, as identified in the Biological Assessment and Preliminary Final Environmental Impact Statement, and would not occur "but for" the proposed reclamation of the site. If it were not for the proposed action of site reclamation, Atlas Corporation and the Nuclear Regulatory Commission would not be assessing the need for groundwater cleanup.

2.) Actions deemed necessary in the Final Ground Water Corrective Action Plan will be dependent on what actions are taken in reclaiming the tailings pile. The Nuclear Regulatory Commission stated in their comments on the Service's Draft Biological Opinion that, "With the decision to reconsider onsite reclamation, it was deemed prudent to defer consideration of revisions to the Corrective Action Plan until the issue of the final location of the tailings was decided". The fact that the decision of onsite reclamation may affect consideration of revisions to the groundwater corrective action plan clearly indicates that the two actions are interrelated.

3.) The Nuclear Regulatory Commission has further identified that Atlas' ability to use alternate concentration limits (NRC 1996), is dependent on the final disposition of the tailings. The Nuclear Regulatory Commission has stated that if the tailings pile is capped in place, the groundwater standards that are applied to the site may be different than those applied to the site if another course of action were followed.

The Nuclear Regulatory Commission regulations permit a narrow view of license amendment requests submitted by licensees, while the regulations governing interagency consultations pursuant to the Endangered Species Act (50 CFR 402.02 et seq.) require the Service to consider not only the discrete action proposed, but also the broad effects of that action on listed species, the ecosystems upon which they depend, and upon designated critical habitat. For that reason, the Service believes that for the purposes of this opinion, the action upon which consultation was requested, the reclamation of the site, cannot be narrowly viewed as the specific action of capping the pile, and that groundwater corrective action, some of which is already underway, is an interrelated action and an indirect effect. Therefore, this opinion deals with groundwater corrective action as part of the "action" with the expectation that the Service will work with the Nuclear Regulatory Commission and Atlas Corporation as further groundwater corrective action, including the formulation of Alternate Concentration Limits, at the site is planned and undertaken.

BACKGROUND

The Atlas Moab Mill is located on the west bank of the Colorado River about 3.7 km (2.3 mi) northwest of Moab, Utah. The property and facilities were originally owned by the Uranium Reduction Company and regulated by the Atomic Energy Commission, precursor to the Nuclear Regulatory Commission. The mill and site were acquired by Atlas Corporation in 1962. Atlas activities at the Moab Mill site are currently covered by Nuclear Regulatory Commission Source Material License SUA-917, which was renewed in 1988. The mill ceased ore milling operations in 1984.

The Atlas tailings pile is about 0.8 km (0.5 mile) in diameter and 28.65 m (94 feet) high. It rises to an elevation of 1237 m (4058 ft) above mean sea level. The height of the pile is about 27 m (90 ft) above the surface of the Colorado River terrace, which is approximately 1,210 m (3,970 ft) above mean sea level at the side of the pile nearest the river. It is unknown exactly how much of the pile lies within the terrace of the Colorado River. The pile is located 3.7 km (2.3 mi) northwest of Moab, Utah and occupies about 53 ha

(130 acres) of land about 230 m (750 ft) from the Colorado River. It consists of an outer compact embankment of coarse tailings and an inner impoundment of both coarse and fine tailings. An interim cover of uncontaminated earth covers the tailings. The amount of tailings is estimated to total 9.5 million metric tons (10.5 million tons).

Initial tailings pond construction was completed in 1956, and with the exception of brief periods, tailings were disposed in the pond continuously from initial startup in October 1956 until the mill ceased operations and was placed on standby status in 1984. The tailings pile has been maintained since that time under various conditions of the Atlas Source Material License. The pile has five embankments that were raised to their present elevation of 1,237 m (4,058 feet) above mean sea level after the 1979 license renewal. A 5.5 m (18 foot) raise in embankment elevation to a projected final elevation of 1,242 m (4,076 feet) was reviewed and approved under License Amendment No. 7 dated June 30, 1982. However, the embankment raise was never initiated because the added capacity was not needed when the mill subsequently entered a long-term shutdown status.

During early operations Atlas utilized an acid leach process for uranium milling. During this period, lime was added to the mill tailings to help neutralize the tailings. In 1961 an alkaline leach process was initiated. In 1967 a new acid leach circuit was installed and, for a period of time, both the acid circuit and an alkaline circuit were operated. From 1982 through 1984, only an acid leach process was used with no neutralization of process water because a recycle process was in use.

To collect water draining from the tailings pile embankments, two sump pits were excavated in the 1980's, one on the northeast side of the pile and the other on the south end of the pile. Pumps were installed to collect the seepage water and pump it to an evaporation pond on top of the tailings pile. Water did not collect in the pits for several years, and the pumps were subsequently removed. The Nuclear Regulatory Commission amended Atlas's license to allow disposal of radioactive contaminated solid waste in the south sump pit.

The 1982-1984 phase of operations appears to have resulted in increased metals mobilization as a result of the lower pH of the water and tailings associated with the acid leach circuit. After the Nuclear Regulatory Commission conformed its groundwater regulations to the Environmental Protection Agency's, they required Atlas to initiate a compliance monitoring and corrective action program by July 1990. A revised program was prepared by Atlas and found acceptable with modification. The program was made mandatory

by license conditions 17 and 55. The program included the establishment of groundwater quality standards, point-of-compliance wells, a background well, sampling frequency, groundwater sampling points, selected constituents for which the groundwater was to be analyzed, and enhanced drying of the tails. Wells were drilled into the tailings to pump water to an evaporative pond on the top of the tailings pile. Both the Nuclear Regulatory Commission and Atlas have identified that this action constitutes implementation of a current Groundwater Corrective Action Plan. The projected date for completion of all Groundwater Corrective Actions is December 1998, as specified in license condition 55, but this date is subject to revision. The Nuclear Regulatory Commission has acknowledged that the current plan needs to be revised and cleanup expedited. The criterion for completion of a revised Groundwater Corrective Action Plan have not been identified. Atlas is currently collecting data and preparing an updated application for its revised Groundwater Corrective Action Plan which will be reviewed by the Nuclear Regulatory Commission in a subsequent decision.

Atlas is currently in the process of closing and reclaiming the tailings site. The Nuclear Regulatory Commission's review of a licensee's proposal to close and reclaim a tailings site consists of three separate reviews:

1. The Nuclear Regulatory Commission reviews a licensee's decommissioning plan, which addresses the decontamination and/or dismantling of buildings and structures and cleanup of land. Atlas's decommissioning plan was previously approved by the Nuclear Regulatory Commission. Atlas has dismantled and disposed of all but one building on the site, in accordance with the decommissioning plan.

2. The Nuclear Regulatory Commission reviews a licensee's reclamation plan, which addresses reclamation of the tailings to achieve long-term isolation. Atlas's reclamation plan is the subject of this consultation. The Nuclear Regulatory Commission is in the process of finalizing an Environmental Impact Statement on the plan.

3. For sites at which ground water concentrations of hazardous constituents from the tailings impoundment have been detected above appropriate standards, the Nuclear Regulatory Commission reviews a licensee's corrective action plan. Atlas is currently implementing a corrective action plan that was approved by the Nuclear Regulatory Commission and has begun to collect additional data to update and revise the Corrective Action Plan for Nuclear Regulatory Commission review.

Atlas has conducted cleanup of windblown tailings and other contaminated soils in several areas on the site. These areas were along the west side of State Route (S.R.) 279, between the tailings pile and the highway, an area northwest of the tailings pile, and an area of about 3 ha (7 acres) southeast of the tailings pile. Cleanup involved excavating the windblown tailings and contaminated soil and placing them on the tailings pile. Additional cleanup of onsite and offsite contaminated windblown materials will be conducted as part of the reclamation activities.

Currently, the Atlas mill tailings site is regulated under Title II of the Uranium Mill Tailings Radiation Control Act of 1978. Atlas Corporation has requested that the Nuclear Regulatory Commission approve an amendment to its existing license for a proposed reclamation plan involving onsite disposal of uranium mill tailings at the former mill site in Moab, Utah. In January 1996, the Nuclear Regulatory Commission published a Draft Environmental Impact Statement evaluating the proposed reclamation plan.

The Utah Department of Environmental Quality directed Atlas Corporation, by letter dated September 12, 1996, to comply with UAC-R317-6-6.15.C1 and to submit a Groundwater Contaminant Investigation Report and Groundwater Corrective Action Plan. In an amendment to the above described notice, dated January 8, 1997, the Utah Department of Environmental Quality directed that Atlas must resolve all State concerns relative to the Groundwater Contaminant Investigation and Corrective Action Plan, to the satisfaction of the Executive Secretary, before construction of closure mechanisms that may require retrofit to meet State requirements. It is unknown at this time to what extent decisions relating to the reclamation of the site may be affected by State law compliance requirements with respect to contaminants in surface water and groundwater over which Utah claims exclusive regulatory authority and, therefore, in design of the cap.

CONSULTATION HISTORY

The Service's Utah Field Office has been involved with the proposed reclamation of the Atlas mill tailings since 1979. At that time, the Department of Interior provided comments which were included in the Final Environmental Statement for the Atlas site. These comments included reference to the proposed critical habitat designation for two endangered fish, the humpback chub and Colorado squawfish.

In 1983, the Utah Field Office of the Fish and Wildlife Service expressed concern, in a letter to the Assistant Regional Director regarding a review of the Emergency and Remedial Response Information System Inventory, that the

only site which posed any potential for a problem was the Atlas Mineral Corporation mill tailings pile at Moab, Utah. The Service identified concerns about possible effects to Colorado squawfish and razorback sucker.

On August 28, 1992, the Service provided the Nuclear Regulatory Commission with a letter identifying the presence of four endangered fishes in the Colorado River. This letter expressed concern that plans for reclamation of the mill tailings ensure that tailings material will never enter the Colorado River system, particularly over the long term when there may not be personnel or equipment to deal with problem situations. This was a concern because in the middle 1980's the river level was up to the base of the tailings pile and equipment operators were barely able to keep the pile from sloughing into the river. At that time the Service also advised the Nuclear Regulatory Commission that any depletion of water from the Colorado River system, including water used in dust suppression, is considered a "may affect" on the endangered Colorado River fish.

On May 13, 1994, the Service sent a letter to the Secretary, Nuclear Regulatory Commission, providing review and comment on the Notice of Intent to prepare an Environmental Impact Statement. In this letter, the Service identified that our Regional Office in Denver had provided extensive comments in a memorandum on the Environmental Assessment prepared for the project in August 1993. A copy of this memorandum was enclosed with the Service's May 13, 1994, letter. In that letter, the Service identified major concerns regarding contaminants and endangered species issues and notified the Nuclear Regulatory Commission that these issues, identified in the memorandum, needed to be fully addressed in the Environmental Impact Statement. These issues included water depletion from the Colorado River, groundwater contamination, release of toxic elements from this site compounding contaminant problems in the Colorado River system, the lack of a discussion of laboratory practices for chemical analyses of toxic elements, selenium in surface water, radiological hazards to wildlife and "take" under the Migratory Bird Treaty Act, the lack of contaminant studies in fish, the attitude that the area will be a maintenance free closed system for 200--1,000+ years, and the possibility of a bank storage of toxic elements during high water flows down the Colorado when water levels would be above the level of the tailings pile.

On November 2, 1994, the Service again provided a list of species that may be affected by the reclamation of the Atlas mill tailings, this time to Oak Ridge National Laboratory, Tennessee. Oak Ridge was a consultant working for the Nuclear Regulatory Commission on preparation of the Environmental Impact Statement for the proposed action. In this letter the Service identified that, not only were four endangered Colorado River fishes (Colorado squawfish,

razorback sucker, humpback chub, and bonytail chub) likely to occur in the vicinity of the proposed project site, but that the peregrine falcon (*Falco peregrinus*) and Jones cycladenia (*Cycladenia humilis* var. *jonesii*) also may be present. The Service again identified that indirect effects could result from water depletions associated with the project and that any depletion of water, including water used for construction activities such as dust suppression, drilling, and mixing of concrete, from the upper Colorado River Basin is considered a jeopardy to the endangered fish. The Service also identified that water depletion is considered to be an adverse modification of designated critical habitat for the endangered Colorado River fishes.

On January 11, 1995, the Service provided comments on the Preliminary Draft Environmental Impact Statement. In these comments the Service identified that it did not agree with the conclusions drawn in the Preliminary Draft Environmental Impact Statement concerning the tailings contamination of the Colorado River. The Preliminary Draft Environmental Impact Statement concluded that little impact on water quality would result and that contamination would not be expected to have toxic effects on wildlife that drink the water or prey on fish or waterfowl. The Service identified that some contaminants of concern can bioaccumulate to harmful levels in wildlife even when contaminant levels remain below water quality standards, and that sampling of aquatic biota is the best way to determine if contaminants are bioaccumulating in the food chain. The Service also stated that dilution by the Colorado River is not an effective means of mitigation for contaminants being carried into the river from the Atlas mill tailings pile. The Service again identified that selenium contamination was a concern and that the literature indicates detrimental effects on fish and waterfowl from selenium levels of 1-3 μg/L in water (Peterson and Nebeker 1992; Hamilton and Waddell 1994; Skorupa and Ohlendorf 1991). Furthermore, Service comments identified inadequate sediment and biota sampling in the river and in the Scott M. Matheson Wetlands Preserve across the river channel and recommended sampling benthic invertebrates, aquatic plants and nonendangered fish. The Service also identified that the Preliminary Draft Environmental Impact Statement provided inadequate radiological hazard evaluation, and an inadequate examination of the environmental impacts of a tailings pile failure.

In April 1995, contaminants staff from the Service's Utah Field Office participated in a 2-day meeting in Moab to determine what studies were needed to characterize the tailings pile constituents and to determine what leachates, if any, were escaping from the pile and ending up in the Colorado River. At this meeting the Federal representatives developed a list of recommended objectives and protocols for the Atlas/Nuclear Regulatory Commission study of the Colorado River below the Atlas tailings pile. The

Service expressed a need for additional data at the site in order to make informed decisions on environmental impacts. These recommendations were submitted to the Nuclear Regulatory Commission and their consultants. For a variety of reasons, most of the recommended data collections were not conducted.

On November 2, 1995, the Service received the biological assessment on the proposed reclamation of the Atlas mill tailings from the Nuclear Regulatory Commission with a request for formal consultation pursuant to the Endangered Species Act of 1973, as amended. A limited review of the biological assessment prompted the Service to request additional materials and analysis in a letter dated February 15, 1996. Additionally, the Service indicated in this letter concerns that the limited data collected did not accurately assess potential impacts to the endangered fish species in the Colorado River, and that the Service would complete a biological opinion upon receipt of the results of some additional analyses.

On March 28, 1996, the Service forwarded comments on the Draft Environmental Impact Statement to the National Park Service. The National Park Service coordinated Department of the Interior comments on the Draft document. After having fully reviewed the Draft Environmental Impact Statement and the Biological Assessment and receiving the results of some additional analyses, the Service provided the Nuclear Regulatory Commission with a letter, on July 22, 1996, which related its ongoing concerns regarding the paucity of data on toxic elements released into the Colorado River system from the Atlas mill tailings pile, as well as the inconsistency in data results. Additionally, the Service recommended a meeting between the Service, the Nuclear Regulatory Commission, and Atlas Corporation to discuss additional data needs.

On August 15, 1996, the Service met with the Nuclear Regulatory Commission and Atlas Corporation to discuss data needs and Service comments on the Draft Environmental Impact Statement. The Atlas consultants, Harding-Lawson Associates, presented some additional data concerning the hydrology of the region and the studies that had been conducted to date.

On October 21, 1996, Service staff again met with Atlas Corporation and the Nuclear Regulatory Commission to discuss regional hydrogeology, surface water quality issues, the potential effects of the tailings pile on the Colorado River and Nuclear Regulatory Commission requirements for the Ground Water Corrective Action Plan.

One additional meeting was held with Service staff, Atlas Corporation, Nuclear Regulatory Commission, and Department of Interior personnel to discuss the

Departments' comments on the Draft Environmental Impact Statement and Atlas's response to these comments. This meeting was held on December 17 and 18, 1996.

On January 14, 1997, the Service provided the Nuclear Regulatory Commission with a letter which detailed ongoing concerns relating to the section 7 consultation and the National Environmental Policy Act process as well as issues which had recently been brought to the Services' attention. The Service, realizing that the Nuclear Regulatory Commission was moving forward with the National Environmental Policy Act process and would soon provide a supplemental biological assessment, informed the Nuclear Regulatory Commission of many continuing concerns regarding the completion of the National Environmental Policy Act process prior to completion of the section 7 consultation, the possible impacts to endangered species from the contaminated groundwater underneath the tailings pile and from the relocation of Moab Wash, the concern with the analytical methods used to characterize the leachate from the pile, the lack of data characterizing the tailings pile itself, the concern that the State of Utah had identified high concentrations of ammonia at and below the Atlas site, and transmitting the Service's concern regarding the presence of southwestern willow flycatcher at the site. The southwestern willow flycatcher had not been included in earlier species lists provided by the Service as the species was not listed as endangered until February 27, 1995.

On January 30, 1997, the Service received the supplemental biological assessment on the proposed reclamation of the Atlas mill tailings, with a cover letter requesting formal section 7 consultation pursuant to the Act.

On February 3, 1997, the Service received a letter from Atlas Corporation transmitting Atlas's perspective on several of the procedural or process and technical issues identified in the Service's January 14, 1997, letter to the Nuclear Regulatory Commission.

On February 6, 1997, the Service received a revised letter from Atlas Corporation requesting that the Service replace the February 3, 1997, letter with this new letter. There were no substantive changes or alterations.

On February 18, 1997, the Service sent a letter to the Nuclear Regulatory Commission acknowledging receipt of the supplemental biological assessment and request for formal consultation. In that letter the Service identified that it would provide the Nuclear Regulatory Commission with a biological opinion by June 15, 1997.

On March 27, 1997, the Service received a letter from Atlas Corporation providing some additional information which had been requested concerning water depletions from the Colorado River and proposed actions for the Ground Water Corrective Action Plan.

On June 26, 1997, the Service released its Draft Jeopardy Biological Opinion for the proposed reclamation of the Atlas mill tailings site in Moab, Utah. Comments on the Draft Biological Opinion were received from the Nuclear Regulatory Commission, dated August 12, 1997, and Atlas Corporation and their consultants, dated August 6, 1997.

On September 9, 1997, Service staff participated in a meeting arranged by the Grand Canyon Trust, with staff from Oak Ridge National Laboratory/Grand Junction, the National Park Service, the State of Utah (by phone), and Grand Canyon Trust, to discuss the potential effects of contaminated groundwater discharge to the Colorado River from the Atlas pile. The Oak Ridge National Laboratory/Grand Junction was assigned the task of developing a sampling scheme to more accurately delineate the content and width of the contaminant plume. A letter proposal was distributed September 19, 1997.

Given the differing opinions concerning the Service's Draft Jeopardy Biological Opinion and its significant impacts, the entire matter was elevated to the Council of Environmental Quality and the Office of the Secretary of Interior. The Council of Environmental Quality approved the Oak Ridge National Laboratory/Grand Junction study proposal.

On October 23, 1997, a meeting was held in the Service's Denver office to address the status of the Oak Ridge National Laboratory/Grand Junction study proposal and refine the work plan. Participants included the Service, Oak Ridge National Laboratory/Grand Junction, Nuclear Regulatory Commission, Atlas Corporation, and Atlas's consultants, Harding-Lawson Associates. At the meeting Oak Ridge National Laboratory/Grand Junction agreed to perform the work and provide a report 60 days following the awarding of funds. Subsequently, Atlas Corporation, the Nuclear Regulatory Commission, and the Service agreed that following receipt of the Oak Ridge National Laboratory/Grand Junction report, the Service would issue a revised draft biological opinion within 30 days, that the Nuclear Regulatory Commission and Atlas Corporation would then have 10 days to review the revised draft biological opinion and get comments to the Service, and that the Service would then have an additional 30 days to finalize the biological opinion.

On November 10, 1997, Oak Ridge National Laboratory/Grand Junction began work on the approved study and on January 9, 1998, submitted the final report to

the Service (received on January 12, 1998) and the Nuclear Regulatory Commission.

Upon receipt and review of the January 9, 1998, Oak Ridge National Laboratory/Grand Junction (1998a, 1998b) studies, and because the modeling that the Service had agreed to had been considerably cut back by the Nuclear Regulatory Commission, the Service determined that additional modeling would be beneficial in determining the long term impacts of leaving the tailings pile in place as opposed to moving it. An additional study that supplemented the earlier modeling effort was agreed to by the Nuclear Regulatory Commission and Atlas Corporation and conducted by Oak Ridge National Laboratory/Grand Junction (1998c). Shortly into this modeling effort, the Nuclear Regulatory Commission decided that a further modeling effort, one which modeled the long term contaminant levels in the Colorado River, was necessary. On February 5, 1998, Service staff met with the Nuclear Regulatory Commission, Atlas Corporation, Harding-Lawson Associates, and Oak Ridge National Laboratory/Grand Junction to discuss future modeling needs. At this meeting Oak Ridge National Laboratory/Grand Junction presented the completed supplemental modeling requested by the Service. After hearing the presentation, the Nuclear Regulatory Commission determined that additional future modeling was not the best course of action at this time as it would not provide substantially more information. All parties then agreed to move forward with a revised draft biological opinion, to be delivered to the Nuclear Regulatory Commission by March 2, 1998.

On March 2, 1998, Atlas Corporation, in a letter to the Nuclear Regulatory Commission, granted an extension of the agreed upon time frame for issuance of the Service's revised draft biological opinion. The letter from Atlas Corporation stated that the length of this extension would be determined pursuant to discussions to be immediately undertaken among Atlas, the Nuclear Regulatory Commission, and the Service.

In a subsequent letter, dated March 11, 1998, from Atlas Corporation to the Nuclear Regulatory Commission, Atlas consented to an extension of an additional 30 days for issuance of the revised draft biological opinion pending a response from the Service on a fundamental issue identified during the consultation process, that of whether the Nuclear Regulatory Commission could require Atlas Corporation to move the tailings pile out of the Colorado River floodplain. The Service provided said response in a letter dated March 11, 1998, which stated that the Nuclear Regulatory Commission did not have the authority to make Atlas Corporation move the pile.

On April 14, 1998, the Service issued a Revised Draft Biological Opinion. Numerous comments were received on the Revised Draft Biological Opinion from the Nuclear Regulatory Commission and Atlas Corporation. These comments facilitated a meeting that was held between the Nuclear Regulatory Commission, the Service, and Atlas Corporation on May 21 and 22, 1998. In this meeting and several subsequent conference calls, all parties agreed that upon receipt of a letter from Atlas Corporation identifying several specific time frames for completion of proposed actions, the Service would issue a final biological opinion within 30 days. The Service received said letter on May 29, 1998.

On June 30, 1998, the parties agreed to an additional extension. The Service agreed to complete and transmit a draft final biological opinion to the Nuclear Regulatory Commission and Atlas Corporation by July 10, 1998, and the final biological opinion by July 20, 1998. This agreement was stated in letters sent by the Nuclear Regulatory Commission and Atlas Corporation and received by the Service on June 30, 1998. On July 9, 1998, the Service completed and transmitted the draft final biological opinion.

In a conference call on July 16, 1998, the parties agreed to extend the date of issuance of the final biological opinion to July 24, 1998. Letters from Atlas and the Nuclear Regulatory Commission agreeing to the extension were received by the Service on July 20, 1998.

In planning and discussing the Oak Ridge National Laboratory/Grand Junction studies and in preparation of this final biological opinion, numerous phone calls, conference calls, E-mail messages and facsimiles were effected between the interested parties.

BIOLOGICAL OPINION

This final biological opinion is based on the best scientific and commercial data available. While there is variability in some of the available information, the Service has evaluated all available information concerning the baseline, background (current) effects of the tailings pile on endangered species and the possible and probable future impacts to the species with the proposed action as well as other reclamation alternatives. After reviewing the current status of the razorback sucker, Colorado squawfish, humpback chub, bonytail chub, and southwestern willow flycatcher, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the Service's biological opinion that the project as proposed, capping of the pile in place, will jeopardize the continued existence of razorback sucker and Colorado squawfish due to the continued leaching of

contaminants into the Colorado River. The project will further jeopardize the continued existence of razorback sucker, Colorado squawfish, bonytail chub, and humpback chub due to water depletion impacts. Additionally, the proposed action will result in the destruction or adverse modification of designated critical habitat for the Colorado squawfish and razorback sucker. The project will not jeopardize the continued existence of southwestern willow flycatcher. The Service has developed reasonable and prudent alternatives to avoid the likelihood of jeopardy to the endangered fishes and to avoid destruction or adverse modification of their critical habitat, and has developed reasonable and prudent measures to minimize the incidental take of southwestern willow flycatcher, razorback sucker, and Colorado squawfish.

DESCRIPTION OF PROPOSED ACTION

Final Structure and Characteristics of the Reclaimed Tailings Pile

While the Nuclear Regulatory Commission has identified that additional modifications to the pile design may result from the ongoing review of the Groundwater Corrective Action Plan, the current project design is outlined below.

Pile Design. Atlas proposes to reclaim the tailings pile at its current location. Rock riprap and clay required for covering the pile would be transported by truck to the site from proposed borrow areas located southeast of Moab in Spanish Valley for cobble-sized rock and gravel, southwest of the Atlas pile near the Moab Salt and Potash Production and Packaging Facility for larger rock, and northwest of Moab on Klondike Flat (a portion of the Plateau Site) for clay.

As proposed, the reclaimed tailings pile at the Moab site would be approximately 0.8 km (0.5 mile) in diameter and 27 m (94 ft) high at its highest point near the river. It would have sloped sides and a concave upper surface with drainage ditches to minimize standing water on the surface of the pile, reducing water infiltration. The pile would contain about 9.5 million metric tons (10.5 million tons) of tailings. In addition, miscellaneous materials, including debris from mill decommissioning, would be disposed of adjacent to the pile's southeastern edge. The currently relatively steep slopes on the sides of the pile would be reduced to 30 percent except at the eastern sides of the pile facing the river, where the slopes would be reduced to 10 percent. The tops and sides of the pile would be covered with rock riprap layers. The elevation at the base of the pile is about 1,210 m (3,970 ft) above mean sea level, and the highest spots on the outer rim of the reclaimed pile would be about 1,238 m (4,062 ft) above mean sea level.

The reclaimed pile would be designed to minimize erosion, infiltration of rainwater into the tailings, and the release of radon gas. The pile would be designed to withstand the probable maximum precipitation event and the probable maximum flood event. Rock for riprap would have acceptable durability to withstand the forces of weathering. The design will comply with Criterion 6 of 10 CFR Part 40, which states that the design must provide reasonable assurance of control of radiological hazards to be effective for 1,000 years to the extent reasonably achievable and, in any case, for 200 years. The layers of the reclaimed pile, from the bottom upward, would include the tailings layer and a cover system (Table 1).

Table 1. The Proposed Cover Profile Over Coarse Tailings, Fine Tailings, and Embankments.

Over Coarse Tailings		Over Fine Tailings	On Embankments
(bottom)	Low grade ore[a] from the mill area-15cm (6 inches)	Regraded coarse tailings-2.1 m (7 ft) minimum	Regraded coarse tailings
	Affected soil-41 cm (16 inches)	Affected soil-41 cm (16 inches) minimum[b]	Sandy soil-2.1 m (7 ft) minimum
	Compacted clay-20 cm (8 inches) minimum	Compacted clay-30 cm (12 inches) minimum	Filter layer-variable thickness
	Sandy soil-23 cm (9 inches)	Sandy soil-23 cm (9 inches) minimum	
(top)	Rock-variable thickness	Rock-variable thickness	Rock-variable thickness

[a]Ore is waste rock-like material that was mined and transported to the mill. All indicated thicknesses of layers are minimums.
[b] Affected soil is soil that must be removed from the mill area and outlying areas to meet cleanup standards.

The cover system would provide a minimum of 94 cm (37 inches) of cover above the tailings on the top and sides of the cell. Generally, the cover would include a layer of affected soil from the mill area and outlying areas directly over the tailings, then a clay layer (radon barrier), a layer of sandy soil, and a surface layer of riprap. As currently proposed, the side slopes of the pile would not have a clay layer. However, if review of the revised Corrective Action Plan reveals the need to further reduce infiltration into the pile, a clay layer on the side slopes may be needed. If necessary to meet surface contour requirements, fill material may be placed in certain low areas over the coarse tailings prior to placing the cover system. The radon

barrier would consist of suitable material to minimize both the escape of radon and the infiltration of rainwater. The rock, which would be at least 10 cm (4 inches) thick, would protect against erosion and restrict the intrusion of vegetation and burrowing animals into the radon barrier. Tailings include both coarse and fine tailings, with the latter having higher radiation levels. As shown in Table 1, a thicker cover system over fine tailings will be required to meet radon emission limits. The placement of coarse tailings over any fine tailings currently at the surface is proposed.

The relatively flat top of the pile would be sloped slightly downward toward the middle and toward the northwest to promote collection of surface runoff and drainage to Moab Wash. Surface runoff on the top of the pile would flow to several collection ditches that would direct rainwater to a channel leading from the top of the pile to Moab Wash. Another ditch would be constructed between the bluff and the southwest slope of the tailings pile to convey runoff to the Colorado River. All ditches would be protected with riprap and one or more layers of gravel under the riprap. The gravel layers are needed in the ditches to provide additional protection against erosion of the underlying soil material during runoff events. Flood protection along the base of the pile would protect the pile from higher floods and the possibility of channel migration.

To provide adequate erosion protection and to prevent erosion of the embankment side slopes, Atlas would provide a large essentially horizontal, rock apron along the toe of the pile, designed to collapse onto the side slope of the migrated river channel. The apron would be provided from the mouth of the southwest drainage channel northeastward to the point where it joins the Moab Wash toe protection in the area of the debris pit. This also would prevent erosion into the tailings pile of Moab Wash, should it migrate towards the pile. The rock volume of the apron would be sufficient to cover the channel bank and to prevent further erosion of the river bank and the pile side slope.

At the toes of the side slopes the riprap would be extended a minimum 0.9 m (3 ft) beneath the earth surface to provide extra protection against flood erosion. Riprap would be extended 2.4 m (8 ft) below the surface at the outlets of the drainage ditches to prevent erosion (head cutting) of the outlets. In addition, the Nuclear Regulatory Commission could require any additional protection determined to be necessary as a condition of plan approval.

Table 2. Riprap sizes and thickness.

Location/Feature	Median Stone Size cm (inches)	Layer Thickness cm (inches)
Upper top slope	3.3 (1.3)	10.2 (4.0)
Lower top slope (1V:10H)	7.6 (3.0)	15.2 (6.0)
Side slope (3V:10H)	13.5 (5.3)	26.7 (10.5)
Collection ditches	13.5 (5.3)	26.7 (10.5)
Upper tailings pile drainage channel	13.5 (5.3)	26.7 (10.5)
Moab Wash channel	22.9 (9.0)	34.3 (13.5)
Southwest drainage channel	22.9 (9.0)	34.3 (13.5)
Apron along Colorado River	28.4 (11.2)	76.0 (30.0)
Southwest drainage channel	28.4 (11.2)	43.0 (17.0)
Lower tailings pile drainage channel	44.2 (17.4)	66.0 (26.0)
Lower southwest drainage channel (outlet)	70.1 (27.6)	106.7 (42.0)

Reconfiguration of Moab Wash

Moab Wash would be rerouted in the vicinity of the pile to run through the former mill site area. The reconfigured channel would discharge into the river upstream of the current discharge point. An inner channel about 0.6 m (2 feet) deep would be designed to carry runoff for a 200-year flood. Material excavated during construction of the reconfigured channel would be used as cover material for the pile. Any materials that were found to be contaminated would be placed on the tailings pile before the cover was installed. Atlas does not propose to provide outlet protection at the outlet of Moab Wash because the elevation of the outlet is controlled by the Colorado River.

On-Site Construction and Operations During the Reclamation Process

The primary activities on the site during reclamation would be the grading required to contour the surface of the tailings pile and the cover system, and operation of earth hauling vehicles and trucks providing cover materials from borrow areas and hauling remaining mill debris to the debris disposal sites at the southern and northeastern edges of the tailings pile. Sand from earthwork associated with reconfiguring Moab Wash would be used as part of the cover system. Earthwork would occur mainly from May to September when weather conditions are favorable. An existing building would provide the needed

facilities for workers and would be dismantled at the end of reclamation activities.

Monitoring and Maintenance of the Tailings Pile

Pre-Reclamation Characterization and Monitoring. Test bores were made at six locations on the tailings pile in 1992 to characterize the chemical and physical constituents of the tailings. Thirty-six samples were collected and grouped into three material types-ore, coarse tailings, and fine tailings. Three composite samples were taken from each of the three groups and tested for specific gravity, radium activity, emanation coefficient, diffusion coefficient, density, moisture, gradation, Atterberg limits, and capillary moisture relationships.

Prior to placing the cover system over the tailings, a system of monuments would be installed to detect any settling of the tailings. Each monument would consist of a 1.9 cm (0.75 inch) diameter metal rod welded to a 61 cm (24 inch) by 61 cm (24 inch) base plate. The rods would extend 15 cm (6 inches) above the final cover system. Before installing the cover system, monitoring would be conducted to insure that sufficient settling of the tailings had occurred. Because differential settling could adversely affect the cover system, monitoring would continue during cover placement to detect any adverse settling that would require correction.

During Reclamation. Monitoring similar to that conducted previously would continue during the reclamation process, with additional monitoring requirements to ensure that contaminants are not released during the reclamation process.

Post Reclamation. Once Atlas completes the reclamation, the agency that would assume responsibility for the tailings pile would prepare a long-term surveillance plan and submit it to the Nuclear Regulatory Commission for approval. Upon Nuclear Regulatory Commission approval of the long-term surveillance plan, the Nuclear Regulatory Commission would terminate the Atlas license (No. SUA-917) and approve transfer of ownership of the tailings pile to the United States or the State of Utah, at the option of the State, subject to a general license issued under 10 CFR Part 40.28 for custody and long-term care of byproduct material disposal sites. At a minimum, the responsible agency would be required to conduct annual site inspections to determine the need, if any, for monitoring and/or maintenance of the reclaimed tailings pile.

Borrow Areas and Transport of Borrow Materials

Required borrow materials include rock riprap, clay, and sand. Sand would be obtained from various areas on the Atlas site. Rock and clay would be obtained from offsite borrow areas and transported to the Atlas site, primarily during the winter months when tourist traffic is reduced. Rock would consist of crushed bedrock and rounded alluvial cobble obtained from Spanish Valley and Kane Creek.

The source of crushed bedrock for the largest sized riprap would be obtained from a borrow area, designated as the Kane Creek site located south of Potash adjacent to the Potash boat ramp on the Colorado River (T26S, R20E, Section 25). The site is approximately 28 km (17.5 miles) south of the Atlas site and approximately 2.3 km (1.4 miles) from the entrance to the Moab Salt and Potash Production and Packaging Facility. Borrow materials would be transported along S.R. 279 directly to the Atlas site.

Smaller cobble-sized rock and gravel would be obtained from a proposed borrow site in Spanish Valley, about 13 km (8 miles) southeast of the center of Moab (T27S, R23E, Sections 7, 8, 17, and 18; and T27S, R22E, Sections 1 and 12). The borrow materials from the Spanish Valley site would be transported along unimproved roads to U.S. 191, and then along U.S. 191 through Moab to the Atlas site.

Clay for the tailings pile cover would be obtained from the Plateau site on Klondike Flat, about 29 km (18 miles) northwest of the Atlas site. Atlas currently has a lease from the State of Utah to obtain clay from a 65-ha (160 acre) portion of the Plateau site. The transport route leaving the borrow area would be along an unimproved dirt road leading to U.S. 191 immediately south of Canyonlands Field, and then southeast along U.S. 191 to the Atlas site.

Borrow materials would be transported primarily during the winter months of November through March when tourist traffic is reduced. The materials would be transported by 23.6 metric ton (26 ton) trucks at an approximate rate of 10-12 trucks per hour during daylight hours. The licensee would probably contract commercial firms to obtain and deliver the rock.

Table 3. Truck hauling of borrow materials under the Atlas proposal.

Spanish Valley Borrow Area (Source of rock less than 9 inches in diameter and gravel)	
Quantity (yd^3)	156,777
One-way haul distance (miles)	10

Number of truck trips (16.5 yd^3 per trip)	9,502
Kane Creek Borrow Area (source of large rock greater than 9 inches in diameter	
Quantity (yd^3)	17,500
One-way haul distance (miles)	17.5
Number of truck trips (16.5 yd^3 per trip)	1,061
Total Quantity of Rock Transported (yd^3)	
Klondike Flat (source of clay)	
Quantity (yd^3)	73,300
One-way haul distance (miles)	18
Number of truck trips (16.5 yd^3 per trip)	4,442
Total cubic-yard miles hauled (yd^3 x miles transported)	3,193,420
Total number of loaded trucks passing through Moab	9,502
Total number of trucks (loaded and empty) passing through Moab	19,004

Schedules for Reclamation and Employment

Interim cover placement to provide for control of tailings pending reclamation was completed in November 1995. It was started in August 1989 and completed in phases as the pond in the center of the pile dried up. Installation of the final cover system would begin at an appropriate time after the National Environmental Policy Act process is completed and after Nuclear Regulatory Commission has made a determination of the acceptability of the Atlas proposal. Atlas proposes to perform reclamation in five 15-week phases, starting once they have obtained required approvals. Approximately 30 weeks would be devoted to the transport and placement of clay and rock material. The remaining 45 weeks would be devoted to earthwork. The truck transport of clay and rock would be conducted primarily during the winter, when tourist traffic is reduced.

Mitigation

Mitigation proposed by the licensee consists of dust suppression measures and erosion control during the reclamation process. Water and/or chemical dust suppressants would be sprayed on the tailings pile and the primary travel routes on the site. At the end of each phase of reclamation, the areas surrounding the tailings pile that have been constructed to final grade would be seeded using a permanent seed mix and mulched. Certain areas where disturbance occurs occasionally would be seeded with fast growing grasses. Silt fences and straw bales would be used as needed to control erosion and minimize runoff of sediments to Moab Wash and the Colorado River.

Atlas has identified that historical and current water use from the Colorado River, from 1973 to present, averaged 805.1 acre-feet annually. The average annual water use during the non-operational years of 1987-1993 was 154.3 acre-feet. Therefore, Atlas estimates that the average annual depletion of water from the Colorado River, under the proposed reclamation plan, for dust control, decontamination, construction, and other uses, would be 154.3 acre-feet.

Riprap placement along the relocated Moab Wash would be completed as soon as practical after relocation of the wash. Other mitigation would consist of the ongoing corrective actions as described above. Existing fuel and oil tanks on the Atlas site and any other tanks that may be brought onto the site would be placed within bermed areas capable of containing accidental spills.

The licensee would implement a plan to minimize emissions of fugitive dust during reclamation. The plan would be required to consider all reasonable measures, including frequent sprinkling with water, use of surfactants, and covering contaminated soils during hauling.

STATUS OF THE SPECIES

Colorado Squawfish

The Colorado squawfish evolved as the main predator in the Colorado River system. The diet of Colorado squawfish longer than 3 or 4 inches consists almost entirely of other fishes (Vanicek and Kramer 1969). The Colorado squawfish is the largest cyprinid fish (minnow family) native to North America and, during predevelopment times, may have grown as large as 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983). These large fish may have been 25-50 years of age.

Based on early fish collection records, archaeological finds, and other observations, the Colorado squawfish was once found throughout warm water

reaches of the entire Colorado River Basin, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, and the Gila River system in Arizona (Seethaler 1978). Colorado squawfish were apparently never found in colder, headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River basin prior to the 1850's. Historically, Colorado squawfish have been collected in the upper Colorado River as far upstream as Parachute Creek, Colorado (Kidded 1977).

A marked decline in Colorado squawfish populations can be closely correlated with the construction of dams and reservoirs between the 1930's and the 1960's, introduction of nonnative fishes, and removal of water from the Colorado River system. Behnke and Benson (1983) summarized the decline of the natural ecosystem. They pointed out that dams, impoundments, and water use practices are probably the major reasons for drastically modified natural river flows and channel characteristics in the Colorado River Basin. Dams on the main stem have essentially segmented the river system, blocking Colorado squawfish spawning migrations and drastically changing river characteristics, especially flows and temperatures. In addition, major changes in species composition have occurred due to the introduction of nonnative fishes, many of which have thrived as a result of changes in the natural riverine system (i.e., flow and temperature regimes). The decline of endemic Colorado River fishes seems to be at least partially related to competition or other behavioral interactions with nonnative species, which have perhaps been exacerbated by alterations in the natural fluvial environment.

The Colorado squawfish currently occupies about 1,030 river miles in the Colorado River system (25 percent of its original range) and is presently found only in the Upper Basin above Glen Canyon Dam. It inhabits about 350 miles of the main stem Green River from its mouth to the mouth of the Yampa River. Its range also extends 160 miles up the Yampa River, 104 miles up the White River, and 82 miles up the Price River, several of the major tributaries of the Green River. In the main stem Colorado River, it is currently found from Lake Powell extending about 201 miles upstream to Palisade, Colorado, and in the lower 33 miles of the Gunnison River, a tributary to the main stem Colorado River (Tyus et al. 1982).

Critical Habitat

Critical habitat, as defined in section 3(5)(A) of the Act, means: "(I) the specific areas within the geographical area occupied by the species at the time it is listed . . . , on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may

require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed . . . , upon a determination by the Secretary that such areas are essential for the conservation of the species."

Designated critical habitat for the endangered Colorado River fishes includes those portions of the 100-year floodplain that contain constituent elements. The constituent elements are those physical and biological features that the Service considers essential for the conservation of the species and include, but are not limited to, the following items: (1) Space for individual and population growth, and for normal behavior; (2) Food, water, air, light, minerals, or other nutritional or physiological requirements; (3) Cover or shelter; (4) Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally (5) Habitats that are protected from disturbance or are representative of the historical geographical and ecological distributions of the species. The primary constituent elements determined necessary for the survival and recovery of the four endangered Colorado River fishes include, but are not limited to:

> Water - A quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species;
>
> Physical Habitat - Areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursing, feeding, and rearing, or corridors between these areas. In addition to river channels these areas also include bottom lands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide spawning, nursery, feeding, and rearing habitats, or access to these habitats;
>
> Biological Environment - Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

Critical habitat has been designated within the 100-year floodplain of the Colorado squawfish's historical range in the following sections of the Upper Basin, excluding the San Juan River Basin (59 FR 13374).

Colorado, Moffat County. The Yampa River and its 100-year floodplain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties; and Colorado, Moffat County. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).

Colorado, Rio Blanco County; and Utah, Uintah County. The White River and its 100-year floodplain from Rio Blanco Lake Dam in T. 1 N., R. 96 W., section 6 (6th Principal Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from the Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

Biology

The life-history phases that appear to be most critical for the Colorado squawfish include spawning, egg fertilization, and development of larvae through the first year of life. These phases of Colorado squawfish development are tied closely to specific habitat requirements. Natural spawning of Colorado squawfish is initiated on the descending limb of the annual hydrograph as water temperatures approach 20° C. Spawning, both in the hatchery and in the field, generally occurs in a 2-month time frame between July 1 and September 1, although high flow water years may suppress river temperatures and extend spawning in the natural system into September.

Conversely, during low flow years when the water warms earlier, spawning may occur in late June.

Colorado squawfish spawn in white water canyons in the Yampa, Green and Colorado Rivers during the period of declining flows in June, July, or August, and rising water temperatures ranging from 22° to 25° C (Tyus and Haines 1991). In the Upper Colorado River Basin, above Glen Canyon Dam, specific spawning sites of Colorado squawfish have not been identified outside of the Green River basin. In the Green River basin, researchers have positively identified two specific spawning areas: (1) in lower Yampa Canyon on the Yampa River, Colorado, and (2) in Gray Canyon of the Green River, Utah. Spawning in the Upper Colorado River has been confirmed by the presence of larval squawfish in two reaches of the Colorado River: Black Rocks to Loma, and Grand Junction to Clifton (McAda and Kaeding 1991). Larval Colorado squawfish also have been collected both upstream and downstream of Redlands Diversion Dam near Grand Junction (Burdick 1997). The presence of larval squawfish aggregations and suitable spawning habitat in the Colorado River near Cataract Canyon, Professor Valley, and upstream from the Dolores River confluence indicate spawning is occurring in or near these areas as well (Archer et al. 1985, Valdez 1990).

The two confirmed spawning sites have the common characteristics of coarse cobble or boulder substrates forming rapids or riffles associated with deeper pools or eddies. It is believed that a stable, clean substrate is necessary for spawning and incubation. Substrates are swept clean of finer sediments by high flows scouring the bed prior to the spawning period.

O'Brien (1984) reported a cobble size range of 50-100 mm with a median size of 75 mm at the spawning site. Milhous (1982) proposes discharges of approximately 0.50 of that required to initiate cobble movement will be capable of extracting sands and fines from the cobble substrate. Thus, after the supply of sand diminishes, flows of sufficient magnitude and duration are required to scour the cobble bed in preparation for spawning and incubation.

After hatching, larvae drift downstream for about 6 days. These fish drift up to 100 miles where they are entrained in backwater nursery habitats in alluvial river reaches (Stanford 1994; Tyus and Haines 1991). These backwater areas are productive habitats that consist of ephemeral, along-shore embayments that develop as spring flows decline.

Larvae captured in the Yampa and upper Green Rivers hatched about 54 days after maximum flows. Postlarvae were captured in two concentration areas between river mile 208 and river mile 280, or about 99 miles downstream of the

Yampa Canyon spawning area. Another concentration area was located about 99 miles downstream of Gray Canyon (between river mile 32 and river mile 160). Tyus and Haines (1991) found most post larval Colorado squawfish in backwaters 84 percent of the time. They were also found in shorelines, side channels and eddies. Tyus and Haines (1991) also believe that the vast majority of age-0 Colorado squawfish found in the upper Green River are the result of downstream drift from the Yampa River. After spawning, adults use a variety of habitats including eddies, backwaters, and shorelines.

Miller et al. (1982) and Archer et al. (1986) demonstrated that Colorado squawfish often migrate considerable distances to spawn in the Green and Yampa Rivers, and similar movement has been noted in the main stem Colorado River. Miller et al. (1982) concluded from collections of larvae and young-of-year below known spawning sites that there is a downstream drift of larval Colorado squawfish following hatching. Extensive studies in the Yampa and upper Green Rivers have demonstrated downstream distribution of young Colorado squawfish from known spawning areas (Archer et al. 1986; Haynes et al. 1985). Miller et al. (1982) also found that young-of-year Colorado squawfish, from late summer through fall, preferred natural backwater areas of zero velocity and less than 1.5-foot depth over a silt substrate. Juvenile Colorado squawfish habitat preferences are similar to that of young-of-year fish, but they appear to be mobile and more tolerant of lotic conditions away from the sheltered backwater environment.

Information on radio-tagged adult Colorado squawfish during fall suggests that fish seek out deep water areas in the Colorado River (Miller et al. 1982), as do many other riverine species. River pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for Colorado squawfish. During winter, adult Colorado squawfish in the Yampa River use backwaters, runs, and eddies, but are most common in shallow ice-covered shoreline areas (Wick and Hawkins 1989). Valdez and Masslich (1989) found that squawfish overwinter in specific regions generally less than 3 miles long. The fish move periodically to one of several "favorite spots" or micro habitats characterized by greater than average depths and low velocity.

In spring and early summer, adult squawfish use shorelines and lowlands inundated during typical spring flooding. This lowland inundation is important for health and reproductive conditioning (Tyus 1990). Use of these habitats may offset winter stress and replenish energy stores needed for long migrations and spawning. During the spawning season adults have been reported to migrate up to 200 miles upstream or downstream to reach spawning areas (Tyus 1990). Migration is an important component in the reproductive life

cycle of Colorado squawfish. Tyus (1990) reported that migration cues, such as high spring flows, increasing river temperatures, and possible chemical inputs from flooded lands and springs, were important to successful reproduction.

Very little information is available on the influence of turbidity on the endangered Colorado River fishes. It is assumed, however, that turbidity is important, particularly as it affects the interaction between introduced fishes and the endemic Colorado River fishes. Because these endemic fishes have evolved under natural conditions of high turbidity, it is concluded that the retention of these highly turbid conditions is an important factor for these endangered fishes. Reduction of turbidity may enable introduced species to gain a competitive edge which could further contribute to the decline of the endangered Colorado River fishes.

Razorback Sucker

The razorback sucker, an endemic species unique to the Colorado River Basin, was historically abundant and widely distributed within warm water reaches throughout the Colorado River Basin. Historically, razorback suckers were found in the main stem Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1983). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and, further, that commercially marketable quantities were caught in Arizona as recently as 1949. In the Upper Basin, razorback suckers were reported in the Green River to be very abundant near Green River, Utah, in the late 1800's (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930's and early 1940's. In the San Juan River drainage, Platania and Young (1989) relayed historical accounts of razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, and removal of large quantities of water from the Colorado River system. Dams on the main stem Colorado River and its major tributaries have segmented the river system and drastically altered flows, temperatures, and channel geomorphology. Major changes in species composition have occurred due to the introduction of numerous nonnative fishes, many of which have thrived due to human-induced changes to the natural riverine system.

The current distribution and abundance of the razorback sucker have been significantly reduced throughout the Colorado River system (McAda 1987; McAda and Wydoski 1980; Holden and Stalnaker 1975; Minckley 1983; Marsh and Minckley 1989; Tyus 1987). The only substantial population of razorback suckers remaining, made up entirely of old adults (McCarthy and Minckley 1987), is found in Lake Mohave; however, they do not appear to be successfully recruiting. While limited numbers of razorback suckers persist in other locations in the Lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the Upper Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic and lotic environments. The largest population of razorback suckers in the Upper Basin is found in the Upper Green River and Lower Yampa River (Tyus 1987). Lanigan and Tyus (1989) estimated that from 758 to 1,138 razorback suckers inhabit the upper Green River. In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) report that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974.

Razorback suckers are in imminent danger of extirpation in the wild. The specific causes of this species' continued decline are largely unknown at this time. As Bestgen (1990) pointed out:

> "Reasons for decline of most native fishes in the Colorado River Basin have been attributed to habitat loss due to construction of mainstream dams and subsequent interruption or alteration of natural flow and physio-chemical regimes, inundation of river reaches by reservoirs, channelization, water quality degradation, introduction of nonnative fish species and resulting competitive interactions or predation, and other man-induced disturbances (Miller 1961, Joseph et al. 1977, Behnke and Benson 1983, Carlson and Muth 1989, Tyus and Karp 1989). These factors are almost certainly not mutually exclusive, therefore, it is often difficult to determine exact cause and effect relationships."

The virtual absence of any recruitment suggests a combination of biological, physical, and/or chemical factors that may be affecting the survival and recruitment of early life stages of razorback suckers. Within the Upper Basin, recovery efforts endorsed by the Recovery Implementation Program include the capture and removal of razorback suckers from all known locations for genetic analyses and development of discrete brood stocks if necessary. These measures have been undertaken to develop refuge populations of the

razorback sucker from the same genetic parentage as their wild counterparts such that, if these fish are genetically unique by subbasin or individual population, then separate stocks will be available for future augmentation. Such augmentation may be a necessary step to prevent the extinction of razorback suckers in the Upper Basin.

Critical Habitat

Critical habitat has been designated within the 100-year floodplain of the razorback sucker's historical range in the following sections of the Upper Basin, excluding the San Juan River Basin (59 FR 13374).

Colorado, Moffat County. The Yampa River and its 100-year floodplain from the mouth of Cross Mountain Canyon in T. 6 N., R. 98 W., section 23 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).

Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties. The Green River and its 100-year floodplain from Sand Wash at river mile 96 at T. 11 S., R. 18 E., section 20 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (6th Principal Meridian).

Utah, Uintah County. The White River and its 100-year floodplain from the boundary of the Uintah and Ouray Indian Reservation at river mile 18 in T. 9 S., R. 22 E., section 21 (Salt Lake Meridian) to the confluence with the Green River in T. 9 S., R 20 E., section 4 (Salt Lake Meridian).

Utah, Uintah County. The Duchesne River and its 100-year floodplain from river mile 2.5 in T. 4 S., R. 3 E., section 30 (Salt Lake Meridian) to the confluence with the Green River in T. 5 S., R. 3 E., section 5 (Uintah Meridian).

Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian).

Colorado, Mesa and Garfield Counties. The Colorado River and its 100-year floodplain from Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) including the Gunnison River and its 100-year floodplain from the Redlands Diversion Dam in T. 1 S., R. 1 W., section 27 (Ute Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from Westwater Canyon in T. 20 S., R. 25 E., section 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

Biology

Specific information on biological and physical habitat requirements of the razorback sucker is very limited. Until very recently, fisheries research investigations throughout the Upper Basin have focused on the other three listed Colorado River fishes, and data collected on the razorback sucker was largely coincident to those studies. Localized extirpation of razorback suckers from some localities, coupled with the species' continued decline in numbers and distribution, has prompted some research; however, details of its life history requirements, particularly in riverine environments, are still not fully understood.

In general, a natural hydrograph with a large spring peak, a gradually descending limb into early summer, and low stable flows through summer, fall, and winter is thought to create the best habitat conditions for endangered fishes while maintaining the integrity of the channel geomorphology. Prior to construction of large main stem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the Upper Basin (Tyus and Karp 1989; Osmundson and Kaeding 1991). The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Tyus (1987) and McAda and Wydoski (1980) reported springtime aggregations of razorback suckers in off-channel impoundments and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the main stem river and that razorback suckers presumably moved to these areas for feeding,

resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. While razorback suckers have never been directly observed spawning in turbid riverine environments within the Upper Basin, captures of ripe specimens, both males and females, have been recorded (Valdez et al. 1982; McAda and Wydoski 1980; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1989; Tyus and Karp 1990; Osmundson and Kaeding 1991; Platania 1990) in the Yampa, Green, Colorado, and San Juan Rivers. Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates (depending on the specific location).

Outside of the spawning season, adult razorback suckers occupy a variety of shoreline and main channel habitats including low runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1987; Tyus and Karp 1989; Osmundson and Kaeding 1989; Valdez and Masslich 1989; Osmundson and Kaeding 1991; Tyus and Karp 1990).

Habitat requirements of young and juvenile razorback suckers in the wild are largely unknown, particularly in native riverine environments. Collection of life stages, other than adults, have been extremely rare in the Upper Basin in recent times. However, larval razorback suckers have been collected in the upper Colorado River Basin in the last 10 years (Tyus 1987; Gutermuth et al. 1994), and specifically in the middle Green River during studies conducted from 1993 to 1996 (Muth et al. 1998), but no significant recruitment has been documented unequivocally (Tyus and Karp 1990; Minckley et al. 1991; Modde et al. 1996).

Humpback Chub

Humpback chub generally do not make migrational movements in the upper Colorado River and tend to reside throughout the year within a limited reach of river. Humpback chub are found inhabiting narrow, deep canyon areas and are relatively restricted in distribution. They seldom leave their canyon habitat (U.S. Fish and Wildlife Service 1990a). While humpback chub are regularly found dispersed in the Green and Yampa Rivers, the only major populations of humpback chub known to exist in the Upper Basin are located in Black Rocks and Westwater Canyons on the Colorado River.

Critical Habitat

Critical habitat has been designated within the humpback chub's historical range in the following sections of the Upper Basin (59 FR 13374).

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the southern boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumners Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Bonytail Chub

Little is known about the biological requirements of the bonytail, as the species has drastically declined in numbers in the Upper Basin since shortly after 1960. Until recently, the Service considered the species extirpated from the Upper Basin; however, a recently collected specimen which exhibits many bonytail characteristics could indicate a small, extant population (Kaeding et al. 1986). It is thought that, should this species persist in the Colorado River, the preferred habitat would be in the larger river reaches.

Critical Habitat

Critical habitat has been designated within the bonytail's historical range in the following sections of the Upper Basin (59 FR 13374).

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).

Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater (river mile 85) in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (river mile 12) in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

Utah, Grand County; and Colorado, Mesa County. The Colorado River from Black Rocks in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).

Utah, Garfield and San Juan Counties. The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).

Southwestern Willow Flycatcher

The southwestern willow flycatcher is a small bird, approximately 15 centimeters (5.75 inches) long. It has a grayish-green back and wings, whitish throat, light grey-olive breast, and pale yellowish belly. Two wingbars are visible; the eye ring is faint or absent. The upper mandible is dark, the lower is light. The song is a sneezy "fitz-bew" or "fit-za-bew", the call a repeated "whitt".

The southwestern willow flycatcher occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows (*Salix* sp.), *Baccharis*, arrowweed (*Pluchia* sp.), buttonbush (*Cephalanthus* sp.), tamarisk (*Tamarix* sp.), Russian olive (*Eleagnus* sp.), or other plants are present, often with a scattered overstory of cottonwood (*Populus* sp.) (Grinnell and Miller 1944, Phillips 1948, Phillips et al. 1964, Whitmore 1977, Hubbard 1987, Unitt 1987, Whitfield 1990, Brown and Trosset 1989, Brown 1991, Sogge et al. 1993, Muiznieks et al. 1994). Throughout the range of the southwestern willow flycatcher, these riparian habitats tend to be rare, widely separated, small and/or linear locales, separated by vast expanses of arid lands. The southwestern willow flycatcher has experienced extensive loss and modification

of this habitat and is also endangered by other factors, including brood parasitism by the brown-headed cowbird (*Molothrus ater*) (Unitt 1987, Erlich et al. 1992; Sogge et al. 1993, Muiznieks et al. 1994).

The southwestern willow flycatcher (Order Passeriformes, Family Tyrannidae) is a subspecies of one of the ten North American flycatchers in the genus *Empidonax*, and one of five subspecies of the willow flycatcher currently recognized (Hubbard 1987, Unitt 1987, Browning 1993). The breeding range of the southwestern willow flycatcher includes southern California, southern Nevada, southern Utah, Arizona, New Mexico, and western Texas (Hubbard 1987, Unitt 1987, Browning 1993). It may also breed in southwestern Colorado, but nesting records are lacking. Records of probable breeding in Mexico are few and are restricted to extreme northern Baja California del Norte and Sonora (Unitt 1987, Wilbur 1987).

The southwestern willow flycatcher nests in thickets of trees and shrubs approximately 4-7 meters (13-23 feet) in height, with dense foliage approximately 0-4 meters (13 feet) above ground, and often a high canopy cover percentage. The diversity of nest site plant species may be low (e.g. willows) or comparatively high (e.g. mixtures of willow, buttonbush, cottonwood box elder, Russian olive, *Baccharis*, and tamarisk). Nest site vegetation may be even or uneven-aged but is usually dense and structurally homogeneous (Brown 1988, Whitfield 1990, Sogge et al. 1993, Muiznieks et al. 1994). Historically, southwestern willow flycatcher nested primarily in willows, buttonbush, and *Baccharis*, with a scattered overstory of cottonwood (Grinnell and Miller 1944, Phillips 1948, Whitmore 1977, Unitt 1987). Following modern changes in riparian plant communities, southwestern willow flycatcher still nests in native vegetation where available, but has been known to nest in thickets dominated by tamarisk and Russian olive (Hubbard 1987, Brown 1988, Sogge et al. 1993, Muiznieks et al. 1994). Sedgewick and Knopf (1992) found that sites selected as song perches by male willow flycatchers exhibited higher variability in shrub size than in nest sites and often included large central shrubs. Habitats not selected for nesting or singing were narrower riparian zones, with greater distances between willow patches and individual willow plants. Nesting willow flycatchers of all subspecies generally prefer areas with surface waters nearby (Bent 1960, Stafford and Valentine 1985, Harris et al. 1987), but southwestern willow flycatcher nearly always nests near surface water or saturated soil (Phillips et al. 1964, Muiznieks et al. 1994). At some nest sites surface water may be present early in the breeding season but only damp soil is present by late June or early July (Muiznieks et al. 1994). Ultimately, a water table close enough to the surface to support riparian vegetation is necessary.

Defining a minimum habitat patch size required to support a nesting pair of southwestern willow flycatchers is difficult. Throughout its range, determining the capability of habitat patches to support southwestern willow flycatchers is confused by the species' rarity, unstable populations, variations in habitat types, and other factors. However, the available information indicates that habitat patches as small as 0.5 ha (1.23 acres) can support one or two nesting pairs. Sogge et al. (1993) found territorial flycatchers in habitat patches ranging from 0.5 to 1.2 ha (1.23 to 2.96 acres). Two habitat patches of 0.5 and 0.9 ha (1.23 and 2.2 acres) each supported two territories. Muiznieks et al. (1994) also reported groups of territorial southwestern willow flycatcher in habitat patches of approximately one to several hectares.

The nest is a compact cup of fiber, bark, and grass, typically with feathers on the rim, lined with a layer of grass or other fine silky plant material, and often has plant material dangling from the bottom (Harrison 1979). The nest is constructed in a fork or on a horizontal branch, approximately 1-4.5 m (3.2 - 15 feet) above ground in a medium sized bush or small tree, with dense vegetation above and around the nest (Brown 1988, Whitfield 1990, Muiznieks et al. 1994.

The southwestern willow flycatcher is present and singing on breeding territories by mid-May, although its presence and status is often confused by migrating individuals of northern subspecies passing through southwestern willow flycatcher breeding habitat. The southwestern willow flycatcher builds nests and lays eggs in late May and early June and fledges young in early to mid-July (Willard 1912, Ligon 1961, Brown 1988, Whitfield 1990, Sogge and Tibbitts 1992, Sogge et al. 1993, Muiznieks et al. 1994). Some variation in these dates has been observed (Caruthers and Johnson 1975, Brown 1988, Muiznieks et al. 1994) and may be related to altitude, latitude, and renesting. The southwestern willow flycatcher is an insectivore. It forages within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage (Wheelock 1912, Bent 1960). It also forages in areas adjacent to nest sites, which may be more open. No information is available on specific prey species.

The migration routes and wintering grounds of the southwestern willow flycatcher are not well known. *Empidonax* flycatchers rarely sing during fall migration, so that a means of distinguishing subspecies is not available (Blake 1953, Peterson and Chalif 1973). However, willow flycatchers have been reported to sing and defend winter territories in Mexico and Central America (Gorski 1969, McCabe 1991). The southwestern willow flycatcher most likely winters in Mexico, Central America and perhaps northern South America

(Phillips 1948, Peterson 1990). However, the habitats it uses on wintering grounds are unknown. Tropical deforestation may restrict wintering for this and other neotropical migratory birds (Finch 1991).

Breeding bird survey data for 1965 through 1979 combined the willow and alder flycatcher's into a "Traill's flycatcher superspecies" because of taxonomic uncertainty during the 15-year reporting period. These data showed fairly stable numbers in central and eastern North America but strong declines in the West, the region including the range of the southwestern willow flycatcher, and where the alder flycatcher is absent (Robbins et al. 1986).

Unitt (1987) reviewed historical and contemporary records of southwestern willow flycatcher throughout its range, determining that it had "declined precipitously", and that "although the data reveal no trend in the past few years, the population is clearly much smaller now than 50 years ago, and no change in the factors responsible for the decline seem likely". Data are now available that indicate continued declines, poor reproductive performance and/or continued threats for most populations (Brown 1991, Whitfield and Laymon, Kern River Research Center, in litt. 1993, Sogge and Tibbitts 1992, Sogge et al. 1993, Muiznieks et al. 1994).

ENVIRONMENTAL BASELINE

The environmental baseline includes the status of the species within the action area (the Colorado River near Moab, Utah) as well as the factors affecting the environment of the species or critical habitat in the action area. The baseline includes: State, tribal, local and private actions already affecting the species or that will occur contemporaneously with the consultation in progress; unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation; and Federal and other actions within the action area that may benefit listed species or critical habitat. The environmental baseline does not include the effects of the action under review in the consultation. Therefore, because section 7 consultation has not been conducted previously on the Atlas mill tailings site, the current water quality conditions in the Colorado River at and below the tailings pile that are affected by the Atlas tailings pile are not included in the environmental baseline. Instead the environmental baseline consists of the upstream water quality in the Colorado River because the water quality upstream represents what water quality at the site would be if the tailings pile did not exist.

Factors Affecting the Species Environment Within the Action Area

Impoundments and diversions have reduced peak discharges in various river reaches throughout the Upper Colorado River Basin since 1942, while increasing base flows in other reaches. These depletions, along with a number of other factors, including the introduction of nonnative fishes and increases in salinity and contaminants in the system, have resulted in such drastic reductions in populations of Colorado squawfish, humpback chub, razorback sucker and bonytail chub that the Service has listed these species as endangered, designated their critical habitats, and has implemented programs to prevent them from becoming extinct.

The numerous impoundments in the upper Colorado River, including Granby, Dillon, Blue Mesa and McPhee Reservoirs, have altered the natural hydrograph of the Colorado River. Reductions in water quantity and changes in flow regime have resulted from upstream developments (USFWS 1993b). Changes in the hydrologic regime through the closure of main stem impoundments has altered sediment transport and resulted in channel degradation (Lyons 1989). Changes in the hydrograph can also lead to changes in the channel geometry. Reduction in channel width has increased the average velocity in the main channel and decreased the number of low-velocity backwaters (Wick et al. 1982). Important backwater habitats and low-velocity shoreline habitats have been eliminated through siltation and subsequent vegetative growth (Wick et al. 1982). In particular, river shorelines have been altered by establishment of the exotic plant tamarisk (*Tamarisk chinensis*). For example, in Canyonlands National Park, the establishment of tamarisk on islands, sandbars, and river shorelines has decreased channel width by an average of 25 percent (Graff 1978).

The impoundment of tributaries and mainstem waters also has resulted in the stocking of a number of nonnative sport and bait fishes for use by local residents and visitors to the basin. While the acceptance of these fishes has been generally favorable to the public, their presence has led to predation, competition, and the general demise of native species (Tyus 1990, Tyus and Saunders 1996). The stocking of nonnative warm water fishes such as channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieu*), and walleye (*Stizostedion vitreum*) have resulted in the continuing high probability of predation on soft-rayed native fishes. Red shiners (*Cyprinella lutrensis*), for example, have been documented as preying on larval suckers, including razorbacks (Rupert et al. 1993, Modde 1997). Other exotics such as sand shiners (*Notropis stramineus*) and fathead minnows (*Pimephales promelas*) compete for food and space in remaining habitats. Some scientists believe (Tyus and Saunders 1996) that changes in the biological environment as a

result of fish introductions may currently be the most significant threat to the native fish fauna of the Colorado River basin.

Water quality has been altered in the Colorado River Basin and also has been identified as a factor resulting in the decline of the endangered fishes. Both the Draft Razorback Sucker Recovery Plan (USFWS 1997) and Colorado Squawfish Recovery Plan (USFWS 1991) identify changes in water quality and introduction of environmental contaminants as factors in the decline of the endangered fish. While several general trends in water quality changes have been identified for the Colorado River system (for example, increasing pH and decreasing turbidity), the water quality parameters and environmental contaminants of concern to the endangered fish tend to be site specific.

The nearest U.S. Geological Survey water quality monitoring station on the mainstem Colorado River to the Atlas site is approximately 31 river miles upstream near Cisco, Utah. The site is located on the left bank of the Colorado River one mile downstream of the Dolores River confluence, 11 miles south of Cisco, Utah, 36 miles downstream from the Utah-Colorado state line. This site has been continuously monitored by the U.S. Geological Survey since 1928. Baseline water quality data for the Colorado River upstream of the Atlas site, at the Cisco station, is included in Table 4 below. While the data is included as baseline, it should be noted that several washes (Salt, Negro Bill, and Courthouse), and Creeks (Onion, Professor, Stearns, and Castle) contribute flows to the Colorado River between the Cisco station and the Atlas site. Therefore, water quality in the Colorado River just above the Atlas site may, at times, be slightly different than that reported for Cisco.

Table 4. Baseline water quality data for the Colorado River, recorded at Cisco, Utah (Water Year 1997).

Date	Discharge (Inst. CFS)	Sulfate Dissolved (mg/l as SO4)	Chloride Dissolved (mg/l as CL)	Nitrogen NO2+NO3 Dissolved (mg/l as N)	Nitrogen Ammonia Dissolved (mg/l as N)	Arsenic Dissolved (ug/l as AS)	Beryllium Dissolved (ug/l as BE)	Cadmium Dissolved (ug/l as CD)	Manganese Dissolved (ug/l as MN)	Molybdenum Dissolved (ug/l as MN)	Selenium Dissolved (ug/l as SE)	Uranium Natural Dissolved (ug/l as U)
11/20/96	4680	270	110	0.600	<0.015	<1	<1.0	<1.0	7.0	4.0	4	5.0
02/19/97	4800	190	92	0.250	<0.015	<1	<1.0	<1.0	15.0	4.0	3	4.0
03/19/97	8990	130	50	0.290	0.090	<1	<1.0	<1.0	7.0	3.0	2	3.0
04/28/97	14300	99	26	0.294	<0.015	1	<1.0	<1.0	2.4	3.2	1	1.9
05/16/97	26500	64	13	0.191	0.017	<1	<1.0	<1.0	2.4	2.8	1	1.3
06/02/97	35800	60	12	0.175	<0.015	<1	<1.0	<1.0	2.0	2.5	<1	1.4
06/10/97	39800	62	11	0.145	<0.015	<1	<1.0	<1.0	1.5	2.5	<1	1.4
06/27/97	25700	59	15	0.194	<0.015	1	<1.0	<1.0	2.0	5.0	<1	1.5
07/14/97	9300	130	45	0.269	<0.015	<1	<1.0	<1.0	2.4	4.9	2	2.7
07/23/97	7200	170	57	0.345	<0.015	1	<1.0	<1.0	1.3	5.7	3	3.3
08/25/97	5630	210	59	0.459	0.035	1	<1.0	<1.0	<1.0	6.0	4	4.0
09/29/97	7810	240	62	0.536	<0.020	<1	<1.0	<1.0	<1.0	3.9	4	4.3

Additional background Colorado River water quality data has been collected by Atlas Corporation and the Utah Department of Environmental Quality. Only the most recent of these collections are relevant to current baseline conditions and these are summarized in table 5 below.

Table 5. Background Colorado River Surface Water Quality Data Collected Upstream of the Atlas Tailings Site. Sample Identification: 495700 = collected by Utah DE in the Colorado River at the mouth of Courthouse Wash; River and SWAM = collected by Atlas in the Colorado River between Courthouse and Moab Wash; both washes within 1/4 mile above the site.

Constituent	Units	Sample Identification						
		495700 11/15/95	495700 12/7/95	495700 1/18/96	River 3/30/95	SWAM 2/8/95	SWAM 2/14/96	SWAM 6/4/96
Ammonia (as N)	mg/l	0.05 Up	0.05 U					0.1 U
Antimony	mg/l			0.003 U				
Arsenic	mg/l	0.005 U	0.005 U	0.005 U	0.005 U	0.003 U	0.003 U	
Barium	mg/l	0.054	0.05	0.051	0.078			
Beryllium	mg/l		0.001 U	0.001 U				
Cadmium	mg/l	0.001 U	0.001 U	0.001 U	0.001 U			
Calcium	mg/l	79	73	75	65			
Chloride	mg/l	86	87.5	116	68	154	114	
Chromium	mg/l	0.007	0.005 U	0.005 U	0.005 U			
Copper	mg/l	0.012	0.012 U	0.012 U	0.012 U	0.01 U	0.01 U	
Gross Alpha	P.I./l	2 U	7	2 U	7			
Gross Beta	P.I./l	10 U	10	10 U	10			
Iron	mg/l	0.12	0.025	0.03	1.7			
Lead	mg/l	0.003 U	0.003 U	0.003 U	0.003			
Magnesium	mg/l	26	25	26	22			
Manganese	mg/l	0.011	0.013	0.017	0.081			0.009
Mercury	mg/l	0.0002 U	0.0002 U	0.0002 U	0.0002 U			
Molybdenum	mg/l		0.004	0.004				0.01 U
Nickel	mg/l		0.01 U	0.01 U				

Nitrate	mg/l					0.4	0.4	
Nitrate/Nitrite	mg/l	0.37	0.43					
PB210	P.I./l					5.9	1.2	
Phosphate	mg/l	0.02	0.01					
PO210	P.I./l					0.2	4 U	
RA226	P.I./l	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.1	
RA228	P.I./l	1 U	1 U	1 U	1 U			
Selenium	mg/l	0.003	0.004	0.004	0.002	0.1 U	0.4	
Silver	mg/l	0.002 U	0.002 U	0.002 U	0.002 U			
Sodium	mg/l	83	84	98	72			
Sulfate	mg/l	232.3	269.2	223.4	170.4	306	210	
TDS	mg/l	612	602	682	490	750	678	
TH230	P.I./l					0.2 U	0.7	
Uranium	P.I./l	5.4	5	4.1	8.4			
Uranium	mg/l					0.0051	0.0003 U	0.0048
Vanadium	mg/l		0.04 U	0.04 U				
Zinc	mg/l	0.03	0.03 U	0.03 U				

[1]U = undetect.

Status of the Species Within the Action Area

Colorado Squawfish

Colorado squawfish populations now only occupy historical habitats in the Upper Colorado River Basin in Colorado, New Mexico, Utah and Wyoming (USFWS 1996a). The species is most abundant in the Green River below the confluence with the Yampa River; the Yampa River from near Hayden, Colorado to the confluence of the Green River; the White River from near Taylor Draw Dam near Rangely, Colorado downstream to the confluence with the Green River; and

mainstem Colorado River from Palisade, Colorado downstream to Lake Powell (Holden and Wick 1982; Miller et al. 1982; Tyus et al. 1982; Tyus et al. 1987; Wick et al. 1985; and Archer et al. 1986). The most important rearing area in the Colorado River for young-of-the-year Colorado squawfish is between Moab, Utah and the confluence with the Green River (USFWS 1990b). In a mark-recapture study of Colorado squawfish in the Upper Colorado River (Osmundson et al. 1997), 33 percent of recaptured fish were caught in the Moab Valley area between river miles 57.3 and 64.9. The Atlas tailings pile site is perched at the top of the Moab Valley.

The Colorado River Fishes Recovery Program implemented an Interagency Standardized Monitoring Program in 1986 to monitor population trends of the Colorado squawfish and humpback chub in the Colorado River Basin. The program targeted young-of-year Colorado squawfish in the Green and Colorado Rivers, subadult and adult Colorado squawfish in the Green, Colorado, White, and Yampa Rivers, and adult humpback chub in Black Rocks and Westwater Canyon on the Colorado River. However, information on other rare or introduced species was collected when they were encountered. During subadult-adult Colorado squawfish collections near the Atlas mill tailings site, between river miles 68-49, low numbers of squawfish, between 1 and 28 fish, were consistently collected between 1986 and 1997. Both adults and subadults were collected in Moab Wash and directly below the Wash. The Atlas mill tailings site is located at river mile 64.3. Young-of-year Colorado squawfish sampling between river miles 48-84 collected anywhere from 0 to 53 squawfish at any one site.

The presence of larval squawfish aggregations and suitable spawning habitat in the Colorado River near Cataract Canyon, Professor Valley, and upstream from the Dolores River confluence indicate spawning is occurring in or near these areas (Archer et al. 1986, Valdez 1990). Larval Colorado squawfish drift downstream with the current and confirmed nursery habitat exists in the Colorado River from above Moab to the confluence with the Green River. This includes the Colorado River at and downstream of the Atlas mill tailings pile. Larval Colorado squawfish congregate in the backwater areas and near shore habitats of this reach of the river. Geomorphology and hydrology of the river results in more and better habitat for young-of-year squawfish beginning in the Moab Valley (UDWR 1998). Therefore, higher numbers of Colorado squawfish are usually found downstream of the Atlas mill tailings during standardized monitoring on the Colorado River. The standardized monitoring data has shown that the average size of larval and young-of-year Colorado squawfish collected below the Atlas site is smaller than larval and young-of-year fish collected in the Green River system. No attempt has been made to explain this difference.

Razorback Sucker

The current range of the razorback sucker in the upper Colorado River Basin is greatly reduced from its historical distribution (Holden and Stalnaker 1975; McAda and Wydoski 1980; Tyus et al. 1982). The species is widely distributed in the Green and lower Yampa Rivers, but the largest concentration is in the Upper Green River, from the mouth of the Duchesne River upstream to the mouth of the Yampa, and in the lower 4 miles of the Yampa (USFWS 1996b).

Razorback sucker are not known to currently inhabit the stretch of the Colorado River in the area of the Atlas site. No razorbacks have been collected during the standardized monitoring of the Colorado River near Moab. However, historically, they were present in the area and limited numbers may still occupy this reach of the river.

Bonytail Chub

Bonytail chub, are for the most part, considered extirpated from the upper Colorado River Basin. However, recovery efforts to restore the species to its former habitat have resulted in the stocking of 2,000 bonytail chub in the Colorado River above the Atlas mill tailings site at River Mile 86. Therefore, it is possible that bonytail chub have drifted downstream and are present in the vicinity of the Atlas mill tailings pile. However, none have been collected during standardized monitoring in the Colorado River near the Atlas mill tailings and presumably they are not present here.

Humpback Chub

There are only two major populations of humpback chub known to exist in the Upper Colorado River Basin. These are located in Black Rocks and Westwater Canyons on the Colorado River. The nearest of these to the Atlas site, at Westwater Canyon, is at River Mile 120-125. It is unlikely that any humpback chub occur near the Atlas tailings pile. None have been collected during the standardized monitoring in the Colorado River near the Atlas mill tailings.

Critical Habitat

Designated critical habitat for both Colorado squawfish and razorback sucker occurs within the entire proposed project area, which includes the Colorado River upstream, adjacent to and downstream of the Atlas mill tailings site and the 100-year floodplain of the river.

Southwestern Willow Flycatcher

The north central limit of breeding southwestern willow flycatchers is in southern Utah. Behle (1985) and Unitt (1987) believed a clinal gradation between southwestern willow flycatcher and *Empidonax traillii adastus* existed, but Browning (1993) disagreed, identifying a range boundary at approximately the 38th north parallel. Southern Utah is characterized by extreme topographic relief. In this region subspecific separation may be a function of elevation, with southwestern willow flycatcher at lower elevations (e.g., Virgin and Colorado Rivers) and *Empidonax traillii adastus* higher (e.g., Sevier River, wet meadows of mountains and high plateaus). However, surveys in the summer of 1998 have identified two nesting pairs of southwestern willow flycatchers in the Fishlake National Forest at elevations of 9,000 feet.

Records that are likely to represent southwestern willow flycatcher are from the Virgin River (Phillips 1948, Wauer and Carter 1965, Whitmore 1977), Kanab Creek and along the San Juan and Colorado Rivers (Behle et al. 1958, cited in Unitt 1987; Behle and Higgins 1959, Behle 1985; see also Browning 1993). Other reports document the subspecies being present along the Virgin, Colorado, San Juan and perhaps Paria Rivers (BLM, unpublished data). Although Behla believed the southwestern willow flycatcher was always rare in southern Utah overall (pers. comm. cited in Unitt 1987), he considered it a locally common breeding resident where habitat existed along the Colorado River and its tributaries in southeastern Utah (Behle and Higgins 1959).

Few data are available on population trends in southern Utah. However, loss and modification of habitat is likely to have reduced populations on the Virgin, Colorado, and San Juan Rivers. These losses have been due to suburban expansion and habitat changes along the Virgin River, inundation by Lake Powell along the Colorado and San Juan Rivers and encroachment of tamarisk throughout the region (Unitt 1987, BLM, unpublished data).

Collection of specific survey data along the Colorado River at Moab is just beginning. However, surveys in the summer of 1998 conducted by the Biological Resources Division, U.S. Geological Survey, identified six (6) southwestern willow flycatcher in the Scott M. Matheson Wetlands Preserve directly across the river, less than one quarter mile from the Atlas tailings pile. Nesting has not been confirmed. Additionally, Bureau of Land Management personnel have identified southwestern willow flycatcher singing in the riparian zone of the Colorado River several miles downstream of the Atlas mill tailings site. Again, no nesting was documented.

Lack of documented nesting activity does not mean nesting is not occurring. Frequently, the song of the species is heard, documenting its presence, but

the individual is not sighted and no nest is observed. The very dense vegetation that the species often nests in makes it very difficult for the surveyor to spot either bird or nest. As identified above, the home range of a nesting pair of flycatchers can range from 0.5 ha to 0.9 ha (1.23 acres to 2.96 acres). Because potential suitable habitat for the southwestern willow flycatcher exists on the Atlas property, it is reasonable to assume should flycatchers be nesting in the Preserve directly across the river from the Atlas site that they are also present on the Atlas site. If flycatchers are only migrating through the area and are not nesting, it would be reasonable to assume that since they are present across the river, they would also be present at the Atlas site. Although an approved protocol survey has not been conducted on the Atlas property, given the known use of adjacent habitat by the southwestern willow flycatcher, there is a high probability that the riparian habitat on the Atlas property is also used by the species.

EFFECTS OF THE PROPOSED ACTION

As discussed under the Environmental Baseline section, the Atlas mill tailings pile and the effects of the pile have not previously undergone section 7 consultation, and therefore, are not considered part of the baseline. In order to evaluate the effects of the proposed action through this biological opinion, the Service will consider current conditions in the river above, at, and below the Atlas tailings pile and how those conditions would change with the proposed action.

The Service has evaluated all available information in determining the effects of the proposed action including, but not limited to, information provided by the Nuclear Regulatory Commission, Atlas Corporation, Oak Ridge National Laboratories/Grand Junction, Harding Lawson Associates, Utah Department of Environmental Quality, Utah Division of Wildlife Resources, Colorado River Fishes Recovery Program, National Park Service, Environmental Protection Agency, U.S. Geological Survey, Grand Canyon Trust, Grand County Council, various other information sources, and literature searches related to the effects of various contaminants on fish. Given the amount of information that was reviewed and evaluated for its relevance to this consultation, it was impractical to include discussions of all information reviewed. Therefore, the following discussion focuses in on the most pertinent information. It should be noted that the absence of certain citations or reported information does not imply that it was not reviewed or evaluated during the consultation process, only that it was not considered pertinent to the Service's conclusions as to the effects of the proposed action.

Furthermore, the data that have been collected by the various entities and the conclusions drawn from that data are not always in agreement. In many instances, this stems from studies that were not complementary or analogous. In other cases this stems from studies conducted that required assumptions to be drawn because of a lack of information. The various parties were not always in agreement on these assumptions. And in still further cases, this resulted from attempts to conduct quick analyses and draw conclusions on information that did not lend itself to simple answers. Whenever this has occurred the Service has attempted to objectively evaluate the information provided and, as required by the Act, has taken a conservative interpretation with regards to the protection of endangered species.

Current Conditions

Characteristics of the Tailings Pile. The majority of the ore for the Atlas Mill came from the Big Indian Uranium District approximately 129 km (80 miles) to the southeast. The ore was primarily a sandstone with minor amounts of carbonate. Other ores came from small private mines in other districts. Ore was trucked to the mill and ground to a sufficiently fine consistency to allow the most efficient chemical reaction for extraction of uranium. During early operations, Atlas utilized an acid leach process for uranium milling. During this period lime was added to the mill tailings to help neutralize the tailings. In 1961 an alkaline leach process was initiated. A new acid leach circuit was installed in 1967, and both acid and alkaline circuits were operated. Only the acid leach process was used from 1982 through 1984, with no neutralization of process water because a water recycle process was in use.

After milling, the waste slurries from both circuits were combined and pumped to the tailings pile. The embankment consists of compacted coarse tailings (sands), whereas the impoundment has both fine tailings (slimes) and coarse tailings. Some unmilled ore is also present.

The exact characterization of the soil constituents of the tailings pile, has not been completed. In Atlas's comments on the Service's Draft Biological Opinion, Atlas stated it refrained from the collection of conventional soil samples to characterize the chemical constituency of the tailings pile because these samples would only represent the tailings over a small area. Atlas has instead sampled the water in the tailings pile and believes that this analysis best indicates the constituency of the tailings pile.

The tailings liquid has been analyzed at least 12 separate times by Atlas and the Nuclear Regulatory Commission. The latest samples known to the Service, were taken on June 18, 1996, and characterized the tailings liquid with high

concentrations of numerous chemicals and radionuclides (Table 6). Those of concern to aquatic wildlife include aluminum, copper, magnesium, manganese, strontium, ammonia, chloride, nitrate/nitrite (N), sulfate, total dissolved solids, gross alpha, gross beta, lead-210, radium 226, radium 228, thorium 230, uranium (P.I./l), and uranium (mg/l). The Oak Ridge National Laboratory/Grand Junction (1998a) further identified average contaminant concentrations in tailings pile wells (PW-1, PW-2, PW-6, PW-9) used in mixing calculations to be 23.5 mg/l, 22,363 mg/l, and 2,320 mg/l for uranium, sulfate, and ammonia, respectively.

Table 6. Concentrations of chemicals and radionuclides in tailings pore waters.

Constituent	Units	11/9/94	6/27/96	9/3/96
Aluminum	mg/l		0.6	
Ammonia (as N)	mg/l		2800	
Antimony	mg/l		0.5U	
Arsenic	mg/l		1.0U	0.044
Barium	mg/l		0.2U	
Beryllium	mg/l		0.4U	
Bicarbonate Alk	mg/l		2240	
Bismuth	mg/l		0.5U	
Boron	mg/l		1.0U	
Cadmium	mg/l		0.06	
Calcium	mg/l		420	
Chloride	mg/l	956	809	
Chromium	mg/l	0.1U	0.1U	0.04
Cobalt	mg/l		0.6	
Copper	mg/l		1.3	
Gross Alpha	P.I./l	15000	14700	
Gross Beta	P.I./l	5300	2190	
Iron	mg/l		1.0U	
Lead	mg/l	0.02U	0.5U	0.006
Lithium	mg/l		1.4	

Magnesium	mg/l		1380	
Manganese	mg/l		14.4	
Molybdenum	mg/l	1.96	2.6	
Nickel	mg/l	0.6	0.5	
Nitrate	mg/l	123		
Nitrate/Nitrite	mg/l		76	
PB210	P.I./l		62	
pH			7.49	
Phosphorus	mg/l		0.5	
PO210	P.I./l		42	
Potassium	mg/l		302	
Radium 226	P.I./l	35	43	
Radium 228	P.I./l	2.7	2.7	
Selenium	mg/l	0.41	1.0U	0.84
Sodium	mg/l	6270	6670	
Strontium	mg/l		13.3	
Sulfate	mg/l	30200	25200	
TDS	mg/l	38170	32000	
TH230	P.I./l		20	
Uranium	mg/l		26	
Uranium	P.I./l	26.1		
Vanadium	mg/l	1.7	1.1	
Zinc	mg/l		0.2U	0.21

U = undetect

In the studies conducted by Oak Ridge National Laboratory/Grand Junction (1998a, 1998b, 1998c), current recharge through the tailings pile resulting from precipitation and subsequent infiltration is estimated to be 3.7 gpm for the entire pile, under the current no cap condition as well as under the proposed cap. Assuming no active dewatering of the pile and given the above rate of recharge and the estimated total recharge of uranium, residual drainage from water in the pile is estimated at 3.0 gpm. However, current

drainage from the pile is estimated to be between 6.7 and 20 gpm. Based on the estimated tailings volume of 7.5×10^6 cubic yards (NRC 1977), a tailings porosity of 0.66 (Klute and Heerman 1978), and a residual moisture content of 0.57 (Klute and Heerman 1978) (percent of pore volume that will not drain under gravitational or capillary influences), there are approximately 426 million gallons of water under saturated conditions that are available for drainage from the pile. While the Oak Ridge National Laboratory/Grand Junction studies acknowledge that the pile may not be fully saturated, considering that the water from the pumping operation (the current Groundwater Corrective Action) has been discharged to the top of the pile and that most of the time there is standing water on top of the pile, the Oak Ridge National Laboratory/Grand Junction studies identified that it appears likely the moisture content of the pile is high.

Ground Water Quality. Ground water quality at the Atlas site is regulated by both the Nuclear Regulatory Commission and Utah Department of Environmental Quality. The Nuclear Regulatory Commission has sole regulatory responsibility for radium 226 and 228, gross alpha, and uranium in the ground water. The Nuclear Regulatory Commission and the State of Utah have concurrent regulatory jurisdiction for lead, molybdenum, selenium, and vanadium. For the remaining constituents discussed in the following sections, the State of Utah has sole regulatory jurisdiction. The Nuclear Regulatory Commission has stated it will require Atlas to meet the applicable Federal standards for those elements under its jurisdiction prior to releasing Atlas from its site specific license. The State of Utah has informed Atlas of the need to develop and complete a groundwater corrective action plan to bring the site into compliance with State standards. However, at the present time, current conditions in both ground water and surface water continue to exceed Nuclear Regulatory Commission and State of Utah standards.

As both the Nuclear Regulatory Commission and the State of Utah have regulatory jurisdiction, numerous water quality analyses have been performed and have identified the Atlas tailings pile as the source of groundwater contamination which is resulting in contaminant discharge to the Colorado River (Oak Ridge National Laboratory/Grand Junction 1998a, Utah Department of Environmental Quality sampling; Atlas sampling). An intensive effort to, in part, characterize the extent of the contaminated groundwater plume from the Atlas tailings pile was conducted by Oak Ridge National Laboratory, Grand Junction, Colorado, during November and December, 1997 (Oak Ridge National Laboratory, Grand Junction 1998a). The contaminant plume of eight constituents (alkalinity, ammonia, chloride, molybdenum, nitrate, selenium, sulfate, and uranium) was tracked using piezometers and existing wells (see Oak Ridge National Laboratory/Grand Junction 1998a, pages 32-43 for plume

delineation maps). The results of this effort identify that all analytes except chloride have been influenced by the tailings pile and exhibit higher than expected concentrations (Table 7).

Table 7. Contaminant groundwater plume concentrations (ug/l) as reported from piezometers installed by ORNL/GJ (1998a). Sites are sequentially numbered from upstream locations to the furthest location downstream of the Atlas tailings pile.

Site ID	Ammonia	Molybdenum	Nitrate	Selenium	Sulfate	Uranium
TP-1	7.7	26.2	12100	9.6	2660,000	380
TP-2		250	8290	3.6		26000
TP-3/duplicate		598/595	826000/809000	18.9/19.2		16100/16800
TP-4		2060	534000	19.9		3330
TP-5		778	262000	24.8		1450
TP-6		334	547000	2.9		5640
TP-7		355	78.7	1.0U		2700
TP-8		977	39500	1.0U		2590
TP-9	1850,000	1230	715000	95.3	15400,000	6700
TP-10		1290	440000	38.4		2480
TP-11		23.8	63.5	1.0U		1.0
TP-12	322000	1420	315000	12.5	4710,000	1460
TP-13		1100	226000	8.3		2530
TP-14/duplicate		386/381	344000/335000	3.8/3.8		4980/4710
TP-15		491	168000	1.0U		4300
TP-16		198	80.6	1.0U		213
TP-17		8.1	14.0U	1.0U		9.5
TP-18		5.8	14.0U	1.0U		11.5
TP-19		5.0U	14.0U	1.0U		5.0U
TP-20		5.0U	14.0U	1.0U		5.0U
TP-21		7.7	14.0U	1.0U		10.3

U=undetect

The Oak Ridge National Laboratory studies concluded that the distribution of uranium in the groundwater suggests the presence of a second source of contamination, other than the tailings pile. The location suggests the source could be a former "catch pit", a site that reportedly received effluent from the mill operations. This site is leaching high concentrations of uranium into the Colorado River. The synergistic effects of the uranium and/or the gross alpha levels in the river from this site may be adversely affecting listed fishes. The Nuclear Regulatory Commission did not specifically identify cleanup of this source of uranium as part of their proposed action. However, the Final Technical Evaluation Report (NRC 1997) prepared by the Nuclear Regulatory Commission expresses the Nuclear Regulatory Commissions belief that additional sites on the Atlas property, other than the tailings pile, were leaching contaminants. In particular, the Report cites a former ore storage pad as a source of leachate.

Nuclear Regulatory Commission regulations at 10 CFR, part 40, Appendix A (5F) require that "where groundwater impacts are occurring at an existing site due to seepage, actions must be taken to alleviate conditions that lead to excessive seepage impacts and restore groundwater quality". Therefore, as part of the proposed action, Atlas Corporation will be required to clean up this source of uranium as well as any other leachate source on the surface as well as in the groundwater.

The Utah Division of Water Quality has informed the Nuclear Regulatory Commission (letter dated November 8, 1996) that the tailings contaminated groundwater, at what Department of Environmental Quality terms the Atlas Seep (a small hole at Moab Wash is dug to the water table surface, groundwater flows into the hole and is then sampled), continues to exceed State groundwater quality standards for at least five parameters including ammonia (as N), manganese (dissolved), molybdenum (dissolved), nitrite and nitrate (as N), and vanadium (dissolved), and for three radionuclides; gross alpha, radium-226 and radium-228, and total uranium (Table 8.). The radionuclides were found to be 60, 1.88, and 31.34 times over the State ground water quality standards, respectively.

Table 8. Average concentrations of inorganic and radionuclide parameters exceeding Utah State Water Quality Standards (GWQS), EPA Drinking Water Maximum Contaminant Levels, Lifetime Health Advisories, Secondary Maximum Contaminant Levels, or Utah Derived Drinking Water Standards based on EPA Reference Dose Values, at the Atlas Seep for five sampling events over a seven month period, September 21, 1995 to April 11, 1996 (taken from letter to NRC dated November 8, 1996 from DEQ).

Parameter	Units	Utah State GWQS, Derived Standard, or EPA Standard	Average Concentration	Standard Deviation
Ammonia (N)	mg/l	30	185.3	127.9
Chloride	mg/l	250	711.9	96.1
Manganese (Dissolved)	µg/l	40	2714.0	758.6
Molybdenum (Dissolved)	µg/l	40	1375.0	202.1
Dissolved NO2 & NO3 (N)	mg/l	10	29.4	NA[1]
Vanadium (Dissolved)	µg/l	60	198.5	94.6
NO2 & NO3 (N)	mg/l	10	120.8	20.9
Sulfate	mg/l	250	4542.3	564.2
Antimony (Total)	µg/l	6	646.8	1115.0
Arsenic (Total)	µg/l	50	170	NA
Beryllium (Total)	µg/l	4	7	8
Cadmium (Total)	µg/l	5	14	NA
Chromium (Total)	µg/l	100	700	NA
Iron (Total)	mg/l	300	379	NA
Lead (Total)	µg/l	15	305	NA
Manganese (Total)	µg/l	40	16,000	NA
Molybdenum (Total)	µg/l	40	1185	290
Nickel (Total)	µg/l	100	267.5	364
Vanadium (Total)	µg/l	60	592	718.4
Gross Alpha	P.I./l	15	444	####
Radium 226 & Radium 228	P.I./l	5	9.4	4.6
Uranium (Total)	P.I./l	30	940.3	156.5

[1]NA = only 1 data point was collected.

Surface Water Quality. Surface water quality in the Colorado River has been monitored upstream, at, and downstream of the Atlas tailings pile by the Utah Division of Water Quality and others for approximately the last 10 years. Some of the upstream data is included in tables 4 and 5 above as background information. However, intensive surface water quality monitoring has twice been conducted by Utah Department of Environmental Quality, and once by Atlas Corporation, to evaluate the effects of the tailings leachate on surface water quality. Ammonia was selected for intensive study due to its confirmed occurrence as a tailings contaminant, known toxicity for aquatic species, existence of established State water quality standards, and ease of laboratory analyses. A second intensive study expanded the list of tailings contaminants known to be affecting surface water quality.

The results of the intensive ammonia sampling have identified that 13 constituents increase at and below the Atlas tailings pile. All of these have previously been identified as known tailings contaminants (Department of Environmental Quality letter to the Nuclear Regulatory Commission dated June 20, 1997). These include ammonia (as N), aluminum, iron, magnesium, manganese, molybdenum, nitrite and nitrate (as N), sulfate, total dissolved solids, total Kjeldahl nitrogen, gross alpha, gross beta, and total uranium (Table 9). While numerous additional analyses have been performed on surface water quality near the Atlas site (this data is summarized in a report by Harding-Lawson Associates dated October 17, 1996), those shown below are the most recent intensive sampling data and are, therefore, highlighted here to enumerate current conditions in the river.

The zone of influence of the mobile tailings contaminants suggests that the interval wherein State water quality numeric criteria are exceeded in the Colorado River is contaminant specific. In the case of gross alpha, this zone may extend more than 1 mile below the Atlas Seep. For ammonia, the State water quality standards are exceeded as far as 1.5 miles below the Atlas tailings pile. The mixing zone for some of these contaminants has been characterized by HLA (1998) to extend over 5000 feet of riverbank and 40 feet into the channel.

Table 9. Surface water concentrations of inorganic and radionuclide parameters in the Colorado River upstream, adjacent to and downstream of the Atlas mill site (sites 191 through A-9, respectively) as sampled by Utah DEQ during two intensive sampling events, January 7, 1997 and September 5, 1996. Only Ammonia concentrations are reported for September 5, 1996. (191= 191 bridge crossing; A-1=200 yards above mill tailings; A-2=200 yards above mill tailings; A-3=100 yards below mill tailings; A-4=below mill tailings; A-5=below mill tailings; A-6=below mill tailings; A-7=below mill tailings; A-8=below mill tailings; A-9=below mill tailings).

Constituent	Units	191	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9
Aluminum	ug/l	230	1900	2670	2200	2200	1500	2300	2300	2400	2300
Ammonia (as N) 1-7-97/9-5-96	mg/l	0.095	0.113 <0.05	0.145 <0.05	1.4 10.8	15.8 7.22	3.33 3.52	1.84 0.63	1.05 0.44	0.92 0.327	0.82 0.13
Barium	ug/l	79	150.0	140.0	140.0	130.0	140.0	150.0	150.0	160.0	150.0
Calcium	mg/l	73	72.2	73.1	73.5	84	75.5	75.7	74.1	74.2	76.4
Chloride	mg/l	97	97	96	97	162.5	113	106	108	108	109
Gross Alpha	P.I./l	22.6	84	29	27	79.5	32.2	32.4	29.5	33.3	30.0
Gross Beta	P.I./l	10.7	42.2	16	22	68	38.5	16	19.4	20.0	19.9
Iron	ug/l	319	3320	3320	3850	3840	3900	3850	3820	4190	4000
Lead	ug/l	<3.0	7.9	7.5	8.1	7.5	8.0	9.2	9.4	11.0	9.6
Magnesium	mg/l	24.5	24.4	24.4	26	42.2	29.5	27.4	25.8	25.4	26.2
Manganese	ug/l	22.0	170.0	170.0	170.0	230.0	200.0	200.0	210.0	260.0	220.0
Molybdenum	ug/l	7.2	3.8	2.4	3.8	11.4	4.8	3.0	2.8	3.2	2.4
Nickel	ug/l	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	28.0	<10.0

Nitrite/Nitrate (as N)	mg/l	0.54	0.64	0.64	0.92	2.34	0.95	0.73	0.67	0.64	0.65
L-pH		7.62	8.25	8.27	8.22	7.74	7.85	7.97	8.18	8.13	8.15
Phosphorus (Total)	mg/l	0.36	0.33	0.32	0.41	0.43	0.40	0.24	0.41	0.43	0.48
Potassium	mg/l	4.11	3.93	3.87	4.28	7.72	5.05	4.65	4.44	4.34	4.47
Radium 226	P.I. /l	1.9	1.6	2.1	0.9	0.5	1.1	1.6	0.9	1.6	1.2
Radium 228	P.I. /l	<1.0	<1.0	<1.0	<1.0	<1.0	2.8	<1.0	1.0	1.0	<1.0
Selenium	ug/l	3.9	4.3	4.1	4.0	4.1	4.0	4.0	4.1	4.0	4.0
Sulfate	mg/l	204.8	228.4	210.7	244.1	420.9	259.8	246.7	229.4	241.3	223.8
TDS@180C	mg/l	628	636	626	662	1006	728	692	676	680	668
TKN	mg/l	1.443	1.083	1.238	2.608	18.038	4.938	2.873	2.276	2.238	2.348
Uranium (Total)	P.I. /l	2.9	37.6	11.3	11.7	51.1	22.5	16.9	7.8	11.5	5.4

While the Oak Ridge National Laboratory/Grand Junction study (1998a), discussed above under Ground Water Quality, did not calculate the effects of contaminant discharge on river water quality, it did calculate an estimated mass flux of four analytes currently discharging to the Colorado River based on estimated aquifer thickness and average groundwater concentrations.

Analyte	Estimated Mass Flux (grams/day)
Uranium	283
Molybdenum	290
Ammonia	150,000
Sulfate	11,000,000

Additional surface water collections were made by Atlas and Harding-Lawson Associates on December 4 and 5, 1997. The results of this sampling effort are identified below in Table 10.

Table 10. Surface water sampling of the Colorado River at the Atlas site conducted on December 4 and 5, 1997 by Atlas and Harding-Lawson Associates (HLA 1998). (NS=nearshore, A=10 feet from shore, B=25 feet from shore, C=50 feet from shore). Concentrations in mg/l.

SITE	AMMONIA[1]				MOLYBDENUM				URANIUM			
	NS	A	B	C	NS	A	B	C	NS	A	B	C
HWY191	0.3U				0.0034				0.0043			
1A[2]	0.08	0.09	0.3U	0.3U	0.0035	0.0032	0.0033	0.0035	0.0268	0.0164	0.0118	0.0056
1A[3]		0.05	0.06	0.3U		0.0034	0.0033	0.0035		0.016	0.009	0.0099
2A[2]	0.11				0.0055				0.0296			
3A[2]	2.4*	1.22 *	0.38 *	0.13	0.0066	0.0058	0.004	0.0034	0.0263	0.0203	0.0126	0.0063
3A[3]		1.28 *	0.32	0.16		0.0052	0.0038	0.0035		0.019	0.0108	0.0072
4A[2]	0.43 *	0.43 *	0.32	0.21	0.0039	0.0039	0.004	0.0035	0.0101	0.0101	0.0092	0.0073
4A[4]		0.39 *	0.36 *	0.24		0.004	0.0039	0.0035		0.0104	0.0096	0.0073
4A[3]		0.4*	0.39 *	0.26		0.0039	0.0037	0.0035		0.0101	0.0093	0.0078
5A[2]	0.25				0.0035				0.0073			
6A[2]	0.22				0.0034				0.0071			
7A[2]	0.25	0.24	0.23	0.19	0.0034	0.0035	0.0035	0.0035	0.0071	0.0072	0.0071	0.0064
7A[3]		0.23	0.22	0.17		0.0035	0.0039	0.0035		0.0071	0.0072	0.0069

8A[2]	0.19				0.0032				0.0064			
9A[2]	0.17				0.0033				0.006			

[1]Given the pH and temperature data collected at the time of sample collection in the river, the ammonia standard was calculated to be 0.33 mg/l..
* Samples in exceedance of calculated ammonia standard.
[2]Samples collected from just below the surface.
[3]Samples collected 1 foot from the bottom of the river.
[4]Samples collected at an intermediate distance from the surface and the bottom of the river.

It should be noted that the ammonia standard calculated by Harding-Lawson Associates as 0.33 mg/l in the above information was based on an average of the pH values both upstream and downstream of the tailings pile. As pH values increase, the concentration of unionized ammonia (the most toxic form) increases while that of the ammonia ion decreases. The data collected by Harding-Lawson Associates (1998) shows that the pH at sites A3 and A4 right at and downstream of the tailings pile, increases from 8.5 to 8.72, increasing the toxicity of the ammonia in the river by approximately 42 percent (Roy Irwin, National Park Service, pers. comm.) and decreasing the standard at these sites. Therefore, more sites than identified in Table 10 above would be in exceedance of State ammonia standards.

River Sediment

Several attempts have been made to characterize the river sediment contamination in the vicinity of the Atlas tailings pile. The Fish and Wildlife Service has sampled the sediment in two separate sampling events conducted in April 1995 and September 1996. Atlas Corporation also sampled the river sediments in May 1995. The Service has previously stated in two separate letters to the Nuclear Regulatory Commission dated July 22, 1996, and January 14, 1997, that because of data concerns (standard operating procedures and recommended protocols were not followed, compromising the validity of the laboratory results; due to analytical cost concerns, sediment samples that were to be in replicate, were later analyzed as a composite, compromising statistical validity; the lack of consistency in collection and performance of tissue, sediment, and radionuclide samples invalidates any comparison of data sets), as well as the inconsistency in data results, available information concerning the extent of sediment contamination is inconclusive. However, all available data have been included in Table 9 below for comparison purposes. The results of the three sampling events are not consistent and show varying degrees of contaminant deposition in the sediment (Table 11).

Table 11. Mean of sediment contamination concentrations upstream of the Atlas mill tailings site and downstream of the tailings site combining data

collected during three separate sampling events (All inorganic units in $\mu g/g$, radiological units in P.I./g).

Parameter	USFWS Data, 4/94 Mean Std. Dev. Up/Down[1] Up/Down	Atlas Data, 5/95 Mean Std. Dev. Up/Down Up/Down	USFWS Data, 9/96 Mean Std. Dev. Up/Down Up/Down	All Data Combined Mean Std. Dev. Up/Down Up/Down
Aluminum	4734/2988 528/1610	5407/6315 743/999	4211/3514 0/727	4856/3874 744/1837
Arsenic	3.46/2.43 0.38/1.42	4.0/5.0 0/2.16	2.76/2.39 0/0.43	3.57/2.99 0.49/1.74
Boron	*/23.21 */32.84	0/0 0/0	17.75/18.63 0/8.54	*/19.94 */15.27
Barium	107.5/68.7 11.13/30.71	187.3/207 2.52/26.8	215.4/100.1 0/36.5	153.5/108.1 52.9/63.5
Beryllium	*/* */*	0.27/0.33 0.06/0.06	0.35/0.24 0/0.06	0.30/0.26 0.07/0.12
Cadmium	0.64/0.39 0.16/0.21	0.30/0.50 0.17/0.17	2.65/0.89 0/0.39	0.79/0.52 0.85/0.36
Chromium	5.50/4.07 0.92/1.87	6.60/7.13 0.95/1.37	17.22/2.89 0/2.93	7.67/4.42 4.30/2.54
Copper	11.66/8.21 2.42/3.94	12.57/14.55 1.46/3.24	10.61/7.86 0/1.69	11.66/9.52 1.65/4.19
Iron	11559/7353 1430/3595	9830/10940 1032/2424	35532/9542 0/4806	14285/8758 9451/3860
Mercury	*/* */*	*/* */*	*/* */*	*/* */*
Magnesium	7698/7299 963/5116	7983/8413 625/1511	5604/4820 0/1362	7251/6858 1191/3879
Manganese	319.9/219.4 8.3/93.4	343/379 31.2/72.6	255/237 0/27.2	305/260 55.5/97.8
Molybdenum	*/* */*	*/* */*	*/* */*	*/* */*
Nickel	7.57/5.91 3.10/2.96	9.67/11.75 0.58/3.10	5.80/3.46 0/1.56	8.21/6.53 2.36/3.97
Lead	9.62/6.22 1.01/3.41	14.0/17.8 3.61/4.72	11.48/7.59 0/2.94	11.66/9.16 3.15/5.84
Selenium	*/* */*	0.53/0.58 0.12/0.25	*/* */*	*/* */*
Strontium	99.5/117.7 7.7/69.3	114.0/120.3 7.0/21.5	58.8/58.5 0/9.1	97.6/101.9 21.2/56.0

Vanadium	13.73/9.70 1.94/4.84	15.83/17.33 1.46/3.39	60.02/15.72 0/8.55	21.35/13.07 17.12/6.53
Zinc	48.8/31.9 6.9/18.7	70.0/80.0 12.5/17.0	49.3/35.6 0/10.6	56.2/43.4 15.6/25.7
Gross Alpha	--/-- --/--	14.66/17.40 3.06/2.03	7.10/4.90 0/0.58	12.78/10.46 4.53/6.72
Gross Beta	--/-- --/--	25.0/25.25 1.73/2.22	3.90/3.78 0/0.23	19.7/13.3 10.6/11.4
Thorium 228	--/-- --/--	--/-- --/--	0.15/0.10 0/0.02	0.15/0.10 0/0.02
Thorium 230	1.52/1.41 0.21/0.77	2.87/1.70 2.89/0.46	0.15/0.15 0/0.14	1.90/1.12 1.96/0.85
Thorium 232	0.71/0.78 0.08/0.40	--/-- --/--	0.14/0.09 0/0.02	0.57/0.54 0.29/0.47
Uranium 234	1.88/7.10 0.30/16.41	0.53/0.85 0.31/0.30	0.10/0.16 0/0.17	1.05/3.79 0.83/11.77
Uranium 235	0.13/0.39 0.05/0.82	0/0 0/0	0.01/0.02 0/0.02	0.10/0.20 0.07/0.60
Uranium 238	1.93/7.44 0.23/16.74	0.80/0.80 0.35/0.39	0.11/0.17 0/0.19	1.18/3.95 0.77/12.04
Total Uranium	3.91/14.91 0.59/33.98	1.33/1.65 0.64/0.55	0.22/0.35 0/0.37	2.28/7.92 1.66/24.40

[1]Up = upstream of the Atlas tailings pile in the Colorado River. Down = at the Atlas seep and downstream of the Atlas tailings pile on the Colorado River. * = less than the detection limit. -- = no value reported.

Fish Tissue

Several attempts have been made to characterize the contaminants in fish tissue in the vicinity of the Atlas tailings pile to determine if contaminant uptake in fish is occurring. The Fish and Wildlife Service has sampled fish tissue in three separate sampling events, conducted in April 1995, August 1996, and September 1996. Atlas Corporation also sampled the river fishery in May 1995. The Service has previously stated in two separate letters to the Nuclear Regulatory Commission dated July 22, 1996, and January 14, 1997, that because of data concerns with the samples collected by Atlas Corporation (standard operating procedures and recommended protocols were not followed, compromising the validity of the laboratory results; due to analytical cost concerns, sediment samples that were to be in replicate, were later analyzed as a composite, compromising statistical validity; the lack of consistency in collection and performance of tissue, sediment, and radionuclide samples invalidates any comparison of data sets), as well as the inconsistency in data

results, available information collected by Atlas concerning possible uptake of contaminants by the endangered Colorado River fish is suspect. However, the data collected by the Service has shown higher levels of contaminants in fish downstream of the tailings pile as opposed to those collected upstream of the pile.

Table 12. Mean concentrations in fish tissue of various contaminants upstream and downstream of the Atlas mill tailings site collected during four separate sampling events (All inorganic units in μg/g, radiological units in P.I./g).

Parameter	USFWS Data, 4/95		Atlas Data, 5/95		USFWS Data, 9/96		USFWS Data, 8/96		All Data Combined	
	Mean Up/Down[1]	Std. Dev. Up/Down	Mean Up/Down	Std. Dev. Up/Down	Mean Up/Down	Std. Dev. Up/Down	Mean Up/Down	Std. Dev. Up/Down	Mean Up/Down	Std. Dev. Up/Down
Aluminum	--/1835	--/840	113/242	43/178	3056/3193	0/1658	362/332	270/191	557/1630[2]	909/1477
Arsenic	--/0.53	--/0.25	0.40/0.70	0/0.14	0.63/1.44	0/0.97	0.23/*	0.07/*	0.26/0.80[2]	0.25/0.80
Beryllium	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*
Boron	--/10.49	--/4.84	*/*	*/*	4.54/4.38	0/2.28	1.99/*	0.85/*	1.56/5.68	1.65/5.49
Barium	--/22.72	--/5.98	11.33/16/75	3.06/7.41	25.4/31.3	0/10.19	10.05/12.2	1.6/1.35	11.0/22.1[2]	5.12/9.37
Cadmium	--/0.26	--/0.18	*/*	*/*	*/0.21	*/0.20	0.92/0.74	0.62/0.09	0.62/0.22	0.67/0.27
Chromium	--/14.27	--/15.04	0.80/1.08	0.14/0.11	3.53/3.59	0/1.17	6.43/7.51	0.72/0.27	4.37/7.89	2.85/10.78
Copper	--/6.18	--/2.08	1.97/2.80	1.19/1.35	3.51/3.69	0/0.97	4.07/4.72	1.40/0.32	3.38/4.66	1.54/2.01
Iron	--/826	--/502	270/421	98/229	2041/2357	0/1146	267/288	128/77.8	445/1047	570/1012
Mercury	--/*	--/*	*/*	*/*	*/*	*/*	0.24/0.20	0.05/0.1	*/*	*/*
Magnesium	--/2013	--/382	828/1126	319/464	2738/3014	0/987	1276/1292	211/28	1288/1977[2]	593/896

Manganese	--/45.8	--/17.0	14.4/22.9	3.5/10.5	62.6/110.4	0/53.6	18.8/27.2	5.6/3.4	21.9/54.6	15.1/43.8
Molybdenum	--/*	--/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*
Nickel	--/5.15	--/5.27	0/0	0/0	3.12/2.29	0/0.52	0.67/0.94	0.19/0.18	0.71/2.77	0.91/3.86
Lead	--/0.94	--/0.31	0.27/0.55	0.06/0.29	1.07/1.38	0/0.66	1.25/1.50	0.30/0.29	0.93/1.06	0.52/0.53
Selenium	--/3.18	--/1.53	6.60/16.33	3.08/17.2	5.46/4.01	0/1.03	2.32/2.83	0.82/0.39	3.92/5.96	2.62/8.74
Strontium	--/121.2	--/30.4	76.5/108.5	35.7/45.0	130.7/134.0	0/28.0	120.5/96.1	46.2/20.7	108/118	44.3/32.2
Vanadium	--/4.08	--/1.42	0.75/1.23	0.21/0.67	3.43/4.13	0/2.56	1.74/2.28	0.56/0.47	1.54/3.19	1.00/2.01
Zinc	--/198.7	--/91.8	129.3/157.3	59.3/56.3	183.1/170.0	0/33.0	203/168	42.4/14.6	179/179	54.6/64.4
Gross Alpha	--/--	--/--	0.67/1.75	0.12/1.03	0.82/3.41	0/6.09	--/--	--/--	0.70/2.67	0.12/4.44
Gross Beta	--/--	--/--	2.67/4.95	0.06/4.04	1.21/10.41	0/11.01	--/--	--/--	2.30/7.98	0.73/8.66
Thorium 228	--/--	--/--	--/--	--/--	0.02/0.23	0/0.44	--/--	--/--	NA/0.23	NA/0.33
Thorium 230	--/0.07	--/0.12	0.10/0.37	0.10/0.15	0.02/0.42	0/0.85	--/--	--/--	0.08/0.29	0.09/0.53
Thorium 232	--/0.04	--/0.05	--/--	--/--	0.02/0.22	0/0.44	--/--	--/--	0.02/0.15	0/0.33
Uranium 234	--/0.08	--/0.11	0/0.03	0/0.05	0.02/0.37	0/0.73	--/--	--/--	0.01/0.16	0.01/0.41
Uranium 235	*/*	*/*	0.0/0.0	*/0.0	0/0.02	0/0.03	--/--	--/--	0/0.01	0/0.02

Uranium 238	--/0.06	--/0.09	0.0/0.0	0.0/0.0	0.01/0.39	0/0.81	--/--	--/--	0/0.16	0.01/0.47
Total Uranium	--/0.15	--/0.20	0.03/0.03	0.02/0.05	0.03/0.77	0/1.57	--/--	--/--	0.03/0.30	0.02/0.86

[1]Up = Upstream of the Atlas tailings pile on the Colorado River. Down = Adjacent to and downstream of the Atlas tailings pile on the Colorado River.

[2]Using all samples combined the mean of the upstream samples was found to be statistically different from the mean of the downstream samples using a one-way analysis of variance test with a probability of 0.05.

* = less than the detection limit. -- = no value reported.

The results of the four sampling events are not consistent and show varying degrees of contaminant uptake in fish tissue (Table 12). However, as can be seen in the combined data column in Table 12 above, almost all of the constituents have been found in higher concentrations in fish tissue downstream of the Atlas tailings pile, including aluminum, arsenic, boron, barium, cadmium, chromium, copper, iron, magnesium, manganese, nickel, lead, selenium, strontium, vanadium, gross alpha, gross beta, thorium 228, thorium 230, thorium 232, uranium 234, uranium 235, uranium 238, and total uranium. Of these results, aluminum, arsenic, barium, magnesium, manganese, and vanadium show statistically lower concentrations in the fish collected upstream of the Atlas tailings pile compared to those collected downstream.

Effects of Capping the Tailings Pile

The Service has determined that the leaching of contaminants from the Atlas tailings pile as well as other contaminated sites on the property may be affecting the endangered fish. Therefore, the following discussion of the effects of capping the tailings pile centers around the issue of the continued leaching of contaminants from the pile as well as other sources. As discussed under the heading "Scope of the Biological Opinion" earlier in this document, a revised Groundwater Corrective Action Plan has not yet been proposed by Atlas Corporation though the Nuclear Regulatory Commission has agreed that a revised plan is necessary. Therefore, the Service, in discussing the long-term contaminant leaching from the pile and other sources, evaluates effects of the proposed capping and current groundwater corrective action plan only.

Leaching of Tailings Pile Constituents into the Colorado River

The action as proposed by the Nuclear Regulatory Commission includes the capping of the tailings pile and relocation of Moab Wash. While the Nuclear Regulatory Commission and Utah Department of Environmental Quality have identified that both agencies will require Atlas to cleanup contaminated ground and surface water to applicable standards, specific plans to achieve this cleanup are not in place. Furthermore, the regulations of the two agencies do not complement one another. For example, the Nuclear Regulatory Commission currently does not regulate or track ammonia concentrations in the river. Therefore, when the Nuclear Regulatory Commission requires Atlas to comply with water quality standards, this does not include ammonia, the major constituent impacting endangered fish.

Utah Department of Environmental Quality does regulate ammonia concentrations in surface water. However, the Service has been informed by both the Nuclear

Regulatory Commission and Utah Department of Environmental Quality that alternate concentration limits may be applied to the Atlas site, meaning that the ammonia standard applied to the site could be relaxed and ammonia concentrations allowed in surface water at levels above the current standard, levels that may be high enough to adversely affect endangered fish.

The Nuclear Regulatory Commission identified in its supplemental biological assessment that contaminants from the Atlas tailings pile are seeping out of the pile and that these contaminants are degrading the quality of the groundwater that discharges into the Colorado River. This is repeatedly demonstrated by the concentrations of contaminants in the river, as identified earlier in the Current Conditions section of this document. The leaching of these contaminants into the river may result in an adverse modification of critical habitat for the listed Colorado River fishes, since, by definition, critical habitat includes both quantity and quality considerations.

The Nuclear Regulatory Commission has further identified that there is considerable uncertainty regarding the seepage rate, ground water flow rates, and contaminant concentrations dissolved in seepage and ground water. Given these uncertainties, the degree of impacts to endangered species and critical habitat from past, current, and future operations at the Atlas mill, are also uncertain. This major uncertainty and disagreement as to future potential impacts to endangered fish with the proposed action was the basis for initiating a series of studies, conducted by Oak Ridge National Laboratories, Grand Junction, Colorado. These studies were initiated after the Service issued its Draft Biological Opinion, dated June, 1997, and are discussed below.

Oak Ridge National Laboratory/Grand Junction (ORNL/GJ) Studies. The Nuclear Regulatory Commission identified in their biological assessment that the impacts of implementing the proposed reclamation plan on aquatic biota in the Colorado River would be a gradual reduction of diluted tailings leachate over time because dewatering operations at the pile will have reduced saturation and hydraulic head, and the cover would retard the movement of water through the tailings pile even further. However, leaching of contaminants would continue for an undetermined amount of time. Further, the Nuclear Regulatory Commission maintained that the impacts to endangered fish from the proposed action were minimal and would not result in jeopardy to the endangered fish. The Service disagreed with this determination when it issued the Draft Biological Opinion on the proposal to cap the pile in place.

To resolve conflicting opinions and accurately assess the degree of impacts to endangered fish, the Council on Environmental Quality facilitated studies in

November and December, 1997, to be conducted by the Oak Ridge National Laboratory/Grand Junction. Atlas Corporation and the Nuclear Regulatory Commission agreed to postpone finalizing the Service's biological opinion until after these studies were completed. The objectives of the studies were to refine information regarding the extent of groundwater contamination leaching from the Atlas mill tailings pile currently and in the future with the proposed action. This would allow a more accurate assessment of potential future impacts to endangered species from the proposed action. Five tasks were agreed to at a meeting between the Nuclear Regulatory Commission, Atlas Corporation, Harding Lawson Associates, and the Service. Several of these tasks were modified during the study period. The results of these studies relating to future impacts to the endangered species are summarized below (ORNL/GJ 1998a; ORNL/GJ 1998b).

Task A. Install two boreholes through the pile to determine the connection between the tailings and the underlying water table. The purpose of the task was to confirm or deny the presence of tailings slimes within the alluvial deposits under the tailings pile. The Service's concern was that if the tailings were left in place there would be a continual rewetting of the tailings pile, drawing contaminated leachate into the Colorado River indefinitely. The study concluded that, except for the possibility of very high river levels, the tailings are not within the alluvial aquifer. Therefore, continual rewetting of the pile would not occur as a result of the proposed action. However, it has been concluded that spring runoff exceeding 45,000 cfs in the river will inundate the base of the tailings pile. For example, the 1993 runoff of 49,000 cfs left the tailings standing in 7 feet of river water. According to the U.S. Geological Survey, which has a measuring gage nearby at Cisco, this level of flood has occurred in 26 different years since record keeping began in 1916 (Heddon, 1998). While the pile continues to drain, the strong head forcing pore water out of the pile would preclude much seepage of river water into the pile. However, once the pile has drained, these high river flows may seep into the pile, pick up contaminants and leach them out to the river in perpetuity.

Tasks B and C. Delineate the lateral extent of groundwater contamination emanating from the tailings pile and evaluate groundwater quality where it discharges to the Colorado River.. Using the available data, a calculation of the flux of selected contaminants (ammonia, uranium, sulfate and molybdenum) from the groundwater to the river was prepared. The purpose of these tasks was to delineate the extent of the contaminant plume to determine the length of river affected by leaching from the pile and to estimate total contaminant discharge rates into the river now and with the proposed action. A total of 21 piezometers and 4 observation wells, for hydraulic testing purposes, were

installed between the tailings pile and the Colorado River, both upstream and downstream of the pile. The results are extensive but several of the significant results include:

(1) The distribution of uranium and nitrate suggests the presence of a second source of contamination, other than the tailings pile. The location suggests the source could be a former "catch pit", a site that reportedly received effluent from the mill operations.

(2) The groundwater contamination plume extends beyond the Atlas property to the south and discharges to the Colorado River along 5,000 feet of riverbank, extending 40 feet into the river. The plume for some contaminants (ammonia, uranium, molybdenum and nitrates) is mature and these constituents have been discharging to the river for many years. For less mobile contaminants like selenium, the plumes are just now beginning to reach the Colorado River. The future effects of these less mobile contaminants have not been analyzed. However, for the purposes of this opinion, because the proposed action would allow continued leaching, the future effects that potentially higher concentrations of these constituents may have on endangered fish are considered.

(3) Current recharge through the tailings pile resulting from precipitation and subsequent infiltration is estimated to be 3.7 gpm for the entire pile, under the current no cap condition as well as under the proposed cap. Given the above rate of recharge and the estimated total recharge of uranium, residual drainage from water in the pile is estimated at 3.0 gpm. However, current drainage from the pile is estimated to be between 6.7 and 20 gpm. Based on the estimated tailings volume of 7.5×10^6 cubic yards (NRC 1997), a tailings porosity of 0.66 (Klute and Heerman 1978), and a residual moisture content of 0.57 (Klute and Heerman 1978) (percent of pore volume that will not drain under gravitational or capillary influences), there are approximately 426 million gallons of water under saturated conditions that are available for drainage from the pile. While the Oak Ridge National Laboratory/Grand Junction study (1998a) acknowledges that the pile may not be fully saturated, considering that the water from the pumping operation (the current Groundwater Corrective Action) has been discharged to the top of the pile and that there is usually standing water on top of the pile, the Oak Ridge National Laboratory/Grand Junction studies identified that it appears likely the moisture content of the pile is high. Using the volume of drainable water divided by the drainage rate of 3.0 gpm in a linear calculation, 270 years would be required to passively drain the pile. Furthermore, because the 3.0 gpm

drainage rate represents a maximum, this 270 year time estimate is a minimum value. Under actual conditions, the drainage rate would decrease exponentially, yielding a significantly higher time estimate for the drainage of the pile (ORNL/GJ, 1998a). If the proposed cap does not reduce infiltration rates, it would have no effect on the rate of leaching from the pile and, therefore, would not eliminate the adverse impacts to the endangered Colorado squawfish and razorback sucker resulting from the leaching of contaminated tailings water. These adverse impacts would continue for decades unless an effective groundwater corrective action plan is implemented.

Task D. Install a new reference well. The purpose of this task was to address concerns about the adequacy of wells being used to assess background conditions at the pile as well as concerns that contamination might have migrated to National Park Service property north of the pile. The task concluded that the reference well is sampling background and that the contamination has not migrated to the National Park Service property.

Task E. Model seepage from the tailings pile. The purpose of this task was to be able to predict future contaminant transport, draining of the tailings pile, transient predictions of contaminant mass flux from the tailings pile to the groundwater, and the subsequent discharge of contaminants from the groundwater system to the Colorado River. This would enable the Service to more adequately assess future impacts of the proposed action on endangered species. The original scope of this task included conducting a full scale numerical simulation of seepage from the tailings pile. However, the Nuclear Regulatory Commission limited the scope of work to a steady state calculation of water movement through the tailings pile as a function of recharge by precipitation. Task E was summarized and reported in a separate document (ORNL 1998b) because it was tasked and funded by the Nuclear Regulatory Commission. The limited study concluded that the saturated hydraulic conductivity of the proposed cap would yield a discharge rate from the pile of 3.7 gallons per minute.

The results of these initial studies, in particular the changes in Task E, prompted the Service to request additional modeling that would allow a more complete evaluation of future impacts to endangered fish with the proposed action. The Oak Ridge National Laboratory/Grand Junction was tasked by the Service, with concurrence from the Nuclear Regulatory Commission, to model transient simulations of pile drainage, transient simulations of the contaminant concentrations discharging from the pile, and impacts of tailings removal on contaminant flux discharging to the alluvial aquifer and the Colorado River. While this study was limited by time constraints, some

significant information pertaining to the future probable impacts to endangered fish were reported by the Oak Ridge National Laboratory/Grand Junction (1998c) and they are summarized below.

In addressing the transient simulations of contaminant concentrations discharging from the pile, the Oak Ridge National Laboratory/Grand Junction report identified that a mature contaminant plume from the pile had reached the Colorado River several years ago and that the contaminant concentrations at the river would continue to increase for 9 more years. Furthermore, contrary to information supplied by the Nuclear Regulatory Commission and Atlas Corporation, the trend analysis conducted identified that there is no strong evidence that contaminant levels in the groundwater are decreasing due to a decrease in the contaminant concentrations in the tailings pile or because of reduced discharge rates. Therefore, the impacts to endangered fish would not decrease with the proposed action for approximately 9 more years.

In a review of historical water level data from the Atlas wells, the Oak Ridge National Laboratory/Grand Junction (1998c) report revealed several things. Fluctuations in monitoring well water levels corresponded to river stage fluctuations indicating that there is hydraulic connection between the river and the alluvial aquifer down gradient of the tailings pile. A comparison of water elevation in the pond at the top of the tailings pile to the river stage from 1989 to 1994 indicated no hydraulic connection. Furthermore, the report identified that there is a larger average decline in water levels for the 17 months prior to the initiation of the dewatering program than for the 42 months after pumping began, indicating that the pumping is having little or no affect on the dewatering of the tailings pile. Lastly, the discharge rate from the pile using several different porosity values was estimated to be somewhere between 2.5 and 20 gpm.

Both Atlas and the Nuclear Regulatory Commission supplied numerous comments on the results presented in the three separate Oak Ridge National Laboratory/Grand Junction reports. The comments mainly dealt with the limited analyses and assumptions used in drawing the conclusions. However, both parties, in cooperation with the Service were aware in the development of these studies that the scopes would be limited by both time and funds. The complexities, unknowns, and sensitivity of the environmental influences controlling the leach rate and contaminant concentrations in the leachate from the pile make definitive conclusions regarding the future impacts of leachates from the pile nearly impossible. The Service, therefore, in its mandate to use the best scientific information available, has deemed it appropriate to use the information provided in the Oak Ridge National Laboratory/Grand Junction reports in its evaluation of the effects of the action on endangered

fish. Given these conclusions, the Service has determined that the proposed action of capping the pile in place, with the cap proposed, will not limit rainwater infiltration into the tailings pile. Furthermore, as proposed with only passive draining of the pile, it will not minimize, reduce or eliminate the amount or shorten the length of time that contaminated leachate from the tailings pile will continue to leach into the Colorado River, adversely affecting endangered fish. While Harding-Lawson Associates and Atlas, in their comments on the Oak Ridge National Laboratory/Grand Junction (1998c) report, disagree regarding the amount of rainwater that will infiltrate with the proposed cap, neither they nor the Nuclear Regulatory Commission have disputed the fact that leaching will continue with the proposed action. The point of contention is the amount of time required before the leaching drops to a level that will not adversely affect endangered fish.

Harmful Effects of the Leachate. The Nuclear Regulatory Commission, in their biological assessment, minimizes the impacts of the tailings leachates by stating that endangered fish are able to successfully avoid areas of potential toxicity. First, fish may not know or be able to avoid a toxic area. Larval endangered Colorado squawfish, that drift passively with the current until they reach a quiet backwater at or downstream of the Atlas tailings pile, would not be able to avoid a toxic area. They do not have the ability to actively maneuver in the current at this sensitive life stage. Second, even if the fish could avoid the area, avoidance behavior is considered an adverse impact, pursuant to the Endangered Species Act. The Act defines "take" of a species to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include but are not limited to, breeding, feeding, or sheltering. Avoidance of protected backwaters and near shore habitats would put larval fish in greater danger from prey and would not allow them the access to food resources that are critical at this life stage. Thus, take of listed species would include behavioral abnormalities such as avoidance. Therefore, avoidance by the endangered fish of reaches of the Colorado River contaminated by the Atlas site would constitute a "take" of endangered species.

Certain constituents of the tailings leachate are known to be toxic to aquatic life. The following constituents from the Atlas tailings pile have been found to exceed the Utah State surface water quality standard in the Colorado River. These standards were developed and are in place to protect aquatic life.

Therefore, it can be assumed, that because these standards have been exceeded, impacts to endangered species have occurred in the past, presently occur, and would continue until drainage from the pile is reduced. Impacts to the endangered species may be occurring directly or indirectly. Direct impacts would include physiological harm to the fish themselves, resulting in reduced growth, infertility, or even death. Indirect impacts would include such things as a reduction in available food resources, avoidance behavior, or other behavioral abnormalities. The trace elements and radionuclides that were found to increase in sediment and fish tissue downstream of the Atlas mill tailings pile are included in the list of contaminants of concern. Contaminants of concern include the following: aluminum, ammonia, arsenic, boron, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, molybdenum, nickel, selenium, strontium, vanadium, gross alpha, gross beta, thorium 228, thorium 230, thorium 232, uranium 234, uranium 235, uranium 238, total uranium, and total dissolved.solids (salinity control standard). While the literature does not identify adverse impacts to aquatic life for some of these individual contaminants, the Service is concerned about the probable additive or synergistic effects of the cumulative contaminant plume.

Synergistic Effects of Chemical Toxins. The effects analyses provided by the Nuclear Regulatory Commission and Atlas fail to address the synergistic effects of toxicants leaching into the Colorado River. Hamilton and Buhl (1997) performed acute toxicity tests for larval Colorado squawfish and razorback sucker in reconstituted water simulating the San Juan River near Shiprock, New Mexico, to determine biological effect concentrations. Tests conducted with arsenate, copper, selenate, selenite, zinc, and numerous mixtures of inorganics simulating environmental mixtures, identified that the major toxic component in the mixtures was copper. Hamilton and Buhl (1997) suggest inorganic contaminant mixtures could adversely affect larval Colorado squawfish and razorback suckers at sites receiving elevated inorganics such as from nonpoint discharges. Although concentrations of individual inorganics in the mixtures tested by Hamilton and Buhl (1997) may not be sufficiently elevated to pose a hazard, they were found to contribute to the toxicity of the inorganic mixtures. Hamilton and Buhl (1997) further state that National Water Quality Criteria for individual inorganics would be protective of the endangered fishes, but the toxicity of mixtures of these inorganics may not be protective based on the margins of uncertainty. The high numbers and concentrations of inorganic chemicals leaching into the Colorado River at and below the Atlas site, identify this site as a nonpoint source discharge, similar to that described by Hamilton and Buhl (1997). Therefore, it is reasonable to assume that synergistic effects may be adversely affecting Colorado squawfish and razorback sucker at and below the Atlas site.

Ammonia. Intensive ammonia sampling identified dramatic increases in ammonia (as N) in the Colorado River adjacent to and downstream of the Atlas tailings pile. The Utah Department of Environmental Quality reported concentrations of ammonia as high as 15.8 mg/l adjacent to the Atlas mill tailings pile. Concentrations remained above the State standard as far as 1.5 mile below the tailings pile on the Atlas bank of the Colorado River. These concentrations were greatest adjacent to the Atlas tailings pile and gradually decreased downstream.

The toxic effects of ammonia to aquatic species are well documented. Thurston et al. (1983) documented that acute toxicity, as the 96-hour median lethal concentration (LC50), occurred in fathead minnow (*Pimephales promelas*) at ammonia concentrations ranging from 0.75 to 3.4 mg/l un-ionized ammonia (34-108 mg/l total ammonia nitrogen). DeGraeve et al. (1980) reported a 96-hour LC50 of 1.59 mg/l un-ionized ammonia for fathead minnow. Ammonia toxicity has been reported for numerous other nonsalmonid fishes. LC50's ranged from 0.14 to 4.2 mg/l un-ionized ammonia for these fishes (Thurston et al. 1983).

The documented chronic effects of ammonia toxicity include reduced growth rate (Rice and Bailey 1980, Burkhalter and Kaya 1977, Broderius and Smith 1979, McCormick et al. 1984, Robinette 1976, Smith 1972, Smith and Piper 1975, Smith et al. 1984, Swigert and Spacie 1983), reduced gamete production, body deformities and malformations (Calamari et al. 1977, Smith 1984), and degenerative gill and kidney appearance and function (Burkhalter and Kaya 1977, Fromm 1970, Smart 1976, Thurston et al. 1978). Reported ammonia concentrations found to reduce growth rates, retard growth, reduce gamete production, or decrease body weight, ranged from 0.0024 mg/l, to 0.49 mg/l.

The U.S. Environmental Protection Agency has recommended a criterion for un-ionized ammonia concentrations of 0.02 mg/l as the "safe" limit for aquatic life (USEPA 1979). The Harding-Lawson Associates (1998) data shows concentrations of unionized ammonia in the Colorado River at the Atlas site well in excess of this criterion.

Furthermore, at high pH values and very low levels of the free carbon dioxide, the levels of un-ionized ammonia found to be toxic may be about five times greater than those applicable to waters with lower pH values (USEPA 1979). The National Park Service has identified that pH values in the Colorado River have increased over the past 50 years and are considered high at the Atlas location (Roy Irwin, National Park Service, pers. comm.). At the Atlas site pH values have been reported to increase (HLA 1998), possibly due to the high concentrations of certain contaminants leaching into the river. Therefore,

the ammonia leaching into the river at the Atlas site is considerably more toxic to aquatic wildlife (42 percent more toxic per the Harding-Lawson Associates 1998 reported data) than the same concentrations of ammonia at other sites with lower pH values.

The U.S. Geological Survey, Environmental Contaminants Research Center, located in Columbia, Missouri, has conducted ammonia toxicity tests with the endangered Colorado squawfish and razorback sucker and has reported the results of these tests to the Service in a letter dated January 23, 1998 (USGS 1998). They found that based on mean LC50s (the concentration at which 50 percent lethality occurs), fathead minnows, razorback sucker and Colorado squawfish appear to be similar in sensitivity to ammonia toxicity. However, individual ammonia trials for a particular species exhibited a large degree of variability. They further determined IC25s (25 percent inhibition concentration) for each of the species but found that there was little difference between the LC50s and IC25s, probably due to the fact that both estimates were calculated after 7 days of exposure and survival is the primary endpoint affecting the IC25 calculation. The U.S. Geological Survey data is summarized in Table 13 below.

Table 13. Individual trials of ammonia toxicity. Ammonia stock solutions were measured and total N concentrations (mg/l) are corrected for the measured stock concentration. Data noted with an * have not been corrected and are nominal concentrations. Un-ionized ammonia concentrations were calculated using the equations provided by Thurston et al. (1977). Un-ionized ammonia concentrations were estimated by calculation using the total ammonia IC25 or LC50 concentrations, the test temperature (25°C) and test pH. The pH used for estimation was the mean of all pH's recorded during a particular test.

Species	7 day LC50 Total N (mg/l)	7 day LC50 Unionized Ammonia (mg/l)	7 day IC25 Total N (mg/l)	7 day IC25 Unionized Ammonia (mg/l)
Razorback sucker	12.3*	1.039*	10.55*	0.891*
	>17	NC[1]	>17	NC[1]
Colorado squawfish	4.44	0.229	4.4	0.227
	22.6	1.416	17.9	1.122
Fathead minnow	12.64	0.652	2.4	0.124
	>17	NC[1]	>17	NC[1]

	7.34*	0.620*	5.7*	0.482*
	11.19	0.277	5.82	0.144
	>17	NC[1]	14.4	0.651

NC[1] = not calculated.

The U.S. Geological Survey letter identifies that based on the ammonia levels reported by the State of Utah (letter dated 6/20/97 to the Nuclear Regulatory Commission from Loren Morton), in comparison with the U.S. Geological Survey data, the ammonia levels in the Colorado River at and below the Atlas site, would be toxic to Colorado squawfish and razorback sucker. It should be noted that this statement is based on LC50s and IC25s. The concentrations that would harm endangered fish would be lower than these values because the "harm" standard is more stringent than an IC25 or LC50.

The ammonia concentrations leaching into the Colorado River from the Atlas tailings pile are well above these chronic and acute effect levels, as far as 1.5 miles downstream. Adverse impacts to Colorado squawfish and razorback sucker from both chronic and acute exposure may be occurring in the form of reduced gamete production, avoidance behavior, gill and kidney malfunction, body deformities and malformations, as well as lethality.

Ammonia as an Indicator for Contaminant Distribution. The Utah Division of Water Quality conducted intensive ammonia sampling of the Colorado River in 1996. Although other contaminants could have been and need to be selected for intensive study, it was the Department of Environmental Quality's intent to use ammonia as an indicator parameter with the hope that it may disclose important information about local water quality conditions and contaminant distribution. The high ammonia concentrations found through intensive study indicate that additional analyses needs to be conducted for other known tailings constituents and that the extent of the toxicity of the tailings leachates also needs to be further characterized.

Total Dissolved Solids. Salinity alone can be toxic to many aquatic species. Total dissolved solids (salinity) in excess of 15,000 mg/l is considered unsuitable for freshwater fishes (USEPA 1986, Rawson and Moore 1944). However, the toxicity of salinity is dependent upon the ionic composition which produces the salinity (Dwyer 1994). While the actual ionic compositions which are toxic to fish are unknown, Pimental and Bulkley (1983) reported salinity concentrations which were avoided by several endangered fish. Pimental and Bulkley (1983) found total dissolved solids above 4,400, 5,100, and 6,600 mg/l were avoided by juvenile Colorado squawfish, humpback chub, and

bonytail chub, respectively. Pimental and Bulkley further stated that eggs and larval fish may be more sensitive to elevated total dissolved solids concentrations. Because the total dissolved solids at and below the tailings pile are from groundwater sources, salinity is probably diluted by less saline surface and ground water. However, complete mixing probably does not occur because at conductivities greater than 10,000 uS/cm water density becomes significantly greater than 1.0 g/cm^3 and water of this density will seek the bottom of the water body (Hem 1970, Kunkle and Wilson 1984 *in* memorandum dated August 4, 1995, for the Recovery Program for Endangered Fishes of the Upper Colorado).

As can be seen in Table 9, total dissolved solids increase in the Colorado River below the tailings pile. Surface water concentrations of total dissolved solids increase to 1.6 times greater below the tailings pile. The Utah Department of Environmental Quality has informed the Nuclear Regulatory Commission (letter dated April 26, 1996) that the high total dissolved solids found at the Atlas seep do not comply with the Colorado River Salinity Standards found in the Utah Standards of Quality for Waters of the State (UAC R317-2-4). These salinity standards have been adopted by Utah in cooperation with the other Colorado River Basin States, and the U.S. Environmental Protection Agency (Colorado River Basin Salinity Control Forum Policy, approved October 20, 1982). Under these standards, dischargers have a responsibility to comply with a "no-discharge" performance goal, to the extent practical, for salts and total dissolved solids.

In the case of existing industrial facilities, such as the Atlas tailings pile, the salinity standard allows a minimal discharge of salts when the facility can successfully demonstrate ". . . that it is not practical to prevent the discharge of all salt from an existing facility." Such a minimal discharge rate is then required to undergo technical justification, part of which includes a cost analysis for salt minimalization. However, such a technical justification and the "no-discharge" requirement may be waived on a case-by-case basis where the total salt or total dissolved solids load to the river is less than one ton (2,000 lbs) per day or 350 tons per year, whichever is less. To date, this requirement has not been waived for Atlas Corporation's Moab site.

The Department of Environmental Quality letter of April 26, 1996, states that recent Department of Environmental Quality ground water quality information and available Atlas hydrological data suggests that the Atlas facility has discharged salts (total dissolved solids) to the Colorado River in excess of 2,000 lb/day. The Department of Environmental Quality further stated that the daily discharge could be as high as 15,523 lb/day and that it was the State's

conclusion that the Atlas tailings pile should be required to meet the Colorado River Salinity Standards.

Given the above information and the known high levels of total dissolved solids at the Atlas site, the Service has concluded that adverse impacts, in the form of avoidance behavior, adverse modification of habitat, as well as osmoregulatory problems, are and will continue to adversely affect endangered fish from high total dissolved solids leaching from the Atlas tailings pile.

Gross Alpha. Gross alpha radiation is often used as a screening tool for radioactivity and includes all alpha emitters such as uranium 234, uranium 235, uranium 238, radium 226 and thorium 230. Each of these has been identified as present in the Atlas tailings water. A gross alpha standard of 15 P.I./l in surface water has been adopted by the State of Utah to protect aquatic wildlife. Gross alpha levels in the Colorado River, while high above the Atlas tailings pile, increase by a magnitude of three (3) adjacent to the tailings pile, exceeding the standard.

The toxicological effects of high gross alpha concentrations may occur both radiologically and chemically. High acute doses of ionizing radiation produce adverse biological affects at every organizational level; molecule, cell, tissue-organ, whole animal, population, community and ecosystem (Eisler 1994). Chronic effects of ionizing radiation include cell death, decreased life expectancy, increased frequency of malignant tumors, increased frequency of gene mutations, altered blood-brain barrier function, and reduced growth and altered behavior (Eisler 1994). It is generally acknowledged that among aquatic organisms older organisms are more resistant than the young to the affects of ionizing radiation. Eisler (1994) reported that developing eggs and young of some species of freshwater fishes are among the most sensitive tested aquatic organisms. Therefore, the larval and young-of-year endangered fish exposed to high gross alpha levels at and below the Atlas tailings pile may be harmed by the contaminated leachate in the river. Likewise, given that the leaching will continue after capping the tailings pile, high gross alpha concentrations may continue to harm the endangered Colorado squawfish and razorback sucker.

Permanent Loss of Floodplain Habitat

The Nuclear Regulatory Commission identified in the Preliminary Final Environmental Impact Statement that 2 ha (5 acres) of the 100-year floodplain of the Colorado River would be lost as a result of leveling of the tailings pile slopes, and that additionally, a small floodplain area would be modified as a result of the relocation of Moab Wash. According to the Flood Hazard

Boundary Map for Grand County, Utah (FEMA 1981), the lowest reaches of Moab Wash, several hundred meters, and possibly a small portion of the eastern base of the tailings pile are located on the 100-year floodplain of the Colorado River.

In comments received on the Service's Revised Draft Biological Opinion, Atlas Corporation questioned the amount of 5 acres of lost 100-year floodplain with the proposed action that had been identified in the Preliminary Final Environmental Impact Statement and provided data and arguments identifying that the actual loss would only be 0.5 acres. They stated that recontouring the tailings pile slopes will only affect about 0.5 acres of the present day 100-year floodplain habitat in comparison to the current configuration of the tailings pile. Given this new information, the Service requested whether the Nuclear Regulatory Commission wanted to change the amount of floodplain habitat loss previously identified. The Nuclear Regulatory Commission requested clarification of the issue from their consultants, Oak Ridge National Laboratories/Tennessee, who had originally identified the amount of 5 acres. After evaluating the comments from Atlas Corporation and the original estimate of 5 acres, they concluded that Atlas had produced a more detailed estimate and that the analysis presented by Atlas appeared to be reasonable. They further concluded that the 0.5 acres that will be affected appears to indicate a permanent modification of floodplain habitat and that it should be noted that in the short term considerable activity will occur along the perimeter of the pile during implementation of the proposed action that will temporarily disturb a considerably larger area. However, once reclamation activities are completed, there is a real potential for improved habitat to be created.

Given this clarification and at Nuclear Regulatory Commission request, the Service has modified the previous amount of permanent floodplain habitat loss identified, from 5 acres to 0.5 acres. However, the temporary modification of an additional unspecified amount of designated critical habitat will also occur.

The importance of floodplain habitats to the endangered Colorado River fishes is well documented (USFWS 1990b, USFWS 1996a). Both the razorback sucker and Colorado squawfish depend on flooded lowlands during various life stages. The loss of backwaters and floodplain habitats has been cited as one of the reasons for the decline of these fishes and is a limiting factor in their recovery. Therefore, the Service has concluded that the permanent loss of 0.5 acres and temporary modification of an additional unspecified amount of the Colorado River floodplain and designated critical habitat, will result in

the destruction and adverse modification of critical habitat for the Colorado squawfish and razorback sucker.

Similarly, the importance of riparian vegetation to southwestern willow flycatcher has been well documented (Bent 1960; Stafford and Valentine 1985; Harris et al. 1987). The flycatcher relies on riparian vegetation for nesting, breeding and migrational habitat. The loss and modification of riparian habitats on the Colorado River is cited in the final rule listing the species as endangered (60 FR 0694), as a likely cause for the decline of the species on the Colorado River. Habitat losses and fragmentation are limiting factors in southwestern willow flycatcher recovery. Therefore, any additional losses of probable habitat may affect the species by reducing the available nesting, breeding, and migrational habitat, and may result in further reductions in the population of southwestern willow flycatcher along the Colorado River. Yong and Finch (1997) reported that small land-bird migrants, especially neotropical long-distance migrants such as the flycatcher, generally do not deposit enough fat to fly nonstop between breeding and wintering grounds. They further concluded that willow flycatchers are seemingly constrained to feed at stopover sites to make progress toward their breeding or wintering destination. Given this information, the Service has concluded that the loss of 0.5 acres of riparian habitat may adversely affect the southwestern willow flycatcher in its ability to successfully migrate from breeding to wintering grounds.

Reconfiguration of Moab Wash

The reconfiguration of Moab Wash will result in increased sedimentation in the Colorado River during construction activities. Best management practices to control erosion will reduce the amount of material released, however, some temporary increase in sedimentation will result.

Similarly, construction activities at the mouth of the wash would disturb the small backwater which provides suitable habitat and is known to be occupied by larval endangered fishes. This could result in the loss of larval fish unable to avoid the construction activity.

The relocation of the Wash will likely result in the elimination of the small backwater currently in the river at the mouth of the Wash. This would adversely affect the Colorado squawfish and razorback sucker due to the importance of these backwaters to young-of-year fish. The limited backwaters in the vicinity of the tailings pile make the loss of one that much more critical. However, it is possible that another backwater would develop at the mouth of the newly relocated Wash.

The Final Technical Evaluation Report for the proposed action identifies concerns that during the 1,000-year design life, Moab Wash could migrate periodically and unpredictably and could move to a location adjacent to the reclaimed tailings impoundment (NRC 1997). If this occurs erosion of the tailings pile would result in a release of toxic material into the Colorado River, adversely affecting endangered fish. Due to this concern, the licensee has proposed to provide a large rock toe/apron along the toe of the embankment adjacent to Moab Wash and the Nuclear Regulatory Commission has informed the Service that the apron will be required by license amendment.

Water Depletion

This biological opinion, in part, addresses an average annual depletion of approximately 154.3 acre-feet from the Upper Colorado River Basin for use in dust control, decontamination, construction, and other uses. Water depletions in the Upper Basin have been recognized as a major source of impact to Colorado squawfish, razorback sucker, humpback chub, and bonytail chub.

Impoundments and diversions have reduced peak discharges by 48 percent since 1942, while increasing base flows by 21 percent in some reaches. These depletions, along with a number of other factors, have resulted in such drastic reductions in the populations of the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker that the Service has listed these species as endangered and has implemented programs to prevent them from becoming extinct. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the fishes.

Water depletions reduce the ability of the river to create and maintain critical habitat. Food supply, predation, and competition are important elements of the biological environment, one of the constituent elements of critical habitat. Food supply is a function of nutrient supply and productivity, which could be limited by reduction of high spring flows brought about by water depletions. Predation and competition from nonnative fish species have been identified as factors in the decline of the endangered fishes. Water depletions contribute to alterations in flow regimes that favor nonnative fishes.

Because of the above affects, the Service has determined and consistently maintained, since the inception of the Colorado River Fishes Recovery Program in 1988, that project depletion impacts are likely to jeopardize the continued existence of, and result in adverse modification and destruction of designated critical habitat for, Colorado squawfish, razorback sucker, bonytail chub and

humpback chub. Any depletion to the system, regardless of how small, is considered to result in jeopardy to all four of the listed fishes while also resulting in adverse modification of any designated critical habitat within the project area. Designated critical habitat for Colorado squawfish and razorback sucker exists within the project area. Therefore, the proposed water depletion would also result in adverse modification of critical habitat for these two species.

Critical Habitat

Critical habitat has been designated for the Colorado squawfish and razorback sucker within the 100-year floodplain in portions of their historical range (59 FR 13374), including that portion of the Colorado River affected by the Atlas tailings pile. Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In considering the biological basis for designating critical habitat, the Service focused on the primary physical and biological elements that are essential to the conservation of the species without consideration of land or water ownership or management. The Service has identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. As discussed above, water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes. The depletion of 154.3 acre-feet will result in adverse modification of critical habitat for Colorado squawfish and razorback sucker.

In addition, sufficient water quality is a characteristic of the primary constituent elements of critical habitat. Any contamination of that water through leaching of the tailings pile or by other methods, adversely modifies designated critical habitat. As previously described, the proposed action will not limit or eliminate leaching of contaminants into designated critical habitat. Therefore, the proposed action will result in adverse modification of a minimum of 1 river mile of critical habitat for the Colorado squawfish and razorback sucker. This is the minimum length of river (the farthest downstream sampling point) showing increased contaminant levels in surface water. The actual surface water contaminant plume may extend well beyond this farthest downstream sampling locale.

In addition to water quantity and quality, physical habitat is a component of the constituent elements of designated critical habitat. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. The Nuclear Regulatory Commission and Atlas Corporation have stated that 0.5 acres of the 100-year floodplain, and thus critical habitat, of the Colorado River would be permanently lost as a result of leveling of the tailings pile slopes, and that additionally, a small floodplain area would be modified as a result of the relocation of Moab Wash. They have further identified that a considerably larger area would be temporarily modified during construction activities.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act. Likewise, the future interrelated action of development and implementation of a revised groundwater corrective action plan for the Atlas mill tailings site, will require consultation pursuant to section 7 of the Endangered Species Act.

The Moab area receives intensive seasonal recreational use that is increasing at over 13 percent yearly and is expected to continue. There may be additional demands for water placed on the water supply and new developments in and around the Colorado River floodplain. Additionally, recreational use of the Colorado River is expected to increase with increased visitors to the Moab area. The Service is unaware of any specific State, local or private actions which will occur in the area that could be included under the cumulative effects analysis.

CONCLUSION

Colorado River Fish. After reviewing the current status of the razorback sucker, Colorado squawfish, humpback chub, and bonytail chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is likely to jeopardize the continued existence of the razorback sucker, humpback chub, bonytail chub and Colorado squawfish, and is likely to destroy or adversely modify designated critical habitat.

It is the Service's biological opinion that implementation of the proposed action: (1) is likely to jeopardize the continued existence of the Colorado squawfish, razorback sucker, humpback chub, and bonytail chub by depleting water from the Colorado River system and; (2) is likely to jeopardize the continued existence of Colorado squawfish and razorback sucker by degrading water quality and; (3) is adversely modifying designated critical habitat by degrading water quality to the point that it appreciably diminishes the value of designated critical habitat. The Service further concludes that the permanent loss of 0.5 acres and temporary modification of an additional unspecified amount of designated critical habitat will not appreciably diminish the value of designated critical habitat in the survival and recovery of Colorado squawfish and razorback sucker.

Southwestern Willow Flycatcher. It is the Service's biological opinion that implementation of the capping of the tailings pile in place and relocation of Moab Wash, as proposed, is not likely to jeopardize the continued existence of the southwestern willow flycatcher. No critical habitat exists for this species within the action area, therefore, none will be destroyed or adversely modified. However, the proposed action will result in the loss of 0.5 acres of flycatcher habitat, reducing the amount of available habitat for nesting, breeding and migration. The available information indicates that all remaining potential habitat, throughout the flycatchers range, is important to the continued survival of the species. The Service believes that it is reasonable to expect that flycatchers may be nesting on the Atlas property, and that the disturbance associated with capping the pile may result in the loss of a nesting site or nest.

REASONABLE AND PRUDENT ALTERNATIVE

Regulations (50 CFR 402.02) implementing section 7 of the Endangered Species Act define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction, (3) are economically and technologically feasible, and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of the listed species or resulting in the destruction or adverse modification of critical habitat.

The Service's responsibility is to protect, now and long-term, listed fishes in the Colorado River near Moab, to protect designated critical habitat in the river and the 100-year floodplain, and to undertake appropriate actions to promote recovery of listed species. Based on the most recent Oak Ridge

National Laboratory studies undertaken pursuant to agreement with the Nuclear Regulatory Commission and furnished to the Service, the Service believes that the long term release of contaminants into the Colorado River will continue indefinitely with the current groundwater corrective action plan and absent any remedial action other than the proposed capping of the pile in place.

In modeling the pile drainage, Oak Ridge National Laboratory/Grand Junction (1998c) concluded that the bulk of the tailings water would passively drain in 100 years, with 238 years required to reach steady state conditions (where inflow in the form of precipitation equals outflow or leaching) (ORNL 1998c). It is the Service's opinion that this length of time to reduce contaminant levels in the river and remove the jeopardy to endangered fish would not be biologically and legally acceptable.

Based on subsequent discussions with the Nuclear Regulatory Commission and Atlas Corporation, active drainage of the pile was considered. An active drainage plan would significantly reduce the length of time required to drain the pile, resulting in less contaminated water reaching the Colorado River and a reduction in the length of time contaminated tailings leachate would continue to jeopardize the endangered fish. Atlas Corporation subsequently committed to specific time frames for dewatering the pile to the extent necessary to place the radon and infiltration barrier and meeting water quality standards in the Colorado River. It is the Service's opinion that these time frames, identified below, are based on the best available technology and professional judgement and, appear to be a reasonable approach to removing jeopardy to the endangered fish in the shortest feasible period of time.

A reasonable and prudent alternative, consisting of five (5) parts, has been developed to avoid the likelihood of jeopardy to the endangered Colorado River fishes from Atlas tailings pile contamination, from destruction and adverse modification of critical habitat and from water depletion from the Colorado River. The Service recognizes that removing the jeopardy to the endangered fish from the contaminated leachate will require time and has taken this into consideration in the following reasonable and prudent alternative and in the incidental take statement. However, should the time frames identified below not be met, the Service would reinitiate consultation.

Because this biological opinion has found jeopardy and destruction and adverse modification of critical habitat, the Nuclear Regulatory Commission is required to notify the Service of its final decision on implementation of the reasonable and prudent alternative.

The reasonable and prudent alternative is identified below:

1. While the Nuclear Regulatory Commission has concurred that a Revised Groundwater Corrective Action Plan is necessary for the Atlas site, no specific plan is currently available, nor has one been proposed as part of the action under consultation. This biological opinion identifies that the effects of leaching from the tailings pile, as well as other sources on the Atlas property, is jeopardizing the endangered Colorado squawfish and razorback sucker and adversely modifying critical habitat for one to two miles, depending on flows and other variables. Therefore, a revised groundwater corrective action plan is necessary to reduce leaching from the pile and other sources such that the fish are no longer jeopardized and the habitat is no longer adversely modified. To avoid jeopardy to the listed fishes from leachates seeping to the Colorado River from contaminated groundwater, the Nuclear Regulatory Commission shall:

   a.) require Atlas Corporation to actively dewater the tailings pile to the extent necessary to place the radon barrier and infiltration barrier, which is the final portion of the cap. This is to be accomplished within 30 months from Atlas's receipt of Nuclear Regulatory Commission approval of the dewatering design. Any water actively withdrawn from the pile must be disposed of in a manner that will not result in impacts to listed species;

   b.) require Atlas Corporation to cleanup contaminated groundwater to the extent necessary to meet relevant standards within 7 years from Atlas's receipt of Nuclear Regulatory Commission approval of the revised groundwater corrective action plan. Any accepted groundwater remediation plan must be designed to achieve cleanup in the shortest feasible period of time, and be designed to minimize the mixing zone in the Colorado River. Relevant standards shall include the ammonia concentrations as identified below as well as other constituents regulated by the Nuclear Regulatory Commission and surface water quality standards for the protection of aquatic life as identified in Utah Administrative Code 51-317 dated December 19, 1997. While several of these constituents are not specifically known to individually jeopardize the endangered fish at levels identified below the Atlas tailings pile, as previously identified under the "Effects of the Proposed Action", the synergistic and/or additive effects of elevated concentrations of the known tailings contaminants may be adversely affecting Colorado squawfish and razorback sucker, and;

c.) expedite approvals of Atlas's barrier design and revised groundwater corrective action plan so that jeopardy to the listed species is removed within 10 years from receipt of this final biological opinion and;

d.) reinitiate consultation with the Service for those portions of any revised groundwater program that may affect endangered or threatened species.

e.) monitor surface water quality in the Colorado River at and downstream of the Atlas site as necessary to insure compliance with the above time frames and ammonia standards identified below. Reports of the monitoring shall be supplied to the Service's Salt Lake City Field Office annually.

2. The leachate constituent of most significant concern to the Service is ammonia. The fact that the proposed action did not specifically address ammonia, and that initially during consultation it was uncertain what levels of ammonia in the water would remain after the proposed action was implemented, it was not possible for the Service to conclude that ammonia concentrations would be reduced to levels that would remove jeopardy to the endangered fish. To assure that ammonia levels will be reduced to levels avoiding future jeopardy to the endangered fish, the Nuclear Regulatory Commission shall incorporate, whether by order or through the request of Atlas Corporation, ammonia as a new constituent in the license held by Atlas Corporation. The Nuclear Regulatory Commission shall require Atlas Corporation to meet the following ammonia standards for surface water at and below the Atlas tailings pile:

a.) The chronic toxicity standard of 0.38 mg/l (see Appendix A for an explanation of this number) total ammonia as N shall not be exceeded in the Colorado River outside of the mixing zone as allowed by the State of Utah water quality standards for the protection of aquatic life. These standards are promulgated in R317-2-5 and allow for the following mixing zone: "A mixing zone is a limiting portion of a body of water, contiguous to a discharge, where dilution is in progress but has not yet resulted in concentrations which will meet certain standards for all pollutants. At no time, however, shall concentrations within the mixing zone be allowed which are acutely lethal as determined by bioassay or other approved procedure...The size of the chronic mixing zone shall not exceed 2,500 feet.". The 2,500 foot mixing zone shall begin at the most upstream point in the Colorado River

where ammonia levels begin to increase as a result of the contaminant plume from the Atlas tailings pile.

An acute toxicity standard of 1.93 mg/l total ammonia as N (see Appendix A for explanation of number) at the point of emergence shall not be exceeded in the Colorado River at or below the Atlas tailings pile. This acute standard shall not allow for any mixing zone because a mixing zone for an acute level of contaminant would, by definition, allow lethal levels at the point of emergence and into the plume, causing an undetermined level of mortality. This would be contradictory to the requirements of the Endangered Species Act in that the Service cannot permit an action that affirmatively causes take.

The acute and chronic standards were developed using average pH (8.5) and temperature (22° C) values in the river during the period larval fish would be present. However, the standards shall be applied throughout the year as juvenile and adults may be present at other times of the year. Should pH values higher than 8.5 be encountered in the river, the toxicity of ammonia would increase and these standards would no longer be valid. In such a scenario, the Utah State water quality standards should be applied.

The standards identified above were not intended to relieve the Nuclear Regulatory Commission or Atlas Corporation of their responsibility to meet other State and Federal standards. These values are only identified by the Service here to inform the Nuclear Regulatory Commission and Atlas Corporation of concentrations that would remove jeopardy to the endangered fish in the Colorado River.

These standards may be refined by the bioassay studies that will be conducted (see below). Any change to these standards will be made when the Nuclear Regulatory Commission reinitiates consultation with the Service on the revised groundwater corrective action plan.

3.) As previously stated, the Service has determined that leachate from the pile, and other sources on the Atlas property, is jeopardizing the continued existence of the Colorado squawfish and razorback sucker and adversely modifying critical habitat. The Service recognizes that the current state of knowledge does not support definitive comprehensive standards for all contaminants which could be applied to protect listed species from jeopardy at this site (for example, pH levels significantly affect the ammonia toxicity in the river and the standard is subject to

pH levels). It is clear that the Colorado River at the Atlas tailings pile is a temporally and spatially sensitive environment, and that additional information may be helpful to finalize the revised Groundwater Corrective Action Plan. In order to more effectively determine cleanup levels required to remove jeopardy to listed species, the Service has initiated previously planned bioassay studies. These bioassay studies will be conducted by the Columbia Laboratory of the Biological Resources Division, U.S. Geological Survey and shall be initiated in July 1998. Various life stages of the endangered fish and/or surrogate species will be tested with groundwater and nearshore river surface water from areas potentially inhabited by endangered fish, at and below the Atlas tailings pile. Further studies will be conducted in the laboratory to determine levels of ammonia required to remove jeopardy to the endangered fish. Bioassay studies will be structured to give a rapid assessment of the cumulative effects of the contaminant plume on endangered fish and will also focus on developing an acute and chronic ammonia standard at the site. Such studies will also provide more specific information about the reduction in contaminant levels required to remove jeopardy to the endangered species.

In order to effectively conduct these studies the Service, and other personnel participating in the study, will require access to the Atlas property to carry out the study. The Nuclear Regulatory Commission shall ensure that access is permitted to the site for purposes of conducting the study. Furthermore, the Service invites and encourages the Nuclear Regulatory Commission and Atlas Corporation to participate in the study by providing funding and technical expertise.

4.) Nuclear Regulatory Commission regulations allow for the establishment of alternate concentration limits at the point of compliance when background concentrations and/or acceptable hazard levels "may not be practically achievable at a specific site." (10 CFR part 40, Appendix A, criterion 5B(6)). Alternate concentration limits must not only protect human health but also must protect listed fishes. Therefore, the Nuclear Regulatory Commission shall consult with the Service, pursuant to section 7, before establishing alternate concentration limits, and exceptions thereto, at the site. The bioassay studies discussed above will help determine if alternate concentration limits can be allowed without jeopardizing endangered species.

5.) Under the proposed action, the Nuclear Regulatory Commission has identified an average annual water depletion to the Colorado River of 154.3 acre-feet. In addition to the above, the Service has developed

the following reasonable and prudent alternative to deal with water depletion impacts to the four endangered Colorado River fishes.

On January 21-22, 1988, the Secretary of the Interior; the Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration were cosigners of a Cooperative Agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (USFWS 1987). An objective of the Recovery Program was to identify reasonable and prudent alternatives that would ensure the survival and recovery of the listed species while providing for new water development in the Upper Basin.

The following excerpts are pertinent to the consultation because they summarize portions of the Recovery Program that address depletion impacts, section 7 consultation, and project proponent responsibilities:

> "All future Section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the Service by water project proponents in the amount of $10.00 per acre-foot based on the average annual depletion of the project . . . . This figure will be adjusted annually for inflation [the current figure is $13.81 per acre-foot] . . . . Concurrently with the completion of the Federal action which initiated the consultation, e.g., . . . issuance of a 404 permit, 10 percent of the total contribution will be provided. The balance . . . will be . . . due at the time the construction commences . . . ."

It is important to note that these provisions of the Recovery Program were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The Recovery Program further states:

> ". . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to ensure instream flows . . . . Since this program sets in

> place a mechanism and a commitment to assure that the instream flows are protected under State law, the Service will consider these elements under Section 7 consultation as offsetting project depletion impacts."

Thus, the Service has determined that project depletion impacts, which the Service has consistently maintained are likely to jeopardize the listed fishes, can be offset by (a) the water project proponent's one-time contribution to the Recovery Program in the amount of $13.81 per acre-foot of the project's average annual depletion, (b) appropriate legal protection of instream flows pursuant to State law, and accomplishment of activities necessary to recover the endangered fishes as specified under the Recovery Implementation Program Recovery Action Plan. The Service believes it is essential that protection of instream flows proceed expeditiously, before significant additional water depletions occur.

With respect to (a) above (i.e., depletion charge), the applicant will make a one-time payment which has been calculated by multiplying the project's average annual depletion (154.3 acre-feet) by the depletion charge in effect at the time payment is made. For Fiscal Year 1998 (October 1, 1997, to September 30, 1998), the depletion charge is $13.81 per acre-foot for the average annual depletion which equals a total payment of $2,131 for this project. This amount will be adjusted annually for inflation on October 1 of each year based on the previous year's Composite Consumer Price Index. The Service will notify the applicant of any change in the depletion charge by September 1 of each year. Ten percent of the total contribution ($213), or total payment, will be provided to the Service's designated agent, the National Wildlife Foundation at the time of issuance of the Federal approvals from the Nuclear Regulatory Commission. The balance will be due at the time the construction commences. The payment will be included by the Nuclear Regulatory Commission as a permit stipulation. Fifty percent of the funds will be used for acquisition of water rights to meet the instream flow needs of the endangered fishes (unless otherwise recommended by the Implementation Committee); the balance will be used to support other recovery activities for the Colorado River endangered fishes. All payments should be made to the National Fish and Wildlife Foundation.

> National Fish and Wildlife Foundation
> 1120 Connecticut Avenue, Suite 900
> Washington, D.C. 20036

In a letter dated July 23, 1998, the Atlas Corporation agreed to this payment (Appendix C).

Each payment is to be accompanied by a cover letter that identifies the project and biological opinion that requires the payment, the amount of payment enclosed, check number, and any special conditions identified in the biological opinion relative to disbursement or use of the funds (there are none in this instance). The cover letter also shall identify the name and address of the payor, the name and address of the Federal Agency responsible for authorizing the project, and the address of the Service office issuing the biological opinion. This information will be used by the Foundation to notify the payor, the lead Federal Agency, and the Service that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program, an additional section 7 agreement and Recovery Plan addressing section 7 consultation on depletion impacts was developed (USFWS 1993b). The section 7 agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and those associated with historic projects in the Upper Basin. Procedures outlined in the section 7 agreement will be used in conjunction with the Recovery Plan to determine if sufficient progress is being accomplished in the recovery of the endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative to avoid jeopardy. The Recovery Plan was finalized on October 15, 1993, and is reviewed annually.

In accordance with the agreement, the Service has agreed to assess impacts of projects that require section 7 consultation and determine if progress toward recovery has been sufficient for the Recovery Program to serve as a reasonable and prudent alternative. If sufficient progress is being achieved, biological opinions will be written to identify activities and accomplishments of the Recovery Program that support it as a reasonable and prudent alternative. If sufficient progress in the recovery of the endangered fishes has not been achieved by the Recovery Program, actions from the Recovery Plan will be identified which must be completed to avoid jeopardy to the endangered fishes. For historic projects, these actions will serve as the reasonable and prudent alternative as long as they are completed according to the schedule identified in the Recovery Plan. For new projects, these actions will

serve as the reasonable and prudent alternative so long as they are completed before the impact of the project occurs. The Atlas mill tailings reclamation project is considered a new project.

The evaluation by the Service to determine if sufficient progress has been achieved considered (a) actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction; (b) status of fish populations; adequacy of flows; and (d) magnitude of the project impact. In addition, the Service considered support activities (funding, research, information and education, etc.) of the Recovery Program if they help achieve a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction. The Service evaluated progress separately for the Colorado River and Green River subbasins; however, it gave due consideration to progress throughout the Upper Basin in evaluating progress toward recovery.

Based on current Recovery Program accomplishments and the expectation that the Recovery Plan will be fully implemented in a timely manner, the Service determined that sufficient progress has been achieved under the Recovery Program so that it could serve as the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by the impacts caused by the water depletion associated with this permit. For historic projects, the responsibility for implementation of all elements of the reasonable and prudent alternative rests with the Recovery Program participants, not the individual project proponent. All actions must be implemented according to the time schedule specified in the Plan. For new projects, the responsibility for implementation of elements of the reasonable and prudent alternative is shared by the Recovery Program and the applicant. Recovery Program participants are responsible for carrying out activities outlined in the Recovery Plan.

The Nuclear Regulatory Commission should condition the permit to retain jurisdiction in the event that the Recovery Program is unable to implement the Recovery Plan in a timely manner. In that case, as long as the lead Federal Agency has discretionary authority over the project, reinitiation of section 7 consultation may be required so that a new reasonable and prudent alternative can be developed by the Service.

The above Reasonable and Prudent Alternative involves time frames that must be met to avoid jeopardy to the endangered fish. Because these time frames are

critical to meeting the stipulations for removing the jeopardy to the endangered fish, the Nuclear Regulatory Commission shall reinitiate consultation if any of the time frames are not met.

INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the Endangered Species Act, as amended, prohibit taking (harass, harm, pursue, hunt, wound, shoot, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish and wildlife without an exemption provided through a permit or biological opinion. Harm is defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include but are not limited to, breeding, feeding, or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Nuclear Regulatory Commission has a continuing duty to regulate the activity covered by this incidental take statement. If the Nuclear Regulatory Commission (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service has developed the following incidental take statement based on the premise that the reasonable and prudent alternative will be implemented.

Southwestern Willow Flycatcher

For the purposes of consideration of incidental take of flycatchers by the proposed action, incidental take can be defined as either the direct mortality

of individual birds, disturbance or the alteration of habitat that affects the behavior (i.e., breeding or foraging) of the birds. They may fail to breed, may fail to successfully rear young due to inadequate food supplies available in altered habitat, raise fewer young, raise less fit young, or desert the area because of disturbance.

The Service has identified that approximately 0.5 acre of southwestern willow flycatcher habitat will be permanently lost while an unspecified additional amount will be temporarily modified as a result of the reclamation of the Atlas mill tailings pile. The Service has further determined that, because it is known that adjacent habitat is occupied by southwestern willow flycatcher, the Atlas property habitat is, likewise, occupied by southwestern willow flycatcher. The loss of habitat reduces the amount of available habitat for nesting, breeding, and migration. Because of this reduction in habitat, and the disturbance associated with the proposed action, the Service authorizes the take of one nesting pair of southwestern willow flycatchers in association with implementing the proposed action.

Colorado River Fish

The Service anticipates that take of Colorado squawfish and razorback sucker will continue for up to 10 years following the issuance of this Biological Opinion from the continued leaching of contaminated groundwater. Take is anticipated to occur whenever ammonia levels in the river exceed the acute and chronic levels identified as necessary to remove jeopardy to the listed fishes. The Service authorizes this expected take with the assumption that a significant decrease in take should occur as soon as the pile is dewatered, and continue to decrease with time as the revised groundwater corrective action plan is implemented.

No take is anticipated to occur as a result of the water depletion.

The Service anticipates that all three constituent elements of designated critical habitat within the river for razorback sucker and Colorado squawfish will continue to be adversely modified for up to 10 years following issuance of this Biological Opinion. These constituent elements include water without harmful levels of contaminants, physical habitat potentially habitable by fish during all life stages, and a biological environment capable of supporting a food supply for the endangered fishes. A significant decrease in the amount of critical habitat adversely modified through leaching should occur as soon as the pile is dewatered and continue to decrease with time as the revised groundwater corrective action plan is implemented.

The Service anticipates the proposed action will further result in the destruction of 0.5 acres of designated critical habitat within the 100-year floodplain of the Colorado River and the temporary modification of an unquantified area considerably bigger than the 0.5 acres, for several years during construction activities within the floodplain.

EFFECT OF THE TAKE

Southwestern Willow Flycatcher

In the accompanying biological opinion, the Service has determined that the loss of habitat and loss of one nesting pair of southwestern willow flycatcher is not likely to result in jeopardy to the species.

Colorado River Fish

In the accompanying biological opinion, the Service has concluded that this level of anticipated take is not likely to result in jeopardy to the species or adverse modification of critical habitat when the reasonable and prudent alternative is implemented.

REASONABLE AND PRUDENT MEASURES

Because the Service anticipates that it will take time to eliminate take and the adverse modification of critical habitat as a result of the leaching of contaminated water from the pile and other sources and, through the Reasonable and Prudent Alternative, has allowed the continued taking of endangered Colorado squawfish and razorback sucker up to ten (10) years after receipt of the final biological opinion,this taking and adverse modification of critical habitat is authorized in this incidental take statement.

The reasonable and prudent measures are intended to minimize the impacts of incidental take to the extent reasonable and prudent. The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of southwestern willow flycatcher, razorback sucker and Colorado squawfish, and minimize the adverse modification of designated critical habitat:

1.) While the Nuclear Regulatory Commission has concurred that a revised Groundwater Corrective Action Plan is necessary for the Atlas site, no specific plan is currently available, nor has one been proposed as part of the action under consultation. This biological opinion identifies that the effects of leaching from the tailings pile and other sources on

the Atlas property is jeopardizing the endangered Colorado squawfish and razorback sucker and adversely modifying critical habitat. Therefore, a revised groundwater corrective action plan is necessary to reduce leaching from the pile and other sources and minimize the take that will occur until the groundwater is cleaned-up to levels protective of endangered fish.

2.) The leachate constituent of most significant concern to the Service is ammonia. The proposed action does not specifically address this concern, making it uncertain at this time what levels of ammonia the water will be cleaned up to with the proposed action. To address this concern, and eliminate take of the endangered fish from high concentrations of ammonia, groundwater cleanup shall reduce concentrations of ammonia in the river to levels identified to be protective of the endangered fish.

3.) As previously stated, the Service has determined that leachate from the pile and other sources on the Atlas property is jeopardizing the continued existence of the Colorado squawfish and razorback sucker. The Service recognizes that the current state of knowledge does not support definitive comprehensive standards for all contaminants which could be applied to protect listed species from take at this site (for example, pH levels significantly affect the ammonia toxicity in the river and the standard is subject to pH levels). It is clear that the Colorado River at the Atlas tailings pile is a temporally and spatially sensitive environment, and that additional information may be helpful to finalize the revised Groundwater Corrective Action Plan. In order to more effectively determine cleanup levels required to reduce and eliminate take of listed species, bioassay studies will be conducted.

4.) Nuclear Regulatory Commission regulations allow for the establishment of alternate concentration limits at the point of compliance when background concentrations and/or acceptable hazard levels "may not be practically achievable at a specific site." (10 CFR part 40, Appendix A, criterion 5B(6)). Alternate concentration limits must not only protect human health but also must protect listed fishes.

5.) The Service has found that the effects of the proposed action of capping the pile in place would result in the loss of designated critical habitat for the razorback sucker and Colorado squawfish. Using the Nuclear Regulatory Commission/Atlas design provided in the Biological Assessment and Preliminary Final Environmental Impact Statement and the comments provided by Atlas Corporation on the Revised Draft Biological

Opinion, capping the pile in place would result in the permanent loss of an additional 0.5 acres of the 100-year floodplain of the Colorado River. Additionally, an unspecified amount of the 100-year floodplain, and thus designated critical habitat, would be temporarily modified during construction.

6.) Because little is known of the southwestern willow flycatcher populations on the Atlas side of the Colorado River near Moab, Utah, monitoring shall be conducted by an individual permitted by the Service and using the Service approved monitoring protocol.

7.) Because larval, juvenile and adult fish are known to use the backwaters and near shore habitats of the Colorado River as nursery and foraging habitat and because of the backwater associated with the current location of Moab Wash, construction activities associated with reconfiguration of Moab Wash shall be implemented in such a way as to minimize take.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Endangered Species Act, the Nuclear Regulatory Commission must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. To implement reasonable and prudent measure number 1, minimizing and reducing take of listed fishes from leachates seeping to the Colorado River from contaminated groundwater, the Nuclear Regulatory Commission shall implement the following terms and conditions.

a.) Require Atlas Corporation to dewater the tailings pile to the extent necessary to place the radon barrier and infiltration barrier, which is the final portion of the cap. This is to be accomplished wihtin 30 months after Atlas's receipt of Nuclear Regulatory Commission approval of the dewatering design. Any water actively withdrawn from the pile must be disposed of in a manner that will not result in jeopardy to listed species.

b.) Require Atlas Corporation to cleanup contaminated groundwater from the tailings pile as well as other sources to the extent necessary to meet relevant standards within 7 years after receipt of Nuclear Regulatory Commission approval of the revised ground water corrective

action plan. Any accepted groundwater remediation plan must be designed to achieve cleanup in the shortest feasible period of time, and be designed to minimize the mixing zone in the Colorado River relative to chronic standards. Relevant standards shall include the ammonia concentrations as identified below as well as other constituents regulated by the Nuclear Regulatory Commission and surface water quality standards for the protection of aquatic life as identified in Utah Administrative Code 51-317 dated December 19, 1997. While several of these constituents are not specifically known to take the endangered fish at levels identified below the Atlas tailings pile, as previously identified under the "Effects of the Proposed Action", the synergistic and/or additive effects of elevated concentrations of the known tailings contaminants may be adversely affecting Colorado squawfish and razorback sucker.

c.) Expedite approvals of Atlas's barrier design and revised groundwater corrective action plan so that the relevant water quality standards, as identified above, in the Colorado River are met within 10 years from receipt of this final biological opinion.

d.) Reinitiate consultation with the Service for those portions of any revised groundwater program that may affect endangered or threatened species.

e.) Monitor surface water quality in the Colorado River at and downstream of the Atlas site as necessary to insure compliance with the above time frames and ammonia standards identified below. Reports of the monitoring shall be supplied to the Service's Salt Lake City Field Office annually.

2. To implement reasonable and prudent measure number 2, reducing and eventually eliminating take of endangered fish from high concentrations of ammonia, the Nuclear Regulatory Commission shall implement the following terms and conditions:

a.) To assure that ammonia levels will be reduced to levels avoiding future take of endangered fish, the Nuclear Regulatory Commission shall incorporate, whether by order or through the request of Atlas Corporation, ammonia as a new constituent in the license held by Atlas Corporation. The Nuclear Regulatory Commission shall require Atlas Corporation to meet the following ammonia standards for surface water at and below the Atlas tailings pile:

1.) The chronic toxicity standard of 0.38 mg/l (see appendices for an explanation of this number) total ammonia as N shall not be exceeded in the Colorado River outside of the mixing zone as allowed by the State of Utah water quality standards for the protection of aquatic life. These standards are promulgated in R317-2-5 and allow for the following mixing zone: "A mixing zone is a limiting portion of a body of water, contiguous to a discharge, where dilution is in progress but has not yet resulted in concentrations which will meet certain standards for all pollutants. At no time, however, shall concentrations within the mixing zone be allowed which are acutely lethal as determined by bioassay or other approved procedure...The size of the chronic mixing zone shall not exceed 2500 feet." The 2,500 foot mixing zone shall begin at the most upstream point in the Colorado River where ammonia levels begin to increase as a result of the contaminant plume from the Atlas tailings pile.

2.) An acute toxicity standard of 1.93 mg/l total ammonia as N (see appendices for explanation of number) shall not be exceeded in the Colorado River at or below the Atlas tailings pile. This acute standard shall not allow for any mixing zone.

Both the acute and chronic standards were developed using an average scenario of pH (8.5) and temperature (22° C) values in the river during the time larval fish would be present. Should pH values higher than 8.5 be encountered in the river, the toxicity of ammonia would increase and these standards would no longer be valid. In such a scenario, the Utah State water quality standards should be applied.

b.) These standards may be refined by the bioassay studies that will be conducted (see below). Any change to these standards will be made when the Nuclear Regulatory Commission reinitiates consultation with the Service on the revised groundwater corrective action plan.

3. To implement reasonable an prudent measure number 3, and allow for bioassay studies to determine levels of ammonia required to eliminate take of the endangered fish, the Nuclear Regulatory Commission shall implement the following terms and conditions:

a.) The Nuclear Regulatory Commission shall ensure that the Service and others participating in the bioassay study are permitted access to the Atlas property to conduct the study.

b.) The Nuclear Regulatory Commission shall encourage the participation of Atlas Corporation in providing funding and technical assistance in implementing the bioassay study.

4. To implement reasonable and prudent measure number 4, and insure that alternate concentration limits are protective of endangered fish, the following term and condition shall be implemented.

The Nuclear Regulatory Commission shall consult with the Service before establishing alternate concentration limits, and exceptions thereto, at the Atlas site. The bioassay studies discussed above will help determine if alternate concentration limits can be allowed without resulting in take of endangered species.

5. To implement reasonable and prudent measure number 5, minimizing or avoiding the loss of critical habitat, the following term and condition shall be implemented.

The Service normally prefers to avoid the loss of critical habitat as its preferred alternative. However, in this instance to do so would involve a delay in implementing the proposed action, thereby, delaying the correction of the current jeopardy situation. The pile could be redesigned and reconfigured so as to move the edge of the pile and any cap out of the floodplain. However, this would involve requiring Atlas Corporation to submit a new design to the Nuclear Regulatory Commission. This would take time requiring amendments to the National Environmental Policy Act documents already prepared, a delay in completing the required permitting process, and a delay in any on the ground activities that would eventually limit the leaching from the pile and remove the jeopardy to the endangered fish. For the above reasons and since the actual loss of critical habitat is fairly small, in this instance it is in best interest of the endangered species to offset the loss of designated critical habitat by other means.

The Nuclear Regulatory Commission shall require Atlas Corporation to offset the loss of 0.5 acre of critical habitat by acquiring, protecting, and/or restoring floodplain habitat of an equal value to that lost due to the capping of the pile. This shall be coordinated with Service personnel to insure the acceptability of the site and compliance with the reasonable and prudent alternative.

6. To implement reasonable and prudent measure number 6, minimizing take of southwestern willow flycatcher, the following terms and conditions shall be implemented.

   a.) Monitoring for southwestern willow flycatcher shall be conducted on the Atlas site by individuals possessing the necessary permits. Monitoring shall be conducted according to the Service approved monitoring protocol (Tibbitts et al. 1994). A report of survey results shall be submitted to the Service and the Utah Division of Wildlife Resources within 1 year of the acceptance of this biological opinion, and shall be used, in part, for planning and implementation of southwestern willow flycatcher recovery efforts.

   b.) Construction activities disturbing southwestern willow flycatcher habitat shall be implemented in such a way to reduce and minimize the loss of shrub habitat. Upon completion of these activities, the Nuclear Regulatory Commission shall require Atlas Corporation to revegetate any disturbed areas with willow plantings.

7. To implement reasonable and prudent measure number 7, the following term and condition shall be implemented.

   Construction activities associated with reconfiguration of Moab Wash shall be seasonally restricted to the time of the year of least likely use by endangered fish, specifically work on the reconfiguration of the Wash should only occur from November through March.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. With implementation of these measures, the Service believes that take will be minimized. If, during the course of the action, take exceeding that authorized above is identified, or take resulting from effects not considered is identified, such incidental take represents new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

REPORTING REQUIREMENTS

The incidental take statement and reasonable and prudent alternative provided in this biological opinion satisfy the requirements of the Endangered Species Act of 1973, as amended. This statement does not constitute an authorization

for take of listed migratory birds under the Migratory Bird Treaty Act, the Bald Eagle Protection Act, or any other Federal statute.

Upon locating dead, injured or sick razorback suckers, Colorado squawfish, humpback chub, bonytail chub, or southwestern willow flycatchers, immediate notification must be made to the Service's Salt Lake City Field Office at (801)524-5001, the Service's Division of Law Enforcement, Ogden, Utah, at telephone number (801) 625-5570, and the Utah Division of Wildlife Resources, 1596 West North Temple, Salt Lake City, Utah 84116 at (801)538-4700. Pertinent information including the date, time, location, and possible cause of injury or mortality of each individual taken shall be recorded and provided to the Service. Instructions for proper care, handling, transport, and disposition of such specimens will be issued by the Service's Division of Law Enforcement. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act directs Federal agencies to utilize their authorities to further the purposes of the Endangered Species Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse affects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. Recommendations are:

1. All project employees should be informed of the presence of razorback sucker, Colorado squawfish, and southwestern willow flycatcher, and of their endangered status, in the proposed project area. They should be advised as to the definition of "take", and the potential penalties (up to $25,000 in fines and 6 months in prison) for "taking" a species listed under the Endangered Species Act.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in the Biological Assessment, Supplemental Biological Assessment and accompanying request for

formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) incidental take is identified; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of take is exceeded, any operations causing such take must cease pending reinitiation. Because the Service has identified in the Reasonable and Prudent Alternatives that specific time frames must be met to remove jeopardy to the endangered species, the Service reserves the right to review and reopen this consultation if after 10 years from issuance of this opinion the jeopardy to the endangered fish still exists.

The Service appreciates your cooperation in the formulation of this biological opinion.

Sincerely,

Ralph O. Morgenweck

Regional Director

cc: Atlas Corporation, Republic Plaza, 370 Seventeenth Street, Suite 3050, Denver, CO 80202 (Attn: Richard Blubaugh)

Department of the Interior, National Park Service, Arches/Canyonlands National Park, 125 W. 200 S., P.O. Box 907, Moab, UT 84532 (Attn: Bruce Rodgers)

Department of the Interior, Office of the Secretary, Office of Environmental Policy and Compliance, Washington, D.C. 20240 (Attn: Terence N. Martin)

Department of the Interior, Regional Solicitor, 755 Parfet St., Suite 151, Lakewood, CO 80215 (Attn: Gina Guy)

Department of the Interior, Office of the Secretary, 1849 C Street, Mailstop 7229, Washington, D.C. 20204 (Attn: Molly McUsic)

bcc: AES/TE, Washington, D.C.
FWS/ES, Grand Junction, CO
FWS/ES, Golden, CO
FWS/ES, Salt Lake City, UT
RO rf, RD rf
COKANUT rf

COKANUT:LShanks:vs:03/02/98(F:\WP\OPINION\ATLASREV.DBO)
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APPENDIX A

JUSTIFICATION FOR AMMONIA STANDARDS IDENTIFIED IN THE REASONABLE AND PRUDENT ALTERNATIVE

As part of the Reasonable and Prudent Alternative for Reclamation of the Atlas Mill Tailings Pond, the Service has identified that the Nuclear Regulatory Commission shall incorporate, whether by order or through the request of Atlas Corporation, ammonia as a new constituent in the license held by Atlas Corporation. The Nuclear Regulatory Commission, in order to designate specific concentrations for chronic and acute ammonia standards at Atlas's point of compliance, has requested that the Service determine concentrations in surface water that would be protective of endangered fish.

At the meetings held on May 21 and 22, 1998, the Service identified that it would be using data gathered from the Biological Resources Division, U.S. Geological Survey, to determine acute and chronic standards. However, the data from the Geological Survey was gathered using lethality as an endpoint in determining effect levels. Using these levels would allow for 25 to 50 percent mortality to occur. The researchers at the Geological Survey, in a memorandum to the Service dated June 12, 1998, identified that the data they had gathered was not as protective of the endangered fish as the State standards and recommended that the State standards be used in any clean-up efforts at the Atlas site until more definitive testing could be conducted.

The current State of Utah surface water quality standards for the protection of aquatic life do not use a single number for an acute or chronic ammonia standard. Instead, because the toxicity of ammonia is dependent on water pH and temperature, these variables are collected at the same time as ammonia concentrations and entered in a formula to determine site specific ammonia standards.

The Service determined that in order to identify a specific concentration for an acute and chronic standard in the surface water that would be protective of endangered fish, pH and temperature values present in the surface water adjacent to the Atlas tailings pile during the time the most sensitive life stages of the endangered fish were present had to be used in the calculation. Therefore, temperature and pH values present in the Colorado River during the months of June, July and August were researched using U.S. Geological Survey Water Resources data, State of Utah Department of Environmental Quality data, and site specific data collected at and below the Atlas tailings pile by Atlas Corporation (HLA 1998). June, July, and August are the months when larval endangered fish (the most sensitive life stage) would be present in the near shore and backwater habitats adjacent to the Atlas site.

The U.S. Geological Survey data collected for the last 10 years (1988-1997), and reported in the yearly Water-Data Reports, identified that the average temperature recorded in the river at the Cisco gage was 22°C. The Service

also looked at State of Utah surface water data for temperatures recorded at the Highway 191 bridge at Moab to get more site specific temperature information. The average water temperature recorded by the State for the months of June, July, and August was 21.5°C. Rounding this number up, it matches the average temperature recorded at Cisco. Therefore, the Service determined that this was a reasonable temperature to insert into the calculations for an ammonia standard protective of endangered fish.

The U.S. Geological Survey data collected at the Cisco gage, and reported in the yearly Water-Data Reports, for the last 10 years (1988-1997) reported a maximum pH of 8.5. Atlas site specific data, collected and reported by Harding-Lawson Associates (HLA 1998) reported an average pH of 8.5. Therefore, a pH value of 8.5 was used in the formula to calculate an ammonia concentration protective of endangered fish.

The temperature of 22°C and pH of 8.5 were inserted into the formula used by the State of Utah Department of Environmental Quality to calculate site specific standards. This formula is identified in the December 1997 Standards of Quality for Waters of the State (Utah Administrative Code R317-2). However, as identified by Department of Environmental Quality personnel, the formula in this document has several errors. To be certain of accuracy, therefore, the Service used a table prepared by Utah Department of Environmental Quality in which the temperature and pH values are inserted into the table which then automaticaly calculates chronic and acute standards for those site specific values. These numbers were then verified for the Service by staff of the Utah Department of Environmental Quality. The tables are shown below.

Table 1. Colorado River Surface Water Quality Numeric Criteria for Total Ammonia (as N) Based on a 4-day Average Chronic Concentration Standard. River Classification at Atlas = 3B.

Approximate Field Temperature	C	22
Approximate Field pH	S.U.	8.5
WQNC Calcs:	FT	1.00
	FPH	1.00
	Ratio	13.5
WQNC: NH3, un-ion (as N)		0.049
Abs. Temp.	K	295.2
	pKa	9.34
WQNC: NH3, Total (as N)		**0.38**

Table 2. Colorado River Surface Water Quality Numeric Criteria for Total Ammonia (as N) Based on a 1-hour Average Acute Concentration Standard. River Classification at Atlas = 3B.

Approximate Field Temperature	C	22

Approximate Field pH	S.U.	8.5
WQNC Calcs:	FT	0.87
	FPH	1.00
WQNC: NH3, un-ion (as N)		0.245
Abs. Temp.	K	295.2
	pKa	9.34
WQNC: NH3, Total (as N)		**1.93**

APPENDIX B

Individuals and/or Organizations Who Provided Technical Assistance or Information to the Service During the Development of the Biological Opinion for the Atlas Mill Tailings Reclamation Plan

Utah Department of Environmental Quality
Division of Radiation Control
168 North 1950 West
P.O. Box 144850
Salt Lake City, Utah 84114-4850

Utah Department of Environmental Quality
Division of Water Quality
288 North 1460 West
P.O. Box 144870
Salt Lake City, Utah 84114-4870

Willow Creek Ecology, Inc.
P.O. Box 280
250 South Main
Mendon, Utah 84325

U.S. National Park Service
Division of Water Resources
Denver, CO

Grand Canyon Trust
Moab, Utah

Environmental and Contaminants Research Center
Biological Resources Division
U.S. Geological Survey
4200 New Haven Rd.
Columbia, MO 65201

Utah Department of Natural Resources
Division of Wildlife Resources
Moab, Utah

Scott M. Matheson Wetlands Preserve
The Nature Conservancy
Moab, Utah

Colorado River Fishes Program, USFWS
Grand Junction, CO
Denver, CO

Oak Ridge National Laboratory
P.O. Box 2567
Grand Junction, CO 81502

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

U.S. National Park Service
Arches National Park
Moab, Utah

Grand County Council
125 East Center Street
Moab, Utah 84532

U.S. Geological Survey
Utah District Office
Water Resources Division
Room 1016 Administration Bldg.
1745 West 1700 South
Salt Lake City, Utah 84104

U.S. Environmental Protection Agency
Region VIII
999 18th Street, Suite 500
Denver, CO 80202-2466

U.S. Department of Energy
Grand Junction, CO

U.S. Nuclear Regulatory Commission
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and
Safeguards
Washington, D.C. 20555-0001

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707 17th St., Suite 2400
Denver, CO 80202

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RICHARD E. BLUBAUGH
Vice President Environmental
and Governmental Affairs

U.S. FISH & WILDLIFE
RECEIVED
JUL 24 1998
REGIONAL DIRECTOR
DENVER, COLO.

July 23, 1998

VIA FACSIMILE: (301) 415-5397
Mr. Joseph J. Holonich, Chief
U.S. Nuclear Regulatory Commission
High-Level Waste and Uranium Recovery
Projects Branch (MS-T7J9)
Division of Waste Management, ONMSS
Washington, D.C. 20555-0001

VIA FACSIMILE: (303) 236-3815
Mr. Ralph Morgenweck, Ph.D.
Regional Director, Region 6
P.O. Box 25486
Denver Federal Center
134 Union, Suite 400
Lakewood, CO 80225-0486

Re: License No. SUA-917, Docket No. 40-3453; Agreement to Pay Average Annual Water Depletion Charge Pursuant to the Final Biological Opinion Resulting from the Section 7 Consultation on the Proposed Reclamation Plan for the Atlas Uranium Mill and Tailings Site, Moab, Utah

Dear Messrs. Holonich and Morgenweck:

As specified on pages 91 – 93 of the July 9, 1998 final draft biological opinion, Atlas Corporation is writing this letter to document its commitment to pay the one-time charge calculated under the cooperative agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (USFWS, 1987). Atlas and NRC identified the average annual water depletion for the proposed surface reclamation plan for the uranium mill and tailings site to be 154.3 acre-feet. Thus, after multiplying this figure by $13.81, the one-time payment based on the average annual depletion for this project is $2,131.

Accordingly, Atlas Corporation hereby agrees to pay ten percent, or $213, to the FWS' designated agent, the National Fish and Wildlife Foundation at the time of issuance of the NRC approval for the proposed reclamation plan, and to pay the balance at the time the authorized construction commences. The payments will be made to:

National Fish and Wildlife Foundation
1120 Connecticut Avenue, Suite 900
Washington, D.C. 20036

Each payment will be accompanied by a cover letter that contains the information specified on page 93 of the July 9, 1998 final draft biological opinion.

Very truly yours,

Richard E. Blubaugh

cc: Gregg Shafter
Jim Jensen
Anthony Thompson, Esq.
Don Baur, Esq.