Final Environmental Impact Statement

1999

LITTLE SNAKE SUPPLEMENTAL IRRIGATION WATER SUPPLY

Carbon County, Wyoming

Wyoming Water Development Commission

U.S. Army Corps of Engineers
Omaha District
FINAL ENVIRONMENTAL IMPACT STATEMENT for the LITTLE SNAKE SUPPLEMENTAL IRRIGATION WATER SUPPLY PROJECT in CARBON COUNTY, WYOMING

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FINAL ENVIRONMENTAL IMPACT STATEMENT

October 1999

Lead Agency: U.S. Department of the Army, Corps of Engineers, Omaha District

Cooperating Agencies:
- U.S. Environmental Protection Agency, Region 8
- U.S. Fish and Wildlife Service, Wyoming and Colorado offices
- Bureau of Land Management, Rawlins District
- U.S. Geological Survey
- U.S. Forest Service
- Wyoming Environmental Quality Department
- Wyoming Game and Fish Department
- Wyoming State Engineer’s Office
- Wyoming State Historic Preservation Office
- Colorado State Engineer’s Office
- Colorado Division of Wildlife
- Little Snake River Conservation District
- Savery-Little Snake Water Conservancy District

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ABSTRACT
This Final Environmental Impact Statement (FEIS) discloses the environmental impacts from the Wyoming Water Development Commission’s plan to provide late-season irrigation water to the Savery-Little Snake Water Conservancy District. Construction of this project would require a Clean Water Act, Section 404, Dredge and Fill permit from the U.S. Army Corps of Engineers and a right-of-way from the U.S. Bureau of Land Management. Five alternatives were selected for in-depth evaluation in the FEIS: Sandstone dam and reservoir, High Savery dam and reservoir, conservation, and no-action. The reservoirs would range in size from 330 to 482 acres at normal pool elevation and would supply 12,000 acre-feet of late-season irrigation water with a frequency of eight out of ten years. The applicant’s preferred alternative, the High Savery dam and reservoir with a minimum pool, would significantly impact water, vegetation, wetlands, wildlife, cultural resources, and endangered species.

Downstream flows would be reduced during the spring and increased in the summer. Average annual flow in the Little Snake River would be reduced 10,800 acre-feet. The reservoir would interrupt the normal transport of stream sediments and scour a portion of the stream bottom downstream of the dam. Changes in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat. The 482-acre reservoir would inundate 8.4 miles of permanently flowing streams, 16 acres of wetlands, 52 acres of riparian shrublands, 482 acres of seasonal range for elk, mule deer, and pronghorn antelope, and 11 cultural resource sites potentially eligible for the National Register of Historic Places. Impacts to the Savery Creek channel would be minimized by the installation of grade control structures downstream of the dam. The lost wetlands and riparian shrublands would be replaced by the creation of new, or the enhancement of existing communities along upper Savery Creek. The lost big game range would be mitigated by the enhancement of a similar amount of existing range. The increased summer base-flow in Savery Creek would improve habitat for trout. The reservoir’s minimum pool would be used by the Wyoming Game and Fish Department as a brood site for a state sensitive species, the Colorado River cutthroat trout, whose offspring would be used to enhance the species’ population in the Little Snake River basin.
SUMMARY

INTRODUCTION AND PROPOSED ACTION

The Wyoming Water Development Commission (WWDC) proposes construction of a dam and reservoir on Savery Creek in Carbon County, Wyoming, to supply late-season supplemental irrigation water to Wyoming water rights holders in the Savery-Little Snake Water Conservancy District. Because construction of the dam would place fill materials in Savery Creek and inundate land administered by the U.S. Bureau of Land Management (BLM), WWDC has applied to the U.S. Army Corps of Engineers (Corps) for a permit, pursuant to Section 404 of the Clean Water Act, to discharge dredged or fill materials into the waters of the United States and for a right-of-way from BLM. The consideration of these applications constitutes federal action that requires the preparation of an environmental impact statement pursuant to the National Environmental Policy Act of 1969 (NEPA).

This Environmental Impact Statement (EIS) was prepared in accordance with Council of Environmental Quality (CEQ) regulations 40 CFR Parts 1500 through 1508 implementing NEPA and provides a complete and objective analysis of environmental effects of the proposed project and its reasonable alternatives.

An earthen-fill dam would be built on Savery Creek approximately 42 stream miles upstream from the Little Snake River. At normal pool elevation, the reservoir would have a surface area of 482 acres and a storage volume of 22,433 acre-feet (AF). Maximum depth in the reservoir would be 130 feet. Water would be stored in the reservoir during the spring when flow in Savery Creek is high from snow-melt. Water for irrigation, 12,000 AF, would be released between July 15 and September 15. A 51-foot vertical change in the reservoir's pool elevation would be expected during the growing season. The reservoir would maintain a minimum pool of 5,724 AF. This pool is sized to accommodate approximately 14,600 adult Colorado River cutthroat trout (CRCT) which the Wyoming Game and Fish Department (WGFD) would use as brood stock for the regional species recovery plan.

PURPOSE AND NEED

The purpose of the proposed project, known as the Little Snake Supplemental Irrigation Water Supply Project (LSSIWSP), is to provide 12,000 AF of late-season irrigation water 8 out of 10 years to lands in the Little Snake River basin over a project life-span of 100 years. The water would be used to reduce the existing amount of unrealized agricultural productivity currently
caused by the lack of a late-season irrigation water supply. As such, this water would not serve as a basis for granting new water rights and would only be used on lands that are currently being irrigated with water under Wyoming water rights.

The normal appropriation of water for irrigation as per Wyoming Water Law is one (1) cubic foot of water per second (cfs) for every 70 acres permitted. Wyoming statutes allow for the diversion of one (1) additional cfs during times when sufficient flow exists to meet all other water rights. After investigating the minimum amount of water that should be supplied on a supplemental basis to supply crop needs during the late-season, WWDC established a minimum of 0.5 cfs per 70 acres. Supplemental water would be provided for a two-month (61-day) period, between July 15 and September 15. This rate converts to 0.864 AF of water per acre of irrigated land.

An analysis of 1983 infrared aerial photography indicated approximately 73 percent of the lands in the Wyoming portion of the basin with Wyoming water rights were actually irrigated. Applying this percentage to the lands in the Colorado portion of the basin yields a total of 17,460 acres of land in the Little Snake River basin that is actually irrigated under Wyoming water rights permits. Based on 0.864 AF of water per acre of irrigated land, a nominal need exists for 15,090 AF of water for supplemental, late-season irrigation water.

**ALTERNATIVES**

A total of twenty-six alternatives were evaluated to identify those best suited to meet the need for 12,000 AF of late-season irrigation water. These alternatives included 22 dam and reservoir alternatives, two groundwater well field alternatives, groundwater recharge, and conservation. The 25 structural water supply alternatives (dams and reservoirs, well fields and recharge) were identified in previous water supply studies in the Little Snake River basin. The alternatives were evaluated using a step-wise screening process to determine which would be evaluated in detail in the draft environmental impact statement (DEIS). The first step, engineering feasibility and geologic criteria, eliminated one reservoir alternative because landslides made the dam site unstable. The second step was a comparison of the effective cost of water provided by the reservoir alternatives and capacity considerations for the groundwater alternatives. The alternatives were ranked by the cost per AF of yield. Sixteen alternatives, including deep aquifer groundwater, exceeded twice the cost of the least expensive alternative and were eliminated from further consideration. The alluvial groundwater alternative was eliminated because alluvial groundwater is considered as surface water in Wyoming and any new wells for the LSSIWSP would have junior water rights. Adequate aquifer storage was not available for the groundwater recharge alternative. Two more alternatives were eliminated from further consideration in the third screening step - a preliminary environmental evaluation. Of the five remaining alternatives, one reservoir alternative was eliminated because it could not provide the necessary 12,000 AF of
late-season water. The remaining alternatives were the Sandstone dam and reservoir, the High Savery dam and reservoir, the Dutch Joe dam and reservoir, and conservation.

A fifth alternative, no-action, was also included in the EIS. The no-action alternative is an essential part of every EIS, as set forth in the CEQ NEPA regulations. In terms of NEPA, the "no action" alternative is defined as how the project need would be met without a Federal permit. For the proposed project, the action required by the Federal Government would be the issuance by the Corps of a Section 404, Dredge and Fill permit for the affected waters of the United States and the granting of a right-of-way from BLM. In this case, the no-action alternative is defined as no construction and no provision of late-season supplemental irrigation water. The conservation alternative would not require federal action but is included as a separate alternative. The no-action alternative is included to help establish the base from which the final alternatives are evaluated.

The Sandstone dam and reservoir water supply alternative would be located on Savery Creek, approximately 10 miles upstream from the Little Snake River and has been proposed in two sizes. The version with a minimum pool would have a surface area of approximately 370 acres, a normal operating pool capacity of approximately 15,800 AF, and a yield of 12,000 AF of late-season, supplemental, irrigation water eight out of ten years. Maximum water depth of the reservoir would be approximately 95 feet. Vertical water level fluctuation could be as large as 47 feet. The minimum pool would have a storage capacity of approximately 3,100 AF and would provide a permanent fishery and other recreational opportunities. The minimum pool would however not be feasible for maintaining a CRCT brood source (Section 4.6.4.2.1). The dead storage pool would contain approximately 100 AF of water. Reservoir storage would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow or 24 cubic feet per second (cfs) to protect downstream aquatic habitats.

The Sandstone dam and reservoir alternative without a minimum pool would have a normal pool surface area of 330 acres, a storage capacity of approximately 12,600 AF, and a yield of 12,000 AF of late-season, supplemental, irrigation water eight out of ten years. The reservoir would have a maximum depth of approximately 85 feet. The vertical fluctuation in water level between the spring filling period and the end of the irrigation season could be as large as 75 feet. Only a dead pool with a storage capacity of approximately 100 AF would remain at the end of the irrigation season. Reservoir storage would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow or 24 cfs.

Both versions of the Sandstone dam and reservoir alternative are expected to thermally stratify in the summer; however, the onset of stratification would be delayed because of reservoir filling and the duration of stratification would be shortened because of the release of water for irrigation. As a result, it is unlikely that the bottom layer of water in the reservoir would have time to become oxygen depleted. Water quality in the reservoir would likely be lower in
turbidity, alkalinity, nitrogen, and phosphorus, but higher in chlorophyll, relative to the incoming stream water. A multi-point release structure would allow water from different depths within the reservoir to be released and provide control over the temperature of the water discharged into Savery Creek.

The **High Savery dam and reservoir** water supply alternative would be located on Savery Creek approximately 42 miles upstream from the Little Snake River and has also been proposed in two sizes. The High Savery dam and reservoir with a minimum pool would have a surface area of approximately 482 acres, a volume of 22,433 AF at normal pool elevation, and a yield of 12,000 AF of late-season, supplemental, irrigation water eight out of ten years. Maximum depth in the reservoir would be 130 feet. A 51-foot vertical change in the reservoir's water elevation could be expected during the growing season. The minimum pool would have a storage capacity of 5,724 AF. The volume of the minimum pool is sized to accommodate approximately 14,600 adult CRCT which the WGFD would use as brood stock for the regional species recovery plan. The dead storage pool would have a volume of 48 AF. Reservoir storage would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow or 12 cfs to protect downstream aquatic habitats.

High Savery dam and reservoir without a minimum pool would occupy approximately 420 surface acres, contain 18,000 AF of water at normal pool elevation, and yield 12,000 AF of late-season, supplemental, irrigation water eight out of ten years. Maximum depth would be approximately 120 feet. Up to a 105-foot vertical change in water level could occur between May and October. The dead pool would have a storage capacity of 48 AF. A minimum flow water release equal to the lesser of natural inflow or 12 cfs will be provided.

Both versions of the High Savery dam and reservoir alternative are expected to thermally stratify in the summer and would have water quality characteristics similar to the Sandstone alternative. A multi-point release structure would allow water from different depths within the reservoir to be released.

The **Dutch Joe dam and reservoir** alternative would be located on Dutch Joe Creek approximately 2 miles upstream from the Little Snake River. At normal pool elevation, the reservoir would cover approximately 300 surface acres and have a volume of 14,400 AF. Approximately 150 acres would be impacted by the water supply pipeline and canal from Savery Creek and the canal from Dutch Joe Reservoir to Savery Creek. The reservoir would yield 12,000 AF of late-season, supplemental, irrigation water eight out of ten years. The size of the reservoir can not be increased to include a minimum pool because the of physical site limitations. The water to fill the reservoir would be diverted from Savery Creek and transported to the reservoir in a pipeline and canal. A minimum flow past the diversion structure equal to the lesser of natural flow or 24 cfs would be maintained in Savery Creek to protect downstream aquatic habitats. All water stored would be released by the end of the irrigation season, leaving only a
dead storage pool containing 100 AF of water. The Dutch Joe reservoir would have a maximum depth of approximately 122 feet. Water surface elevation could vary during the growing season by as much as 114 feet. Because Dutch Joe Creek is intermittent, no minimum flows would be released. Water held in Dutch Joe reservoir is expected to thermally stratify during the summer. In addition, water released initially from Dutch Joe in July would likely be low in dissolved oxygen and cold. A multi-level outlet would be included to help increase the oxygen content and reduce the temperature difference of waters in Dutch Joe Creek and the Little Snake River. The addition of cold water could adversely impact existing natural fish populations in the Little Snake River immediately downstream of Dutch Joe Creek.

The conservation alternative would involve changes in agricultural practices within the basin, improvements to irrigated lands, and rehabilitation of existing structures facilitating irrigation activities. These changes would include:

- Large-scale conversion of grass pasture to alfalfa
- Land leveling
- Purchase, installation, and use of sprinkler systems
- Intensive on-farm water management including more frequent applications of smaller water quantities
- Large-scale lining of irrigation canals, both major transport canals and smaller on-farm canals
- Replacement and construction of headgates and diversion structures
- Placement and use of metering devices.

Under normal conditions, conservation measures generally reduce water loss and provide a more even distribution of existing, available water. However, conservation cannot produce new water and conservation cannot save water when water is not available. Without concurrent storage, conservation cannot affect the timing of, or the season, when water is available. In the Little Snake River basin, late-season demand for water is much greater than the amount of water available. Conservation could not provide more late-season irrigation water or sufficiently reduce late-season demand to match the existing, limited, late-season supply.

Conservation is also not a viable alternative to supply late-season irrigation because: 1) insufficient acreage exists within the Little Snake River Water Conservancy District (LSRWCD) to provide for 12,000 AF of water savings through conservation and 2) farmers would be unlikely to recover the cost of on-farm improvements with increased production or decreased water costs. However, to adequately respond to comments received during the public scoping process, the conservation alternative was included in the EIS.

Under the no-action alternative, the Corps would not issue a Section 404 permit and a dam and reservoir would not be built. Because no other water storage facilities, including off-channel
storage, exist in the basin, the no-action alternative would not involve initiating any measure to provide supplemental irrigation water within the Little Snake River basin. Irrigation and livestock husbandry practices would continue in much the same way they are presently conducted. Late-season irrigation water shortages would occur annually, limiting forage production and necessitating the continued purchase of hay, wintering livestock elsewhere, and premature sale of livestock. The fisheries habitat and recreational opportunities would remain unchanged. Although the no-action alternative would not provide any of the benefits of a new water supply, this alternative was retained in the EIS because it is required by the NEPA process and serves as a baseline against which the impacts of the other alternatives can be compared.

ENVIRONMENTAL CONSEQUENCES

The dam and reservoir alternatives for the LSSIWSP would, to varying degrees, significantly impact the same natural resources. The impacted resources would include surface water quantity and quality, wetlands and other vegetation communities, wildlife, fisheries, threatened or endangered species and cultural resources. The conservation and no-action alternatives would not significantly impact the natural or human environment.

The Sandstone dam and reservoir alternative with a minimum pool would affect the flow of water in Savery Creek and the Little Snake River. Average monthly discharge in Savery Creek at the dam site would be reduced up to 63 percent when the reservoir is being filled in the spring. In late-summer, average monthly discharge in Savery Creek would be increased up to 934 percent. The project’s relative impact on streamflows would decline as the distance downstream from the dam increased. In the Little Snake River, just upstream from the Yampa River, the maximum reduction in average monthly discharge would be 14 percent and the maximum increase would be 24 percent. The average annual reduction in flow in the Little Snake River caused by the increased irrigation this project would allow would be 9,580 AF. Average annual peak flows in Savery Creek just upstream from the Little Snake River would be reduced by approximately 120 cubic feet per second (cfs) and delayed 4 days. The project would increase the average recurrence interval for out-of-bank flows from 5.2 to 7.8 years. The reservoir would trap sediments and release water which, lacking sediment, would scour and down-cut the stream channel below the dam. This effect would likely extend downstream until another significant source of sediment entered the stream. Most of the water released by the reservoir would be diverted for irrigation and lost because of evapotranspiration. The maximum concentrations of salts in the Little Snake River at Lily, Colorado are predicted to increase approximately 25 percent in the fall. Due to return flows, total salt deliveries to the Yampa River will not increase. Changes in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat. The U.S. Fish and Wildlife Service (FWS) considers the changes and depletion in river flow and interruption of sediment transport caused by the project to be a jeopardy to the continued existence of the endangered Colorado pikeminnow, humpback chub, bonytail, and razorback sucker.
The reservoir with a minimum pool would unavoidably inundate 370 acres including 111 acres of sagebrush steppe, 36 acres of grassland meadow, 126 acres of riparian cottonwood, 8 acres of riparian willow/alder, 42 acres of aspen and fir/aspen forests, and 25 acres of jurisdictional wetlands. The loss of wetlands and riparian vegetation would be significant impacts. Jurisdictional wetlands are protected by the Clean Water Act. Riparian cottonwoods and willow/alder shrublands have high value to wildlife and are relatively uncommon in the surrounding area. The reservoir would also inundate 370 acres of crucial winter range and 172 acres of birthing range for elk. About 7 miles of permanently flowing streams containing enough habitat to support nearly 400 pounds of trout would be lost. However, increased summer flows caused by the release of water for late season irrigation would improve the habitat in Savery Creek to the extent an additional 337 pounds of trout could be supported downstream of the dam. The reservoir’s minimum pool would allow the development of a recreational fishery. Two cultural resources sites, which have been determined to be eligible for listing on the National Register of Historic Places (NRHP), and one site potentially eligible for listing would be inundated by the reservoir.

The Sandstone alternative without a minimum pool would have essentially the same downstream impacts as the with-minimum-pool version because the same amount of water would be released. The slightly smaller reservoir, 330 acres, would inundate commensurately smaller areas of vegetation communities, big game ranges, and fish habitat.

The High Savery dam and reservoir alternative with a minimum pool would affect the flow of water in Savery Creek and the Little Snake River. Average monthly discharge in Savery Creek at the dam site would be reduced up to 89 percent when the reservoir is being filled in the spring. In late-summer, average monthly discharge in Savery Creek would be increased up to 1,300 percent. The project’s relative impact on streamflows would decline as the distance downstream from the dam increased. In the Little Snake River just upstream from the Yampa River, the maximum reduction in average monthly discharge would be 10 percent and the maximum increase would be 23 percent. The average annual reduction in flow in the Little Snake River caused by the increased irrigation this project would allow would be 10,836 AF. Average annual peak flows in Savery Creek just upstream from the Little Snake River would be reduced by approximately 165 cfs and delayed 3 days. The project would increase the average recurrence interval for out-of-bank flows at the dam site from 10.3 to 31.0 years. The reservoir would trap sediments and release water which, lacking sediment, would scour and down-cut the stream channel below the dam until another significant source of sediment entered the stream. Most of the water released by the reservoir would be diverted for irrigation and lost because of evapotranspiration. With the High Savery alternative, the maximum concentrations of salts in the Little Snake River at Lily, Colorado are predicted to increase approximately 25 percent in the fall. Total salt deliveries to the Yampa River would not increase due to return flows from irrigation. Changes in TDS concentrations are seasonal and temporary; they do not represent a change that would adversely alter the quality of the existing stream habitat. FWS considers the
changes and depletion in river flow and interruption of sediment transport caused by the project to be a jeopardy to the continued existence of the endangered Colorado pikeminnow, humpback chub, bonytail, and razorback sucker.

The reservoir with a minimum pool would unavoidably inundate 482 acres including 247 acres of sagebrush steppe, 146 acres of grassland meadow, 1 acre of riparian cottonwood, 52 acres of riparian willow/alder, and 16 acres of jurisdictional wetlands. The loss of wetlands and riparian vegetation would be significant impacts. Jurisdictional wetlands are protected by the Clean Water Act. Riparian cottonwoods and willow/alder shrublands have high value to wildlife and are relatively uncommon in the surrounding area. The reservoir would also inundate 482 acres of seasonal range for elk, mule deer, and pronghorn antelope. Winter yearlong ranges are in the “high” mitigation category according to WGFD policy (WGFD 1999). Habitat in this category is important to sustain a community population, or subpopulation, but can be reconstructed or enhanced where avoidance is not possible. About 8 miles of permanently flowing streams containing enough habitat to support 143 pounds of trout would be covered by the reservoir. However, increased summer flow caused by the release of water for late season irrigation would improve the habitat in Savery Creek to the extent an additional 1,200 pounds of trout could be supported downstream of the dam. The reservoir’s minimum pool would allow the development of a brood stock of CRCT which would contribute to the recovery of this species in the Little Snake River basin. Five cultural resources sites, which are potentially eligible for listing on the NRHP, would be inundated by the reservoir.

The High Savery alternative without a minimum pool would have essentially the same downstream impacts as the with-minimum-pool version because the same amount of water would be released. The slightly smaller reservoir, 420 acres, would inundate commensurately smaller areas of vegetation communities, big game ranges, and fish habitat.

The Dutch Joe dam and reservoir alternative would affect the flow of water in Savery Creek and the Little Snake River. Average monthly discharge in Savery Creek at the diversion point in spring would be reduced up to 40 percent when the reservoir is being filled. In late-summer, average monthly discharge in Savery Creek would be unaffected because the reservoir would release water into Dutch Joe Creek. In the Little Snake River just upstream from the Yampa River, the maximum reduction in average monthly discharge would be 10 percent and the maximum increase would be 20 percent. The average annual reduction in flow in the Little Snake River caused by the increased irrigation this project would allow would be 9,114 AF. Average annual peak flows in Savery Creek just upstream from the Little Snake River would be reduced by 89 cfs and delayed 3 days. The reservoir would trap sediments and release water which, lacking sediment, would scour and down-cut the stream channel below the dam until another significant source of sediment entered the stream. Most of the water released by the reservoir would be diverted for irrigation and lost because of evapotranspiration. The maximum concentrations of salts in the Little Snake River at Lily, Colorado are predicted to increase with
Dutch Joe dam and reservoir approximately 25 percent in the fall. Due to return flows, total salt deliveries to the Yampa River would not increase. Changes in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat. The FWS considers the changes and depletion in river flow and interruption of sediment transport caused by the project to be a jeopardy to the continued existence of the endangered Colorado pikeminnow, humpback chub, bonytail, and razorback sucker.

The reservoir would unavoidably inundate 300 acres including 261 acres of sagebrush steppe, 34 acres of grassland meadow, and 3.2 acres of wetlands. In addition, the water supply and delivery pipeline and canal would impact an additional 150 acres consisting of riparian willow and cottonwood (5.5 acres), 91 acres of sage brush steppe, and 53.5 acres of irrigated meadow. The loss of wetlands would be a significant impact because wetlands are protected by the Clean Water Act. The reservoir in total would inundate 330 acres of winter range for elk, 450 acres of crucial range for mule deer, and 125 acres of crucial range for pronghorn antelope. Big game crucial winter range cannot be successfully mitigated.

**MITIGATION**

The methods used to mitigate significant environmental impacts caused by the LSSIWSP would be similar for each of the dam and reservoir alternatives. The impacts on the four endangered fish species from flow alterations would be mitigated by a monetary contribution to the Colorado River Recovery Program based on the average annual amount of water depleted from the Colorado River basin by the project. The loss of wetlands and riparian cottonwoods and willow/alder shrublands would be mitigated by creation of replacement communities and/or the enhancement of lower quality existing communities. The mitigation ratio, the amount of new or enhance community relative to the amount lost, would vary depending on if mitigation was by replacement or enhancement, the proximity of the mitigation site to the impacted community, and, for enhancement, the initial quality of the community to be enhanced. Typical mitigation ratios would be 2:1 for replacement and 3:1 for enhancement. Crucial big game winter range for mule deer and pronghorn as found with the Dutch Joe alternative cannot be mitigated. According to WGFD (1999), crucial winter range is subject to the following policy:

*The Mitigation Policy of the Wyoming Game and Fish Commission categorizes crucial winter range as "vital". According to Commission Policy, the vital category is the highest existing habitat classification in Wyoming. Habitat in this category directly limits a community, population, or subpopulation, and restoration or replacement may not be possible. Since a variety of factors are involved in the delineation of crucial winter range (climate, aspect, snow depth, forage, cover, etc.), there is no known way to create replacement habitat for crucial habitat which is lost. Commission policy directs the Wyoming Game and Fish Department to recommend no loss of functional crucial winter range.*
Other lost big game ranges would be mitigated by improving existing comparable range. Crucial ranges, if they can be mitigated, would be at a 3:1 ratio while seasonal ranges would be mitigated at a 1:1 ratio. Cultural resources potentially eligible for the NRHP that would be inundated would be evaluated. Eligible sites would require the development, submittal, approval, and execution of a Treatment Plan prior to any disturbance of the sites.

**MAJOR CONCLUSIONS**

- At need exists for at least 12,000 AF of late-season, supplemental irrigation water for the LSRWCD.
- The applicant’s preferred alternative would deplete downstream flows, modify downstream seasonal flow patterns, scour portions of the Savery Creek streambed, block sediment transport, and increase fall salinity in the lower Little Snake River. The reservoir would inundate 16 acres of wetlands, 53 acres of riparian vegetation, 482 acres of season range for big game, and 5 cultural resources site potentially eligible for the NRHP.
- The downstream impacts would, in the opinion of the FWS, jeopardize the continued existence of the federally endangered Colorado pikeminnow, humpback, bonytail, and razorback sucker.
- Most adverse impacts would be minimized or mitigated. Streambed scouring would be minimized by the installation of grade control structures downstream of the dam. Inundated wetlands and riparian willow/alder vegetation would be replaced by the creation of new and the enhancement of existing wetlands and riparian willow/alder vegetation. Impacts on the endangered fish species would be mitigated by a monetary contribution to the Colorado River Recovery Program. Crucial winter range found on the Dutch Joe site for mule deer and pronghorn cannot be mitigated. If other big game ranges are determined by geographic factors which prevent their replacement, these inundated big game ranges would be offset by the enhancement of existing low-quality range.
- The High Savery alternative would enhance the trout habitat in Savery Creek downstream of the dam through increased summer flows, provide a site to rear CRCT brood stock, and provide a site for flat-water recreation.

**AREAS OF CONTROVERSY**

The most prominent controversy concerning the LSSIWSP identified in the public scoping process was the monetary and environmental costs of the project relative to the benefits. Many respondents suggested this project would be a large, tax-payer funded subsidy to a relatively small number of farmers and ranchers. This project would be funded entirely by the State of
Wyoming. An evaluation of how the state appropriates its funds, however, is not a factor considered in the decision to proceed with the federal action of granting a permit and a right-of-way.

The selection of the High Savery dam and reservoir as the preferred alternative is controversial because the Dutch Joe alternative would have lower impacts to the aquatic environment in terms of the loss of wetlands and riparian vegetation. The Dutch Joe alternative, however, has other drawbacks. The Dutch Joe alternative would:

- inundate or severely modify over 450 acres of big game crucial winter range which is more important to the survival of the local herds than seasonal range and the loss of which could not be mitigated
- not enhance downstream trout habitat
- not provide a minimum pool for use in the recovery of CRCT
- provide relatively little recreational opportunities
- release cold water down Dutch Joe Creek in the Little Snake River and adversely impact natural fish populations immediately downstream.
- cost more than $7 million dollars (over 25 percent) more to construct.

Considering the wetlands and riparian vegetation inundated by the High Savery reservoir can be mitigated, the ultimate benefits of the High Savery alternative outweigh the initial lower adverse impacts to the aquatic environment caused by the Dutch Joe alternative.

ISSUES TO BE RESOLVED

The issues which still need final resolution are related to the mitigation for impacts to wetlands, riparian vegetation, stream channel habitat, big game range, and cultural resources. Mitigation plans have been proposed to prevent downstream stream channel scouring and to replace lost wetlands and willow/alder and cottonwood riparian vegetation communities, and seasonal big game range for the High Savery alternative. However, as explained in the following WGFD statement (WGFD 1999), crucial winter range are not considered mitigatable:

*The Mitigation Policy of the Wyoming Game and Fish Commission categorizes crucial winter range as “vital”. According to Commission Policy, the vital category is the highest existing habitat classification in Wyoming. Habitat in this category directly limits a community, population, or subpopulation, and restoration or replacement may not be possible. Since a variety of factors are involved in the delineation of crucial winter range (climate, aspect, snow depth, forage, cover, etc.), there is no known way to create replacement habitat for crucial habitat which is lost. Commission policy directs the Wyoming Game and Fish Department to recommend no loss of functional crucial winter range.*
The details of these plans will be finalized prior to issuance of a 404 permit. These details include the integration of reservoir operation and maintenance into the mitigation plan, the specific placement of grade control structures, and the final location of mitigation wetlands and riparian areas.

The mitigation plan for the cultural resources which would be inundated is still being developed. This development will culminate in a Memorandum of Agreement between the Wyoming State Historical Preservation Office and the Corps with concurrence by the WWDC and affected Native American tribes. The agreement will then require approval from the Advisory Council on Historic Preservation. Cultural resource mitigation will be incorporated into conditions of the 404 permit that the Corps is presently evaluating.
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CHAPTER 1
PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

The Wyoming Water Development Commission (WWDC) has submitted a letter of intent to the U.S. Army Corps of Engineers (Corps) to develop a late-season, supplemental irrigation water supply for use in the Little Snake River basin of southcentral Wyoming and northwest Colorado (Figure 1-1). This project will require WWDC to submit an application to the Corps for a permit, pursuant to Section 404 of the Clean Water Act, to discharge dredge or fill materials into the waters of the United States.

The WWDC is responsible for the Water Development Program (Program) in the state of Wyoming, including statewide water resource planning and development. The Program was authorized by the legislature to insure that Wyoming's water, as allocated by compacts and decrees, is available for economic stability and growth. The WWDC is the sponsor of the proposed action.

The major consumptive use of water in the Little Snake River basin is irrigation. Irrigation is accomplished through direct stream flow diversion and a system of ditches. Approximately 20,600 acres in Wyoming and 3,400 acres in Colorado are presently permitted in the basin under Wyoming water law to receive irrigation water (WWDC 1990, Leonard 1997). The irrigated lands and the ditches which provide water to them are within the Savery-Little Snake Water Conservancy District (SLSWCD) (Figures 1-2 and 1-3). Irrigated crops include alfalfa, hay, and small grains, which are used for livestock production.

The need for supplemental irrigation water stems from the lack of sufficient full season supplies in the Little Snake River basin. Typically, the full growing season in the area extends from mid-April to late September, with the period from mid-July to the end of September defined as late-season. Water supplies are abundant in April, May, and June because of high volumes of snow melt runoff. During these months, water supplies significantly exceed the demand (Figure 1-4). However, the supply of irrigation water in the basin is substantially reduced during late July, August, and September as snowmelt slows and ceases. During these months, the supply of irrigation water is unable to meet the demand in the basin (Figure 1-4).
1" = approximately 4500 feet
Source: Western Water Consultants
*1" = approximately 4500 feet

Source: Western Water Consultants
Note: Supply shown is the minimum available.
Source: Wright Water Engineers, Inc. and Black & Veatch 1983

Figure 1-4
WATER SUPPLY AND DEMAND
1.2 PURPOSE

A 1991 WWDC study evaluated the condition of irrigation canals and diversion structures in the Little Snake River basin. In response to this study, the WWDC and the SLSWCD invested $2,700,000 to repair, rehabilitate, and improve seven diversion dams and six canal systems - Baggs Ditch, Stateline, West Side, Lower Savery, Trowell, and First Mesa. The canal system work included new canal lining; some canal realignment; and new check structures, siphons, headgates, and water measuring devices. These system improvements were designed to more effectively convey water into and through the canals, reduce water loss, and more efficiently distribute water to all irrigated lands and crops. The actual amount of water savings has not been determined. These improvements, however, were not designed to increase the amount of water available for late-season irrigation or reduce the demand for supplemental irrigation water. Water allocation was not changed after completion of the rehabilitation projects, and the severity of late-season shortages of irrigation water remained the same.

Several other water conservation measures are in use within the basin. These measures include raising alfalfa instead of grass, land leveling, and sprinkler systems. However, these measures are generally implemented on a small scale because of their cost. The cost to irrigators for implementing conservation measures on a large scale is prohibitive, even with assistance from State grant programs. More discussion of the conservation alternative is included in Chapter 2.0, Alternatives.

The widespread use of conservation measures within the basin would not eliminate the need for late-season supplemental irrigation water. Utilization of conservation measures would increase the efficiency of water delivery, including water from storage facilities, and reduce overall water use. However, conservation measures by themselves cannot change when water is available, and even the best conservation measures could not reduce late-season demand sufficiently to match existing availability. Because no additional water supplies have been developed, between six and eight weeks of late-season irrigation water need remains unsatisfied in years with normal and above normal water runoff. In below normal years, and especially consecutive low runoff years, the irrigation season ends in June.

The primary purpose of the proposed project, known as the Little Snake Supplemental Irrigation Water Supply Project (LSSIWSP), is to provide reliable late-season irrigation water to lands in the Little Snake River Basin. The water would be used to reduce the existing amount of unrealized productivity currently caused by the lack of late-season irrigation. As such, this water would not serve as a basis for granting new water rights and would only be used on land with Wyoming water rights that are currently being irrigated.
1.3 NEED

The normal appropriation of water for irrigation as per Wyoming Water Law is one (1) cubic foot of water per second (cfs) for every 70 acres permitted (Black & Veatch and Wright Water Engineers 1984). Wyoming statutes allow for the diversion of one (1) additional cfs during times when sufficient flow exists to meet all other water rights. In establishing the amount of supplemental irrigation water to be provided by the water supply project, the WWDC investigated the minimum amount of water that should be supplied on a supplemental basis to supply crop needs during the late-season. They established a minimum of 0.5 cfs per 70 acres (WWDC 1990). Supplemental water would be provided for a two month (61 days) period, between July 15 and September 15. This rate converts to 0.864 acre-feet of water per acre of irrigated land.

An analysis of infrared aerial photography taken in 1983 indicated approximately 73 percent of the lands in the Wyoming portion of the basin with Wyoming water rights were actually irrigated (O’Grady 1985). Applying this percentage to the lands in the Colorado portion of the basin yields a total of 17,460 acres of land in the Little Snake River Basin that is actually irrigated under Wyoming water rights permits. Based on 0.864 acre-foot of water per acre of irrigated land, a nominal need exists for 15,090 acre-feet of water for supplemental, late-season irrigation.

Since 1983, changes in commodities prices have made it feasible to pump water to permitted lands which, in 1983, could not be reached by gravity flow. Today, therefore, the need for late-season water is likely greater than the 15,090 acre-feet calculated above.

1.4 PROPOSED FACILITY

Based on WWDC policy and historic practice, the proposed facility would be a reservoir designed to supply 12,000 acre-feet of late-season, supplemental water eight out of ten years over a project life-span of 100 years. This supply would amount to 0.864 acre-feet of supplemental irrigation water per acre for 13,900 of the approximately 17,500 acres which are currently irrigated. This water supply would be available for irrigation after natural flows decrease to a level where direct diversion cannot be accomplished. Diversion of late-season supplemental water would be made in a manner that protects senior water rights and is in keeping with compacts between Wyoming and Colorado. Based on average conditions, the 12,000 acre-feet of water would be seasonally allocated and released for irrigation as follows:

- 3,000 acre-feet delivered between July 15 and July 31
- 6,000 acre-feet delivered between August 1 and August 31
- 3,000 acre-feet delivered between September 1 and September 15

The 12,000 acre-feet of supplemental, late-season water would be delivered to two locations for downstream diversion. Up to 2,000 acre-feet of water would be available for diversion to
irrigated lands along Savery Creek, a major tributary of the Little Snake River, just downstream of the former U. S. Geological Survey gaging station (number 0925600, discontinued in 1992) located on Savery Creek near the town of Savery, Wyoming. The remaining 10,000 acre-feet of supplemental irrigation water would be available for diversion from the Little Snake River downstream of the confluence with Savery Creek. Diversion points for the various irrigation ditches on Savery Creek and the Little Snake River are shown on Figures 1-2 and 1-2. The WWDC would authorize the SLSWCD to allocate the 12,000 acre-feet of water to be provided by the project for application to existing irrigated lands on Savery Creek and on the Little Snake River below the confluence with Savery Creek. It is expected that the water would be allocated to the permit holders on a first-come-first-serve basis. Secondary benefits to the Little Snake River basin associated with the project would include increased availability of water-based recreation and a more reliable municipal water supply for the two small municipalities of Baggs and Dixon, Wyoming.

Funding for the LSSIWSP would be provided by the State of Wyoming through the WWDC and the SLSWCD. No federal funds would be involved. The WWDC has indicated that construction of the project would not be initiated unless firm contracts are executed for at least 80 percent (9,600 acre-feet) of the proposed reservoir water.

1.5 PROJECT HISTORY

Studies for development of additional irrigation water supplies in the Little Snake River basin began in the 1940's. One of the first studies involved the U.S. Bureau of Reclamation (BOR) and the states of Wyoming and Colorado, and resulted in the formulation of several water supply scenarios known as the Savery-Pot Hook Project, Wyoming and Colorado. Over the next 35 to 40 years, numerous studies and concepts were explored to develop irrigation water sources in the basin. Included in these studies were the Cheyenne Stage I, II, and III projects.

The Savery-Pot Hook Project included the construction of two reservoirs and two conveyance systems (BOR 1976). One reservoir would have been on Savery Creek and would have had a volume of 15,500 acre-feet. The other reservoir would have had a volume of 60,000 acre-feet and would have been located on Slater Creek in Colorado. These reservoirs were designed to produce a total of 44,000 acre-feet of water for late-season irrigation. This project was not constructed because of an unfavorable cost/benefit ratio calculated by BOR.

The Cheyenne Stage I project, completed in 1964, diverts about 7,200 acre-feet of water annually, via tunnel, from the Little Snake River basin to Hog Park Reservoir in the North Platte River basin. In 1979 the Wyoming legislature discussed the Little Snake River's "in-basin needs" and the Cheyenne Stage II and III Projects, which would transfer additional waters out of the basin. Implementation of Cheyenne Stage II resulted in an additional annual diversion from the basin of 13,700 acre-feet of water. A larger Cheyenne Stage III project was planned but was not
implemented. It was no longer considered a viable project because of lack of an apparent need, high cost, and serious environmental impacts.

In 1980, the legislature directed the WWDC to "... study the feasibility of constructing in the Little Snake River drainage, above the confluence of the river and Savery Creek, a reservoir of at least three thousand (3,000) acre feet."

The legislature stated that the "... reservoir shall satisfy immediate in-basin agricultural, recreational, and municipal needs and shall promote in-basin water purity."

In 1983, the Wyoming legislature included a provision in the State's water development program that required trans-basin diversions to assess impacts to the basin of origin and recommend mitigation measures. In 1984, the legislature included in the WWDC project budget request the following criteria for a project in the basin:

"At least ten thousand (10,000) acre-feet of storage shall be provided for use in the Savery Creek drainage and fifty thousand (50,000) acre-feet of storage shall be provided for use in the Little Snake River drainage."

The intent was to make sure that appropriate mitigation was available to alleviate any water supply or existing and future economic impacts in the Little Snake River basin caused by the Cheyenne Stage I and II projects. Under Wyoming law, such impacts are prohibited.

The residents in the Little Snake basin believe that this project is required as mitigation for the Cheyenne Stages I and II transbasin diversion projects. As part of the NEPA process, the issue has been examined. It has been concluded by the Corps that no mitigation is required for the impacts caused by the Cheyenne Stages I and II projects.

In the period from 1983 to 1987, session laws of the Wyoming legislature identified the Sandstone dam and reservoir as the Little Snake River basin component of the Cheyenne Stage III project. This facility would be located on Savery Creek just below its confluence with Little Sandstone Creek. Preliminary designs by the WWDC included a Sandstone dam and reservoir with a firm annual yield of 32,000 acre-feet. Approximately 12,000 acre-feet was to be used for supplemental irrigation water and 20,000 acre-feet for future industrial development.

The WWDC requested construction funding for Sandstone dam from the Wyoming legislature in 1987. Although denied initially, the legislature subsequently appropriated a total of $10,000,000 toward the dam's construction in 1988 and 1989. In 1990, the WWDC submitted a Section 404(b)(1) Showing for the Sandstone dam and reservoir as part of the Section 404 permit application to the Corps. The Corps subsequently denied the permit for the Sandstone dam and reservoir, primarily because of the undefined allocation of 20,000 acre-feet of annual yield for
industrial uses. The WWDC permit was denied by the Corps "without prejudice" and with the suggestion that, as an alternative, the project be rescoped and downsized.

In 1991, the Wyoming legislature appropriated $400,000 of the $10,000,000 for a study to see if smaller water supply alternatives could be identified in the Little Snake River basin that would be economically competitive with the Sandstone dam and reservoir. The legislature also directed WWDC to prepare an evaluation of irrigation system diversion and canal structures in the SLSWCD. More than 20 alternative water supply reservoir sites were identified and assessed, before concluding that a downsized concrete dam at the Sandstone site was feasible and cost-effective.

In 1993, the Wyoming legislature appropriated an additional $20,400,000 from Water Development Account No. 1 (Carnevale 1993) for the downsized Sandstone dam and reservoir. This appropriation, when combined with the previously uncommitted 1988 and 1989 combined appropriations of $9,600,000, provide the proposed Level III budget of $30,000,000 for the downsized Sandstone dam and reservoir.

In 1997, the Wyoming legislature amended the project authorization from “Project - Sandstone Dam and Reservoir Project” to “Project - Little Snake River Valley Dam and Reservoir Project”. This amendment provided for a broader definition of what could be considered mitigation for Cheyenne Stages I, II, and III transbasin diversion projects (Jackson 1999).

In 1998, the Wyoming legislature amended the project authorization for the Little Snake River Valley Dam and Reservoir Project mitigation to remove specific reference to the Cheyenne Stage III transbasin diversion project.

The 1997 and 1998 amendments provided for consideration of sites other than the Sandstone dam and reservoir site as mitigation for the existing Cheyenne Stages I and II transbasin diversion projects (Jackson 1999).

The 404 permit application from the WWDC for the High Savery dam and reservoir was received by the Corps on July 14, 1998.
CHAPTER 2
ALTERNATIVES

2.1 INTRODUCTION

This chapter presents the reasonable alternatives that are capable of supplying at least 12,000 acre-feet of late-season irrigation water eight out of ten years as described in Chapter 1, Purpose and Need. A brief discussion of the alternatives that were considered, but eliminated, is also provided. Three feasible alternatives were identified which could meet this need. The discussion summarizes the major physical, operational, economic, and environmental aspects of these alternatives.

2.2 IDENTIFICATION OF ALTERNATIVES

Twenty-six water supply alternatives were initially identified. After a rigorous screening, three water supply alternatives were identified for detailed evaluation. These alternatives are:

- Sandstone dam and reservoir
- High Savery dam and reservoir
- Dutch Joe dam and reservoir

The no-action alternative is an essential part of every Environmental Impact Statement (EIS), as set forth in the National Environmental Policy Act of 1969 (NEPA). In terms of NEPA, the “no action” alternative is defined as how the project need would be met without a Federal permit. For the proposed project, the action required by the Federal Government would be the issuance of permits necessary for construction such as a Section 404, Dredge and Fill permit for all affected waters of the United States and a right-of-way from the Bureau of Land Management (BLM). In this case, the no-action alternative is defined as no construction and no provision of late-season supplemental irrigation water. The no-action alternative is included to help establish the base from which the final alternatives are evaluated. The water conservation alternative would not necessarily require federal action. It has also been included in the EIS as a separate alternative because of input received during the project scoping meetings.

2.3 ALTERNATIVES ELIMINATED FROM CONSIDERATION

A total of twenty-six alternatives were evaluated to identify those best suited to meet the need for 12,000 acre-feet (AF) of late-season irrigation water. These alternatives included 22 dam and reservoir alternatives, two groundwater well field alternatives, groundwater recharge, and
conservation. Twenty-five structural water supply alternatives (dams and reservoirs, well fields and recharge) were identified in previous water supply studies in the Little Snake River Basin (Corps 1988; WWDC 1990; Western Water Consultants, Inc. 1992). A list of the alternatives evaluated is given in Table 2-1. The locations of the 22 dam and reservoir alternatives are shown on Figure 2-1. For comparison purposes, and in keeping with WWDC policy and practice, all alternatives were conceptually designed for a 100-year life-span.

<table>
<thead>
<tr>
<th>Table 2-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTERNATIVES INITIALLY EVALUATED</td>
</tr>
<tr>
<td>Non-structural Alternatives</td>
</tr>
<tr>
<td>• No-Action</td>
</tr>
<tr>
<td>Structural Alternatives</td>
</tr>
<tr>
<td>Groundwater Alternatives</td>
</tr>
<tr>
<td>• Alluvial</td>
</tr>
<tr>
<td>• Recharge</td>
</tr>
<tr>
<td>Reservoir Alternatives</td>
</tr>
<tr>
<td>• Muddy Creek</td>
</tr>
<tr>
<td>• Cottonwood Creek</td>
</tr>
<tr>
<td>• Loco Creek</td>
</tr>
<tr>
<td>• Dutch Joe Creek</td>
</tr>
<tr>
<td>• Negro Creek</td>
</tr>
<tr>
<td>• High Savery Creek</td>
</tr>
<tr>
<td>• Sandstone</td>
</tr>
<tr>
<td>• Old Upper Savery</td>
</tr>
<tr>
<td>• Grieve</td>
</tr>
<tr>
<td>• Big Gulch</td>
</tr>
<tr>
<td>• Lower Battle Creek</td>
</tr>
</tbody>
</table>

The 25 structural water supply alternatives were first evaluated in 1995 by a multi-step screening process using a variety of criteria including engineering and geological features, water rights issues, cost, and environmental impacts. A detailed discussion of the screening process is presented in Appendix A. The following is a brief summary of the process.

The screening process first considered engineering and geology criteria. The Old Upper Savery Creek dam and reservoir was eliminated because the existence of landslide areas made the proposed dam site geologically unstable.
Figure 2-1

ALTERNATIVE WATER SUPPLY RESERVOIR LOCATIONS
SANDSTONE PROJECT, WYOMING
The second screening step was a comparison of the effective cost of water (dollars per acre-foot of average annual effective yield) provided by the remaining structural alternatives and capacity considerations for groundwater alternatives. Effective water supply costs for each alternative were ranked from lowest to highest. Alternatives with costs exceeding the cost of the least expensive alternative (Pot Hook, $1,769/AF) by a factor of two ($3,538/AF) were eliminated from further consideration. This step eliminated the following 14 alternatives:

- Cottonwood Creek
- Loco Creek
- Negro Creek
- Grieve Reservoir
- Roaring Fork
- Muddy Creek
- Upper Battle Creek
- Lower Battle Creek
- Upper Slater Creek
- East Willow Creek
- Fish Creek
- Three Forks
- Lower Willow Creek
- Deep Groundwater

Deep groundwater was eliminated as a water supply source for several reasons including low projected yields, the reliability of installed wells, and the associated high costs for construction and maintenance. Deep groundwater wells would be located in the Browns Park Formation which underlies most of the project area. The Wyoming State Engineer's Office states that the specific capacity for existing wells in the project area indicates that the development of high yield wells is unlikely (Stockdale 1995). An optimistic estimate of average well yield from this formation is 100 gallons per minute. At this rate, approximately 445 wells would need to be installed, operated, and maintained in order to provide 12,000 AF of irrigation water during the time needed. Given an installation cost of $100,000 per well and an average annual operation and maintenance cost of $1.56 million over a 100-year project life, the cost per acre-foot of water for this approach exceeded the cost threshold established for this screening step.

Groundwater recharge would involve the storage of surplus surface water in an underground aquifer and the withdrawal of that water for late-season irrigation. This alternative was eliminated because of the lack of an appropriate recharge formation (Stockdale 1995). The only deep groundwater aquifer in the project area with existing water quality that would not contaminate stored surface water is the Brown Park Formation. This formation, however, is not sufficiently confined and much of the water put into the aquifer would only contribute to the base flow of area streams. The same constraints which would make the Brown Park Formation an unlikely source of groundwater for irrigation (i.e., low yields, high cost) would also make injection of water into the aquifer a slow and expensive process. Therefore, groundwater recharge was eliminated as a viable alternative.

Alluvial groundwater (found in the sand and gravel substrate in a river or stream course) was eliminated as a water supply because of the reliability of this source in view of water rights governing such water. Under Wyoming water law, alluvial groundwater is subject to surface water rights if an established connection to the surface water exists. Such a connection has been
established in the project area. Because the availability of senior water rights to the surface water was not assured, alluvial groundwater was not considered a reliable water supply.

The remaining eight alternatives were subjected to a third screening step - an environmental review based on the ecological value of lost habitat. The alternatives were ranked in terms of environmental impact. Four out of the five alternatives with the highest impact rankings were eliminated from further consideration: Pot Hook, South Fork, Middle Battle Creek, and Upper Willow Creek (Appendix A, pages 14 through 16). The Sandstone alternative ranked second highest in environmental impact but was retained because it was the WWDC's current preferred alternative based on directives from the Wyoming State Legislature.

The alternatives evaluated and eliminated and the reasons for their elimination are summarized in Table 2-2.

Of the four dam and reservoir water supply alternatives remaining - Sandstone, High Savery, Dutch Joe and Big Gulch - only Sandstone dam and reservoir had the capability by itself to supply the water need established in Chapter 1. The other three dam and reservoir alternatives, as originally designed, could provide the desired water need only by being combined with a second dam and reservoir. The original designs were based on the objective of building the most cost effective size for each water supply, rather than providing a targeted quantity of water. As a result, three water supply alternatives were developed that were a combination of two dams and reservoirs each. The following water supply alternatives were evaluated in more detail:

- Sandstone dam and reservoir
- High Savery/Dutch Joe dams and reservoirs
- High Savery/Big Gulch dams and reservoirs
- Dutch Joe/Big Gulch dams and reservoirs

None of the storage capacities of the four remaining storage facilities were adjusted from their original designs as defined in previous water supply studies. Sandstone dam and reservoir was in fact oversized, and provided for the established water need more frequently than the required eight out of ten years. Each of the three combination alternatives (High Savery/Dutch Joe, High Savery/Big Gulch, and Dutch Joe/Big Gulch) had combined water supply capacities that either equaled or exceeded the established water need.

Multiple dam and reservoir water supply facilities must be operated as a system, which increases the work effort required for reservoir operations and maintenance. A subsequent review of the four dam and reservoir alternatives determined that the Sandstone, High Savery, and Dutch Joe alternatives could be resized to provide the target of 12,000 AF of irrigation water eight out of ten years. The size of the Big Gulch dam and reservoir, however, could not be increased enough...
Table 2-2

ALTERNATIVES ELIMINATED FROM CONSIDERATION

<table>
<thead>
<tr>
<th>Water Supply Source</th>
<th>Effective Annual Yield (AF)</th>
<th>Water Cost ($/AF)</th>
<th>Reason for Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alluvial Groundwater</td>
<td>N/A</td>
<td>N/A</td>
<td>Water Rights</td>
</tr>
<tr>
<td>Deep Aquifer</td>
<td>12,000</td>
<td>7,235</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Recharge</td>
<td>N/A</td>
<td>N/A</td>
<td>No Receiving Aquifer</td>
</tr>
<tr>
<td>Dams and Reservoirs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muddy Creek</td>
<td>6,077</td>
<td>6,456</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Cottonwood Creek</td>
<td>507</td>
<td>16,937</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Loco Creek</td>
<td>622</td>
<td>32,903</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Negro Creek</td>
<td>218</td>
<td>19,263</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Old Upper Savery</td>
<td>N/A</td>
<td>N/A</td>
<td>Dam Safety</td>
</tr>
<tr>
<td>Grieve</td>
<td>1,109</td>
<td>4,414</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Lower Battle Creek</td>
<td>11,850</td>
<td>4,223</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Middle Battle Creek</td>
<td>11,721</td>
<td>3,435</td>
<td>High Environmental Impact</td>
</tr>
<tr>
<td>Upper Battle Creek</td>
<td>9,723</td>
<td>4,287</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Roaring Fork</td>
<td>847</td>
<td>16,800</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Lower Willow Creek</td>
<td>2,689</td>
<td>3,944</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Upper Willow Creek</td>
<td>1,764</td>
<td>3,301</td>
<td>High Environmental Impact</td>
</tr>
<tr>
<td>Pot Hook</td>
<td>8,363</td>
<td>1,860</td>
<td>High Environmental Impact</td>
</tr>
<tr>
<td>Upper Slater Creek</td>
<td>10,609</td>
<td>4,333</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>East Willow Creek</td>
<td>2,375</td>
<td>9,579</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Three Forks</td>
<td>11,452</td>
<td>7,871</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>South Fork</td>
<td>4,515</td>
<td>3,392</td>
<td>High Environmental Impact</td>
</tr>
<tr>
<td>Fish Creek</td>
<td>4,069</td>
<td>7,010</td>
<td>Exceeded Cost Threshold</td>
</tr>
</tbody>
</table>

To meet the established water need as a single water supply source. Because single-dam alternatives could provide the same average annual effective yield as the multiple-reservoir combinations with lower operating and maintenance costs, a combination of two dams and reservoirs no longer considered reasonable. As a result, the Big Gulch alternative was eliminated from further consideration.

Changing the storage capacities and yields of Sandstone, High Savery, and Dutch Joe dams and reservoirs to meet the established 12,000 acre-foot need eight out of ten years altered the overall sizes of each facility and affected the estimated construction costs. As a result, new construction costs were estimated for each of the three dam and reservoir alternatives. The current unit costs
were projected to a 1999 construction start. Revised construction costs for each of the nineteen other original dam and reservoir water supply alternatives were also compared using the same criteria and unit costs. The overall position of the various alternatives remained approximately the same (Table 2-3).

Table 2-3
ALTERNATIVES ELIMINATED FROM CONSIDERATION USING 1999 CONSTRUCTION START

<table>
<thead>
<tr>
<th>Water Supply Source</th>
<th>Effective Annual Yield (AF)</th>
<th>Water Cost ($/AF)</th>
<th>Reason for Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groundwater:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alluvial Groundwater</td>
<td>N/A</td>
<td>N/A</td>
<td>Water Rights</td>
</tr>
<tr>
<td>Deep Aquifer</td>
<td>12,000</td>
<td>7,959</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Recharge</td>
<td>N/A</td>
<td>N/A</td>
<td>No Receiving Aquifer</td>
</tr>
<tr>
<td><strong>Dams and Reservoirs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big Gulch</td>
<td>2,642</td>
<td>3,842</td>
<td>Could Not Meet Need</td>
</tr>
<tr>
<td>Muddy Creek</td>
<td>6,077</td>
<td>8,399</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Cottonwood Creek</td>
<td>507</td>
<td>21,779</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Loco Creek</td>
<td>622</td>
<td>26,565</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Negro Creek</td>
<td>218</td>
<td>32,258</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Old Upper Savery</td>
<td>N/A</td>
<td>N/A</td>
<td>Dam Safety</td>
</tr>
<tr>
<td>Grieve</td>
<td>1,109</td>
<td>7,811</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Lower Battle Creek</td>
<td>11,850</td>
<td>4,943</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Middle Battle Creek</td>
<td>11,721</td>
<td>4,400</td>
<td>High Environmental Impact</td>
</tr>
<tr>
<td>Upper Battle Creek</td>
<td>9,723</td>
<td>5,478</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Roaring Fork</td>
<td>847</td>
<td>19,024</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Lower Willow Creek</td>
<td>2,689</td>
<td>5,413</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Upper Willow Creek</td>
<td>1,764</td>
<td>5,176</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Pot Hook</td>
<td>8,363</td>
<td>3,031</td>
<td>High Environmental Impact</td>
</tr>
<tr>
<td>Upper Slater Creek</td>
<td>10,609</td>
<td>5,497</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>East Willow Creek</td>
<td>2,375</td>
<td>11,718</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Three Forks</td>
<td>11,452</td>
<td>8,381</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>South Fork</td>
<td>4,515</td>
<td>5,204</td>
<td>Exceeded Cost Threshold</td>
</tr>
<tr>
<td>Fish Creek</td>
<td>4,069</td>
<td>9,473</td>
<td>Exceeded Cost Threshold</td>
</tr>
</tbody>
</table>

In this comparison, sixteen water supply alternatives were eliminated because their construction cost using 1999 dollars exceeded the established cost threshold. This cost threshold ($4,788/AF) was twice that of the least costly water supply alternative (High Savery, $2,394/AF).
Two alternatives that successfully met the cost threshold, Pot Hook and Middle Battle Creek, were eliminated from further consideration based on relatively high environmental impacts primarily caused by the loss of habitat for federally listed threatened and endangered species, birds of prey, and migratory birds. Thus, the final alternatives were the single dam and reservoir alternatives Sandstone, High Savery, and Dutch Joe (Figure 2-2).

2.4 ALTERNATIVES CONSIDERED IN DETAIL

The alternative selection process identified three structural alternatives for detailed consideration. Based on comments received from the public, the conservation alternative remains under consideration. The no-federal-action alternative also is included in the evaluation because it provides a baseline to which the other alternatives can be compared.

2.4.1 STRUCTURAL ALTERNATIVES

When designing water supply facilities, it is the policy of the WWDC to provide multi-purpose facilities when ever possible. Maintaining a minimum pool for a reservoir fishery and recreational use in each of the three viable dam and reservoir sites is one option for providing additional benefits for Wyoming from this state-funded project. The High Savery and Sandstone alternatives have the site capability to include a minimum pool consisting of approximately 20 percent of the normal pool volume. Therefore, all comparisons carried forward in the EIS for Sandstone and High Savery contain both with and without minimum pool configurations. The site of the Dutch Joe alternative can not accommodate a reservoir with a yield of the 12,000 AF of irrigation water plus a 20 percent minimum pool.

After the three structural alternatives were identified, additional studies were conducted for design refinement and impact analysis. These studies included detailed contour mapping, further geologic testing, conveyance loss modeling, and additional hydrologic modeling. The following descriptions contain the most recent data from these studies, therefore, some of the alternative specifications differ slightly from those used in the preceding alternative selection process.

Hydrologic analyses indicated that each of these alternatives can supply 12,000 AF of irrigation water eight out of ten years; otherwise, considerable physical variation exists among the water supplies. Storage capacities range from 12,600 AF for the Sandstone alternative without a minimum pool to 22,433 AF for the High Savery alternative with a minimum pool (Table 2-4). The lowest cost alternative, High Savery without a minimum pool, would cost approximately $28.75 million while the most expensive alternative, Sandstone with a minimum pool would cost $39.15 million (Table 2-4).
Table 2-4

<table>
<thead>
<tr>
<th>CHARACTERISTICS OF WATER SUPPLY ALTERNATIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone with min pool</td>
</tr>
<tr>
<td>Surface area (acres)</td>
</tr>
<tr>
<td>Total capacity (AF)</td>
</tr>
<tr>
<td>Minimum pool (AF)</td>
</tr>
<tr>
<td>Average annual effective yield (AF)&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total cost (million)&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Effective water cost ($/AF yield)&lt;sup&gt;3,4&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Dead pool.
<sup>2</sup>Average Annual Effective Yield is the amount of water released minus the amount of water lost during conveyance downstream. This amount of water would be available for irrigation at an estimated frequency of eight out of ten years.  
<sup>3</sup>1999 dollars
<sup>4</sup>Estimated water cost was calculated by dividing the total cost of constructing, operating, and maintaining the reservoir facilities by the average annual effective yield. Mitigation costs are not included.

2.4.1.1 Sandstone Dam and Reservoir (with minimum pool)
The Sandstone dam and reservoir water supply alternative would be located on Savery Creek. The version with a minimum pool would have a surface area of approximately 370 acres at elevation 6,866 feet above mean sea level (msl). The reservoir would have a normal operating pool capacity of approximately 15,800 AF. Maximum water depth of the reservoir would be approximately 95 feet. Vertical water level fluctuation could be as large as 47 feet. The top of the minimum pool would be at elevation 6,819 feet msl and would have a storage capacity of approximately 3,100 AF. A dead storage pool would underlie the minimum pool at elevation 6,819 feet msl and would contain approximately 100 AF of water. Reservoir storage would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow or 24 cfs to protect downstream aquatic habitats.

The reservoir is expected to thermally stratify in the summer. However, the onset of stratification would be delayed because of reservoir filling, and the duration would be shortened because of the release of water for irrigation. As a result, it is unlikely that the bottom layer of water in the reservoir would have time to become oxygen depleted. Water quality in the reservoir would likely be lower in turbidity, alkalinity, nitrogen, and phosphorus, but higher in chlorophyll, relative
to the incoming stream water. A multi-point water release structure would allow water from
different depths within the reservoir to be released and provide some control over the temperature
of the water discharged into Savery Creek.

Total reservoir average annual yield is estimated to be 13,310 AF (Appendix A, Table A-5).
After accounting for conveyance losses of approximately 1,310 AF, the effective average annual
yield would be 12,000 AF. With construction, operation, and maintenance costs totaling
approximately $39.15 million, Sandstone dam and reservoir with a minimum pool would provide
late-season irrigation water at an effective cost of $3,263/AF (Table 2-4).

With a minimum pool, the Sandstone dam and reservoir would inundate approximately 4.8 miles
of Savery Creek, 1.3 miles of Little Sandstone Creek, and 1.0 mile of Big Sandstone Creek. This
action could result in the loss of habitat for 12 threatened and endangered species, crucial big
game winter range, and wetlands. Habitats that would be inundated include sagebrush, improved
rangeland, and riparian cottonwoods. Mitigation would be required for all wetlands, riparian
communities, and wildlife habitat inundated or degraded.

2.4.1.2 Sandstone Dam and Reservoir (without minimum pool)
This Sandstone water supply alternative would also be located on Savery Creek. No minimum
pool would be maintained in this scenario. With a normal operating pool elevation at 6,857 feet
msl, the reservoir would have a surface area of 330 acres and a storage capacity of approximately
12,600 AF. The reservoir would have a maximum depth of approximately 85 feet. The vertical
fluctuation in water level between the spring filling period and the end of the irrigation season
could be as large as 75 feet. Only a dead pool at elevation 6,781 feet msl with a storage capacity
of approximately 100 AF would remain at the end of the irrigation season. Reservoir storage
would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow
or 24 cfs to protect downstream aquatic habitats.

The reservoir is expected to thermally stratify in the summer; however, the onset of stratification
would be delayed because of reservoir filling and the duration of stratification would be shortened
because of the release of water for irrigation. As a result, it is unlikely that the bottom layer of
water in the reservoir would have time to become oxygen depleted. Water quality in the reservoir
would likely be lower in turbidity, alkalinity, nitrogen, and phosphorus, but higher in chlorophyll,
relative to the incoming stream water. A multi-point release structure would allow water from
different depths within the reservoir to be released and provide some control over the temperature
of the water discharged into Savery Creek.

Sandstone dam and reservoir without a minimum pool would have the same average annual yield,
conveyance losses, and effective average annual yield as the with minimum pool configuration.
Construction, operation, and maintenance costs are estimated to be $35.81 million for an effective
cost of $2,984/AF.
Development of the Sandstone dam and reservoir without a minimum pool would inundate approximately 4.6 miles of Savery Creek, 1.2 miles of Little Sandstone Creek, and 0.6 miles of Big Sandstone Creek. This inundation could likewise result in the loss of habitat for threatened and endangered species, crucial big game winter range, and wetlands. Habitats that would be inundated include sagebrush, improved rangeland, and riparian cottonwoods. Mitigation would be required for all wetlands, riparian communities, and wildlife habitat inundated or degraded.

2.4.1.3 High Savery Dam and Reservoir (with minimum pool)

With a minimum pool, the High Savery dam and reservoir would occupy approximately 482 acres at an elevation of 7,305 feet msl and have a volume of 22,433 AF (Table 2-4). Maximum depth in the reservoir would be 130 feet. A 51-foot vertical change in the reservoir’s water elevation could be expected during the growing season. The minimum pool would be located between elevations 7,254 and 7,175 feet msl and would have a storage capacity of 5,724 AF. The volume of the minimum pool would exceed 20 percent of the total reservoir capacity. This larger pool is sized to accommodate approximately 14,600 adult Colorado River cutthroat trout (CRCT) which the Wyoming Game and Fish Department (WGFD) would use as brood stock for the regional species recovery plan. The dead storage pool would be located below elevation 7,190 feet msl and would have a capacity of 48 AF.

The reservoir is expected to thermally stratify in the summer. However, the onset of stratification would be delayed because of reservoir filling, and the duration would be shortened because of the release of water for irrigation. As a result, it is unlikely that the bottom layer of water in the reservoir would have time to become oxygen depleted. Water quality in the reservoir would likely be lower in turbidity, alkalinity, nitrogen, and phosphorus, but higher in chlorophyll, relative to the incoming stream water. Reservoir storage would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow or 12 cfs to protect downstream aquatic habitats. A multi-point water release structure would allow water from different depths within the reservoir to be released and provide some control over the temperature of the water discharged into Savery Creek.

The estimated average annual yield of the reservoir and subsequent conveyances losses are estimated to be 13,700 and 1,700 AF, respectively for an average annual effective yield of 12,000 AF. Given a cost for construction, operation, and maintenance of $30.00 million, the High Savery dam and reservoir alternative with a minimum pool would have an effective cost of $2,500/AF.

At normal pool elevation, the High Savery reservoir with minimum pool would inundate approximately 2.9; 2.3; 1.6; and 1.9 miles of mainstem Savery Creek, the North Fork of Savery Creek, the East Fork of Savery Creek and Dirtyman Creek, respectively. Sagebrush, improved rangeland habitat, and some wetlands would be inundated; however, improved rangeland that provides big game crucial winter range and riparian cottonwoods that provide potential threatened and endangered species habitat would not be impacted. Mitigation would be required for all wetlands, riparian communities, and wildlife habitat inundated or degraded.
2.4.1.4 High Savery Dam and Reservoir (without minimum pool)

High Savery dam and reservoir would be located in the upper Savery Creek watershed. Under this scenario, the reservoir would occupy approximately 420 surface acres at an elevation of 7,295 feet msl and would contain 18,000 AF of water (Table 2-4). Maximum depth would be approximately 120 feet. Up to a 105-foot vertical change in water level could occur between May and October. The dead pool located between elevations 7,175 and 7,190 feet msl would have a storage capacity of 48 AF. Reservoir storage would be sufficient to provide a minimum flow water release equal to the lesser of natural inflow or 12 cfs to protect downstream aquatic habitats.

The reservoir is expected to thermally stratify in the summer. However, the onset of stratification would be delayed because of reservoir filling, and the duration would be shortened because of the release of water for irrigation. As a result, it is unlikely that the bottom layer of water in the reservoir would have time to become oxygen depleted. Water quality in the reservoir would likely be lower in turbidity, alkalinity, nitrogen, and phosphorus, but higher in chlorophyll, relative to the incoming stream water. A multi-point water release structure would allow water from different depths within the reservoir to be released and provide some control over the temperature of the water discharged into Savery Creek.

The High Savery water supply alternative version without a minimum pool would have the same conveyance losses and average annual effective yield as the version with a minimum pool. Construction, operation, and maintenance costs are estimated to be $28.75 million. The effective cost, $2,394/AF, however, would be less because of the smaller size of the reservoir.

At normal pool elevation, the reservoir would inundate approximately 2.9 miles of the Savery Creek mainstem, 2.1 miles of North Fork Savery Creek, 1.3 miles of East Fork Savery Creek, and 1.5 miles of Dirtyman Creek. As with the with minimum pool configuration, sagebrush, improved rangeland habitat, and some wetlands would be inundated. Improved rangeland that provides big game crucial winter range and riparian cottonwoods that provide potential threatened and endangered species habitat, however, would not be impacted. Mitigation would be required for all wetlands, riparian communities, and wildlife habitat inundated or degraded.

2.4.1.5 Dutch Joe Dam and Reservoir (no minimum pool)

At normal pool elevation of 6,680 msl, Dutch Joe reservoir would cover approximately 300 surface acres and have a volume of 14,400 AF. An additional 150 acres will be impacted by the supply and delivery canals into and out from the reservoir. The size of the reservoir can not be increased to include a minimum pool because the depth of the valley cannot accommodate a higher dam and the width of the valley cannot feasibly accommodate a dam farther downstream. All water stored would be released by the end of the irrigation season, leaving only a dead storage pool at an elevation of 6,566 feet msl containing 100 AF of water. Dutch Joe reservoir would have a maximum depth of approximately 122 feet. Water surface elevation could vary during the growing season by as much as 114 feet. Because Dutch Joe Creek is intermittent, no minimum
flows would be released. A multi-point water release structure would be included in the design of the facility and would allow water from different depths within the reservoir to be released. Some control over the temperature of water discharged into Dutch Joe Creek and the Little Snake River would be maintained.

The reservoir is expected to thermally stratify in the summer. However, the onset of stratification will be delayed because of reservoir filling and the duration would be shortened because of the release of water for irrigation. As a result, it is unlikely that the bottom layer of water in the reservoir would have time to become oxygen depleted. Water quality in the reservoir would likely be lower in turbidity, alkalinity, nitrogen, and phosphorus, but higher in chlorophyll, relative to the incoming stream water.

Dutch Joe Creek does not have adequate drainage area to provide the water supply necessary for the reservoir. To fill the reservoir, surface water would be diverted and conveyed from Savery Creek to the reservoir. A minimum flow past the diversion structure equal to the lesser of natural inflow or 24 cfs would be maintained in Savery Creek to protect downstream aquatic habitats. Conveyance would be through a gravity flow canal and pipeline facility. The gravity flow canal would be partially lined (earth, concrete, or PVC) to minimize seepage losses caused by porous surface conditions along the canal route. The canal and pipeline structures would impact approximately 150 acres of sagebrush, riparian meadow, riparian scrub/shrub, riparian cottonwood and irrigated meadow.

The Dutch Joe alternative is expected to have an average annual yield of 12,275 AF and conveyance losses of 275 AF for an average annual effective yield of 12,000 AF. The construction, operation, and maintenance cost for this alternative, approximately $37.70 million, is based on the assumption that 50 percent of the conveyance canal would be lined. The effective cost of water for this alternative is $3,142 AF.

Approximately 2,000 AF of water from Dutch Joe dam and reservoir would be transported via pipeline to supply the irrigation need in the lower Savery Creek valley. Water from Dutch Joe reservoir would also be directly diverted from Dutch Joe Creek into the First Mesa Ditch. The remaining water from Dutch Joe reservoir would be delivered via Dutch Joe Creek to the confluence of the Little Snake River. Supplemental irrigation water would be supplied to other irrigation water supply ditches following Dutch Joe Creek’s confluence with the Little Snake River.

Approximately 3.3 miles of Dutch Joe Creek would be inundated with the development of the dam and reservoir. Environmental impacts from the Dutch Joe dam and reservoir would result from the loss of crucial big game range and wetlands. Habitats inundated by Dutch Joe dam and reservoir would include sagebrush, some improved rangeland, and approximately 3.2 acres of wetlands. In addition, 5.5 acres of riparian cottonwood and willow shrub habitat would be impacted by the water supply canal from Savery Creek to the Reservoir. Mitigation would be
required for all wetlands and wildlife habitat inundated or degraded. The loss of crucial big game winter range cannot be mitigated (WGFD 1999).

2.4.2 CONSERVATION
The conservation alternative would involve changes in agricultural practices within the basin, improvements to irrigated lands, and rehabilitation of existing structures facilitating irrigation activities. These changes would include:

- Large-scale conversion of grass pasture to alfalfa
- Land leveling
- Purchase, installation, and use of sprinkler systems
- Intensive on-farm water management including more frequent water applications of smaller water quantities
- Large-scale lining of irrigation canals, both major transport canals and smaller on-farm canals
- Replacement and construction of headgates and diversion structures
- Placement and use of metering devices.

Some small-scale conservation measures have already been implemented in the SLSWCD and WWDC has recently invested approximately $2.7 million to rehabilitate primary water transport canals and river diversion structures. These projects have concentrated on small problem areas within the SLSWCD. The cost for large-scale rehabilitation throughout the system and for on-farm structures has not been calculated.

Changing crops or irrigation practices and methods would be expensive to implement on a large scale (Virgil 1995). Conversion to alfalfa would require three years at a cost of approximately $100 per acre for tilling, seed, and fertilizer. During this conversion process, no alfalfa hay would be produced the first two years and production the third year would be approximately half of normal. Normal hay production is approximately 4 tons per acre per year, thus, approximately 10 tons per acre of hay production would be lost during the conversion process. Replacement hay would have to be purchased during this period. At an average cost of $90 per ton, replacement hay would cost $900 per acre converted. The total cost of conversion would, therefore, be approximately $1,000 per acre. During times when water is available, the savings due to crop conversion, at best, would be 20 percent or 0.2 AF of water per acre of land converted per year. For this savings to be equivalent to the 12,000 AF average annual effective yield of the proposed reservoirs, 60,000 acres would have to be converted assuming irrigation occurred throughout the growing season. At $1,000 per acre, the cost would be $60 million or $5,000/AF.

Land leveling to improve water distribution or the installation of sprinkler irrigation would cost approximately $500 per acre. This cost does not include compensation for lost hay production after land leveling (e.g., 1.5 years lost production = 6 tons hay/acre @ $90/ton = $540/acre), the cost of land leveling that could be needed for the sprinklers, or the cost of possible crop

2-15
conversion. Water savings could be as much as 20 percent for land leveling and 50 percent for sprinklers assuming water was available when needed. To save 12,000 AF of water, at least 60,000 acres would have to be leveled or 24,000 acres would have to be sprinkled for the duration of the growing season. The costs would be $30 million or $2,500/AF for land leveling or $12 million or $1,000/AF for sprinklers. Although these costs are comparable to the cost of water from a new reservoir, the amount of land required by these conservation alternatives to produce a water savings of 12,000 AF would exceed the 20,600 acres currently permitted to receive irrigation water in the basin under Wyoming water law. Therefore, even if sprinklers, the most efficient conservation measure, were installed on all of the irrigated farm land in the basin and water were available during the entire irrigation season, the savings in water would only be 10,300 AF.

Under normal conditions, conservation measures generally reduce water loss and provide a more even distribution of existing, available water. However, conservation cannot produce new water and conservation cannot save water when water is not available. Without concurrent storage, conservation cannot affect the timing of, or the season when, water is available. In the Little Snake River basin, late-season demand for water is much greater than the amount of water available (Figure 1-4). Conservation could not provide more late-season irrigation water or sufficiently reduce late-season demand to match the existing, limited, late-season supply.

Some of the cost of implementing water conservation measures could be shared with the Federal government. A 70/30 cost share program, up to $3,500 annually for five years, is available through the Consolidated Farm Services Agency (formerly the Agricultural Stabilization and Conservation Service). The NRCS provides a 50/50 cost share for up to $10,000 over ten years for irrigation improvements. Even with these programs, however, the water savings or increases in yield would be insufficient for land owners to recuperate the investment.

Clearly, conservation is not a viable alternative to supply late-season irrigation because: 1) insufficient acreage exists within the SLSWCD to provide for 12,000 AF of water savings through conservation; 2) farmers would be unlikely to recover the cost of on-farm improvements with increased production or decreased water costs; and 3) without the addition of storage, conservation could not provide water in the late summer when it is needed. However, to adequately respond to comments received during the public scoping process, the conservation alternative will be evaluated for its environmental impacts (Chapter 4).

2.4.3 NO-ACTION
Under the no-action alternative, the Corps would not issue a Section 404 permit and a dam and reservoir would not be built. Because no other water storage facilities, including off-channel storage, exist in the basin, the no-action alternative would not involve initiating any measure to provide supplemental irrigation water within the Little Snake River basin with the possible exception of water conservation measures as previously discussed. Because conservation could not supply late-season water, irrigation and livestock husbandry practices would continue in much
the same way they are presently conducted. Late-season irrigation water shortages would occur annually, limiting forage production and necessitating the continued purchase of hay, wintering livestock elsewhere, and premature sale of livestock. The fisheries habitat and recreational opportunities would remain unchanged. Although the no-action alternative would not provide any of the benefits of a new water supply, this alternative is retained for analysis in the EIS (Chapter 4) because it is required by the NEPA process and serves as a baseline against which the impacts of the other alternatives can be compared.

2.5 COMPARISON OF IMPACTS OF ALTERNATIVES

For comparison purposes, Table 2-5 summarizes the potential environmental and social impacts of each of the reservoir alternative described in section 2.4 and the water conservation and no-action alternatives. The table includes environmental criteria and specific environmental impacts that were not included in the initial alternative selection process. A detailed discussion of each potential impact is included in Chapter 4. Mitigation measures to compensate for adverse impacts are summarized in Table 2-6.

2.6 PREFERRED ALTERNATIVE

The applicant's (WWDC) preferred alternative is the High Savery dam and reservoir with a minimum pool. Although this alternative would inundate more wetlands, riparian vegetation, and stream channel than the Dutch Joe alternative, it would not inundate crucial big game ranges and it would improve the habitat for adult trout in Savery Creek, provide a brood site for CRCT, and would cost less.

The identification of the Corps' preferred alternative or alternatives in an EIS is required by CEQ regulations unless another law prohibits the expression of such a preference. Corps regulations state that, in regulatory permit actions, the Corps takes an impartial position on whether to permit or deny a particular action until public interest review is complete. The regulations further state that the Corps is not a proponent of any action but rather determines whether or not actions proposed by the applicant are in the public interest. Based on this regulation, the Corps does not identify its preferred alternative in the EIS; it states its decision in the Record of Decision.
### Table 2-5

**SUMMARY OF BENEFICIAL AND ADVERSE ENVIRONMENTAL IMPACTS**

<table>
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<tr>
<th>EVALUATION CRITERIA</th>
<th>Sandstone w/min pool</th>
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<th>High Savery w/min pool</th>
<th>w/o min pool</th>
<th>Dutch Joe no min pool</th>
<th>Water Conservation</th>
<th>No-Action</th>
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2-18
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<td>Reduced nutrient and sediment levels in Savery Creek; increased salinity and reduced sediment loads in the Little Snake River</td>
<td>Reduced nutrient and sediment levels in Savery Creek; increased salinity and reduced sediment loads in the Little Snake River</td>
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<td>Temporary, localized increased level</td>
<td>Temporary, localized increased level</td>
<td>Temporary, localized increased level</td>
<td>None</td>
</tr>
<tr>
<td>Vegetation (exclusive of wetlands)</td>
<td>Loss of 323 acres, mainly sagebrush and cottonwood</td>
<td>Loss of 286 acres, mainly sagebrush and cottonwood</td>
<td>Loss of 446 acres, mainly sagebrush and meadow</td>
<td>Loss of 389 acres, mainly sagebrush and meadow</td>
<td>Loss of 450 acres, mainly sagebrush and meadow, 5.5 riparian</td>
<td>Temporary disturbance from land leveling; loss of native grasslands through conversion to alfalfa</td>
<td>None</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Loss of 10.4 acres emergent, 13.5 acres scrub/shrub, 0.9 acres forested; potential gain in wetlands downstream</td>
<td>Loss of 10.2 acres emergent, 13.3 acres scrub/shrub, 0.8 acres forested; potential gain in wetlands downstream</td>
<td>Loss of 9.5 acre emergent, 6.5 acres scrub/shrub; potential gain in wetlands downstream</td>
<td>Loss of 7.5 acre emergent, 5.8 acres scrub/shrub; potential gain in wetlands downstream</td>
<td>Loss of 3.2 acres emergent</td>
<td>Possible fillings from land leveling; loss of wetlands incidentally maintained by current irrigation practices; potential benefit from decreased input of agricultural chemicals</td>
<td>None</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Minor disturbance from construction and human presence, some mortality during initial reservoir filling</td>
<td>Minor disturbance from construction and human presence, some mortality during initial reservoir filling</td>
<td>Minor disturbance from construction and human presence, some mortality during initial reservoir filling</td>
<td>Minor disturbance from construction and human presence, some mortality during initial reservoir filling</td>
<td>Minor disturbance from construction and human presence, some mortality during initial reservoir filling</td>
<td>Minor disturbance from land leveling activities</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 2-5
SUMMARY OF BENEFICIAL AND ADVERSE ENVIRONMENTAL IMPACTS
<table>
<thead>
<tr>
<th>EVALUATION CRITERIA</th>
<th>Sandstone w/ min pool</th>
<th>Sandstone w/o min pool</th>
<th>High Savery w/ min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
<th>Conservation</th>
<th>No-Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>Loss of 370 acres, mainly sagebrush and cottonwood</td>
<td>Loss of 330 acres, mainly sagebrush and cottonwood</td>
<td>Loss of 482 acres, mainly sagebrush and meadow and some willow/alder</td>
<td>Loss of 420 acres, mainly sagebrush and meadow and some willow/alder</td>
<td>Loss of 450 acres, mainly sagebrush and meadow</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Big Game</td>
<td>Loss of elk CW, W/Y, and birthing; mule deer SSF, W/Y; pronghorn SSF</td>
<td>Loss of elk CW, W/Y, and birthing; mule deer SSF, W/Y; pronghorn SSF</td>
<td>Loss of elk W/Y; mule deer and pronghorn SSF</td>
<td>Loss of elk W/Y; mule deer and pronghorn SSF</td>
<td>Loss of elk W/Y, W; mule deer CW, SSF; pronghorn CW, SSF, W/Y</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Fisheries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent Streams Inundated</td>
<td>Length</td>
<td>Area</td>
<td>Habitat Units (HU)</td>
<td>Habitat Units (HU)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.1 miles</td>
<td>19.5 acres</td>
<td>Loss of 395 HU</td>
<td>Loss of 395 HU</td>
<td></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>6.4 miles</td>
<td>17.9 acres</td>
<td>Creation of 337 HU</td>
<td>Creation of 337 HU</td>
<td></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Threatened, Endangered, Candidate, or Proposed Species</td>
<td>Loss of nesting and rooting sites; increase in prey</td>
<td>Loss of nesting and rooting sites; increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Bald eagle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peregrine falcon</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Northern goshawk</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>Increase in prey</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Swift fox</td>
<td>Improved habitat</td>
<td>Improved habitat</td>
<td>Improved habitat</td>
<td>Improved habitat</td>
<td>Improved habitat</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Colorado squawfish</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions disrupted sediment transport and unseasonable temperature</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

1 CW = Crucial Winter Range; W/Y = Winter and Yearlong Range; SSF = Spring, Summer, and Fall Range, W = Winter Range. CW is considered to be the most important range in terms of population survival.
<table>
<thead>
<tr>
<th>EVALUATION CRITERIA</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
<th>Water Conservation</th>
<th>No-Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>w/min pool</td>
<td>w/o min pool</td>
<td>w/min pool</td>
<td>w/o min pool</td>
<td>no min pool</td>
</tr>
<tr>
<td>Razorback suckers</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>None</td>
</tr>
<tr>
<td>Bonytail</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>Habitat degradation caused by flow depletions and disrupted sediment transport</td>
<td>None</td>
</tr>
<tr>
<td>Humpback chub</td>
<td>Habitat degradation caused by low depletions disrupted sediment transport</td>
<td>Habitat degradation caused by low depletions disrupted sediment transport</td>
<td>Habitat degradation caused by low depletions disrupted sediment transport</td>
<td>Habitat degradation caused by low depletions disrupted sediment transport</td>
<td>None</td>
</tr>
<tr>
<td>Species of Special Concern</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Unseasonable temperature in the Little Snake River</td>
</tr>
<tr>
<td>Bluehead sucker</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Roundtail chub</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Unseasonable temperature in the Little Snake River</td>
</tr>
<tr>
<td>Flannelmouth sucker</td>
<td>Increase in habitat, blockage of movement</td>
<td>Increase in habitat, blockage of movement</td>
<td>Increase in habitat, blockage of movement</td>
<td>Increase in habitat, blockage of movement</td>
<td>Unseasonable temperature in the Little Snake River</td>
</tr>
<tr>
<td>Colorado River cutthroat trout</td>
<td>Increase in habitat, brood stock holding area</td>
<td>Increase in habitat</td>
<td>Increase in habitat, brood stock holding area</td>
<td>Increase in habitat</td>
<td>None</td>
</tr>
<tr>
<td>Ferruginous hawk</td>
<td>Loss of nesting and foraging habitat</td>
<td>Loss of nesting and foraging habitat</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

2-21
Table 2-5

SUMMARY OF BENEFICIAL AND ADVERSE ENVIRONMENTAL IMPACTS

<table>
<thead>
<tr>
<th>EVALUATION CRITERIA</th>
<th>Sandstone w/min pool</th>
<th>Sandstone w/o min pool</th>
<th>High Savery w/min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
<th>Water Conservation</th>
<th>No-Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-billed curlew</td>
<td>Increase in foraging habitat</td>
<td>Increase in foraging habitat</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Social and Economic Conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>Temporary increase</td>
<td>Temporary increase</td>
<td>Temporary increase</td>
<td>Temporary increase</td>
<td>Temporary increase</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Land Use</td>
<td>Loss of 111 acres rangeland, 36 acres pasture</td>
<td>Loss of 95 acres rangeland, 33 acres pasture</td>
<td>Loss of 247 acres rangeland, 146 acres pasture</td>
<td>Loss of 217 acres rangeland, 126 acres pasture</td>
<td>Loss of 261 acres rangeland, 35 acres pasture</td>
<td>Conversion of unknown quantity of grass pasture to alfalfa</td>
<td>None</td>
</tr>
<tr>
<td>Employment</td>
<td>Temporary increase, minimal permanent</td>
<td>Temporary increase, minimal permanent</td>
<td>Temporary increase, minimal permanent</td>
<td>Temporary increase, minimal permanent</td>
<td>Temporary increase, minimal permanent</td>
<td>Temporary increase, minimal permanent</td>
<td>Temporary increase</td>
</tr>
<tr>
<td>Income</td>
<td>Increased farm, additional recreational</td>
<td>Increased farm, additional recreational</td>
<td>Increased farm, additional recreational</td>
<td>Increased farm, additional recreational</td>
<td>Increased farm, additional recreational</td>
<td>Increased farm, additional recreational</td>
<td>Increased farm, additional recreational</td>
</tr>
<tr>
<td>Cultural Resources</td>
<td>11 sites affected, 3 could be eligible for NRHP</td>
<td>11 sites affected, 3 could be eligible for NRHP</td>
<td>24 sites affected, 10 could be eligible for NRHP</td>
<td>24 sites affected, 10 could be eligible for NRHP</td>
<td>3 sites affected but not eligible for NRHP</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Recreation</td>
<td>Provide additional opportunities</td>
<td>Provide additional opportunities</td>
<td>Provide additional opportunities</td>
<td>Provide additional opportunities</td>
<td>Provide additional opportunities</td>
<td>Provide additional opportunities</td>
<td>None</td>
</tr>
<tr>
<td>Visual and Aesthetic Resources</td>
<td>Addition of lake to landscape; loss of 9.1 miles of stream visual element</td>
<td>Addition of lake to landscape; loss of 8.5 miles of stream visual element</td>
<td>Addition of lake to landscape; loss of 10.7 miles of stream visual element</td>
<td>Addition of lake to landscape; loss of 9.4 miles of stream visual element</td>
<td>Addition of lake to landscape; loss of 4.4 miles of stream visual element</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

2NRHP = National Register of Historic Places
Table 2-6
SUMMARY OF MITIGATION MEASURES¹

<table>
<thead>
<tr>
<th>IMPACT CATEGORY</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Setting</td>
<td>Borrow areas developed outside of the dam and reservoir area would be reshaped and revegetated</td>
<td>Borrow areas developed outside of the dam and reservoir area would be reshaped and revegetated</td>
<td>Borrow areas developed outside of the dam and reservoir area would be reshaped and revegetated</td>
</tr>
<tr>
<td>Geology</td>
<td>Additional, detailed geologic investigation of each dam site would be required to prepare final design plans</td>
<td>Additional, detailed geologic investigation of each dam site would be required to prepare final design plans</td>
<td>Additional, detailed geologic investigation of each dam site would be required to prepare final design plans</td>
</tr>
<tr>
<td>Soils</td>
<td>Implement erosion and sedimentation control plans; restrict human activity to specific access points and vehicular traffic to prepared roadways and parking areas; remove livestock grazing activities on adjacent valley slopes</td>
<td>Implement erosion and sedimentation control plans; restrict human activity to specific access points and vehicular traffic to prepared roadways and parking areas; remove livestock grazing activities on adjacent valley slopes</td>
<td>Implement erosion and sedimentation control plans; restrict human activity to specific access points and vehicular traffic to prepared roadways and parking areas; remove livestock grazing activities on adjacent valley slopes</td>
</tr>
<tr>
<td>Seismicity</td>
<td>Design the project to withstand a 6.25 RS earthquake with a peak horizontal bedrock acceleration of 20% gravity</td>
<td>Design the project to withstand a 6.25 RS earthquake with a peak horizontal bedrock acceleration of 20% gravity</td>
<td>Design the project to withstand a 6.25 RS earthquake with a peak horizontal bedrock acceleration of 20% gravity</td>
</tr>
<tr>
<td>Mass Movements and Landslides</td>
<td>Grading and installation of trenches or French drains if more movement of a slide occurs than anticipated</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Mineral Resources</td>
<td>Preferential use of recoverable sand and gravel deposits located within the reservoir inundation zone</td>
<td>Preferential use of recoverable sand and gravel deposits located within the reservoir inundation zone</td>
<td>Preferential use of recoverable sand and gravel deposits located within the reservoir inundation zone</td>
</tr>
<tr>
<td>Water Quantity</td>
<td>Minimum flow release of lesser of 24 cfs or natural inflow</td>
<td>Minimum flow release of lesser of 12 cfs or natural inflow</td>
<td>None</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Implement erosion and sedimentation control plans during construction; install energy dissipating structures below the dam; use of a multi-level outlet structure; if salinity is increased because of project, water conservation or other measures to reduce salinity will be implemented</td>
<td>Implement erosion and sedimentation control plans during construction; install energy dissipating structures below the dam; use of a multi-level outlet structure; if salinity is increased because of project, water conservation or other measures to reduce salinity will be implemented</td>
<td>Implement erosion and sedimentation control plans during construction; install energy dissipating structures below the dam; use of a multi-level outlet structure; if salinity is increased because of project, water conservation or other measures to reduce salinity will be implemented</td>
</tr>
<tr>
<td>Water Use</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

¹ No mitigation measures are proposed for the conservation and no-federal-action alternatives.
<table>
<thead>
<tr>
<th>IMPACT CATEGORY</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>Spray water or other approved dust control chemicals on haul roads and revegetate disturbed areas outside the inundation zone to control dust; contractor required to maintain all construction vehicles in good working condition and to comply with all local, state, and federal air pollution rules</td>
<td>Spray water or other approved dust control chemicals on haul roads and revegetate disturbed areas outside the inundation zone to control dust; contractor required to maintain all construction vehicles in good working condition and to comply with all local, state, and federal air pollution rules</td>
<td>Spray water or other approved dust control chemicals on haul roads and revegetate disturbed areas outside the inundation zone to control dust; contractor required to maintain all construction vehicles in good working condition and to comply with all local, state, and federal air pollution rules</td>
</tr>
<tr>
<td>Noise Quality</td>
<td>Construction work periods near residences restricted to daytime hours; no construction activities between November and May</td>
<td>Construction work periods near residences restricted to daytime hours; no construction activities between November and May</td>
<td>Construction work periods near residences restricted to daytime hours; no construction activities between November and May</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Protection and enhancement of lower quality cottonwood areas at a ratio of 3 acres protected and enhanced for each acre inundated and/or creation of new cottonwood areas in the vicinity of the dam and reservoir at a ratio of 2:1; enhancement of willow/alder shrublands at a ratio of 3:1; install grade control structures downstream of dam</td>
<td>Protection and enhancement of lower quality cottonwood areas at a ratio of 3 acres protected and enhanced for each acre inundated and/or creation of new cottonwood areas in the vicinity of the dam and reservoir at a ratio of 2:1; enhancement of willow/alder shrublands at a ratio of 3:1; install grade control structures downstream of dam</td>
<td>Protection and enhancement of lower quality cottonwood areas at a ratio of 3 acres protected and enhanced for each acre inundated and/or creation of new cottonwood areas in the vicinity of the dam and reservoir at a ratio of 2:1; enhancement of willow/alder shrublands at a ratio of 3:1; install grade control structures downstream of dam</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Enhance existing wetlands and create new wetlands at replacement ratios determined by the Corps</td>
<td>Enhance existing wetlands and create new wetlands at replacement ratios determined by the Corps</td>
<td>Enhance existing wetlands and create new wetlands at replacement ratios determined by the Corps</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Seasonal restrictions on construction and public access; staged filling of the reservoir; enhancement or protection of habitats similar to those inundated at 1:1 ratio; the loss of big game crucial range is unmitigatable</td>
<td>Seasonal restrictions on construction and public access; staged filling of the reservoir; enhancement or protection of habitats similar to those inundated at 1:1 ratio</td>
<td>Seasonal restrictions on construction and public access; staged filling of the reservoir; enhancement or protection of habitats similar to those inundated at 1:1 ratio; the loss of big game crucial range is unmitigatable</td>
</tr>
</tbody>
</table>

1 No mitigation measures are proposed for the conservation and no-federal-action alternatives.
## Table 2-6

### SUMMARY OF MITIGATION MEASURES

<table>
<thead>
<tr>
<th>IMPACT CATEGORY</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fisheries</strong></td>
<td>Implement erosion and sedimentation control plans during construction;</td>
<td>Implement erosion and sedimentation control plans during construction;</td>
<td>Implement erosion and sedimentation control plans during construction;</td>
</tr>
<tr>
<td></td>
<td>install energy dissipating structures below the dam; use of a multi-level</td>
<td>install energy dissipating structures below the dam; use of a multi-level</td>
<td>install energy dissipating structures below the dam; use of a multi-level</td>
</tr>
<tr>
<td></td>
<td>outlet structure; if salinity is increased because of project, water</td>
<td>outlet structure; if salinity is increased because of project, water</td>
<td>outlet structure; if salinity is increased because of project, water</td>
</tr>
<tr>
<td></td>
<td>conservation or other measures to reduce salinity will be implemented;</td>
<td>conservation or other measures to reduce salinity will be implemented;</td>
<td>conservation or other measures to reduce salinity will be implemented;</td>
</tr>
<tr>
<td></td>
<td>minimum flow releases of 24 cfs; instream habitat improvements to</td>
<td>minimum flow releases of 12 cfs; use reservoir to raise genetically</td>
<td>minimum diversion bypass of 24 cfs</td>
</tr>
<tr>
<td></td>
<td>replace inundated trout habitat units</td>
<td>pure Colorado River cutthroat trout</td>
<td></td>
</tr>
<tr>
<td><strong>Threatened and Endangered</strong></td>
<td>Replacement or enhancement of cottonwood riparian habitat; monetary</td>
<td>Replacement or enhancement of cottonwood riparian habitat; monetary</td>
<td>Monetary contribution to the Colorado River Recovery Program</td>
</tr>
<tr>
<td><strong>Species</strong></td>
<td>contribution to the Colorado River Recovery Program</td>
<td>contribution to the Colorado River Recovery Program</td>
<td></td>
</tr>
<tr>
<td><strong>Species of Special Concern</strong></td>
<td>See mitigation measures for water quality and quantity, vegetation,</td>
<td>See mitigation measures for water quality and quantity, vegetation,</td>
<td>See mitigation measures for water quality and quantity, vegetation,</td>
</tr>
<tr>
<td></td>
<td>wetlands, wildlife, fisheries, and threatened and endangered species</td>
<td>wetlands, wildlife, fisheries, and threatened and endangered species</td>
<td>wildlife, fisheries, and threatened and endangered species</td>
</tr>
<tr>
<td><strong>Social and Economic Conditions</strong></td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Cultural Resources</strong></td>
<td>Sites to be mitigated have been identified, specific mitigation</td>
<td>Sites to be mitigated have been identified, specific mitigation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>measures are under development</td>
<td>measures are under development</td>
<td></td>
</tr>
<tr>
<td><strong>Recreation</strong></td>
<td>Maintenance of minimum pool (larger version only); reservoir fish</td>
<td>Maintenance of minimum pool (larger version only); potential development</td>
<td>Enhancement of wildlife habitat</td>
</tr>
<tr>
<td></td>
<td>stocking; potential development of boat ramp, camping, picnicking, and</td>
<td>of boat ramp, camping, picnicking, and restroom facilities; minimum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>restroom facilities; minimum flow releases; enhancement of wildlife</td>
<td>flow releases; enhancement of wildlife habitat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>habitat</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visual and Aesthetic Resources</strong></td>
<td>Concentrate, as much as possible, mitigation efforts for wetlands,</td>
<td>Concentrate, as much as possible, mitigation efforts for wetlands,</td>
<td>Concentrate, as much as possible, mitigation efforts for wetlands,</td>
</tr>
<tr>
<td></td>
<td>riparian vegetation, and wildlife habitat in one area</td>
<td>riparian vegetation, and wildlife habitat in one area</td>
<td>riparian vegetation, and wildlife habitat in one area</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. No mitigation measures are proposed for the conservation and no-federal-action alternatives.
CHAPTER 3
AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Twenty-three structural alternatives were initially considered as alternatives to meet the identified need for 12,000 acre-feet of late-season supplemental irrigation water in the Little Snake River basin. A selection process based on engineering, cost, and environmental considerations (Chapter 2) identified three dam and reservoir alternatives as feasible. In addition to the reservoirs, the alternatives of conservation and no-federal-action also remained under consideration. Chapter 3, Affected Environment, describes the natural resources, such as vegetation and wildlife, and the human resources, such as socioeconomics and cultural resources, which are in the vicinity of these alternatives and could be impacted by the alternatives still under consideration.

Existing environmental conditions are described using areas or scales appropriate for the geographic variability of the factor. Features such as general setting, topography, and climate are reasonably consistent on approximately a county-scale. Most natural resources features such as geology, soils, mineral resources, land cover, and wildlife are described using a 12-square mile area around each of the reservoir sites. This area is considered large enough to adequately describe the typical conditions at each reservoir site but small enough to demonstrate the differences that exist among the sites (Figure 3-1). In the case of socioeconomics and recreation, the relevant study area was increased to cover Carbon County, Wyoming and Moffat and Routt counties, Colorado because impacts relevant to these features were considered to have more far-reaching effects.

3.2 LAND FEATURES

3.2.1 GENERAL SETTING
The LSSIWSP area is within the Little Snake River drainage basin in extreme southern Carbon County, Wyoming, and northern Moffat County, Colorado. The majority of the project area is in south-central Wyoming, with a small portion lying in northwest Colorado.

Land in the LSSIWSP project area is primarily used for agricultural activities. These activities include livestock grazing and hay production. Areas with low relief, adjacent to the Little Snake River and Savery Creek, are generally where irrigated hay fields, pastures of grass, and fields of alfalfa and small grains are found. Adjacent sagebrush areas with more relief are fenced and used as range. Occasionally these areas may be improved by the establishment of drought
Figure 3-1
WATER SUPPLY
STUDY AREAS FOR THE
RESERVOIR ALTERNATIVES
tolerant grasses to provide additional livestock forage. Lands in the project area are also used for recreational activities, particularly big game hunting.

3.2.2 TOPOGRAPHY
The project area is about 20 miles west of the Continental Divide in the Sierra Madre Range. The general relief consists of mountains and erosional valleys. Some areas along valley floors have little relief. High mesas with steep sideslopes and deep intervening canyons are characteristic of the areas outside the larger drainage basins. Surface elevations range from approximately 6,000 feet above mean sea level (msl) in the valleys to 8,000 feet msl on the mountain tops. Drainage for this area is generally to the south and west.

3.2.3 CLIMATE
South-central Wyoming and northwest Colorado are characterized by cool, dry summers and cold winters. July is normally the warmest month with an average maximum temperature of 80 degrees Fahrenheit (°F) and an average minimum temperature of 47 °F (Gale Research Company 1985). January is the coldest month, with an average maximum temperature of 32 °F and an average minimum of 10 °F. Temperatures above 90 °F are uncommon during the summer months while temperatures of -40 to -50 °F may occasionally occur during the winter months. The frost-free season ranges from 60 to 120 days long, depending on elevation, and occurs generally between the middle of May and late September. Winds vary from calm to periods of sustained winds with velocities of 30 to 40 miles per hour during the winter. The sustained winds during the winter may cause some areas to be blown free of snow while other areas may have deep drifts.

Precipitation averages approximately 14 inches per year, or 1.15 inches per month. May has the highest average rainfall at 1.7 inches and March averages the greatest snowfall at 15 inches. Average rainfall is the least in September (1.13 inches). The lowest snowfall month during the winter is February with an average of 10 inches. Stream flows are variable from year-to-year and season-to-season (Section 3.3.2). Highest stream flows occur during April through June as a result of snowmelt runoff. Lowest stream flows occur during September.

3.2.4 GEOLOGY AND SOILS
The geology of the project area consists of unconsolidated overburden and bedrock. The strata vary in composition across the area depending on how they were deposited, topography, erosional features, and structural uplift.

3.2.4.1 Unconsolidated Overburden
The unconsolidated overburden varies across the project areas primarily as a result of topography and erosional features (Figure 3-2). Terrace deposits are located on the sides of mountains where the slopes are less steep. These deposits consist of weathered colluvium (material deposited at the foot of a slope or cliff primarily by gravity) and bedrock. A thin soil has developed over
these deposits that supports sagebrush, grasses, and some woody vegetation. The steeper sideslopes consist of colluvium, slopewash, and bedrock deposits. Landslide areas are also present along some sideslopes in the project area (Figures 3-2 and 3-3). Materials that make up landslide deposits may include terrace, colluvial, alluvial (material primarily deposited by water), and slopewash deposits as well as bedrock material. A more detailed discussion of mass movements is included in Section 3.2.10.

Lower elevations, consisting of creek and river bottoms, have alluvial deposits, which are primarily sand and gravel derived from all of the material found in the area. Sediments are generally medium to coarse sand. Finer material is generally washed from the creek and river bottoms and flushed farther downstream because of the high velocity of water.

Soils in the project area are highly variable. They formed from alluvium, colluvium, slopewash, glacial, terrace, and residual soil deposits. Soil depths range from none to very thin on sideslopes, from thin to moderate depths on terraces, and from thin to deep in the valley bottoms. Most soils are very well drained with moderate to rapid permeability. Wind and water erosional hazards range from slight to severe, dependent upon the slope. There are no prime farmland soils designated in the project area. Hydric soils occur as small scattered patches or as inclusions within other soil types.

3.2.4.2 Bedrock Geology
The bedrock of the project area consists of Precambrian basement rocks, Cretaceous rocks of the Steele Shale and Mesaverde Group, and Oligocene-Miocene rocks of the Browns Park Formation (Figure 3-3).

The Precambrian rocks of the Sierra Madre Uplift located to the east of the project area are Proterozoic in age and representative of the basement rocks that underlie the project area. They consist primarily of volcanic rocks and sediments that have been subjected to high temperatures and pressures to form metamorphic rocks.

The Steele Shale is the lowest and oldest rock found within the middle to eastern part of the project area. It consists of marine shales with some interbedded sandstone and siltstones and is up to 4,000 feet thick. The Steele Shale is overlain by the Mesaverde Group, which underlies most of the project area. The Mesaverde Group is divided into the Haystack Mountains Formation and the Allen Ridge Formation.

The Haystack Mountains Formation consists primarily of marine sandstones and form the prominent cliffs in the project area; the softer rocks tend to form the broader slopes. The Allen Ridge Formation lies directly on top of the Haystack Mountains Formation and is primarily made up of sandstones and shales. The upper part of the Allen Ridge Formation is missing in much of the area because of erosion. Thin coal beds are found in the lower Allen Ridge Formation.
Figure 3-3
GENERAL GEOLOGY
The Browns Park Formation blankets the higher broad uplands of the project area. The basal portion of the formation is a conglomerate while the remaining portion of the formation generally grades from sandstone to siltstone with interbedded volcanic ash deposits. Coarser materials within the formation may accumulate groundwater and appear as seeps in valley walls.

3.2.4.3 Structural Geology
The Cretaceous bedrock formations generally strike northwest to southeast and dip to the southwest in the project area. The dip of the bedrock becomes steeper to the east because of the Sierra Madre Uplift. The Browns Park Formation is tertiary in age and is fairly flat lying over the Cretaceous rocks in the project area.

Several mapped faults are located northeast of the town of Savery. They generally cut across Savery Creek from the southeast to the northwest (Stone and Webster Engineering Corporation (SWEC) 1986). Some of the faults are mapped close to the Sandstone and Dutch Joe sites (Figure 3-3). These faults were probably formed in association with the uplift of the Sierra Madre to the east.

3.2.4.4 Sandstone Dam and Reservoir
The soils in this area consist primarily of colluvial material on the sideslopes, alluvial material in the valley bottom, and terrace deposits and outcrops outside the valley. Areas of mapped mass movements or landslides occur along Savery Creek (Figure 3-3).

The bedrock along Savery Creek within the Sandstone site is relatively flat and consists primarily of the upper and Middle parts of the Haystack Mountains Formation of the Mesaverde Group. The steep-sided slopes are primarily sandstones of the Haystack Mountains Formation and capped on either side of the valley by the Browns Park Formation. Outcrops of the Steele Shale Formation occur along the upstream portions of the area (Figure 3-3).

The faults in the area are probably associated with Tertiary volcanic and tectonic activity. These faults are considered stable with a low probability of future movement (SWEC 1986).

3.2.4.5 High Savery Dam and Reservoir
The Savery Creek valley is relatively narrow at this location. The soils consist of colluvial material along the valley sideslopes, alluvial material in the valley bottom, and residual soils and outcrops outside the valley. No major landslides are mapped in this area.

The bedrock at the High Savery Creek site consists of sandstone and shale of the Steele Shale Formation (Figure 3-3). Several massive sandstone outcrops occur along the sideslopes of the valley. The higher areas on either side of the valley are capped with the Browns Park Formation. No faults have been identified in the vicinity of the High Savery site (Figure 3-3).
3.2.4.6 Dutch Joe Dam and Reservoir
The soils in this area consist of colluvium on the sideslopes, alluvial material in the valley bottom, and residual soils and outcrops outside the valley. There are no major mass movements mapped in this area. The bedrock of Dutch Joe Creek is made up of the Browns Park Formation sandstones and conglomerates. The bedrock may also have areas where seepage could occur.

One fault is mapped in this area (Figure 3-3). The faults in the area are probably associated with Tertiary volcanic and tectonic activity. These faults have not been active in the last 1 million years and are considered stable with a low probability of future movement (SWEC 1986).

3.2.5 SEISMICITY
The two closest areas of well documented seismic activity include the Yellowstone, Wyoming region, about 300 miles northwest of the project area, and the Wasatch Fault Zone, about 200 miles west. A maximum probable event in the Wasatch Fault Zone could result in on-site effects similar to a 5.0 Richter Scale (RS) magnitude (SWEC 1986). The Richter Scale is an open-ended logarithmic scale used to describe the magnitude of a seismic event (i.e., earthquake). As an example, an earthquake of 1.5 RS is the smallest that can be felt; earthquakes of 4.5 RS and 8.5 RS cause slight and devastating damage, respectively.

Seismic events have been reported within 150 miles of the project area since 1882 (SWEC 1986, Case 1994). The magnitude of the seismic activity has historically averaged about 4.0 RS. Larger earthquakes have occurred as listed below:

- A 4.4 RS earthquake occurred in 1971 located about 40 miles southeast of the project area.
- A magnitude 5.5 RS earthquake, the largest known in Wyoming outside of Yellowstone National Park, occurred in 1984 about 150 miles northeast of the project area.
- A recent seismic event with a magnitude 5.3 RS occurred 140 miles west of the project area (20 miles west of Green River, Wyoming) in February 1995 because of a mine collapse.
- Another recent 4.1 RS magnitude earthquake occurred about 100 miles southwest of the project area, in Dinosaur National Monument, in March 1995.

The faults in the project are considered stable with a low probability of future movement (SWEC 1986). No correlations exists between any recorded seismic events and these faults.

A complete review of earthquake activity in the region of High Savery Reservoir is presented in Appendix B (Case, 1999). The report concludes:
"Damaging Earthquakes have occurred and will continue to occur in south-central Wyoming. A maximum credible "random" earthquake of magnitude 6.25 is postulated for the area. In addition, exposed active fault systems, within 100 miles of the project area, are capable of generating earthquakes in the magnitude 6.5 - 7.0 range.

The largest peak acceleration projected for the project area is 15%g. That acceleration is derived from placing a "random" magnitude 6.25 earthquake at 15 kilometers from the sites under consideration. That acceleration is similar to the 14%g acceleration that is derived from the 2,500-year probabilistic analysis (2% probability of exceedance in 50 years). Exposed active faults, within 100 miles of the project area, are not expected to generate peak horizontal accelerations in excess of 1.5%g at the project area. This is because the Faults are so distant from the sites under construction.

Based upon the methods of analysis utilized in this report, it is recommended that a peak horizontal acceleration of 15%g be considered for all dam sites in the Little Snake Supplemental Irrigation Water Supply Project Area. The design acceleration will be larger, depending on the factor of safety utilized. If a factor of safety of 1.3 is used, which is common for some types of construction, then an acceleration of 20%g should be considered in the design of the dam."

3.2.6 MASS MOVEMENTS
Mass movements in the project area generally occur in areas with steep sideslopes and are considered to be either recent or ancient. Recent movements are generally small and associated with hillside weathering, particularly during wet seasons when the soil strength is reduced (SWEC 1986).

Two large mass movement areas occurring in the vicinity of the Sandstone site are classified as ancient (Figure 3-3). These movements were apparently initiated by rapid stream valley erosion 10,000 years ago at the end of the last glacial period (SWEC, 1986). These areas consist of a series of roughly parallel ridges, which have moved toward the streams in recent times. This slide movement is classified as a "creep" and is perpetuated by the continued erosion of the toe of the slide by the streams (SWEC 1986).

The layer where movement has occurred is a bentonite clay layer found well below the Savery Creek valley floor at the Sandstone site. Slide mass movement has been measured at an annual rate of 2 inches at the clay layer and up to 4 feet on the surface (SWEC 1986).

3.2.7 MINERAL RESOURCES
Major deposits of coal, uranium, oil, natural gas, sand, and gravel are found in Carbon County. The Sandstone, High Savery, and Dutch Joe sites are all located in the Little Snake River Coal Field (Figure 3-4). Strippable deposits are located above the Browns Park Formation in the eastern part of this field (Keystone Coal Industry Manual 1986). However, no economically
recoverable coal deposits occur in the project area. Test borings drilled within and in the vicinity of the Sandstone site provided no evidence of coal deposits within 150 feet of the surface (SWEC 1986).

The Baggs, Shirley Basin, and Ketchum Buttes uranium resource areas are found in Carbon County. The Ketchum Buttes Area, located west of the High Savery Creek site, is the only uranium resource area in the project vicinity (Figure 3-4). Other minor uranium resources occur in the south-central portion of Carbon County (Hausel et al. 1979). No uranium mining currently occurs in the project area.

Several major gas fields and many minor oil and gas fields occur in Carbon County (Stephenson et al. 1984). Most producing fields are to the west and northwest of the project area. Three small oil and natural gas fields are located in the project area (Figure 3-4). These fields occur in the vicinity of the Sandstone and Dutch Joe sites but should not affect the development of a water supply.

Extensive deposits of sand and gravel exist in recent stream and Quaternary terrace deposits throughout Carbon County. These are located primarily in the stream valleys. The Wyoming Geological Survey classifies alluvial areas as potential sand and gravel resources. Sand and gravel deposits occur within the creek bed at the Sandstone and High Savery sites. Dutch Joe contains side slope deposits which would be economical to recover. An existing sand pit is located about one mile west of Savery, Wyoming, in the Little Snake River alluvium. Small amounts of copper, silver, and gold occur in Carbon County and have been mined in the past. No evidence of recoverable reserves has been found in the project area (U.S. Army Corps of Engineers (Corps) 1988).

3.3 WATER RESOURCES

3.3.1 STUDY AREA
The Little Snake River Basin drains approximately 3,770 square miles in south-central Wyoming and north-central Colorado (United States Geological Survey (USGS) 1984). The river originates in the Wyoming portion of the Sierra Madre range and flows southwest to the Yampa River in northwest Colorado. The Yampa River is a tributary of the Green River, which is a tributary of the Colorado River.

3.3.2 SURFACE HYDROLOGY
The major tributaries of the Little Snake River upstream of Baggs, Wyoming, are the North, Middle, South, and Roaring forks of the Little Snake River, and Battle, Slater, Savery, Willow, and Muddy creeks. Of these tributaries, Savery Creek is the only major tributary that would be directly impacted by the development of any of the water supply alternatives.
Stream flow data from USGS gaging stations on Savery Creek near Savery, Wyoming, and on the Little Snake River near Dixon, Wyoming, illustrate the dramatic variations in annual discharge volumes from year to year (Figure 3-5). As is typical of mountainous regions, a significant portion of the annual discharge is snowmelt. In the Little Snake River, over 80 percent of the annual discharge normally occurs during the months of April, May, and June as a result of melting snow. Lowest flows generally occur during September. Late summer and early fall flows have been further reduced in modern times because of upstream irrigation diversions. Monthly discharge can vary by over ten-fold between a dry and a wet year (Figure 3-5).

A flood frequency analysis for the Little Snake River was completed in 1986 using data from the gaging station near Dixon, Wyoming, (Appendix B) (SWEC 1986). The U.S. Bureau of Reclamation (BOR) has estimated the channel capacity of the Little Snake River at approximately 3,500 cubic feet per second (cfs) (Banner Associates, Inc. (BAI) 1980a). Based on the results of the flood frequency analysis, the channel capacity of the river is equal to floods that generally occur one out of every two years.

3.3.2.1 Sandstone Dam and Reservoir Site

Originating along the Continental Divide in eastern Carbon County, Wyoming, Savery Creek flows in a southerly direction to the Little Snake River. It is the largest tributary of the Little Snake River upstream of Baggs, Wyoming. Major tributaries to Savery Creek include the North and East forks of Savery Creek, Little Savery Creek, Big Sandstone Creek, and Little Sandstone Creek (Figure 3-1).

Based on historical stream flow data for Savery Creek near Savery, Wyoming, the average annual discharge is approximately 150,000 acre-feet (AF) (Corps 1988). Peak flows occur between the months of April and June and account for over 80 percent of the annual flow. Lowest flows typically occur during the months of August and September.

A flood frequency analysis for Savery Creek was completed in 1986 for the gaging station near Savery, Wyoming (Appendix B) (SWEC 1986). The BOR has estimated the channel capacity of Savery Creek to be approximately 1,000 cfs (BAI 1980b). Like the Little Snake River, Savery Creek's channel capacity is equal to floods that generally occur one out of every two years.

3.3.2.2 High Savery Dam and Reservoir

For the purpose of this study, the High Savery Creek site includes Savery Creek upstream of the confluence of Little Savery and Savery creeks. Major tributaries to upper Savery Creek are the North and East forks of Savery Creek (Figure 3-1).

No recent stream flow data is available for this portion of Savery Creek. The nearest stream gaging station, located approximately three miles downstream of the High Savery Creek site, was discontinued after 1972. However, seasonal flow variation is expected to be the same as reported for Savery Creek near the Sandstone site in Section 3.3.2.1.
Savery Creek near Savery, Wyoming

Little Snake River at Dixon, Wyoming

Figure 3-5
RANGES OF DISCHARGES AT SELECTED POINTS IN THE LITTLE SNAKE RIVER BASIN

Note: Maximum and minimum years were selected based on annual discharge.
3.3.2.3 Dutch Joe Dam and Reservoir
Dutch Joe Creek is an intermittent tributary of the Little Snake River east of Dixon, Wyoming. No stream flow data is available for Dutch Joe Creek. Peak and low flow seasons should be similar to those reported for Savery Creek.

3.3.3 EXISTING WATER USE
All surface waters within the State of Wyoming have been assigned a beneficial use classification by the Wyoming Department of Environmental Quality (WDEQ). These classifications are based on the suitability of the water for coldwater fishery, agricultural and industrial use, and body contact recreation. The Little Snake River and Savery Creek in the vicinity of the Sandstone and High Savery sites are classified Class II. Dutch Joe Creek is classified as a Class III surface water. Class II surface waters include those which support a game fish population or have the hydrologic and natural water quality potential to support a game fish population. Class III surface waters are those waters which presently support a non-game fish population or have the hydrologic and natural water quality potential to only support a non-game fish population. WDEQ beneficial use classifications differ from the stream classification of the WGFD because the latter are based primarily on the nature of the trout fishery.

The Little Snake River Basin is one of the basins in the state of Wyoming where unused and unappropriated water is available for development. Currently, water is used in the basin for agricultural irrigation, municipal, and limited industrial purposes.

Agricultural irrigation is the primary water use within the Little Snake River Basin. An estimated 20,600 acres of agricultural lands within the basin are presently permitted under Wyoming water law to receive irrigation water (WWDC 1990). Irrigation is accomplished through direct streamflow diversion from Savery Creek and the Little Snake River via a system of ditches and canals. Irrigated crops include alfalfa, hay, and small grains, which are used for livestock production.

Approximately 20,900 AF of water is diverted annually from the Little Snake River Basin to the North Platte River Basin via the Cheyenne Stage I and II projects. A larger Cheyenne Stage III project, which would annually divert a total of 40,250 AF of water from the Little Snake River basin, is no longer considered viable because of high cost and excessive environmental impacts.

Cheyenne, Wyoming is the largest municipal user of water from the Little Snake River Basin. The towns of Baggs and Dixon, Wyoming also obtain municipal water from the Little Snake River Basin. The latter two towns obtain their water supply through infiltration galleries in the Little Snake River alluvium. Neither town has adequate raw water storage capability and could be adversely impacted by extended low-flow or drought periods. August 1996 through July 1997 municipal water demands at Baggs and Dixon were 88.4 and 18.4 AF, respectively. Annual water demands by the year 2041 are projected to be 131 AF for Baggs and 59 AF for Dixon (Western
However, these demands may be over-estimates because the populations of Baggs and Dixon have declined slightly since 1990 (Section 3.7.2).

A few small mining or manufacturing operations currently use water for industrial purposes within the basin (BAI 1980a). A number of potential industrial water users within the Little Snake River Basin have been identified by the WWDC (Corps 1988), however, no firm commitments from these potential industrial users have been made to the WWDC or the Corps at this time.

**3.3.4 WATER QUALITY**

Although the only active USGS stream gaging station within the project area is on the Little Snake River near Dixon, Wyoming, historic water quality data were available for gaging stations on Savery Creek near Savery, Wyoming and on the Little Snake River near Baggs, Wyoming. No existing water quality data for Dutch Joe Creek are available.

The water temperatures in Savery Creek and the Little Snake River ranged from 0 degrees Celsius (°C) in the winter months to 20 - 23 °C in the summer. Compared to the Little Snake River, the maximum temperature in Savery Creek is slightly higher and occurs sooner in the year (Figure 3-6). Dissolved oxygen (DO) in both streams is highest in the winter and lowest in the summer (Figure 3-6). This pattern reflects the inverse relationship between temperature and the solubility of oxygen in water. Because Savery Creek is a smaller stream, it has less thermal buffering capacity than the Little Snake River and, consequently, greater annual temperature and DO fluctuations. These DO data suggest that neither stream is receiving excessive amounts of organic material. The pH of the water in the Little Snake River and Savery Creek is typically between 7.8 and 8.5 (Figure 3-6) and well within the range suitable for aquatic life. The pH in Savery Creek is between 8.1 to 8.3 for most of the year except during December, January, and February when pH ranges from 7.8 to 8.0. In the Little Snake River, pH is lowest through spring and early summer and is highest in late summer and fall. Total phosphorus (TP) concentrations in Savery Creek were relatively low, < 0.01 mg/l P, throughout the year (Figure 3-6). In the Little Snake River, TP concentrations were much greater in the spring during a period corresponding to the beginning of the snow melt period. Total nitrogen concentrations had a distinct peak during the late-winter and spring in both streams. Total dissolved solids (TDS) concentrations were lowest in both stream during the spring runoff period (Figure 3-6). In the Little Snake River, TDS spiked in August, perhaps as a results of more saline irrigation return flows.

The Little Snake River contributes approximately 77 percent of the sediment load to the Yampa River at Deerlodge Park, approximately 4.5 miles below their confluence (O’Brien 1987 in Hawkins and O’Brien 1997). Approximately 60 percent of the sediment load in the Yampa River at Deerlodge Park originates from tributaries between the Dixon and Lily gaging stations (Andrews 1978 in Hawkins and O’Brien 1997) which account for 66.4 percent of the Little Snake River watershed. This means 17 percent of the sediment in the Yampa River comes from the remaining 33.6 percent of the Little Snake River basin, which includes tributaries such as Savery Creek, Battle Creek, the South Fork of the Little Snake River, and others.
Figure 3-6
SEASONAL WATER QUALITY IN THE LITTLE SNAKE RIVER AND SAVERY CREEK

Notes: Data plotted are means for each month over the period of record. Data was not available for all parameters for all months. Total nitrogen data were not available for the Little Snake River near Baggs, WY.

Periods of record:
Little Snake River near Baggs, WY 1970 - 1979
Little Snake River near Dixon, WY 1974 - 1986
Savery Creek near Savery, WY 1975 - 1991

Source: U.S. Geological Survey
The USGS evaluated soils, rocks, water, and plants in the Savery Creek drainage basin for the presence of potentially toxic trace elements such as arsenic and selenium. Results of the study identified some locations that contain elevated levels of these elements. The highest selenium concentrations (ranging from 3.7 to 150 parts per billion) were found in rock samples taken from the Ketchum Buttes uranium resource area (Figure 3-4) where uranium exploration has occurred. This area is located in the Little Savery Creek drainage basin. Water samples collected from Savery Creek and its tributaries typically had selenium concentrations very near or below the detection limit of one part per billion (ppb). The highest total selenium concentration recorded from the water samples was 3 ppb (USGS 1991), which is below the Wyoming water quality standard of 5 ppb for the protection of aquatic life.

### 3.4 AIR QUALITY

The general study area is considered to be Class II by the States of Wyoming and Colorado. This classification means that air quality deterioration that occurs with moderate, well-controlled growth would probably not be significant.

Because of the undeveloped, rural nature of the study area, the air quality is good. All three counties (Carbon County, Wyoming, and Moffat and Routt counties, Colorado) in the study area are in attainment/unclassified for all criteria pollutants and meet established ambient air quality standards (Chick 1995, Schick 1995). The State of Colorado has adopted the U.S. National Ambient Air Quality Standards. The State of Wyoming, however, has adopted more stringent standards for some pollutant criteria.

A short-term air quality monitoring program was conducted in the immediate project area by the State of Wyoming from 1979 to 1982 (Corps 1988). Only total suspended particulates (TSP) were measured. TSP measurements were well below the standards established by the State of Wyoming. Local municipalities and agricultural industries are not expected to emit high levels of any pollutants that would exceed established air quality standards.

The Colorado Department of Health and WDEQ-Air Quality Division were contacted to determine if any long-term ambient air monitoring stations are, or have been, located in Carbon County, Wyoming, or in Moffat or Routt counties, Colorado. The WDEQ indicated that the air quality in Carbon County was considered to be good, and typical of a rural environment. No long-term ambient air monitoring stations have been or are located in any of these counties.

### 3.5 NOISE

All potential sites in the project area are located in sparsely populated rural environments. Ambient noise levels in these areas are typically low. The primary sources of noise in the study
area are vehicles on roads and highways, and farm equipment. Ambient noise quality data are not available for Carbon County, Wyoming, or Moffat and Routt counties, Colorado.

Municipalities in Carbon County, Wyoming, and in Moffat and Routt counties, Colorado, were contacted to determine if ambient noise quality standards had been established. Construction noise limits have been established for the municipalities of Steamboat Springs and Craig, Colorado, and Rawlins, Wyoming. No noise ordinances have been established for areas outside of these municipalities.

### 3.6 BIOLOGICAL RESOURCES

#### 3.6.1 VEGETATION

The project area is located in the sagebrush steppe on the high plains of Wyoming. The arid climatic conditions favor plant species with an ability to avoid or tolerate drought conditions. Uplands and sideslopes are dominated by low-growing shrubs and short to medium height grasses. Drainage ways and stream valleys receive moisture throughout the spring and early summer from snow melt at higher elevations. These areas may support several different vegetative communities.

The dominant upland plant community at each of the potential water supply source areas is the big sage/serviceberry shrubland (Figure 3-7). Even though the degree of dominance of the big sage/serviceberry shrubland varies among the water supply source areas, this community occurs throughout the LSIIWSP project area on high uplands and steep slopes with shallow soils. Common species found in the big sage/serviceberry shrubland include big sage, silver sagebrush, white sage, serviceberry, rabbitbrush, snakeweed, antelope bitterbrush, buckbrush, needlegrass, wild rye, bluegrass, and bluebunch wheatgrass. This upland community occasionally changes to more of a yucca-blue grama association on the high plains, dominated by yucca and blue grama. Other species found in these often heavily grazed areas include cheatgrass and gumweed. The Ground cover in the uplands ranges from 25 - 75 percent.

North and east-facing upland slopes contain inclusions of aspen, serviceberry, and snowberry shrublands. These locations receive less direct sunlight and allow these less drought tolerant species to dominate. At still higher elevations, forests of spruce and fir intermixed with aspen are present. These communities generally occur on north- or east-facing slopes or in draws where moisture is sufficient to support them. Common species include subalpine fir, limber pine, and blue spruce.

Drainage ways and stream valleys may contain a mosaic of riparian communities, depending on the available moisture. Riparian forest vegetation is only found in areas that have a relatively constant groundwater table within reach of the roots during the driest parts of the year. Cottonwoods, predominantly narrowleaf cottonwood with some plains cottonwood, usually
dominate this community. A mixed riparian community is usually located in areas with varying moisture regimes. Willow-alder shrublands often dominate depressional areas that receive more runoff during precipitation events. These sites include populations of willows, alder, and cinquefoil.

Areas within valleys that do not receive much runoff or do not have a dependable water table are dominated by meadows and pasture. Irrigation is often used to enhance these areas and increase the production of grasses for grazing or hay. Dominant species include a mixture of native and introduced species such as salt and pepper grass, bluegrass, timothy, junegrass, squirreltail, and sedges. Descriptions of the vegetation present at the water supply source areas are provided below. A summary listing of vegetation in the area is contained in WGFD (1988a, included in Appendix C).

3.6.1.1 Sandstone Dam and Reservoir
The Savery Creek valley within the area of Sandstone dam and reservoir ranges in width from broad to narrow, is generally flat, and contains the largest number of distinct vegetation communities of the potential water supply sites (Table 3-1). This stream valley contains a mosaic of cottonwood woodland, willow/alder shrubland, meadow, and pasture (Figure 3-7). In addition, transitional communities made up of a mixture of species from each community occur between different riparian communities, and between riparian and upland communities. These transitional zones add to the vegetative diversity in the valley. Many of these communities are in poor condition because of heavy ungulate (livestock and big game) grazing, which disturbs and lowers the percent of plant cover. Regeneration of the cottonwoods and other woody species in

<table>
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<th>Community Type</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
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<td>w/o min pool</td>
<td>w/min pool</td>
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<tr>
<td>Grassland/Meadow</td>
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<td>33</td>
<td>146</td>
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<tr>
<td>Cottonwood Riparian</td>
<td>126</td>
<td>117</td>
<td>1</td>
</tr>
<tr>
<td>Willow/Alder Shrub</td>
<td>8</td>
<td>28</td>
<td>52</td>
</tr>
<tr>
<td>Aspen and Fir/Aspen</td>
<td>42</td>
<td>33</td>
<td>--</td>
</tr>
<tr>
<td>Forest</td>
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<td></td>
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</tr>
<tr>
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<td>25</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Streams and Ponds</td>
<td>22</td>
<td>2</td>
<td>20</td>
</tr>
</tbody>
</table>
Figure 3-7
VEGETATIVE COMMUNITIES
the riparian community has been severely reduced, because of the heavy grazing of seedlings and hydrologic modification that has forced the formerly meandering stream channel into a more rigid alignment or bed.

Slopes and mesas adjacent to this portion of Savery Creek are primarily covered by big sage/serviceberry and blue grama/yucca/wheatgrass communities (Table 3-2). However, patches of aspen woodland and spruce/fir woodland also occur on north- and east-facing slopes and in draws adjacent to the higher peaks and ridges above the valley.

### 3.6.1.2 High Savery Dam and Reservoir

The High Savery Creek valley is broad and flat. Existing plant communities generally consist of pasture and meadow, with small patches of willow and alder shrubland (Table 3-1). Shrublands occur primarily in clumps along the streambed and in old stream oxbows (Figure 3-7). Because of the high elevation and cattle grazing of the area, woody vegetation is limited to shrubs and grasslands are moderately utilized.

Leaving the stream valley, the vegetation changes to the big sage community common on uplands throughout the project area (Figure 3-7). This community comprises most of the sideslopes and mesas adjacent to the valley, and may be interspersed with small patches of aspen.

<table>
<thead>
<tr>
<th>Community Type</th>
<th>Sandstone Inundation Zone</th>
<th>Sandstone Adjacent Lands</th>
<th>High Savery Inundation Zone</th>
<th>High Savery Adjacent Lands</th>
<th>Dutch Joe Inundation Zone</th>
<th>Dutch Joe Adjacent Lands</th>
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<td>8</td>
<td>&lt;1</td>
<td>--</td>
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<td>--</td>
</tr>
<tr>
<td>Willow/Alder Shrub</td>
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<td>10</td>
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<td>--</td>
</tr>
<tr>
<td>Aspen and Fir/Aspen Forest</td>
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<td>15</td>
<td>--</td>
<td>8</td>
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<td>--</td>
</tr>
<tr>
<td>Wetland</td>
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<td>15</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>&lt;1</td>
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<tr>
<td>Streams and Ponds</td>
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<td>2</td>
<td>4</td>
<td>2</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

1For the with minimum pool variant.
2Adjacent lands consist of a 12 square mile area around the dam and reservoir site (i.e., the boxes in figures 3-1 through 3-8).
3.6.1.3 Dutch Joe Dam and Reservoir
Dutch Joe Creek is an intermittent tributary to the Little Snake River. It drains an area dominated by the big sage community (Table 3-2). This community persists down to a narrow band adjacent to the creek bed (Figure 3-7). In some areas, no streambed is apparent.

Small riparian zones are located adjacent to and within the drainage way. Intermittent pools and depressions that receive more consistent runoff support populations of sedges and rushes. The community composition of the upland areas is similar to the area of the Dutch Joe Creek valley which would be inundated (Table 3-2).

The entire Dutch Joe Creek site is heavily grazed by wildlife and domestic livestock. Essentially all of the plant species must reproduce vegetatively because the frequent removal of the tops of the plants eliminates most flowering and seed production.

3.6.2 WETLANDS
Wetlands are important natural communities protected by the Clean Water Act and provide the following important functions:

• contain vegetation that filters sediment and impurities from surface runoff to improve water quality
• increase flood water retention and erosion control
• provide recreational opportunities like bird watching, canoeing, and fishing
• provide important habitat for many rare and endangered plants and animals
• are important fish spawning and nursery areas, as well as nesting, resting, and feeding areas for waterfowl and mammals

Section 404 of the Clean Water Act regulates discharges of fill or dredged material, unless exempted, into "waters of the United States," which include jurisdictional wetlands and other aquatic habitats. Jurisdictional wetlands are defined for regulatory purposes in the Clean Water Act, and this definition is used by the Environmental Protection Agency and the Corps to administer the Section 404 permit program:

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (Environmental Laboratory 1987). Wetlands generally include swamps, bogs, and similar areas (40 CFR 230.3 and 33 CFR 328.3).
This definition recognizes and emphasizes the fact that wetlands possess three essential characteristics: hydric soils, prevalence of hydrophytic vegetation, and wetland hydrology. These three characteristics are the mandatory technical criteria required for wetland determination. Areas must meet all three of these criteria before being designated as jurisdictional wetlands.

Wetlands are frequently located between open water and upland systems. They are inundated or saturated for prolonged periods during the growing season (May through September in the project area). Wetland hydrology in the project area is generally provided by stream flooding or saturation from the water table. The majority of the project area consists of upland, or non-wetland, communities. Because of the existing topography, soils, and climate, only a few wetlands are present in the project area.

Wetlands may be classified within three broad categories based upon dominant vegetation species. Forested wetlands are characterized by woody vegetation that is 6.0 meters tall or taller (Cowardin et al. 1979). The dominant tree found in forested wetlands in the project area is cottonwood. Forested wetlands contain an understory of young trees or shrubs, and a herbaceous layer. Forested wetlands are temporarily flooded.

Scrub/shrub wetlands are dominated by woody vegetation less than 6.0 meters tall. Dominant species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Scrub/shrub wetlands may represent a successional stage leading to forested wetland, or they may be stable communities (Cowardin et al. 1979). Common species dominating scrub/shrub wetlands in the project area include: willow, alder, sedges, rushes, bentgrass, and red top. Shrub/scrub wetlands within the project area are located within old oxbows, stream scours, point bars, and sandbars. These oxbows function as catchment basins. They contain poorly drained soils that hold excess flood water for extended durations.

Emergent wetlands are characterized by erect, rooted, herbaceous plants adapted to wet soil conditions. These wetlands appear as wet meadows or fringe wetlands within stream floodplains in the project area. These seasonally flooded, emergent wetlands are dominated by sedges, rushes, bluegrass, iris, bentgrass, and timothy. Other emergent wetlands are associated with small seeps in the project area. Seeps are natural areas usually located on side slopes, where groundwater permeates to or near the soil surface. The moist soil conditions create a micro-environment conducive to hydrophytic (water-loving) plant growth. Seeps in the project area are small and are generally dominated by sedges and rushes.

3.6.2.1 Sandstone Dam and Reservoir
The Sandstone site contains 24.8/24.3 acres of wetlands (with/without minimum pool versions, respectively) (Table 3-1). Shrub/scrub wetlands dominated by willow and alder, covering 13.5/13.3 acres, are located in poorly drained oxbows adjacent to Savery Creek. Following intensive runoff events, these depressional basins hold water for a prolonged period of time.
The remainder of the phreatophytic (groundwater using) shrublands are classified as non-wetlands. While dominated by hydrophytic vegetation, these shrubland sites do not contain hydric soils. Inundation and saturation are not at a frequency or duration sufficient to meet wetland hydrology parameters.

Less than one acre (0.9/0.8 acres) of forested wetlands are located within the Sandstone dam and reservoir inundation area. Although large clumps of cottonwood are present throughout the project area, most of these woodlands do not contain hydric soils and, therefore, are not wetlands.

Emergent wetland covers 10.4/10.2 acres of the Sandstone inundation area. These areas are vegetated with wetland herbaceous species such as sedge, rush, reedgrass, redtop, timothy, and bentgrass. These emergent wetlands are seasonally inundated by surface water.

Wetlands and riparian areas within the Sandstone site are heavily grazed by livestock and wildlife. Livestock tend to congregate and feed close to Savery Creek because of the abundance and palatability of forage, cooler temperatures in the summer, warmer temperatures in the winter, proximity to water, and flat terrain.

3.6.2.2 High Savery Dam and Reservoir
Wetlands cover approximately 16.0/13.3 acres of the High Savery Creek alternative site (Table 3-1). Shrub/scrub wetlands cover 6.5/5.8 acres within poorly drained stream oxbows. Willow and alder dominate these depressional wetlands. Willow and alder are found growing throughout the High Savery Creek valley. However, not all of these shrublands are wetlands. The shrub species have their root systems penetrating three to five feet below the soil surface to the available water table.

Emergent wetlands, covering 9.5/7.5 acres, are located within the ordinary high water mark. Some of these wetlands are intermittently scattered along the stream. During peak flow periods (spring) these narrow wetland bands are covered with water. Emergent wetlands are also located in small seep areas located within the High Savery Creek site.

Forested wetlands are not present at the High Savery location.

In general, the High Savery Creek valley and associated wetlands have been moderately grazed by livestock and wildlife. Some local areas have been grazed more severely than others.

3.6.2.3 Dutch Joe Dam and Reservoir
The Dutch Joe Creek area consists of an incised intermittent streambed surrounded by big sagebrush rangeland. The area within and directly adjacent to the streambed is emergent wetland. Emergent wetlands make up approximately 3.2 acres of the Dutch Joe Creek site inundation area. No other types of wetlands occur in the Dutch Joe inundation area. Common species of these seasonally inundated wetlands are sedge, rush, and foxtail barley. Wetland and riparian
communities within and adjacent to the Dutch Joe Creek stream channel have been heavily grazed by livestock and wildlife.

3.6.3 WILDLIFE
The general project area contains a variety of wildlife habitat types utilized by a diverse group of species. A discussion of the various habitats present and the common species found in the vicinity of each dam and reservoir water supply alternative follows. Summary lists of birds and mammals found in the project area are contained in Appendix C.

The majority (65 percent or more) of the general project area is dominated by sagebrush (Table 3-2, Figure 3-7). Typical wildlife species that use this type of habitat are pronghorn antelope, badger, white-tailed jackrabbit, ground squirrels, sage grouse and ferruginous hawk. Golden eagle, rough-legged hawk (in winter), red-tailed hawk, and turkey vulture (in summer) forage over these areas. Mule deer seasonally use sagebrush areas at lower elevations for winter browse.

Sagebrush gives way to aspen woodlands and fir-spruce forests at higher elevations and on north- and east-facing slopes. Mule deer, elk, bobcat, marten, porcupine, and black bear may be found in these habitats. These wooded areas provide roosting and nesting habitat for a variety of raptors and songbirds.

Riparian woodlands also occur adjacent to streams and through canyons and draws. These areas consist of primarily cottonwood, serviceberry, willow, and occasionally aspen. They provide habitat for mule deer, songbirds, furbearers, and small mammals. Wintering elk particularly use these woodlands. Larger trees, particularly cottonwoods, provide nesting and roosting sites for golden eagles and hawks and roosting sites for wintering bald eagles. Woody and brushy canyons provide cover and hunting areas for mountain lions.

Along with riparian woodlands, stream valleys also contain shrub/scrub areas, forested and emergent wetlands, pasture, and wet meadows (usually developed through human activity and by irrigation). Beaver, muskrat, raccoon, red fox, coyote, mule deer, and numerous species of songbirds, waterfowl, shorebirds, and raptors use these riparian woodlands for foraging and nesting.

Mule deer, pronghorn, and elk are common in the general project area. These big game species use different habitats at different times of the year (WGFD 1987) and typically migrate between summer and winter habitats. Many migration routes are well established. Frequently, separate areas are used by females during parturition (birthing) periods in spring and summer. To manage these mobile populations, WGFD has established management units based on the geographic areas used by each species and herd. The general project area is located in the Baggs Management Unit for mule deer and pronghorn and in the Sierra Madre Elk Management Unit.
3.6.3.1 Sandstone Dam and Reservoir
Sandstone contains a diversity of wildlife habitat types (Figure 3-7). The stream valley is broad and contains riparian woodlands, emergent wetlands, pastureland, and irrigated meadows. However, extensive grazing has degraded all these areas, reducing the cover and forage available for wildlife. Deer, beaver, raccoon, golden eagles, waterfowl, and songbirds frequent these areas. The valley also provides wintering habitat for elk and grouse. Mountain lions and bobcats occur in wooded canyons and draws leading into the valley. Bald eagles may use wooded canyons as roost sites in winter.

Valley side-slopes and mesas above the valley are dominated by sagebrush. Pronghorn, cottontail rabbit, jackrabbit, badger, and sage grouse occupy this habitat. Numerous raptor species forage in search of rodents, jack-rabbits, and birds. Mule deer find winter forage on snow-free sagebrush slopes and mesa tops.

The Sandstone site contains spring/summer/fall and yearlong range for mule deer (Figure 3-8). Crucial mule deer winter range occurs outside of the inundation area below the confluence of Savery and Big Gulch creeks. Migration corridors for mule deer moving between higher and lower elevations cross this area. Farther west, corridors for pronghorn movement to crucial winter range also cross the area. The area provides spring/summer/fall range for pronghorn (Figure 3-8). The entire Sandstone inundation area is within elk wintering range designated as crucial (Figure 3-9). The lower elevation of the valley and the presence of woodlands and meadows contribute to this area’s designation as crucial winter range. Some elk also utilize the area year-round. An elk parturition area is located along Savery Creek, upstream of the confluence with Big Gulch Creek. A portion of this area would be within the inundation area of the Sandstone reservoir.

3.6.3.2 High Savery Dam and Reservoir
The High Savery Creek site is characterized by flat mesas sloping steeply into a wide stream valley. Extensive meanders bordered by shrub/scrublands and meadows create a mosaic of meadows and small patches of shrubby vegetation throughout the stream valley (Figure 3-7). Sideslopes and adjacent mesas are primarily sagebrush, although small patches of aspen, willow or serviceberry woodland do occur on north-facing slopes and in small draws. While these areas show the effects of grazing, they remain in generally good condition.

Numerous wildlife species occur in this area. Deer, waterfowl, furbearers, and songbirds all find suitable habitat in the stream valley. Adjacent sagebrush habitat supports pronghorn, badger, and jackrabbit. Raptors, including golden eagles, are common throughout the area. In winter, however, deer, antelope, raptors, and songbirds migrate to lower elevation to escape the deeper snow cover and colder winds at higher elevations. Other wildlife species concentrate in nearby wooded and shrubby areas for shelter and food.
The High Savery Creek site is included in the spring/summer/fall range of deer and antelope (Figure 3-8). Elk may be found yearlong in the area, but winter in low numbers. High Savery Creek occurs in the elk migration corridors as they move between higher elevations in the Sierra Madre (to the east and southeast) and crucial wintering areas to the northwest (Figure 3-9). Big game generally do not stay yearlong in the High Savery Creek area because deep snows cover food sources and force big game species to migrate to lower elevations during winter months.

3.6.3.3 Dutch Joe Dam and Reservoir
The land area surrounding Dutch Joe Creek is almost exclusively sagebrush rangeland (Figure 3-7, Table 3-2) and is heavily grazed by livestock and wildlife. Only the immediate streambed consists of non-sagebrush habitats. The streambed is a patchwork of small emergent wetlands, meadow grasses, and temporary open-water pools.

The area surrounding Dutch Joe Creek provides habitat for pronghorn, jackrabbit, coyote, badger, prairie rattlesnakes, and sage grouse. Hawks and eagles may forage throughout the area. Emergent wetlands and open water pools provide limited habitat for waterfowl, frogs, and snakes.

The Dutch Joe Creek area is located at lower elevation and does not receive sufficient winter snows to cover wildlife forage. The entire Dutch Joe Creek inundation area is classified as crucial mule deer winter range (Figure 3-8). The lower portion of the basin is within crucial winter range for pronghorn; the remainder is yearlong pronghorn range and crossed by a pronghorn migrating corridor leading south to crucial winter range. Due to the area’s lower elevation and less snow during the winter, the Dutch Joe area provides crucial forage and cover for mule deer and pronghorn. Loss of this acreage could impact the species viability in this area. In addition, the presence of a canal used when filling the reservoir in the spring could alter existing wildlife migration routes. Dutch Joe Creek is classified as non-crucial elk wintering range. The area directly east of the dam and reservoir location, however, is classified as crucial elk range (Figure 3-9).

3.6.4 FISHERIES
The Little Snake River Basin and its tributaries provide habitat for a number of fish species, including several species of trout. The WGFD has classified all rivers and streams in the State of Wyoming based upon the ability of the water to support a trout population. All perennial streams in the project area including the Little Snake River and Savery Creek are Class 3. Dutch Joe Creek which is an intermittent stream is Class 5. Class 3 trout streams support a trout fishery that is considered regionally important within the state. Class 5 trout streams support a trout fishery that may be locally important, but are not able to support substantial fishing pressure. Trout stream classifications differ from beneficial use classifications, which are established by the WDEQ and are based on the use for coldwater fishery, agriculture, industry, and body contact recreation.
Historically, Savery Creek supported what are considered to be sensitive, native fish species including CRCT (*Oncorhynchus clarki pleuriticus*), flannelmouth sucker (*Catastomus latipinnis*), bluehead sucker (*C. discobolus*), and possibly roundtail chub (*Gila robusta*) (WGFD 1998a,b). The earliest survey of Savery Creek found that flannelmouth and bluehead suckers were widely distributed in the basin (Kanaly and Williams 1958). A recent resurvey found that the abundance and distribution of these two species had declined considerably (Wheeler 1997).

Currently, the native fish fauna of the Savery Creek basin consists of flannelmouth sucker, mountain sucker (*C. platrhyynchus*), CRCT, mottled sculpin (*Cottus bairdi*), and speckled dace (*Rhinichthys osculus*). Native species that apparently no longer occur in Savery Creek are the mountain white fish (*Prosopium williamsoni*) and the bluehead sucker. Non-native species include, white sucker (*C. commersoni*), Bonneville redside shiner (*Richardsonius balteatus*), creek chub (*Semotilus atromaculatus*), rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*). The three trout species, along with the Snake River cutthroat trout (*Oncorhynchus clarki* sp.), have been stocked into Savery Creek by WGFD since the 1930s. Competition from brook trout is believed to have contributed to the population decline and isolation to headwaters of the CRCT (WGFD 1998b). Continued declines in the regional populations of CRCT, bluehead sucker, and flannelmouth sucker could make these species candidates for federal listing as threatened or endangered.

To assess the fisheries within the project area, existing data were obtained from the WGFD and fisheries studies were conducted by and in coordination with the WGFD in August 1994 and August and October 1997 (WGFD 1994, 1998a, b). For these studies, fish species composition and population structure data were collected by electro shocking. Stream habitat quality was evaluated using the Habitat Quality Index (HQI) method (Binns 1982). The HQI was developed by the WGFD for use on Wyoming streams and is WGFD's standard trout habitat evaluation procedure. Results are expressed in habitat units (HU), where one HU is defined as the amount of habitat quality that will support one pound of trout. The HQI is an expression of habitat and does not precisely correlate with fish standing crop because fish densities naturally fluctuate considerably from season to season and year to year.

Habitat data were collected from many sites located on Savery Creek from near its mouth through the area that would be occupied by the High Savery reservoir (Figure 3-10). Sampling sites were also on Dutch Joe Creek, the Little Snake River, and several major tributaries of Savery Creek which could be impacted by the project.

### 3.6.4.1 Sandstone Dam And Reservoir

Five sites have been used since 1984 to assess the fish community and habitat in the vicinity of the Sandstone alternative (Figure 3-10). Two of these sites were on Savery Creek and three were on tributaries. Data on fish collections were available for the sites on Savery Creek and Hell Canyon Creek. A total of nine species were collected in Savery Creek including flannelmouth sucker,
Figure 3-10
LOCATIONS FOR FISHERY DATA COLLECTION
rainbow trout, and brown trout. One species, CRCT, was captured at the Hell Canyon Creek site (Table 3-3).

### Table 3-3

<table>
<thead>
<tr>
<th>Sample Sites</th>
<th>Data collection</th>
<th>HU /acre</th>
<th>Trout lbs/acre</th>
<th>Fish species (composite of all sites)</th>
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<td>22.4</td>
<td>--</td>
<td>white sucker</td>
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<tr>
<td></td>
<td>1994 X</td>
<td>27.4</td>
<td>3.7</td>
<td>flannelmouth sucker</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>mountain sucker</td>
</tr>
<tr>
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<td></td>
<td>brown trout</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mottled sculpin</td>
</tr>
<tr>
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<td>speckled dace</td>
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<td>1997 --</td>
<td>26.6</td>
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</tbody>
</table>

1Site abbreviations correspond to site locations on Figure 3-10.
2Only collected in Hell Canyon Creek.

Source: WGFD 1994, 1997a, b.

Habitat units generally ranged from 17 to 27 HU/acre for sites in the vicinity of the Sandstone alternative (Table 3-3). The exception was Little Sandstone Creek which had 7.1 HU/acre. The sites on Savery Creek were evaluated twice for trout habitat quality. The habitat measures made in 1984 and 1994 at the lower site (MSC-1) were similar (22.4 and 27.4, respectively). The measures made at the upper site (MSC-2) in 1994 and 1997, however, were quite different (17.4 and 7.1, respectively). At the lower Savery Creek site, four trout were collected in the 1994 sampling. Based on the size of the trout and the area sampled, these four trout were equivalent to 3.7 pounds per acre. The habitat quality analysis indicated this site could support approximately 25 pounds per acre. This suggests that the available trout habitat at this site was not being fully utilized.
3.6.4.2 High Savery Dam and Reservoir
Ten sites have been used since 1984 to assess the fish community and habitat in the vicinity of the High Savery alternative (Figure 3-10). Four of these sites were on Savery Creek and six were on tributaries. Data on fish collections were made at all of these sites except USC-2. A total of 8 species were collected in Savery Creek including flannelmouth sucker, rainbow trout, brown trout, and CRCT. Brook trout and mountain sucker were found in some of the tributaries (Table 3-4).

Habitat units ranged from 5.4 to 15.4 HU/acre for sites in the vicinity of the High Savery alternative (Table 3-4). Sites on Savery Creek averaged about 10 HU/acre and sites on East Fork of Savery Creek had about 8 HU/acre. The highest quality stream was North Fork Savery Creek with about 13.5 HU/acre. However, HUs did not always reflect trout standing crop. Sites on the East Fork had an average trout standing crop of 20 pounds/acre which was considerably above

<table>
<thead>
<tr>
<th>Map reference</th>
<th>Data collection</th>
<th>HU/acre</th>
<th>Trout lbs/acre</th>
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<td>1997 X</td>
<td>5.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Site abbreviations correspond to site locations on Figure 3-10.
Only collected in tributaries to Savery Creek.
One trout was collected at this site but no weight was given.
Source: WGFD 1994, 1997a, b.
the 8 pounds/acre predicted from the habitat analysis. Sites on Savery Creek and the North Fork averaged about 7 and 5 pounds/acre of trout, respectively. These standing crops are slightly below the respective stream HUs.

In general, compared to the Sandstone alternative, the streams around the High Savery site had similar richness of fish species and standing crop of trout but lower habitat quality scores. This suggests that fish are making relatively better use of the available habitat at the High Savery site and that other, structural (e.g., spawning habitat) or non-structural habitat parameters (e.g., water quality) are having a relatively greater adverse impact at the Sandstone site.

### 3.6.4.3 Dutch Joe Dam and Reservoir

Dutch Joe Creek is an intermittent stream. No data exists for this stream, although the WGFD conducted a cursory survey in August 1992 (Site DJ on Figure 3-10). No fish were observed in 1992 and the water temperature was 75 °F (WGFD 1992a). In 1994, Dutch Joe Creek was dry, except for small, shallow, extremely turbid pools. No evidence of fish was observed. Consequently, fish may only inhabit this creek on a seasonal basis.

### 3.6.4.4 Additional Downstream Sites

Fishery surveys were conducted in 1985 and 1994 at four additional sites (Table 3-5). Site LSC-1, also known as Thomas Ranch, was located on Savery Creek approximately two miles upstream of the confluence with the Little Snake River (Figure 3-10). Site LSC-2 was located on Savery Creek at the Page Ranch approximately 6 miles upstream from the Little Snake River. Site LSC-3 was at the Wren Bridge, approximately 1 mile downstream of the Sandstone dam site. Fish were also collected from the Little Snake River approximately 2 miles downstream from Savery Creek (site LSR).

Only one of the sites (LSC-1) on lower Savery Creek was sampled for fish. At that time in 1994 only 6 species of fish were collected including rainbow trout and mountain sucker (Table 3-5). The site on the Little Snake River was also sampled in 1994. This site yielded only 4 fish species including rainbow trout and flannelmouth sucker.

Trout habitat quality was quantified for the three sites on lower Savery Creek in 1985. Among these sites, habitat quality was fairly consistent, ranging from 5.5 to 6.1 HU/acre, and generally lower than sites upstream on Savery Creek.

In general, the upstream sites on Savery Creek and the tributaries to Savery Creek had the greatest standing crops of trout, the highest species richness, and habitat quality better than or equal to any other portion of Savery Creek. The portion of Savery Creek below the Sandstone dam site had obviously lower fish species richness and habitat quality. Taken together, the fish species richness, habitat quality, and trout standing crop data suggest a declining trend in fisheries quality from upstream to downstream in Savery Creek.
Table 3-5
CHARACTERISTICS OF FISHERIES SAMPLING SITES
DOWNSTREAM OF THE SAVERY CREEK ALTERNATIVES

<table>
<thead>
<tr>
<th>Sample Sites</th>
<th>Data collection</th>
<th>Habitat</th>
<th>Fish units/acre</th>
<th>Fish species (composite of all sites)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Map reference</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSC-1</td>
<td>X</td>
<td>1985</td>
<td>--</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1994</td>
<td>X</td>
<td>white sucker</td>
</tr>
<tr>
<td>LSC-2</td>
<td>X</td>
<td>1985</td>
<td>--</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>mountain sucker^1</td>
</tr>
<tr>
<td>LSC-3</td>
<td>X</td>
<td>1985</td>
<td>--</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>speckled dace^2, mottled sculpin</td>
</tr>
<tr>
<td>LSR</td>
<td>--</td>
<td>1994</td>
<td>X</td>
<td>redside shiner^3</td>
</tr>
</tbody>
</table>

1 Site abbreviations correspond to site locations on Figure 3-10.
2 Only collected in Savery Creek.
3 Only collected in the Little Snake River.
Source: WGFD 1994, 1997a, b.

3.6.5 THREATENED, ENDANGERED, AND CANDIDATE SPECIES
The Endangered Species Act of 1973 (ESA) affords federal protection to those species and their habitats determined to meet the criteria for listing as either federally threatened or endangered. The ESA defines a federally threatened species as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." A federally endangered species is defined by the ESA as "any species which is in danger of extinction throughout all or a significant portion of its range." Candidate species are those for which a sufficient amount of information has been gathered to support a listing as threatened or endangered, but listing at the present time is precluded by other listing activities (50 CFR 17).

3.6.5.1 Species
Six endangered, two threatened, and three candidate species and one species which has been proposed for listing were identified by FWS as potentially occurring in the project areas (Table 3-6). Brief descriptions of each species are presented below. More detailed descriptions are in the Biological Opinion (Appendix D).

3.6.5.1.1 Ute’s Ladies Tresses Orchid The federally threatened Ute’s ladies tresses orchid was identified by the FWS as a species potentially occurring within the project area. In Wyoming, this species is only known from the eastern slope of the Rocky Mountains. It is found in Laramie, Goshen and Converse counties. These populations were discovered in 1997, 1993.
Table 3-6

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ute Ladies’ Tresses Orchid</td>
<td><em>Spiranthes diluvialis</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Colorado Pikeminnow</td>
<td><em>Ptychocheilus lucius</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Bonytail</td>
<td><em>Gila elegans</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Humpback Chub</td>
<td><em>Gila cypha</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Razorback Sucker</td>
<td><em>Xyrauchen texanus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Western Boreal Toad</td>
<td><em>Bufo boreas</em></td>
<td>Candidate</td>
</tr>
<tr>
<td>Bald Eagle</td>
<td><em>Haliaeetus leucocephalus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Peregrine Falcon</td>
<td><em>Falco peregrinus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Mountain Plover</td>
<td><em>Charadrius montanus</em></td>
<td>Candidate</td>
</tr>
<tr>
<td>Northern Goshawk</td>
<td><em>Accipiter gentilis</em></td>
<td>Petitioned</td>
</tr>
<tr>
<td>Swift Fox</td>
<td><em>Vulpes velox</em></td>
<td>Candidate</td>
</tr>
<tr>
<td>Black-footed ferret</td>
<td><em>Mustela nigripes</em></td>
<td>Endangered</td>
</tr>
</tbody>
</table>

and 1994, respectively (FWS 1995). An intensive recovery effort is currently underway in Goshen County (FWS 1995). The orchid also occurs within the floodplain of the Yampa River, of which the Little Snake River is a tributary. The FWS requires that perennial tributaries of the Yampa River west of Steamboat Springs, Colorado, which are below 6,500 feet msl be surveyed for this species (FWS 1992). This requirement does not apply to Wyoming.

Little is known about the habitat requirements of the species because of its rare occurrence (FWS 1992). This orchid generally occurs below 6,500 msl in seasonally moist soils such as wet meadows, old stream channels, and seeps. However, it may occur in grazed pastures, or on heavily disturbed sites that have revegetated. Well drained soils with high moisture content seem to be preferred (FWS 1992). Suitable habitat contains open vegetation that is not densely overgrown or over grazed. Flowering normally occurs from mid-July until the end of August.

3.6.5.1.2 Colorado Pikeminnow The Colorado pikeminnow is a federally endangered fish species. The Colorado pikeminnow is native to the Yampa and Green River systems in the upper Colorado River Basin. Adults are found in deep water inhabiting eddies, pools, and other areas adjacent to the main channel. Juvenile pikeminnow inhabit shallow, quiet backwater areas off of main river channels (FWS 1991 and references therein).

Pikeminnow spawn in early to mid-summer over gravel bars when water temperatures reach 68-72 °F. A study conducted by Haynes and Muth (1982) indicated that spawning fish seek out the same spawning sites every year. Adult pikeminnow often move as much as 100 miles upstream or downstream to suitable spawning areas. Upon completion of spawning activities, adult fish have been found to return to their year-round habitat almost immediately. Adult pikeminnow have
been documented to reside in the Little Snake River when not spawning in the Yampa River. However, data are insufficient to confirm their presence in the project area. Populations of Colorado pikeminnow appear to be stable where presently found.

3.6.5.1.3 Bonytail The bonytail is listed as federally endangered. Historically, this species was found throughout the Colorado River drainage. The bonytail prefers eddies and pools. The decline of this species is believed to be associated with lower water temperatures resulting from deep water releases from reservoirs and hybridization of the species (Woodling 1985). They exist in extremely small populations in the upper Colorado River system and exhibit very poor reproductive success.

3.6.5.1.4 Humpback Chub. The humpback chub is a federally endangered fish species. Historically, this species ranged in the mainstem Colorado River downstream to below Hoover Dam. This big river species prefers areas with slower current such as eddies and pools. Spawning occurs when water temperatures are between 58 and 62 °F. Small populations of humpback chubs exist in the lower Yampa River. This species has been collected in the Little Snake River during periods of high flow but apparently returns to the Yampa River before base flows return (Tyus and Karp 1989).

3.6.5.1.5 Razorback Sucker The razorback sucker is listed as federally endangered. Historically, the razorback sucker was found throughout the Colorado River drainage, but is now very rare above the Grand Canyon. This species is restricted to large rivers and is not found in smaller tributaries or headwaters (Tyus and Karp 1989). They are found in areas of strong current and backwaters in depths of 4 to 10 feet. Spawning occurs spring through early summer, which is typical of most suckers. Recently, spawning success has been higher than expected. However, fry have not been found to survive to adulthood in large numbers (Barker 1994).

3.6.5.1.6 Western Boreal Toad The western boreal toad is a Candidate species. Formerly listed as common (Baxter and Stone 1985), boreal toad numbers appear to have declined significantly. The reason for this decline is unknown. A status survey for various anurans (frogs and toads) in Wyoming (Garber 1994) recommended boreal toads be listed as endangered. The
Biodiversity Legal Foundation has also petitioned for the boreal toad to receive federal endangered status. The FWS has concurred with this petition but no further action to list the species is anticipated in the near future (50 CFR 17).

Boreal toads inhabit the moist areas of montane and foothill regions (Baxter and Stone 1985). In early summer, adults move to small lakes, ponds, or streams to breed. Eggs are laid in small ponds or in slack water areas along streams (Corn 1994). Tadpoles metamorphose in late summer and early fall. Adults and newly metamorphosed young may move from moist areas into adjacent dry, sagebrush areas to forage for food, primarily insects.

3.6.5.1.7 Bald Eagle The bald eagle is a federally threatened species. Populations of the species are increasing nationwide which resulted in a recent down listing from endangered to threatened. Habitat requirements for bald eagles revolve around food preference and nesting behavior. The bald eagle’s primary food source is fish (Grier et al. 1983). Because of their reliance on fish, nesting occurs in proximity to large water bodies including lakes, rivers, and oceans where large trees with strong branches or rock cliffs are present. The majority of North American bald eagles migrate to coastal or more southerly climates during the winter to find open-water feeding areas. Wintering bald eagles are found throughout the United States but are most abundant in the west and midwest. In Wyoming, bald eagles occur as breeding residents and winter visitors (WGFD 1992b).

3.6.5.1.8 Peregrine Falcon The peregrine falcon is one of the rarest raptors in Wyoming. It is listed as federally endangered. Once close to extinction, peregrine falcons are increasing in number in Wyoming and currently are known to have resumed nesting in the state (WGFD 1992b).

Peregrine falcons inhabit remote areas of canyons where they nest on cliff ledges. They feed almost exclusively on birds, which they capture while in flight. During winter, areas attracting concentrations of waterfowl provide important foraging areas. Nesting occurs in spring, with young fledging in mid-to-late summer (FWS 1984).
3.6.5.1.9 **Mountain Plover**  The mountain plover is a Candidate species. The present decline of this species is likely because of conversion of shortgrass prairie to cropland. Primary breeding areas for mountain plovers in Wyoming include the southeastern portion of the state, generally on the east side of the Continental Divide (Leachman and Osmundson 1990). Mountain plovers have been documented in the project area (WGFD 1985).

Unlike other plover species, the mountain plover does not prefer moist areas such as marshes or mudflats. Optimal mountain plover habitat consists of large areas of shortgrass prairie (Leachman and Osmundson 1990). Sagebrush-grasslands provide marginal habitat and, in Wyoming, is rarely used for nesting (White 1995). Mountain plovers nest on the ground in relatively exposed areas, often near cow droppings, which may be used for nest material. Insects are their primary food source.

3.6.5.1.10 **Swift Fox**  At about the size of a domestic cat, the swift fox is the smallest of North American canids (Dunn 1997). Its common name is based on this fox’s running speed which can exceed 30 miles per hour. Habitat for this fox is short- to mid-grass and mixed-grass prairie (Carbyn 1993). The historic range of the swift fox was from western Texas through southern Canada and the Missouri River to the Rocky Mountains including the Upper Colorado River Basin. Today the swift fox exists in greatly reduced numbers in disjunct populations in the core of its historical range. The swift fox was declared extirpated from Canada in 1975 but a reintroduction process, started in the early 1980s, appears to have been successful (Carbyn 1993). Factors that contributed to the decline of this species were the conversion of large portions of prairie to cropland and poisoning programs aimed at coyotes and wolves. The swift fox was made a candidate for listing pursuant to the ESA in 1995.

The swift fox feeds primarily on small mammals, birds, insects, and reptiles. Carrion can be important in their diet when other prey is scarce, such as in winter (Dunn 1997). Swift foxes hunt at night and spend most of the day in burrows that they have either dug themselves or appropriated from badgers or marmots. Unlike other denning foxes, swift foxes use their dens all year. Kits are typically born in March or April in litters of 3 to 6, are weaned at about 6 to 7 weeks of age, and can breed by the end of the year. The life span in the wild of swift foxes is estimated to be 8 to 10 years (Carbyn 1993).

3.3.3.1.11 **Black-footed Ferret**  The black-footed ferret is federally endangered. Though never
common, black-footed ferrets once ranged over most of west-central North America. Currently in danger of extinction, re-introduced populations of black-footed ferrets have been released in Montana, South Dakota and Wyoming. The decline of this species is believed to be directly related to the decline in prairie dog populations.

Black-footed ferrets are dependent on prairie dogs. They feed primarily on prairie dogs and utilize their burrows for dens. Large prairie dog towns appear to be required to support viable populations of ferrets. Numerous small prairie dog towns in close proximity may support ferrets, provided ferrets can move easily between them (FWS 1988). Probable sightings of ferrets within the project area were recorded between 1970 and 1980 and again between 1981 and 1982 (Novak et al. 1987).

3.6.5.2 Reservoir Sites
The threatened or endangered species have varying degrees of likelihood to occur in the vicinity of each of the three water supply alternatives (Table 3-7).

3.6.5.2.1 Sandstone Dam and Reservoir Portions of Savery Creek watershed within the project area of Wyoming meet the locational survey requirements established by the FWS for Ute ladies’ tresses. This area was surveyed for this species and its potential habitat during the summer of 1994 by personnel of Burns & McDonnell, Inc.; however, no orchids were found. No records exist of boreal toads occurring in the project area. However, suitable habitat for the boreal toad exists along this portion of Savery Creek except that the elevation is below that of known populations. A survey of the area by personnel of Burns & McDonnell, Inc. in 1994 did not find any of these toads. The closest documented locations of boreal toads are in Medicine Bow National Forest approximately 10 miles east of the project area.

Habitat for the four endangered fish species is characterized by large rivers and it is highly unlikely that these fish would use a stream as small as Savery Creek, except incidentally. None of these endangered fish species have been documented from Savery Creek. These fish do occur downstream of Savery Creek to varying degrees in the Little Snake, Yampa, and Green rivers.

Although not known to nest in the project area, an active bald eagle nest is located west of Baggs on the Little Snake River. An abandoned nest is located on the Little Snake River near Savery. Bald eagles primarily inhabit the area during the winter months as migrants. The tall, mature cottonwood trees at this site provide sites for feeding, perching, and roosting. Peregrine falcons have not been documented from the Sandstone area, but may occur as incidental migrants. Northern goshawks have been documented to occur in the area (WGFD 1985) but breeding in the area by these raptors would be unlikely. Mountain plovers have been documented in the vicinity of the Sandstone site where appropriate habitat, upland grasslands, is plentiful.

Suitable habitat, in the form of open grasslands, also exists around the Sandstone site for the swift fox; however, these foxes have not been documented to occur in the area. Black-footed ferrets
do not occur at the Sandstone site because suitable habitat, in the form of prairie dog colonies, does not exist.

Table 3-7

SUMMARY OF OCCURRENCE OF THREATENED, ENDANGERED OR CANDIDATE SPECIES IN THE PROJECT AREAS

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
<th>Downstream in the Little Snake River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ute Ladies’ Tresses Orchid</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Colorado Pikeminnow</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>Bonytail Chub</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>P</td>
</tr>
<tr>
<td>Humpback Chub</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>Razorback Sucker</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>P</td>
</tr>
<tr>
<td>Western Boreal Toad</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Bald Eagle</td>
<td>D</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Peregrine Falcon</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Mountain Plover</td>
<td>D</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Northern Goshawk</td>
<td>D</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Swift Fox</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Black-footed Ferret</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>n/a</td>
</tr>
</tbody>
</table>

1D = documented occurrence. P = potential occurrence. U = unlikely to occur because suitable habitat is not present. n/a = not applicable.

3.6.5.2.2 High Savery Dam and Reservoir Habitat for Ute ladies’ tresses orchid was identified along High Savery Creek; however, the area exceeds the maximum reported elevation for the orchid. No orchids were observed during the 1994 summer survey by personnel of Burns & McDonnell, Inc. Suitable habitat at the appropriate elevation for boreal toads exists along Savery Creek in the vicinity of the High Savery Reservoir. As with the Sandstone site, however, the closest documented occurrence of boreal toad is approximately 10 miles east of the site in Medicine Bow National Forest. No threatened or endangered fish species have been documented from Savery Creek.

The High Savery site provides marginal foraging area for bald eagles because large trees for perching are scarce. This site would provide more favorable foraging for peregrine falcons and northern goshawk. However, nesting habitats for these raptors are lacking at the High Savery
site. These species could occur in the area as migrants or occasional foragers. Mountain plovers are likely to occur in the vicinity of the High Savery site because grassland habitat is plentiful. These open grasslands would also provide suitable habitat for the swift fox, however, these foxes have not been documented to occur in the area. Black-footed ferrets do not occur at the High Savery site because prairie dog colonies do not exist.

3.6.5.2.3 Dutch Joe Dam and Reservoir Dutch Joe Creek is within the elevation requirements for the Ute's ladies tresses orchid. Suitable habitat for it was found, but no individuals of the species were identified during summer 1994 surveys by personnel of Burns & McDonnell, Inc. Dutch Joe Creek is an intermittent stream which does not appear to support a fishery; therefore, Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker would not occur at this site. Bald eagle, northern goshawk, and peregrine falcon may forage over the area, but, like the High Savery site, suitable nesting habitat is not present. Suitable habitat exists for mountain plover and swift fox in the grasslands that occur in the southern portion of the site. Black-footed ferrets do not occur at the Dutch Joe site because suitable habitat, in the form of prairie dog colonies, does not exist.

3.6.5.2.4 Downstream in the Little Snake River The federally endangered Colorado pikeminnow and humpback chub have been documented within the Little Snake River Basin. Adult Colorado pikeminnow have been captured in the Little Snake River up to near Baggs, Wyoming and humpback chubs have been collected in the lower 10 miles of the Little Snake River (FWS 1996). However, the bonytail chub and razorback sucker are known to exist in the Colorado River system (FWS 1996) and could potentially use the Little Snake River.

3.6.6 WYOMING SPECIES OF SPECIAL CONCERN The State of Wyoming has identified species within its borders that currently do not meet the criteria outlined in ESA for listing as threatened or endangered but for which concerns exist about their continued existence in the state. Nongame mammals, birds of most concern, fish, and amphibian species which are native to Wyoming have been classified under a new system. This system consists of a continuum of classifications from Native Species Status 1 (NSS1) through NSS7. NSS1 species are those most sensitive and in danger of extirpation from Wyoming and NSS7 are species which are expanding in range and population. In general, NSS1 through NSS3 species are at more than a minimal risk of extirpation from the state.

3.6.6.1 Species Ten animal species of special concern which could possibly be affected by the proposed water supply project were identified by WGFD. One rare, potentially affected plant species was identified by FWS. Nine of the 11 species (Table 3-8) are discussed in the following section. Two species, the wolverine and the lynx, are known to exist in Carbon County, Wyoming but are not discussed because the high mountain habitat they require does not exist in the area around the proposed reservoir sites.
Table 3-8

<table>
<thead>
<tr>
<th>SPECIES OF SPECIAL CONCERN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common Name</strong></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Weber's Ipomopsis</td>
</tr>
<tr>
<td>Bluehead Sucker</td>
</tr>
<tr>
<td>Roundtail Chub</td>
</tr>
<tr>
<td>Flannelmouth Sucker</td>
</tr>
<tr>
<td>Colorado River Cutthroat Trout</td>
</tr>
<tr>
<td>White-faced Ibis</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
</tr>
<tr>
<td>Black Tern</td>
</tr>
<tr>
<td>Long-billed Curlew</td>
</tr>
<tr>
<td>Lynx²</td>
</tr>
<tr>
<td>Wolverine²</td>
</tr>
</tbody>
</table>

¹NSS = Native Species Status.
²Not considered further because the high alpine habitat required by this species is not present in the project area.

3.6.6.1.1 Weber's Ipomopsis  Weber's ipomopsis is a rare plant species in Wyoming. While uncommon in Wyoming, this member of the phlox family is common farther south in Colorado, particularly along the front range of the Rocky Mountains (Weber 1976).

Weber's ipomopsis is found in dry, sandy soils on hillsides of sagebrush grasslands. This annual species has scarlet flowers but is known to widely hybridize with other similar white flowering species. Hybridization produces a variety of scarlet, red, pink, and white flowers.

3.6.6.1.2 Bluehead Sucker  In Wyoming, the bluehead sucker is classified as NSS1. It is found in a variety of areas from headwater streams to large rivers. It inhabits streams and rivers having moderate to fast current and is absent in areas of standing water. The bluehead sucker prefers rock substrates where it feeds on algae, invertebrates, and other material scraped from the rocks. Little is known of their breeding habits, although they are spring or summer spawners. Coldwater releases from reservoirs may be partly responsible for declining populations in some rivers (Woodling 1985). Bluehead suckers were once wide-spread in Savery Creek (Kanaly and Williams 1958) but recent surveys suggest they are no longer present (WGFD 1994, 1998b).

3.6.6.1.3 Roundtail Chub  The roundtail chub is listed in Wyoming as NSS2. The roundtail chub generally inhabits large rivers where it occupies slow moving waters adjacent to areas of faster water. Young-of-the-year prefer shallow river runs and feed on small insects and algal films. Decline of the species in some rivers could be related to cold water releases from reservoirs that lower downstream temperatures and inhibit roundtail chub spawning (Woodling 1985).
Roundtail chub have been reported in Savery Creek but these findings were not confirmed (WGFD 1998b).

3.6.6.1.4 Flannelmouth Sucker The flannelmouth sucker is a NSS2 species in Wyoming. Research and management for this species are listed as a high priority by the WGFD. It inhabits larger streams and rivers in all habitat types including riffles, runs, eddies, and backwaters. Flannelmouth suckers are spring/summer spawners, although little is known about the spawning habits or sites of this species. The flannelmouth sucker has been replaced in some waters by human-introduced white and longnose suckers. Flannelmouth suckers have been found with regularity in Savery Creek (WGFD 1994, 1998a, b).

3.6.6.1.5 Colorado River Cutthroat Trout The CRCT is an NSS2 species in Wyoming. All known populations in Wyoming are located at elevations above 7,500 feet. Habitat degradation, displacement by brook trout, and hybridization with rainbow trout have been largely responsible for the general decline of the CRCT. Recent collections in Savery Creek basin found this trout primarily in the tributaries of Savery Creek (WGFD 1994, 1998a, b).

3.6.6.1.6 White-faced Ibis The white-faced ibis is a Wyoming NSS3 species. Its breeding range extends into southeastern Wyoming and large migrating flocks have been observed in the Little Snake River valley (White 1995).

White-faced ibis inhabit marshes and swamps. They nest in colonies, usually in shrubby vegetation in or over water (Ehrlich et al. 1988). They prefer areas where aquatic insects, amphibians, crayfish, leeches, and snails are abundant (Kansas Department of Wildlife and Parks 1992). Uncommon throughout their range, white-faced ibis are generally found outside the Rocky Mountain region.

3.6.6.1.7 Ferruginous Hawk The ferruginous hawk is a Wyoming NSS3 species. This species appears to be declining in many parts of its range. However, the state of Wyoming has the largest nesting population in the U.S. and ferruginous hawk populations appear to be stable within the state (Ritter 1994).

Ferruginous hawks generally inhabit open country. They usually nest in large trees with a wide field of view. However, they may nest on the ground atop mesas or on slopes (Ehrlich et al. 1988). Ferruginous hawks eat primarily small mammals and their nesting population and nest success often fluctuate with jack-rabbit population.

3.6.6.1.8 Black Tern The black tern is listed as a Wyoming NSS3. Where present, this species can be common (Robbins et al. 1983). In western North America, black terns breed in the plains of Canada and the northern United States and in the Great Basin between the Rocky Mountains and the Cascade Range. They winter in South America.
Black terns inhabit marshes, wet meadows, and sloughs. They breed in small, loose colonies on mats of floating vegetation or in dense stands of emergent vegetation. Individuals may return to the area where they hatched to nest. Nesting success is extremely low, possibly because of agricultural chemicals (Ehrlich et al. 1988). Insects are the main diet, but terns may feed on crayfish and small fish. Black terns have been observed taking insects while following farming equipment.

3.6.6.1.9 Long-billed Curlew  This shore bird breeds in high plains areas of the western United States and Canada and winters along the west coast of the United States, Mexico, Central America and along the Gulf of Mexico and Atlantic coast from Florida to South Carolina (Peterson 1980, 1990). Nests are usually located near water. The diet of the long-billed curlew consists mostly of insects but also includes worms, burrow-dwelling crustaceans, mollusks, toads, eggs and nestlings of other birds, and berries (Ehrlich et al. 1988).

This species' breeding range as been diminished and continues to shrink because of habitat loss and degradation from farming and grazing. Organochlorine pesticides have also been implicated in species population decline (Ehrlich et al. 1988). The long-billed curlew is listed as NSS3 in Wyoming.

3.6.6.2 Reservoir Sites

The species of special concern in Wyoming have varying potential to occur among the three alternative water supply areas (Table 3-9).

3.6.6.2.1 Sandstone Dam and Reservoir  Weber's ipomopsis may occur in sagebrush communities around the proposed reservoir site although the elevation is below that typical for known populations. The bluehead and flannelmouth suckers have been documented from this portion of Savery Creek (Kanaly and Williams 1958), however, only the flannelmouth sucker has been collected from lower Savery Creek in recent fisheries surveys (WGFD 1994, 1998b). In the vicinity of the Sandstone alternative, CRCT have been collected from Hell Canyon Creek, a tributary of Savery Creek. This species was not found in the lower portion of Big Sandstone Creek, Little Sandstone Creek, or in Savery Creek (WGFD 1985, 1994, 1998b). Roundtail chubs have never been positively identified from the Savery Creek basin; however, appropriate habitat is present, thus their presence cannot be ruled out. White-faced ibis have been seen migrating throughout the Little Snake River basin which would presumably include the Sandstone site. Although preferred habitat is not present and the white-faced ibis is not known to nest in the project area, they could visit this portion of Savery Creek. Ferruginous hawks have been observed in the area (WGFD 1985) and may nest and forage throughout the riparian woodlands, shrublands, and sagebrush areas. Black terns and long-billed curlew could find potential habitat in the wetlands and grasslands along Savery Creek but neither of these species has been observed in the area.
Table 3-9

SUMMARY OF SPECIES OF SPECIAL CONCERN OCCURRENCE IN THE PROJECT AREA

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
<th>Downstream in the Little Snake River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weber’s Ipomopsis</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Bluehead Sucker</td>
<td>D</td>
<td>P</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>Roundtail Chub</td>
<td>P</td>
<td>P</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>Flannelmouth Sucker</td>
<td>D</td>
<td>D</td>
<td>U</td>
<td>D</td>
</tr>
<tr>
<td>Colorado River Cutthroat Trout</td>
<td>D</td>
<td>D</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>White-faced Ibis</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>n/a</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Black Tern</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
<tr>
<td>Long-billed Curlew</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>n/a</td>
</tr>
</tbody>
</table>

D = documented occurrence; P = potential occurrence; U = unlikely to occur because suitable habitat is not present; n/a = not applicable.

3.6.6.2.2 High Savery Dam and Reservoir  Weber’s ipomopsis could occur in sagebrush communities on the sideslopes around the proposed reservoir site although the elevation of the area is below that typical for known populations. Bluehead sucker apparently no longer exist in the streams around the proposed High Savery Reservoir. Flannelmouth sucker is present in upper Savery Creek and the East Fork of Savery Creek. Hybridized CRCT were found in the East Fork in 1997; however, this does not indicate the presence of a viable population of CRCT. White-faced ibis have been seen migrating throughout the Little Snake River basin which would presumably include the High Savery site. Although preferred habitat is not present and the white-faced ibis is not known to nest in the project area, they may potentially visit this portion of Savery Creek. The ferruginous hawk may forage over open sagebrush steppes around this reservoir site. Black terns and long-billed curlew could find suitable habitat in the wetlands and grasslands along Savery Creek.

3.6.6.2.3 Dutch Joe Dam and Reservoir  Weber’s ipomopsis may occur in areas of sagebrush around the Dutch Joe Creek site, however, the elevation of the area is below that typical for known populations. Dutch Joe Creek is an intermittent stream that is not capable of supporting a permanent fishery, therefore, no fish species of special concern have been documented in this stream. White-faced ibis have been seen migrating throughout the Little Snake River basin which would presumably include the Dutch Joe Creek site. Although preferred habitat is not present and the white-faced ibis is not known to nest in the project area, they may potentially visit this portion
of Dutch Joe Creek. Ferruginous hawks may forage over open sagebrush steppes which dominate this site. A slight possibility exists that black terns and long-billed curlew could be found associated with the fringe wetlands along Dutch Joe Creek and the grasslands in the southern portion of the reservoir site.

3.6.6.2.4 Downstream in the Little Snake River
The bluehead and flannelmouth suckers and the roundtail chub have been documented in the Little Snake River downstream of the confluence of Savery Creek (WGFD 1985). In 1994, the flannelmouth sucker was the only species of special concern that was collected from the Little Snake River (WGFD 1994). However, existing habitat in the river is suitable for the bluehead sucker and roundtail chub. Colorado River cutthroat trout are not expected to occur in this portion of the Little Snake River because it is below the elevation at which this species currently occurs.

3.7 SOCIOECONOMICS

3.7.1 STUDY AREA
The Little Snake River flows through parts of Carbon County, Wyoming and Moffat County, Colorado. Likewise, the proposed project would primarily affect the residents and economic activities within these two counties. Therefore, these two counties form the study area for the socioeconomic component of this report (Figure 3-11). Information on the population, land use, economy, and communities is included in this section.

3.7.2 POPULATION
The population of Carbon County is spread throughout a number of small towns. The largest community is Rawlins, the county seat. It had a 1997 estimated population of 8,947. The towns closest to the reservoir sites are Dixon and Baggs. Their estimated populations in 1996 were 67 and 256, respectively.

Craig, Colorado, is the major community in Moffat County. With an estimated 8,590 residents, it contained more than 70 percent of the estimated county population in 1996. No communities in Moffat County are located near the Little Snake River.

The populations of Wyoming and Colorado have fluctuated over the last century along with mineral development. The most recent boom in growth occurred in the 1970's (Table 3-10) with energy-related development. In particular, the construction of the Craig Generating Station in Moffat County provided the major impetus for growth in that county and the surrounding area. Between 1980 and 1990, however, population declined in Wyoming and in the counties and towns in the study area (Table 3-10). All of the jurisdictions in the study area, except Riverside, displayed the same pattern of population growth from 1970 to 1980 and decline from 1980 to 1990. The decline was more dramatic in Carbon County (23.9 percent) than in Moffat County.
(13.5 percent). Part of the explanation is that the construction at Craig Station was not completed until 1986. Since 1990, populations in Wyoming and Moffat County and Craig, Colorado, have grown while the populations of Carbon County and communities therein have continued to declined (Table 3-10).

The Wyoming Department of Administration and Information projects a slight decline in the population of Carbon County over the next 10 years. The estimated population in 2006 is 16,080. Moffat County, on the other hand, is expected to increase in population. The projected population for Moffat County in 2006 is 14,705 according to the Colorado Division of Local Government.

3.7.3 LAND USE
While land ownership in the two counties is split between public and private ownership, the dominant use is agriculture. Approximately 60 percent of the land in each county is owned by federal or state governments (Table 3-11). The majority of the public land, over 2 million acres in Carbon County and 1.4 million acres in Moffat County, is managed by the U.S. Bureau of Land Management, which permits much of the land to ranchers for grazing. Approximately 665,600 acres in Carbon County and 41,000 acres in Moffat County are managed by the U.S. Forest Service. Of the land in farms, approximately 90 percent is in rangeland and pasture. Cropland makes up less than five percent of the total land in each county.

The majority of the land within the inundation zones of the three reservoir alternatives is privately owned (Table 3-12). At the Sandstone site, all of the land that would be inundated is privately owned. At the High Savery and Dutch Joe site, approximately 75 and 50 percent, respectively, of the land inundated would be privately owned.

The principal agricultural activity is the production of livestock, including cattle, sheep, and horses. In 1992, livestock accounted for approximately 95 and 85 percent of agricultural sales in Carbon and Moffat counties, respectively (Table 3-13). Cattle are typically allowed to graze on the public and private rangeland in the spring and summer. In the fall they are brought down to the valleys, such as along the Little Snake River and Savery Creek, to graze on pastures, cropland, and hay. Approximately one-third of the cropland in Carbon County was used as pasture in 1992. In addition, some of the crops, such as hay and corn, are used to support the livestock.

The main cash crops are wheat, barley, and corn. Irrigation is essential to support the crops and pastures in the area, particularly in Carbon County, and the farmland adjacent to the Little Snake River and Savery Creek. Of the 106,081 acres of cropland harvested in Carbon County in 1992, 98,121 acres were irrigated. In Moffat County, 14,121 acres of the 54,376 acres of cropland were irrigated.
### Table 3-10

**POPULATION TRENDS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyoming</td>
<td>332,416</td>
<td>469,557</td>
<td>453,589</td>
<td>41.3</td>
<td>-3.4</td>
<td>480,011</td>
</tr>
<tr>
<td>Carbon County, WY</td>
<td>13,354</td>
<td>21,896</td>
<td>16,659</td>
<td>64.0</td>
<td>-23.9</td>
<td>16,089</td>
</tr>
<tr>
<td>Baggs</td>
<td>146</td>
<td>433</td>
<td>272</td>
<td>196.6</td>
<td>-37.2</td>
<td>256</td>
</tr>
<tr>
<td>Dixon</td>
<td>72</td>
<td>82</td>
<td>70</td>
<td>13.9</td>
<td>-14.6</td>
<td>67</td>
</tr>
<tr>
<td>Encampment</td>
<td>321</td>
<td>611</td>
<td>490</td>
<td>90.3</td>
<td>-19.8</td>
<td>n/a</td>
</tr>
<tr>
<td>Rawlins</td>
<td>7,855</td>
<td>11,547</td>
<td>9,380</td>
<td>47.0</td>
<td>-18.8</td>
<td>8,947</td>
</tr>
<tr>
<td>Riverside</td>
<td>46</td>
<td>55</td>
<td>85</td>
<td>19.6</td>
<td>35.3</td>
<td>83</td>
</tr>
<tr>
<td>Saratoga</td>
<td>1,181</td>
<td>2,410</td>
<td>1,969</td>
<td>104.1</td>
<td>-18.3</td>
<td>1,865</td>
</tr>
<tr>
<td>Sinclair</td>
<td>445</td>
<td>586</td>
<td>500</td>
<td>32.4</td>
<td>-14.7</td>
<td>457</td>
</tr>
<tr>
<td>Moffat County, CO</td>
<td>6,525</td>
<td>13,133</td>
<td>11,357</td>
<td>101.3</td>
<td>-13.5</td>
<td>12,102</td>
</tr>
<tr>
<td>Craig</td>
<td>4,205</td>
<td>8,133</td>
<td>8,091</td>
<td>93.4</td>
<td>-0.5</td>
<td>8,590</td>
</tr>
</tbody>
</table>

¹Most recent available estimates are from 1996. Source: U.S. Census Bureau.

n/a = not available

Other sources:
- Colorado 1996: Colorado Demography Information Service
- State of Wyoming and Carbon County 1996: U.S. Census Bureau

### Table 3-11

**LAND USE**

(aces)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Carbon County, WY</th>
<th>Moffat County, CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Land</td>
<td>5,147,245¹</td>
<td>3,028,480²</td>
</tr>
<tr>
<td>Public Lands</td>
<td>3,155,496¹</td>
<td>1,819,620²</td>
</tr>
<tr>
<td>Land in Farms³</td>
<td>2,720,903</td>
<td>1,159,813</td>
</tr>
<tr>
<td>Cropland</td>
<td>171,309</td>
<td>124,325</td>
</tr>
<tr>
<td>Rangeland &amp; Pasture</td>
<td>2,524,387</td>
<td>994,194</td>
</tr>
<tr>
<td>Woodland</td>
<td>17,352</td>
<td>20,008</td>
</tr>
</tbody>
</table>

¹Wyoming Department of Administration and Information 1994
²Colorado State University Cooperative Extension 1994
³U.S. Census Bureau, Census of Agriculture 1992
Table 3-12

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Sandstone w/min pool</th>
<th>Sandstone w/o min pool</th>
<th>High Savery w/min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of Wyoming</td>
<td>0</td>
<td>0</td>
<td>87</td>
<td>79</td>
<td>147</td>
</tr>
<tr>
<td>Federal</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Private</td>
<td>370</td>
<td>330</td>
<td>369</td>
<td>320</td>
<td>153</td>
</tr>
<tr>
<td>Total</td>
<td>370</td>
<td>330</td>
<td>482</td>
<td>420</td>
<td>300</td>
</tr>
</tbody>
</table>

1Owned by the Wyoming Land Investment Board

Table 3-13

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Carbon County, WY</th>
<th>Moffat County, CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farms (number)</td>
<td>287</td>
<td>350</td>
</tr>
<tr>
<td>Average Size (acres)</td>
<td>9,480</td>
<td>3,314</td>
</tr>
<tr>
<td>Irrigated Farms (number)</td>
<td>198</td>
<td>127</td>
</tr>
<tr>
<td>Irrigated Land (acres)</td>
<td>161,498</td>
<td>20,382</td>
</tr>
<tr>
<td>Harvested Cropland (acres)</td>
<td>98,121</td>
<td>14,121</td>
</tr>
<tr>
<td>Pastureland (acres)</td>
<td>63,327</td>
<td>6,261</td>
</tr>
<tr>
<td>Total Cropland (acres)</td>
<td>171,309</td>
<td>124,325</td>
</tr>
<tr>
<td>Harvested Cropland (acres)</td>
<td>106,081</td>
<td>54,376</td>
</tr>
<tr>
<td>Cropland for pasture (acres)</td>
<td>57,164</td>
<td>not disclosed</td>
</tr>
<tr>
<td>Value of Products Sold ($1,000)</td>
<td>$46,164</td>
<td>$16,644</td>
</tr>
<tr>
<td>Crops ($1,000)</td>
<td>$2,311</td>
<td>$2,580</td>
</tr>
<tr>
<td>Livestock ($1,000)</td>
<td>$43,853</td>
<td>$14,064</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, Census of Agriculture 1992

3.7.4 EMPLOYMENT AND INCOME
The labor force in the study area decreased during the last decade as did the population (Table 3-14). The total labor force in Carbon County declined by 1,574 between 1982 and 1994. The
labor force in Moffat County declined by 1,508 during that time. As the labor force has declined, so has the unemployment rate. Despite a drop in unemployment, the rate was still higher for both counties than the Wyoming state average.

The income of the local population rose between 1979 and 1994. The median family income in Carbon County has kept pace with the state level, and Moffat County has a higher level than either (Table 3-14).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Wyoming</th>
<th>Carbon County, WY</th>
<th>Moffat County, CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1982(^1)</td>
<td>1994(^2)</td>
<td>1982(^1)</td>
</tr>
<tr>
<td>Labor Force</td>
<td>253,000</td>
<td>253,000</td>
<td>10,268</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>5.8</td>
<td>5.3</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td>1979(^1)</td>
<td>1994(^2)</td>
<td>1979(^1)</td>
</tr>
<tr>
<td>Median Family Income</td>
<td>22,433</td>
<td>37,800</td>
<td>24,596</td>
</tr>
</tbody>
</table>

\(^1\)U.S. Census Bureau, County and City Data Book 1983
\(^3\)U.S. Department of Housing and Urban Development Income Limits 1994

The economy of Carbon County is primarily based on agriculture, mining, and oil extraction. The largest employment, however, is in the public administration, services, and retail trade sectors. Trade and manufacturing are based in Rawlins.

The economy of Moffat County is based on agriculture and energy production, which includes both the electrical generating station and coal mining. Tourism also contributes to the economy because of Dinosaur National Monument and Routt National Forest. Trade, services, and public administration are the major employment sectors.

3.7.5 HOUSING
The loss of population is reflected in the housing statistics (Table 3-15). According to the 1990 Census, the vacancy rate in Carbon County was 26.7 percent and in Moffat County 20.2 percent. These rates were double the national average of 10.1 percent. Part of the reason these rates were higher was because of seasonal housing in the area. The cost of housing also is lower than the national average, which was $79,100 for owner-occupied housing and $447 for rent.
### Table 3-15

**1990 HOUSING CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Carbon County, WY</th>
<th>Moffat County, CO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing Units, Number</strong></td>
<td>8,190</td>
<td>5,235</td>
</tr>
<tr>
<td>Percent Vacant</td>
<td>26.7%</td>
<td>20.2%</td>
</tr>
<tr>
<td><strong>Owner Occupied, Number</strong></td>
<td>4,149</td>
<td>2,785</td>
</tr>
<tr>
<td>Median Value ($)</td>
<td>$52,700</td>
<td>$52,900</td>
</tr>
<tr>
<td><strong>Renter Occupied, Number</strong></td>
<td>1,852</td>
<td>1,393</td>
</tr>
<tr>
<td>Median Value ($/ month)</td>
<td>$301</td>
<td>$299</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, County and City Data Book 1994

### 3.7.6 COMMUNITY SERVICES

The services addressed here include health, education, and security.

One hospital exists in each county, which provides acute care to the local residents. Memorial Hospital in Rawlins is a 70-bed facility and Memorial Hospital in Craig has 42 beds. The Noyes Health Care Center, located in Baggs, would be the closest health care facility to the proposed project sites. Volunteers provide ambulance service to the Little Snake River valley.

Two school Districts exist in Carbon County. Enrollment has declined in recent years along with the population. The fall 1997 enrollment was 3,084 compared with 3,934 in the fall of 1986. School District One, which serves western Carbon County, including Rawlins, Baggs, and Dixon, had a fall 1997 enrollment of 2,067. District One has one high school (grades 9 through 12), one middle school (grades 6 through 8), one K through 12 school, one K through 8 school, and four K through 5 schools. The students in the southwestern part of the county attend the K through 12 Little Snake River Valley School in Baggs. The enrollment for fall 1997 was 157 compared to a capacity of 350.

All of Moffat County is served by the Re-1 School District. Total enrollment for fall 1997 was 2,755 compared to 2,650 in 1984-1985. Colorado Northwest Community College provides post-secondary education.

Police protection is provided by local departments and county Sheriff's Departments. Every community has a police department, except for Dixon. It is served by the Carbon County Sheriff's Department.

Fire protection within these counties is primarily provided by volunteers. Rawlins has eight full-time staff, assisted by volunteers. The City of Craig likewise relies on volunteers.
3.7.7 PUBLIC FACILITIES
Interstate 80 is the major east-west highway through the region. It connects Rawlins to Cheyenne and Salt Lake City. U.S. Highway 40 is the main east-west highway through Moffat County. It connects Craig with Denver and Salt Lake City. The main north-south highway is Route 789, which runs from Craig to Interstate 80, passing through Baggs. State Highways 70 and 71 are secondary highways which primarily provide access to the Medicine Bow National Forest. Highway 70 runs east from Baggs through Dixon, Savery and the national forest to Encampment, Wyoming. This portion of the highway has been upgraded to a paved surface. Most secondary roads are gravel, including the ones which currently lead to the alternative reservoir sites.

Water and wastewater treatment facilities are provided in each of the towns. The water and wastewater systems in Rawlins, Baggs, Dixon and Craig all have excess capacity. Rural residents rely on wells and septic systems.

3.7.8 PUBLIC FINANCES
The main source of general revenue in each county is property taxes. The 1997 assessed valuation for Carbon County was $323,550,812. The assessed valuation for Moffat County in 1997 was $332,024,037. According to the Carbon County Assessor, most of the assessed valuation is industrial property, including coal and gas production. In Moffat County, approximately 85 percent of the assessed valuation in 1997 was public utilities and extraction industries (the power plant and coal mines). Agricultural land in Moffat County accounted for approximately 3 percent of the valuation. In 1997, Carbon and Moffat counties received $22,309,777 and $21,917,372, respectively, in property, use, and sales taxes.

3.8 CULTURAL RESOURCES

3.8.1 STUDY AREA
This prehistoric overview will briefly discuss aboriginal cultural stages as they are defined for the Northwest Plains by Frison (1991). The chronological/cultural stages are Paleoindian, Archaic, Late Prehistoric, and Protohistoric. The Archaic stage is further divided into the Early Plains Archaic, Middle Plains Archaic, and Late Plains Archaic.

The Paleoindian stage of cultural development is divided into a number of different complexes. Some of these complexes are well documented while others are lacking documentation. Pre-Clovis sites, while suspected to exist, lack documentation in the Northwestern Plains. What is thought to be Pre-Clovis evidence from the Little Canyon Creek Cave in the southern Big Horn Mountains has not been substantiated. (Frison 1991, Frison 1978). Until recently, all of the Pre-Clovis sites have been considered controversial, but, as the evidence mounts from sites across the America’s, the possibility of Pre-Clovis is becoming a reality.

1This overview is adapted from Tyler 1995.
The best documented of the early Paleoindian occupations in North America are those recognized by their distinctive Clovis style projectile points. Clovis Complex people are believed to have focused largely on the hunting of megafauna, particularly mammoth, by small mobile bands of hunter-gatherers (Frison and Todd 1986). The Colby site, east of Worland in the central Big Horn Basin, contained distinctive caches of mammoth and was radiocarbon dated to between 11,200 and 10,864 years before present (BP) (Frison and Todd 1986).

Following the Clovis Complex is the Folsom Complex, which, like the Clovis Complex, is recognized by its distinctive heavily fluted, pressure flaked Folsom projectile points. An intermediate projectile point, known as the Goshen, may exist in the Northwestern Plains; however, its exact relationship or position in the chronology is still poorly understood. The Hanson site on the eastern edge of the Big Horn Basin is a well known Folsom site that dates approximately 10,300 to 10,700 years BP (Ingbar 1992, 1986). Regardless of the technology, Folsom people continued to be large game specialists who focused upon large extinct species of bison. However, it is likely that this subsistence pattern was supplemented by small game and plants and, toward the later stages, by modern forms of bison. Whether or not Folsom people supplemented their subsistence with small game and plants is still a debatable subject because of the lack of evidence in the archaeological record.

Other important complexes in the Paleoindian period include Agate Basin and Hell Gap, which date to approximately 10,500 to 9,500 years BP. Some of the more important sites associated with these complexes are the Hell Gap and Agate Basin Sites, the Jones-Miller site, the Casper site, and the Carter/Kerr-McGee site (Irwin-Williams et al. 1973, Frison and Stanford 1982, Frison 1974, and Frison 1984). The Cody Complex closely follows the Agate Basin and Hell Gap complexes and is well represented on the Northwestern Plains. The most notable of these sites are the Horner, Medicine Lodge, and Laddie Creek with the Horner site providing a date range of 9,500 to 9,000 years BP (Frison and Todd 1987, Frison 1976, 1991).

The Late Paleoindian period (9,000 to 7,500 years BP) is marked by an increasing complexity in the archaeological record but the identifying factors are still rooted in recognizing the different projectile point styles. These projectile point styles include the James Allen and Lusk with their concave bases and distinctive parallel oblique flaking, and at the same time stemmed and notched varieties such as the Pryor Stemmed, Federick, Angostura, and Lovell Constricted. Important sites during this period include Mummy Cave, Wyoming, Medicine Lodge Creek, Lookingbill, and Paint Rock V (McCracken et al. 1978, Husted 1969, Frison 1976, 1983, 1992).

Most of the complexes discussed above are present in surface collections in or near the project area but few sites are known to exist. The majority of what is known about the Paleoindian period in the area is based upon information from outside the area.

The Archaic period is normally defined as a period of diversification and expansion of subsistence practices and a slowly developing complexity in the social organization. While this change is not
a sudden switch, it appears to be a steady trend with technological improvements allowing for the more efficient collection and storage of the available resources. In the Northwestern Plains this lifestyle continues into the historic period with little modification.

The Archaic is divided into Early, Middle and Late periods over most of the northwestern Plains (Frison 1991). Each of these periods are differentiated by changes in projectile point styles and subsistence strategies. The most notable change from the Paleoindian period to the Early Plains Archaic (7,500 to 5,000 years BP), other than those already noted, is the appearance of pit houses. While these pithouses represent one settlement pattern and appear in the open, stabilized, sand-dune areas of the Wyoming Basin, the Early Plains Archaic people also utilized rockshelters along the margins of the Big Horn Basin and hunting camps/kill sites such as the Hawken site in the Wyoming Black Hills (Eakin 1987, McGuire et al. 1984, Harrell and McKern 1986, McKern 1987, Reust et al. 1993, Frison 1991).

The Middle Plains Archaic (5,000 to 3,000 years BP) is primarily distinguished from the Early Plains Archaic by the increased specialization in the use of the arid interior basin habitats, the appearance of stone circles (ceremonial or habitation), and an expanded use of groundstone. Major sites include Paint Rock V, Medicine Lodge Creek, and Dead Indian Creek (Frison and Wilson 1975, Frison 1991, Frison and Walker 1984, Ingbar 1986). Some of the distinguishing projectile points include the Duncan, Hanna, Mallory, and Yonkee.

A stronger emphasis on communal bison hunting and a continuance and intensification of a broad ranged foraging subsistence mark the Late Plains Archaic (3,000 to 1,500 years BP). The sites containing Late Plains Archaic materials also appear to increase dramatically. Frison indicates that many of the changes observed during the Late Plains Archaic, such as more sophisticated hunting technology, cord-marked ceramics, distinctive side-notched points and the use of burial mounds can be attributed to the Besant hunters which were preceded by the Pelican Lake Complex with its corner-notched projectile points, bison hunting, and broad ranging use of other resources (Frison 1991). Two important sites attributed to this period, and from whom phases have been named, are the Deadman Wash site and the Pine Spring site (Armitage et al. 1982).

The Late Prehistoric period (1,700 to 300 years BP) is in many ways a continuation of the preceding Archaic period, according to Frison (1991). Bison hunting is still very important as is broad based foraging, but there appears to be an increase in the population, introduction of new groups into the area, and other evidence of population movement. These factors and others lead to a complex and extensive archaeological record. Some of the Late Prehistoric sites include Deer Creek, Glenrock Buffalo Jump, Buffalo Hump, Worthan Shelter, Beehive Butte, and Firehole Basin 11 (Metcalfe 1987, Frison 1991, Larson et al. 1984, Greer 1978, and Harrel 1989). One of the larger research questions that remains to be fully addressed for the Late Prehistoric is the question of ethnicity. Evidence exists of early Crow and Shoshonean occupations at some of the sites but questions yet to be satisfactorily answered include when the Hidatsa and Crow split, and the movements of the various Late Prehistoric groups.
The Protohistoric period is defined by the introduction to Europeans, European goods, and European culture to the native inhabitants. In particular, is the introduction of horses and trade goods, which in turn sparked increases in group mobility and group size. Horses enhanced mobility which increased the competition among groups for resources and likely increased the incidence of warfare. The Protohistoric period also marked the appearance in the archaeological record of the conical timber lodges, mountain sheep traps, and rock art (also seen in older sites). This period saw the Shoshone expand into southern Alberta as early as 1700 AD. However, northern groups such as the Blackfoot, and eastern groups such as the Crow, Cheyenne, Arapaho and the Sioux pushed the Shoshone back into the main spine of the Rocky Mountains by the time serious Euroamerican settlement had begun (Shimkin 1986).

The Historic period in Wyoming begins with an influx of explorers, fur traders and gold miners during the 1700s. This influx was the beginning of the end for the native inhabitants’ way of life which essentially ceased to exist by the late 1800s. By this time, the majority of the Native Americans had been forced onto reservations and Euroamericans began to settle the area and establish sheep and cattle ranches. The following discussion will focus on Carbon County, Wyoming. For a more comprehensive overview of the historic settlement of Wyoming see Tyler (1995) or Larson (1990).

As a result of the booming cattle industry in the 1860s where cattle could be purchased in the west for $3 to $4 a head and sold in the east for $40, Wyoming became what has been termed “the purest cattle state of all” (Schlebecker 1963). Cattle were moved from Texas north to Wyoming and then fattened on Wyoming grass before being shipped to the east on the recently completed Union Pacific Railroad.

In Carbon County, as in other areas of Wyoming, cheap land, such as a free 160 acres under the Homestead Act of 1862 or prices as low as $1.25 per acre under other land laws, allowed a settler to settle land along a water course and then use the surrounding public land to graze their cattle. Noah Reader settled one of the first ranches in the Little Snake River Valley, near the mouth of Savery Creek, in 1871 (Moore 1962). Reader was followed into the region in 1873 by Jim Baker, a well-known mountain man, and then by a man named Hughes who arrived in approximately 1875. The common thread among all of these men was ranching. The number of cattle in Carbon county increased from 5,000 head in 1877 to 72,055 in 1880 (Osgood 1954).

While this growth made many men rich, reality hit in 1886 when overstocking, overgrazing and a harsh winter lead to the death of 3 to 4 hundred thousand cattle. In 1887, the Carbon County assessor cut the number of cattle listed in his records by 23 percent (Barnhart 1969). This disaster was followed by a dramatic drop in the beef market. These events lead to a change in the Wyoming cattle industry with the owners beginning to buy or lease land and they began to fence their holdings (Schlebecker 1963).
A general growth of the cattle industry is evident between 1890 and 1920. There were also changes with sheep ranching becoming big business. The ranchers were now committed to winter feeding which meant they had to begin limited farming to produce the necessary feed. Cyclic ups and downs occurred in the cattle market because of many factors with drought and a glutted market being two of the most common. These fluctuations continued until the outbreak of WWII when the cattlemen entered an era of prosperity. By the 1980s, Wyoming ranked ninth in cattle production in the United States.

Raising sheep was also important in Wyoming and in Carbon County history. Some of the first sheep to graze on Wyoming grass were driven through the state in the 1840s and 1850s on their way to Utah on the Oregon Trail. It is also reported that Jim Bridger kept a small flock at Fort Bridger as early as 1845 (Writers Program 1981). Realizing that sheep tend to prefer weeds over grass made them ideal for the more arid regions of Wyoming. This fact combined with the free or inexpensive grazing land and water available nearly halved production costs.

The first important Carbon County sheepman was Ike C. Miller who started in 1875, and then in 1881 partnered with Joel Hurt. By 1882, 16 sheep operations existed in Carbon County. The Rocky Mountain states and Wyoming became so popular for raising sheep that between 1884 and 1914 this region was the only one in America that gained in sheep production (Hurtz and Hill 1931). Sheep continued to be important to Wyoming and Carbon County and by the 1950s 25 percent of the state’s sheep production was raised in the Red Desert region.

The cultural resources and artifacts found at the water supply alternative sites conform to what is generally known for the Wyoming/Colorado/Utah region. These sites further document the presence of prehistoric peoples in the area. Later historic sites document widespread ranching and farming activities. In general, prehistoric sites include those dating earlier than 300 years BP while historic sites are those that date from 300 years BP to the present. Isolated finds include single artifacts not associated with other cultural debris.

3.8.2 SANDSTONE DAM AND RESERVOIR SITE
Cultural resource investigations found prehistoric and historic sites within the Sandstone inundation area (Table 3-16). A total of 16 sites, five of which were isolated finds, were found during the records search. Of the remaining 11 sites, four were prehistoric, six were historic, and one contained both historic and prehistoric material. Two of these sites (48CR4265 and 48CR1181) are considered eligible for nomination to the National Register of Historic Places (NRHP). One historic site (48CR3600) may be eligible for nomination to the NRHP but it has not been evaluated (Tyler 1995).

3.8.3 HIGH SAVERY DAM AND RESERVOIR
Twenty-two cultural resource sites were recorded in the vicinity of the High Savery Creek alternative (Table 3-16). Eight of the sites were historic, 22 were prehistoric, and 15 contained both prehistoric and historic features. One of the prehistoric/historic sites contained an apparent
buried prehistoric component, as indicated by a variety of flakes and tools eroding from a cut bank. The historic portion of the site is not considered eligible for the NRHP. The remaining historic site consist of cans, glass scatters, and one is the remains of a homestead. The prehistoric sites include lithic scatters, open camps, open tipi camps, and secondary procurement workshops. Eleven of the sites have been recommended for further testing to determine their NRHP eligibility: 48CR92, 48CR695, 48CR696, 48CR699, 48CR6900, 48CR6902, 48CR6910, 48CR6911, 48CR6912, and 48CR6913 (Quick and Light 1995, Seacat and Latham 1997). Of the four isolated finds, three were unassigned prehistoric and one was a historic bottle.

3.8.4 DUTCH JOE DAM AND RESERVOIR
Three cultural resource sites and two isolated artifacts were recorded and evaluated in the Dutch Joe Creek area (Table 3-16). One prehistoric site consisted of a sparse scatter of lithic artifacts and fire-cracked rock. The second, a historic site, consisted of an irrigation ditch. The third site contained a scatter of prehistoric and historic artifacts. None of these cultural resource sites are considered to be eligible for the NRHP and no further investigations are recommended (Quick and Rosenberg 1995).

3.9 RECREATION

Carbon County, Wyoming and Moffat and Routt counties in Colorado contain many significant natural resources that currently are developed and used to satisfy the public's recreation demands. Developed recreational resources located within 50 and 100 miles of the study area for Wyoming and Colorado are assessed. Recreational opportunities of almost every type are available on lands administered by various Federal and state agencies.

Recreational opportunities within the immediate project area in Carbon County are limited, given that most of the land is in private ownership with relatively poor access. The exception to this lies to the east of the study area at the Medicine Bow National Forest, where numerous multiple-use recreation opportunities can be found.
Recreational opportunities typical of more urban environments are found in Rawlins, Wyoming, and Craig and Steamboat Springs, Colorado. These activities are oriented more toward both team and spectator sports instead of individual activities or groups.

The 1990 Wyoming State Comprehensive Outdoor Recreation Plan (SCORP) evaluated recreation needs for individual counties. Recreation needs were identified as either of local or state significance. For Carbon County, 11 local needs were identified. The top five were:

- ballfield improvement and development
- park development
- picnic area development
- rodeo arena and equestrian area
- development/replacement of outdoor swimming pools.

The three most significant state issues were snowmobile trails and facilities, park improvements, and historic site improvements.

As opposed to the 1990 SCORP, the 1995 Wyoming SCORP identified outdoor recreation issues most critical to counties and communities throughout the state rather than specific facility needs. Local recreation users in Carbon County identified money/funding, additional personnel, community support, maintenance money and restoration of existing facilities as the most critical recreation issues in their own community. Lack of funding for recreation development was identified in the 1995 SCORP as the state’s number one priority issue among recreational professionals.

Recreation needs in Colorado were assessed in the 1992 Colorado SCORP. The state was divided into multi-county recreation regions. Moffat County was in one region and Routt County was in another. Recreation professionals were surveyed to determine the issues of importance, the specific facility needs of the region and the visitor needs of the area.

The major recreation issue identified in Moffat County was funding for parks and recreation (Table 3-17). Trail-related issues also rated very high for the region, with funding specifically for trail development as the second most important issue.
Table 3-17

RECREATION ISSUES AND NEEDS IN MOFFAT COUNTY, COLORADO

<table>
<thead>
<tr>
<th>Rank</th>
<th>Recreation Issues</th>
<th>Facility Needs</th>
<th>Visitor Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Funding-parks and recreation</td>
<td>Wildlife observation</td>
<td>Wildlife observation</td>
</tr>
<tr>
<td>2</td>
<td>Funding-trails development, wild and scenic river</td>
<td>Jog/walk trails</td>
<td>Nature photography</td>
</tr>
<tr>
<td></td>
<td>designation, recreation trails, inter-agency coordination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pleasure biking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Mountain biking, river rafting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hunting, nature study</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 1992 Colorado SCORP.

The major recreation issue for Routt County was access to public lands (Table 3-18). The size of budgets for recreation programs and visitor safety were also important issues. Facilities for bicycling were identified as the most important need.

Table 3-18

RECREATION ISSUES AND NEEDS IN ROUTT COUNTY, COLORADO

<table>
<thead>
<tr>
<th>Rank</th>
<th>Recreation Issues</th>
<th>Facility Needs</th>
<th>Visitor Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recreational access to public lands, funding for</td>
<td>Pleasure biking</td>
<td>Mountain biking,</td>
</tr>
<tr>
<td></td>
<td>parks and recreation, recreation trail opportunities</td>
<td></td>
<td>wildlife observation</td>
</tr>
<tr>
<td>2</td>
<td>Wildlife observation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Jog/walk trails</td>
<td></td>
<td>River fishing, hiking</td>
</tr>
<tr>
<td>4</td>
<td>Budgets for recreation programs</td>
<td>Baseball and softball,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>environmental education</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Visitor safety and protection</td>
<td>Environmental education</td>
<td></td>
</tr>
</tbody>
</table>

Source: 1992 Colorado SCORP.

Although recreation is not an identified project purpose of the LSSIWSP, development of a new water supply could provide additional recreation opportunities for residents and visitors in the general project area. The development of multipurpose facilities is part of WWDC policy. The 1990 and 1995 Wyoming SCORP and the 1992 Colorado SCORP found that flat-water
recreation was not an identified need for residents in the local area (Baggs, Dixon, Savery, and Slater) and the region (southern Wyoming and northwestern Colorado). However, neither SCORP determined recreation demand on a local or community level. To address this lack of information, a recreation needs analysis was conducted in cooperation with the WWDC and the Corps to determine flat-water recreation demand among residents in the vicinity of the LSSIWSP. Persons in the small communities surrounding the project would be the prime beneficiaries of additional flat-water recreation development. In addition, local interest had been expressed to the WWDC for additional recreation opportunities.

A recreation needs analysis was conducted in July 1996. Two survey questionnaires were developed to help determine whether future recreation needs and demands would be significant enough to be an integral part of the project. Recreation professionals, public officials, agencies and other recreation interests in southern Wyoming and northwestern Colorado were surveyed in the first questionnaire. The second questionnaire was sent to the residents in Baggs, Dixon, and Savery in Wyoming, and Slater in Colorado.

Regional recreation interests in Wyoming and Colorado were included in this survey to gather opinions regarding flat-water recreation demand outside the immediate project area. This information would be important to the needs analysis because of the large number of outdoor recreation opportunities, including reservoir-oriented opportunities currently provided by the national forests, wilderness areas, state parks and other recreational resources surrounding the project area. Given these opportunities in the region, it was considered questionable whether recreation development associated with the LSSIWSP reservoir would result in additional recreational activities or take visitors away from existing recreation areas.

The regional residents in the survey were selected mainly from the 1995 Wyoming SCORP and 1996 Colorado SCORP mailing lists. A total of 44 questionnaires were returned from the 113 persons contacted for this survey (39 percent response rate). Questionnaires were also mailed to all post office box addresses in the communities of Baggs, Dixon, Savery, and Slater. A total of 129 questionnaires were returned from the 489 sent to the persons at these addresses (26 percent response rate).

The results of the regional recreation needs survey indicated little demand for additional flat-water recreation development, suggesting that existing flat-water recreation opportunities were sufficient to meet regional demand for water-based recreation. Regional recreational activity trends pointed to a need for improving access to fishing lakes and streams, rather than new resource development. In view of these and other findings, recreation facility development associated with the LSSIWSP would probably attract few visitors beyond 100 miles from the project area. Regional recreation needs, therefore, were concluded to be insufficient to justify recreation as a purpose for water supply development.
The survey results also indicated recreation among local residents is generally water-based. A large majority of the respondents felt outdoor recreation opportunities in the local area were inadequate. The survey results also pointed to a demand for additional water-based recreational development. Based on these findings, the proposed LSSIWSP could provide basic recreation opportunities to satisfy the recreation needs for a small, localized population of users. A reservoir-based LSSIWSP would attract some visitors from the local area but few, if any, from the surrounding region because most regional water-based recreation demands can better be met at existing lakes and reservoirs surrounding the project area.

3.10 VISUAL/AESTHETICS

3.10.1 STUDY AREA
Topography, vegetation, and land use are the primary determinants of visual character. The unique combination of vegetation, topography, and manmade features create the aesthetic quality of a site. These components work together to create the landscape of a specific area.

Located in the south central part of Wyoming, Carbon County is bounded on three sides by mountain ranges rising abruptly from the sagebrush-covered plains. The majority of the county is a high, semi-arid plateau. The Continental Divide runs along the eastern edge of the county and through the Medicine Bow National Forest. The forest contains the Medicine Bow and Snowy Ranges, along with four wilderness areas. The western edge of the county is a level plain along the rim of the Red Desert. A number of broad fertile valleys cut through the terrain, watered by the Platte River and its tributaries. Altitudes range from 5,000 feet along the valley floors to above 12,000 feet in the Snowy Range.

The general topography of southern Carbon County ranges from low rolling hills and wide valleys to steeper, rugged slopes. Tall, woody vegetation is found mainly along the creeks where willows and cottonwoods are common. Scattered low growing junipers, sagebrush, and short prairie grasses dominate the hillsides. Although isolated, the project area has been modified by agricultural activities. Fences and irrigated fields are evident in the valleys. Occasional dirt roads or utility lines provide other evidence of man's influence on the area.

3.10.2 SANDSTONE DAM AND RESERVOIR
The Sandstone portion of lower Savery Creek is in a narrow valley averaging 600 to 800 feet in width with a wide variety of visual elements. Visual qualities include the higher slopes that are relatively steep, with bedrock outcrops. The lower slopes are flatter, consisting of eroded rock and soil. A minor ridge line on the west side of the valley widens out to the north. The walls are cut by numerous small drainages. The west side rises to a plateau in the Medicine Bow National Forest, which is cut by the Big Sandstone, Little Sandstone, and other smaller creeks. Vegetation in the area is sparse. The valley contains mostly grasses, with cottonwoods along the creek. The slopes are covered mostly with sagebrush and some grasses. Aspen and evergreens are scattered
on north-facing slopes. The land is primarily used for grazing with hay being produced in valley meadows and irrigated pastures.

3.10.3 HIGH SAVERY DAM AND RESERVOIR
The High Savery site, lying in a flat, wide valley bordered by gently sloped hills, also has many visual elements. The hills are old and weathered, forming smooth, rounded edges sloping to the stream valley. Several smaller drainages, including Dirtyman Creek, and the East and North forks of Savery Creek, confluence in this area to form Savery Creek. The hills bordering the valley to the northwest rise to a plateau. Higher, steeper hills rise above the plateau to the north. A variety of shrubby vegetation is found along the creeks. The hillsides are covered with sagebrush. Land use is primarily livestock grazing.

3.10.4 DUTCH JOE DAM AND RESERVOIR
Dutch Joe Creek is in a wide valley surrounded by gradually rising hills. The dry hills are covered with sagebrush and short grasses. The general terrain is rolling and open, with long vistas. Livestock grazing is the predominant use of the Dutch Joe Creek area; no hay is produced and no irrigated or improved meadows or pastures are present. Because of the flatter topography and relatively uniform existing plant community, it has the least variety of visual elements of the three reservoir areas.
CHAPTER 4
ENVIRONMENTAL CONSEQUENCES AND MITIGATION

4.1 INTRODUCTION

Chapter 4, Environmental Consequences and Mitigation, discusses the adverse and positive impacts associated with the development of the LSSIWSP and how the significant adverse impacts would be mitigated. The alternatives considered are three water supply alternatives, water conservation, and no federal action. The impacts addressed include those to natural and human resources. The description of mitigation measures are intended as brief summaries. A detailed mitigation plan is included as Appendix E.

The water supply alternatives are Sandstone, High Savery, and Dutch Joe dams and reservoirs (see Chapter 2). The Sandstone water supply would impound Savery Creek just below the confluence with Little Sandstone Creek. The High Savery alternative would impound Savery Creek farther upstream. The Sandstone and High Savery alternatives are designed with and without minimum pools. The Dutch Joe dam and reservoir would be located on Dutch Joe Creek, an intermittent stream adjacent to Savery Creek. Limited storage capacity at the Dutch Joe site prevents inclusion of a minimum pool. Water to fill this alternative would be transferred from Savery Creek using a pipeline and canal facility.

The natural resources evaluated include land, water, air, vegetation communities, wildlife, and threatened and endangered species. The human resources examined are population, land use and ownership, employment, economics, recreation, cultural resources, and aesthetics. For each resource, the methodology for determining impacts and the criteria for evaluating the significance of the impacts are described. The impacts of the three dam and reservoir water supply alternatives and of the water conservation and no-action alternatives are then discussed. The impacts are further categorized as to their significance and, for potentially significant impacts, mitigation measures are proposed.

4.2 LAND FEATURES

4.2.1 GENERAL SETTING

The general setting of an area is a function of its geographic location, topography, climate, and land cover. Location can not be changed by human activity, although the selection of alternatives in different locations could result in different types and levels of impact to the general setting. Climate can only be changed by human activity on a massive scale. Topography and
physiography can be altered or modified by human activities conducted on a local scale. However, extensive measures would normally be required to significantly change the overall topography or physiography of an area. Land cover is a result of the combination of the above factors, and as such, is not subject to change without large-scale modifications.

4.2.1.1 Methodologies and Significance Criteria
Site visits and best professional judgement were used to gauge the effects the water supply projects would have on location, topography, climate, and land cover. Impacts to the general setting of the project area would be significant if they resulted in a dramatic change in the overall character of the area.

4.2.1.2 Impacts

4.2.1.2.1 Water Supply Alternatives. A water supply alternative would alter a specific portion of the existing project area through the construction and operation and maintenance of a dam and reservoir. Changes to the general setting of the local area would be limited to the lands temporarily disturbed or permanently modified by construction or operation and maintenance. No changes in climatic conditions would result.

Changes in local topography would result from the construction of a dam, possibly over 100 feet high, and the removal of local sand and gravel for the fill material and concrete necessary for dam construction. These materials would be removed from within the inundation zone of the reservoir where possible; however, some new borrow pits could be developed outside the proposed dam and reservoir area. Construction of a dam and reservoir would stop flow in a portion of the impounded stream and alter seasonal flow regimes downstream. This water supply, however, would not create new stream channels, alter watershed boundaries, change the direction of flow in existing streams, or transfer water from one basin to another. No significant changes in area topography would result.

Changes in land cover could occur if the availability of supplemental late-season irrigation water resulted in additional land being irrigated. However, only land currently being irrigated with an adjudicated Wyoming water right would be eligible to receive the supplemental water. Therefore, large-scale changes in the amount or type of land cover currently found in the Little Snake River valley would not occur.

No significant changes in local area climate, topography, or land cover would occur as a result of construction of a supplemental irrigation water supply. Therefore, the overall impacts on the general setting would be insignificant.

4.2.1.2.2 Conservation and No-action Alternatives. The water conservation alternative could have minor impacts on local topography as a result of land leveling or improvements to water conveyance facilities. However, no major changes in the quantity of land cover types would
result. The no-action alternative would not change the climate, topography, or land cover of the local area. The water conservation and no-action alternatives would not significantly impact the general setting of the area.

4.2.1.2.3 Mitigation
Borrow areas developed outside of the dam and reservoir area would be reshaped and revegetated after construction. No other mitigation is proposed for the minor impacts to the general setting of the project area resulting from the water supply, conservation, or no-action alternatives.

4.2.2 GEOLOGY
Rock formations, overburden, and their physical properties combine to form the geology of an area. Excavation of overburden and blasting of rock could alter the local geology in the dam and reservoir area.

4.2.2.1 Methodologies and Significance Criteria
Geologic investigations necessary to support preliminary dam design of the three alternative dam sites included drilling, test pits, pedestrian surveys, and the review of existing data.

Impacts on geology would be significant if natural geologic process such as uplift, faulting, landslides, or weathering were changed. Conversely, local geology would significantly impact the project if expensive and time consuming engineering solutions were required for dam construction.

4.2.2.2 Impacts

4.2.2.2.1 Water Supply Alternatives. Minor impacts to surface geology would occur on about 150 to 250 acres in the immediate vicinity of each of the three dam sites. Impacts would be caused by the blasting and excavation necessary to remove overburden and borrow material and prepare the dam foundation, abutments, and emergency spillway. Some additional areas would be disturbed for construction of roads and other reservoir facilities. These impacts would be relatively superficial and would not affect natural geologic processes or local area geology. Overall, no significant impacts to the areas' geology would result.

The geology of each of the alternative sites was found to be suitable for the construction of dams. A roller-compacted concrete dam is proposed for the Sandstone alternative. The bedrock at this site contains clay seams and is sufficiently fractured to require the dam to have a 10-foot deep shear key to prevent slippage and grout curtains to control seepage (SWEC 1993). At the High Savery dam site, suitable geology and materials exist to construct an earthen dam or a roller-compacted concrete dam. Grouting of the entire centerline of the High Savery dam would be necessary to prevent excessive seepage (Hollingsworth Associates, Inc. 1997). Geologic conditions at the Dutch Joe dam site are also suitable for an earthen dam with a 15-foot deep cutoff trench and 100-foot deep grout curtain under the dam (Western Water Consultants, Inc.)
None of the required design features for the water supply dams represent expensive and time consuming engineering solutions to extraordinary geologic conditions. Therefore, geology would have no impacts on the dam and reservoir water supply alternatives.

4.2.2.2 Conservation and No-action Alternatives. Because the conservation and no-action alternatives would not disturb or be affected by area geology, no impacts would occur.

4.2.2.3 Mitigation
Additional, detailed geologic investigation of each dam site would be required to prepare final design plans. These investigations would establish design criteria that would insure sound and safe construction and operation of the dam and associated facilities. No mitigation is proposed for the conservation or no-action alternatives.

4.2.3 SOILS
The impacts to soils resulting from the development of a dam and reservoir include the disturbance and mixing of soil profiles during excavation and grading, erosion during construction and operation, and sedimentation in the reservoir. Erosion could occur in areas where vegetative cover has been removed for construction. Traffic from construction vehicles could further erode and compact soils. Changes in water level and wave action could cause bank erosion and slumping of sideslopes along the shoreline of the reservoir. Changes in the frequency of out-of-bank flows could affect the maintenance of current soil conditions in riparian areas.

Construction of any reservoir would inundate the soils within the normal pool water level and sediments would be deposited over the original soils.

4.2.3.1 Methodologies and Significance Criteria
A published soil survey does not exist for Carbon County, Wyoming. The soils information that is available for the county was collected on an as-needed basis from scattered locations (Vigil 1998). For the reservoir sites, soils information is not available or is incomplete. Therefore, impacts were determined based on the review of available reports and soil characteristics observed in the field.

Impacts on soils would be significant if they changed or eliminated locally or regionally important soil resources.

4.2.3.2 Impacts
4.2.3.2.1 Water Supply Alternatives. Although specific soil types have not been determined, it is known that no prime farmland soils occur in the project area; therefore, no prime farmland soils would be impacted by dam and reservoir construction or operation and maintenance. Soils in the project area are generally shallow and sandy. Where these soils occur on steep slopes, the potential for erosion could be substantial if vegetation is removed. Soil disturbance and vegetative clearing during construction would decrease soil surface stability and increase erosion.
on about 150 to 250 acres. These impacts would be temporary and confined to the construction zones. Following construction, permanent vegetative cover would re-established and soil erosion would return to pre-construction levels.

After construction, soils within the inundated portion of the stream valley would be permanently covered with sediment. Fluctuations of the reservoir water levels would create a large area of unvegetated shoreline vulnerable to erosion by wind and wave action. Increased soil compaction and erosion could occur if the dam and reservoir generated increased pedestrian activity and off-road vehicle traffic in the area.

Soils within the floodplain of Savery Creek are occasionally inundated by out of bank flows. These flows deposit sediments which are typically richer in nutrients than the soils they cover. The classic example of soils being enriched by flooding was the annual flooding of the Nile River in Egypt. The proposed water supply alternatives would reduce the flow in the Savery Creek during the spring high-flow period and reduce the number of out-of-bank flow events (see Section 4.3.1.2). As a result, the natural fertility of soils in the floodplain of Savery Creek below the Sandstone dam, High Savery dam, or Dutch Joe diversion would be reduced.

Because the soils at the water supply alternative sites do not appear to be locally or regionally important, the direct impacts to soils would not be significant.

4.2.3.2.2 Water Conservation and No-Action

Soil loss, caused by the rehabilitation of water delivery facilities and land leveling, could occur with implementation of the water conservation alternative. These impacts would be temporary, localized, and insignificant. The no-action alternative would have no impact on soils.

4.2.3.3 Mitigation

Although the direct impacts of the project on soils would not be significant, increased soil erosion would have significant impacts on water quality and aquatic life that would require mitigation. Soil loss caused by construction or operation and maintenance would be minimized by implementation of erosion and sedimentation (ES) control plans. Silt fences, silt traps, sedimentation basins, reshaping, and reseeding would be used to control erosion caused by construction and operation and maintenance. Restricting human activity to specific access points and vehicular traffic to prepared roadways and parking areas would reduce or eliminate impacts from recreational activities. The removal of livestock grazing activities on adjacent valley slopes would decrease soil disturbance and subsequent erosion. Implementing these mitigation measures would avoid significant soil disturbance and loss and secondary impacts on water quality and aquatic life.

No mitigation measures are proposed for impacts to soils disturbed by water conservation activities. No mitigation would be needed for the no-action alternative because this alternative would not affect soils.
4.2.4 SEISMICITY
As with geology, dams and reservoirs can impact local area seismic activity and, conversely, can be impacted by the area’s seismicity. Induced seismic activity can occur when hydraulic pressure created by stored water in a reservoir forces water into a fault (SWEC 1986). Induced seismic events of less than magnitude 2.5 on the Richter Scale (RS) are not uncommon for all reservoirs. Induced earthquakes of magnitude 2.5 to 4.9 RS were judged to be unlikely to occur for an earlier design of the Sandstone reservoir which would have contained 52,000 AF of water (SWEC 1986). An earthquake of 2.5 RS would not typically be felt or noticed; earthquakes of the 4.9 RS magnitude may be felt, but no damage to structures would result.

4.2.4.1 Methodologies and Significance Criteria
Impacts of the water supply alternatives on local area seismicity were evaluated by identifying the location of known faults in the project area, determining the magnitude and frequency of seismic events within 150 miles of the project area, and comparing the size of the proposed reservoirs to the size of induced seismic events.

Seismic impacts would be significant if the proposed project would induce earthquakes greater than 2.5 RS or if extreme engineering measures would be required to make the proposed water supply dam and reservoir safe from damage or failure caused by earthquakes.

4.2.4.2 Impacts

4.2.4.2.1 Water Supply Alternatives. Increased seismic activity is most common in reservoirs with water depths exceeding 330 feet (SWEC 1986). Maximum depths for the three proposed reservoirs range from 95 to 130 feet. The proposed water supplies, therefore, are not expected to induce significant seismic activity.

The project area is located in the Wasatch-Utah fault zone within the Uinta-Elkhead Seismotectonic Province. Kirkham and Rogers (1981) suggested the maximum magnitude of earthquake would be 5.5 to 6.5 RS for the province and 6.0 RS for the fault zone. Algermissen et al. (1982) estimated maximum horizontal bedrock acceleration would not exceed 2.9 feet/second$^2$ with a magnitude 3.5 to 4.0 RS seismic event. Algermissen et al. (1982) also estimated that an earthquake of magnitude 3.5 RS or greater had a 90 percent probability of occurring along the Wasatch-Utah fault zone once every 250 years.

Of the three water supply sources, only the Sandstone site has known fault zones in the area of the dam and reservoir. In addition, several southeast to northwest-trending faults occur downstream of the proposed Sandstone dam site (Figure 3-3). These faults have shown no signs of activity in the last one million years (SWEC 1986). Although the probability of activity along these faults is low, for design purposes, the faults were considered active with the location of the nearest earthquake epicenter approximately 1,000 feet downstream of the dam site.
A southeast to northwest-trending fault exists just south of the Dutch Joe dam site (Figure 3-3). This fault is probably associated with the other faults in the area which have similar trends and have been inactive for the past one million years.

No faults are known to occur in the High Savery dam and reservoir area (SWEC 1986) (Figure 3-3).

Based on this information and the limited data for the area, the water supply would be designed to withstand a seismic event of 6.0 RS with a maximum horizontal acceleration of 9.7 feet/second² (SWEC 1986). More recent studies by Case (1999) indicate that a maximum credible earthquake of 6.25 is postulated for the project area, and an acceleration of 20 percent gravity should be used in design of the dam. These design parameters are considered reasonable and should not require extraordinary engineering measures (SWEC 1986). Therefore, normal seismic activity would have no significant impact on the dam and reservoir alternatives.

4.2.4.2.2 Water Conservation and No-Action. The water conservation and no-action alternatives would not affect or be affected by area seismicity.

4.2.4.3 Mitigation
Mitigation for potential and existing area seismic activity would involve designing the project to withstand a 6.25 RS earthquake with a peak horizontal bedrock acceleration of 20 percent g. Although the Sandstone dam and reservoir would be the water supply alternative most likely affected by seismic activity, the same design criteria would be applied to the High Savery and Dutch Joe alternatives.

No mitigation is proposed to accommodate seismic impacts on or by the water conservation or no-action alternatives.

4.2.5 MASS MOVEMENTS AND LANDSLIDES
The inundation of a slide area by water from a reservoir could reduce the natural frictional forces which tend to keep rock layers in place. As a result, the rate at which rock layers slide into the reservoir area could be increased. Additionally, the lubrication of slides could increase the probability and magnitude of a mass movement or landslide during a seismic event. The project would be impacted if material from a mass movement or landslide entered the reservoir and reduced its storage volume.

4.2.5.1 Methodologies and Significance Criteria
Mass movements, or landslides, in the region have been mapped by the Wyoming Geological Survey (Case 1990a, 1990b, 1992). Field investigations, including borings, piezometers, an inclinometer, and surface monuments, were conducted to determine their potential impacts and significance (SWEC 1986).
Impacts on mass movements from the project would be significant if the presence of the water supply would increase the likelihood or magnitude of a mass movement or landslide that would interfere with existing geological, hydrological, or biological processes. Impacts on the project from mass movements or landslides would be significant if sufficient quantities of material slid into the reservoir and reduced the reservoir’s storage capacity or life span.

4.2.5.2 Impacts

4.2.5.2.1 Sandstone Dam and Reservoir. Of the three water supply sources, only the Sandstone dam and reservoir area contains evidence of historic or active mass movements and landslides. Two major and several smaller mass movement areas occur in the vicinity of the Sandstone dam and reservoir (Case 1990a) (Figure 4-1). The upstream end of the reservoir would inundate to within a few feet of one slide area, which extends to a height of about 700 feet above the high water level of the reservoir (Figure 4-1). Inundation of this area could increase the possibility of slide movement by saturating the underlying bentonite zone which would reduce the resisting shear force and increase the weight of the overlaying material. No mass movement or slide areas exist near the proposed Sandstone dam site.

Increased slide movement could result in additional material moving into the reservoir throughout the life of the project. In the unlikely event that a large slide moved into the reservoir, the storage volume of the reservoir would be reduced without affecting the design or safety margin of the dam.

4.2.5.2.2 Other Alternatives. No landslides have been identified in the vicinity of the High Savery (Case 1992) and Dutch Joe (Case 1990b) alternatives; therefore, these alternatives would not impact mass movements or landslides and, conversely, mass movements and landslides would not impact these alternatives. Neither the water conservation nor the no-action alternative would impact mass movements or landslides.

4.2.5.3 Mitigation

In the event that more movement of a slide occurs than anticipated, certain steps would be taken to stabilize the landslide mass, such as grading and installation of trenches or French drains. Because the site of the Sandstone water supply alternative can accommodate a larger dam, the option exists to raise the dam if slide material reduced the storage capacity of the reservoir. No mitigation is proposed for the High Savery, Dutch Joe, conservation, or no-action alternatives because no mass movements or landslides would be impacted by their construction or operation and maintenance.

4.2.6 MINERAL RESOURCES

A variety of mineral resources occur throughout the project area. Several have been or continue to be mined, although mostly on a small scale (Section 3.2.7). Construction of a dam and reservoir would render those mineral resources covered by the dam and inundated by the reservoir...
Figure 4-1

MASS MOVEMENTS
SANDSTONE DAM
ALTERNATIVE

Source: USGS 7.5' Topographic Quad Map for Tullis, Wyoming.


Land Slide or Block Slide
Little Snake Supplemental Irrigation Water Supply Project

4.2.6.1 Methodologies and Significance Criteria
The impacts to mineral resources was assessed by comparing the distribution of known resources (Figure 3-4) to the dams and inundation zones of the proposed reservoirs. Impacts to mineral resources would be significant if mining of large amounts of economically recoverable materials was made impractical or uneconomical for the life of the reservoir and beyond.

4.2.6.2 Impacts

4.2.6.2.1 Water Supply Alternatives. The mineral resources impacted by each alternative are primarily sand and gravel. A significant portion of the deposits located at each site would be used to construct the dam and associated facilities. The sand and gravel remaining in the inundation zone would be unrecoverable for the life of the reservoir. After the project life is over, the layer of sediment deposited as a result of impoundment would probably make recovery of these resources uneconomical. No recoverable quantities of oil, natural gas, uranium, or coal are known to occur beneath the areas immediately surrounding the proposed water supply alternatives. No significant impacts to mineral resources would result from construction of any of the water supply alternatives.

4.2.6.2.2 Conservation and No-action. Because the conservation and no-action alternatives would have little impacts on land use or land cover and would not consume large amounts of mineral resources, impacts on mineral resources would be insignificant.

4.2.6.3 Mitigation
Impacts to mineral resources would be mitigated by preferentially using the recoverable sand and gravel deposits located within the reservoir inundation zone during dam construction. No mitigation is proposed for the conservation and no-action alternatives relative to mineral resources.

4.3 WATER RESOURCES

Development of the Sandstone and High Savery water supply alternatives would result in the inundation of portions of Savery Creek and several of its tributaries. The Dutch Joe alternative would inundate a portion of Dutch Joe Creek; however, this stream is intermittent and the water stored in this reservoir would be diverted from Savery Creek. The lengths of streams inundated would range from 4.4 to 12.2 miles (Table 4-1). The total storage capacity of the water supply alternatives would range from 12,600 to 22,433 AF. The High Savery alternative would have the greatest volume and surface area but the Dutch Joe alternative would have the greatest maximum and average water depths (Table 4-1).
### Table 4-1

**CHARACTERISTICS OF EACH WATER SUPPLY ALTERNATIVE**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Total Storage Capacity (acre-feet)</th>
<th>Surface Area (acres)</th>
<th>Depth (feet)</th>
<th>Stream Length (miles)</th>
<th>Drainage Area (sq. miles)</th>
<th>Little Snake R. Drainage Area (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>w/ min pool</td>
<td>15,800</td>
<td>370</td>
<td>102</td>
<td>43</td>
<td>9.1</td>
<td>294</td>
</tr>
<tr>
<td>w/o min pool</td>
<td>12,600</td>
<td>330</td>
<td>92</td>
<td>38</td>
<td>8.3</td>
<td>294</td>
</tr>
<tr>
<td>High Savery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>w/ min pool</td>
<td>22,433</td>
<td>482</td>
<td>130</td>
<td>47</td>
<td>10.7</td>
<td>124</td>
</tr>
<tr>
<td>w/o min pool</td>
<td>18,000</td>
<td>420</td>
<td>120</td>
<td>43</td>
<td>9.4</td>
<td>124</td>
</tr>
<tr>
<td>Dutch Joe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no min pool</td>
<td>14,400</td>
<td>300</td>
<td>132</td>
<td>48</td>
<td>4.4</td>
<td>300³</td>
</tr>
</tbody>
</table>

1. At normal pool elevation.
2. Permanent and intermittent streams.
3. Includes area of Savery Creek watershed above Dolan Ditch diversion.

### 4.3.1 WATER QUANTITY

Any of the reservoir alternatives would alter normal stream flows, impoundment, or diversion. During spring, peak flows downstream from the dam or diversion would be reduced and delayed because of reservoir filling. During late summer, downstream low flow would be increased as a result of the release of water for late-season supplemental irrigation. Some of the water diverted for irrigation would flow back into the stream as return flow.

Operation of the Sandstone and High Savery water supply alternatives would include minimum flow releases. The minimum release for the Sandstone dam and reservoir would be the lesser of the natural stream discharge or 24 cfs. For the High Savery alternative, the minimum release plan would be the lesser of the natural stream discharge or 12 cfs. Operation of the Dutch Joe dam and reservoir would include a minimum flow bypass of the Dolan Ditch that is the same as the Sandstone alternative. Stream flow would not be used for reservoir filling if natural inflow is less than the minimum flow release requirement. Because Dutch Joe Creek is historically intermittent, no minimum releases would be made from the Dutch Joe dam and reservoir.

#### 4.3.1.1 Methodologies and Significance Criteria

The Wyoming Integrated River System Operation Study (WIROS) computer model of the Little Snake River Basin was used to assess changes in stream discharge resulting from development of the three alternative dams and reservoirs. Because impacts could occur within the immediate project area or extend downstream throughout the drainage basin, changes in streamflow
attributable to each alternative were estimated for Savery Creek just below the proposed dam sites and for the Little Snake River at Dixon, Wyoming, and at Lily, Colorado (Figure 4-2). Dixon is approximately 10 miles downstream from the confluence of Savery Creek and the Little Snake River and Lily is approximately 70 miles downstream from Baggs, Wyoming, near the confluence of the Little Snake and Yampa rivers. Average monthly and annual discharges were calculated based on stream gage data from 1930 through 1982. These data were adjusted to reflect the full use of all valid water rights, including Stages I and II of the Cheyenne Project, except the Dolan Mesa diversion from Savery Creek. The Dolan Mesa ditch has not been used in over 20 years and is currently in a state of disrepair. It is unlikely the water rights associated with this ditch would ever be used again because the geology along the ditch is unstable, which would make repairs expensive, and the irrigation water once delivered by this ditch has been replaced with groundwater. Minimum flow releases from the proposed reservoirs were included in the WIROS modeling.

Mean daily flow data from the USGS gaging stations “Savery Creek near Savery” (Station 09256000) and “Savery Creek at Upper Station” (Station 09255500) were used as the basis for the analysis of peak-day flow. For the Sandstone and Dutch Joe alternatives, the analysis was based on data from Station 09256000 from the period 1953 through 1972 (WWCI 1996a). For the High Savery alternative, the analysis was based on both gaging stations. The analysis was limited to the period over which these two stations have concurrent records, 1953 through 1971.

Changes in streamflow would cause corresponding changes in water depth and velocity, which are important elements determining aquatic and riparian habitat quality. These changes were estimated at five locations on Savery Creek where cross-sections of the stream channel or stage-velocity-discharge relationships were available (Table 4-2, Figure 4-2). Average daily discharges for pre-construction conditions were estimated at each location using USGS data from Savery Creek for water years 1941 through 1971. Post-construction releases from the High Savery dam and reservoir were obtained from WIROS modeling results.

### Table 4-2

<table>
<thead>
<tr>
<th>Name</th>
<th>Source</th>
<th>Location</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below High Savery Dam</td>
<td>WGFD</td>
<td>Sec. 17, T15N, R88W</td>
<td>Approximately two miles below the proposed High Savery Dam</td>
</tr>
<tr>
<td>Upper Station</td>
<td>USGS</td>
<td>Sec. 2, T14N, R89W</td>
<td>Located at former stream gage No. 09255500, approximately two miles downstream from Coal Gulch Creek</td>
</tr>
<tr>
<td>Wren Bridge</td>
<td>USGS</td>
<td>Sec. 14, T13N, R89W</td>
<td>Located at former stream gauge No. 0925600, approximately 2 miles downstream from the Sandstone dam site</td>
</tr>
<tr>
<td>Page Ranch</td>
<td>WGFD</td>
<td>Sec. 27, T13N, R89W</td>
<td>Approximately 5 miles above the mouth of Savery Creek</td>
</tr>
<tr>
<td>Thomas Ranch</td>
<td>WGFD</td>
<td>Sec. 5, T12N, R89W</td>
<td>Approximately 2 miles above the mouth of Savery Creek</td>
</tr>
</tbody>
</table>
HYDROLOGIC MEASUREMENT SITES

Figure 4-2

HYDROLOGIC MEASUREMENT SITES
Daily streamflow impacts were estimated as the difference between daily reservoir inflow and release. These flow differences were added to the streamflow at each cross-section to estimate post-construction conditions and pre- and post-construction daily water depths and velocities. From these estimates, median values for streamflow, water depth, and velocity were determined at each cross-section for the entire year and for the growing season of May through September. The median is the value in the distribution, in this case, daily flows, depths, or velocities, which is exceeded half of the time. As a measure of central-tendency, the median is less influenced by rare, extreme events than the arithmetic average. As such, the median is considered to be more representative of "typical" conditions.

The elevation of the top of the stream bank for each cross-section was estimated. The days with flows above these streamed elevations were counted. The impacts of the project on water depth, velocity, and out-of-bank flows in Savery Creek were estimated for the High Savery alternative. The High Savery and Sandstone alternatives would deliver essentially the same amounts of water to Savery Creek below the Sandstone dam. Therefore, the results of the water depth and velocity analysis for the Sandstone alternative and the High Savery dam and reservoir would be similar. An analysis was not performed for the Dutch Joe alternative because the streamflow changes that would occur in Savery Creek in all months, except April, are expected to be minor. Dutch Joe Creek would continue to be an intermittent stream, except during irrigation releases from the reservoir, with limited aquatic and riparian habitat.

The impact on streamflow from the retention and subsequent release of supplemental irrigation water would be significant if post-construction stream flows were outside the normal, historical range. The determination of significance was made for monthly and annual discharges using a statistical analysis called Student's t-test. This test determined the probability that the difference between the with and without project average flow could have been the result of random sampling variation. If this probability was less than 5 percent, the difference between the with and without project flow was considered significant. Other significant impacts would be a change in the season in which peak flows occur or the elimination or change in seasonal timing of out-of-bank flows. These characteristics are important for maintenance of stream and riparian habitats and fish populations.

4.3.1.2 Impacts

4.3.1.2.1 Sandstone Dam and Reservoir. Peak stream flows for Savery Creek and the Little Snake River generally occur during the months of April, May, and June. April and May would be the primary reservoir filling period when reductions in peak stream flows would be the greatest. Significant declines in average monthly streamflow of 50 and 63 percent are predicted in Savery Creek for March and April, respectively, downstream of the reservoir (Table 4-3).
Table 4-3

AVERAGE CHANGES IN MONTHLY STREAM DISCHARGE CAUSED BY THE SANDSTONE ALTERNATIVE

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline discharge (AF)</th>
<th>Change (AF)</th>
<th>Percent change</th>
<th>Baseline discharge (AF)</th>
<th>Change (AF)</th>
<th>Percent change</th>
<th>Baseline discharge (AF)</th>
<th>Change (AF)</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1,253</td>
<td>-73</td>
<td>-5.8</td>
<td>4,640</td>
<td>-74</td>
<td>-1.6</td>
<td>5,345</td>
<td>-73</td>
<td>-1.4</td>
</tr>
<tr>
<td>February</td>
<td>1,395</td>
<td>-226</td>
<td>-16.2</td>
<td>4,582</td>
<td>-226</td>
<td>-4.9</td>
<td>5,354</td>
<td>-226</td>
<td>-4.2</td>
</tr>
<tr>
<td>March</td>
<td>2,857</td>
<td>-1,441*</td>
<td>-50.4</td>
<td>9,710</td>
<td>-1,441*</td>
<td>-14.8</td>
<td>12,721</td>
<td>-1,442</td>
<td>-11.3</td>
</tr>
<tr>
<td>April</td>
<td>13,193</td>
<td>-8,318*</td>
<td>-63.0</td>
<td>48,883</td>
<td>-8,318*</td>
<td>-17.0</td>
<td>60,079</td>
<td>-8,318</td>
<td>-13.8</td>
</tr>
<tr>
<td>May</td>
<td>27,882</td>
<td>-1,814</td>
<td>-6.5</td>
<td>121,670</td>
<td>-1,814</td>
<td>-1.5</td>
<td>127,748</td>
<td>-1,761</td>
<td>-1.4</td>
</tr>
<tr>
<td>June</td>
<td>13,609</td>
<td>424</td>
<td>-3.1</td>
<td>82,878</td>
<td>406</td>
<td>0.5</td>
<td>88,188</td>
<td>388</td>
<td>0.3</td>
</tr>
<tr>
<td>July</td>
<td>2,194</td>
<td>2,500*</td>
<td>114</td>
<td>6,721</td>
<td>984</td>
<td>14.6</td>
<td>9,819</td>
<td>503</td>
<td>5.1</td>
</tr>
<tr>
<td>August</td>
<td>617</td>
<td>5,763*</td>
<td>934</td>
<td>1,014</td>
<td>2,170*</td>
<td>214</td>
<td>3,955</td>
<td>203</td>
<td>5.1</td>
</tr>
<tr>
<td>September</td>
<td>559</td>
<td>2,765*</td>
<td>495</td>
<td>875</td>
<td>732*</td>
<td>83.7</td>
<td>1,576</td>
<td>220*</td>
<td>14.0</td>
</tr>
<tr>
<td>October</td>
<td>1,110</td>
<td>0</td>
<td>0.0</td>
<td>1,606</td>
<td>90</td>
<td>5.6</td>
<td>3,681</td>
<td>866*</td>
<td>23.5</td>
</tr>
<tr>
<td>November</td>
<td>1,303</td>
<td>-132</td>
<td>-10.1</td>
<td>5,339</td>
<td>-84</td>
<td>-1.6</td>
<td>6,526</td>
<td>143</td>
<td>2.2</td>
</tr>
<tr>
<td>December</td>
<td>1,264</td>
<td>-87</td>
<td>-6.9</td>
<td>4,871</td>
<td>-87</td>
<td>-1.8</td>
<td>5,698</td>
<td>-85</td>
<td>-1.5</td>
</tr>
<tr>
<td>Total</td>
<td>67,237</td>
<td>-640</td>
<td>-1.0</td>
<td>292,734</td>
<td>-7,606</td>
<td>-2.6</td>
<td>330,688</td>
<td>-9,580</td>
<td>-2.9</td>
</tr>
</tbody>
</table>

1Positive values represent an increase in discharge, negative numbers represent a decrease in discharge. The analysis shown is for the with minimum pool configuration and assumed that the dead and minimum pools were already filled. Results for the without minimum pool configuration were essentially the same because the amounts of water released would be the same.

2Location of discharge estimates is at the proposed dam site.

*The change is a significant impact.

The stored water would be released from mid-July through mid-September and would result in significant streamflow increases in Savery Creek immediately downstream of the Sandstone dam. Stream flows are predicted to be more than 10 times greater than normal in August and nearly six times greater in September (Table 4-3). The late-summer releases from the reservoir would nearly offset the spring reductions in streamflow in Savery Creek. The average annual decrease in discharge of 640 AF immediately below the dam site would not be significant (Table 4-3). This net loss would be the result of evaporation from the reservoir.

The impact on monthly streamflow would decrease with increasing distance downstream from the dam. In the Little Snake River at Dixon, a significant decline in monthly streamflow (15 percent) would occur during March and significant increases would occur in August (214 percent) and September (84 percent) (Table 4-3). The average annual net reduction in streamflow at Dixon was estimated to be 2.6 percent. Farther downstream on the Little Snake River at Lily, no significant reductions in streamflow are predicted, but smaller significant increases would occur in September and October (14 and 24 percent, respectively) (Table 4-3). The average annual net loss at Lily is estimated to be 2.9 percent. The net loss would increase with distance downstream.
from the dam because the cumulative volume of water removed for late-season supplemental irrigation would increasingly leave less water to offset springtime reductions. However, while difficult to predict, some of the loss would be reduced by irrigation return flows.

The changes in streamflow in Savery Creek downstream of the Sandstone dam would affect the depth and velocity of water and the quantity and quality of aquatic and riparian habitats. Stream depth is an indicator of habitat quantity because stream width usually increases with water depth. Water velocity influences stream substrate composition and helps determine the species composition of aquatic organisms. Out-of-bank flows affect riparian vegetation and communities, such as cottonwoods, willows, and wetlands.

At the Wren Bridge location (Table 4-2), the annual median streamflow (the flow which is exceeded 50 percent of the time) would increase from 29.0 cfs without the project to 41.6 cfs with the project (Table 4-4). Although this increase is greater than 40 percent, the changes to water velocity and depth would be less. The annual median streamflow velocity would increase by 25 percent from 0.60 to 0.75 feet per second (Table 4-4) while median depth would increase by only 4 percent from 2.6 to 2.7 feet (Figure 4-3). During the growing season, the median discharge would increase approximately 4-fold, the median velocity would more than double (Table 4-4), and median stream depth would increase 36 percent from 2.5 feet to 3.4 feet (Figure 4-3). Increases in depth would occur during the growing season when water levels in the stream are typically low (Table 4-3, Figure 4-3).

<table>
<thead>
<tr>
<th>Location</th>
<th>Analysis period</th>
<th>Median Discharge (cfs)</th>
<th>Percent change</th>
<th>Median Velocity (fps)²</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre- Construction</td>
<td>Post- Construction</td>
<td></td>
<td>Pre- Construction</td>
<td>Post- Construction</td>
</tr>
<tr>
<td>Below Wren Bridge</td>
<td>Annual</td>
<td>29.0</td>
<td>41.6</td>
<td>43</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>Growing season</td>
<td>30.0</td>
<td>118.0</td>
<td>293</td>
<td>0.62</td>
</tr>
<tr>
<td>Page Ranch</td>
<td>Annual</td>
<td>29.6</td>
<td>42.9</td>
<td>45</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Growing season</td>
<td>30.6</td>
<td>118.3</td>
<td>287</td>
<td>0.83</td>
</tr>
<tr>
<td>Thomas Ranch</td>
<td>Annual</td>
<td>30.1</td>
<td>43.7</td>
<td>42</td>
<td>1.85</td>
</tr>
<tr>
<td></td>
<td>Growing season</td>
<td>31.1</td>
<td>118.7</td>
<td>282</td>
<td>1.87</td>
</tr>
</tbody>
</table>

¹The median is the value in a distribution where half of the observations are greater and half of the observation are less.
²fps = feet per second.
³For 1941 - 1971, 11,322 total days.
Notes:
1. Flow depths estimated at USGS stream gaging station 09255000. Stage-discharge relationship provided by USGS.
2. Flow depths derived from pre- and post-construction discharge estimates for this location for water years 1941-1971.
3. Growing season assumed to be months of May through September.
At Page Ranch (Table 4-2), the water supply project would increase the median water depth from 0.9 to 1.0 feet (11 percent) annually and from 0.9 to 1.3 feet (44 percent) during the growing season. Pre- and post-construction changes in median streamflow and velocity would be essentially the same as at Wren Bridge (Table 4-4). At Thomas Ranch (Table 4-2), the project would increase median depth from 0.6 to 0.7 feet (17 percent) annually and from 0.6 to 1.0 feet (67 percent) during the growing season. As with the Wren Bridge site, water depths would be increased at a time when depths have been historically low (Figure 4-4).

The Sandstone dam would affect annual peak-day flows in Savery Creek. At the reservoir site and the mouth of Savery Creek, modeling indicated the average annual peak-day flows would be reduced from 874 to 724 cfs and from 945 to 826 cfs, respectively, by the Sandstone alternative (Table 4-5). The date of occurrence of peak-day flows would be delayed an average of 4 days. The maximum delay was 43 days (Table 4-5). Fifty-five percent of the years in the period of record had no change in the date of occurrence of annual peak flow.

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre- Construction</th>
<th>Post- Construction</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone Reservoir Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earliest date</td>
<td>April 4</td>
<td>April 20</td>
<td>delayed 16 days</td>
</tr>
<tr>
<td>Latest date</td>
<td>June 5</td>
<td>June 5</td>
<td>none</td>
</tr>
<tr>
<td>Delay in annual peak flow occurrence (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>--</td>
<td>--</td>
<td>4</td>
</tr>
<tr>
<td>Maximum</td>
<td>--</td>
<td>--</td>
<td>43</td>
</tr>
<tr>
<td>Minimum</td>
<td>--</td>
<td>--</td>
<td>-12¹</td>
</tr>
<tr>
<td>Peak flows (cfs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>874</td>
<td>763</td>
<td>-104</td>
</tr>
<tr>
<td>Maximum²</td>
<td>1,503</td>
<td>1,280</td>
<td>-510</td>
</tr>
<tr>
<td>Minimum²</td>
<td>204</td>
<td>163</td>
<td>0</td>
</tr>
<tr>
<td>Mouth of Savery Creek³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak flows (cfs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>945</td>
<td>826</td>
<td>-119</td>
</tr>
<tr>
<td>Maximum¹</td>
<td>1,713</td>
<td>1,421</td>
<td>-581</td>
</tr>
<tr>
<td>Minimum¹</td>
<td>233</td>
<td>233</td>
<td>0</td>
</tr>
</tbody>
</table>

¹A "-" represents a decline and a "+" represents an increase relative to without-project conditions.
²Maximum and minimum without and with project peak-day flows do not necessarily occur in the same year.
³The dates of peak flows at the mouth of Savery Creek are the same as at Sandstone reservoir site.

Notes:
1. Flow depths estimated at Wyoming Game and Fish Department (WGF) cross section "Thomas Ranch." Stage-discharge relationship estimated from WGF data.
2. Flow depths derived from pre- and post-construction discharge estimates for this location for water years 1941-1971.
3. Growing season assumed to be months of May through September.

Figure 4-4
STAGE DURATIONS FOR SAVERY CREEK AT THOMAS RANCH
The occurrence of out-of-bank flows in lower Savery Creek would be reduced with the Sandstone dam. At Wren Bridge, the recurrence interval for years with out-of-bank flow events would increase from once every 5.2 years to once every 7.8 years; however, the average duration of each event would increase slightly from 2.0 to 2.3 days (Table 4-6). The earliest occurrence of out-of-bank flows would also be pushed back from early to late April. The latest occurrence of out-of-bank flows would still be in late May (Table 4-6). Farther downstream, at the Page and Thomas Ranch locations, years with out-of-bank flows would occur approximately once every 15.5 years during late April through mid-May, with or without the Sandstone dam (Table 4-6).

4.3.1.2.2 High Savery Dam and Reservoir. The High Savery dam and reservoir would impound Savery Creek and inundate portions of the East and North Forks of Savery Creek and Dirtyman Creek. Stream hydrology downstream and immediately upstream of the dam would be altered after dam and reservoir construction.

Compared to the Sandstone water supply alternative, the High Savery dam and reservoir would be located 31.5 miles farther upstream in the Savery Creek watershed. As a result, the average annual discharge in Savery Creek at the High Savery dam site is about 60 percent lower than at the Sandstone dam site. The Savery Creek dam and reservoir would store and release approximately 1,200 AF more water than the Sandstone alternative to offset larger stream conveyance losses. Therefore, the impacts on the hydraulics of Savery Creek by the High Savery dam and reservoir would be greater than the Sandstone alternative. Significant reductions in monthly streamflow at the High Savery dam site are predicted to occur in November, December, February, March, April, and May. Significant increases in monthly streamflow would occur in July, August, and September (Table 4-7).

For the High Savery alternative, the average annual reduction in total stream discharge of 628 AF would be nearly identical to that caused by the Sandstone water supply. This reduction would represent 2.2 percent of total discharge in Savery Creek at the High Savery location (Table 4-7). The net loss would be caused by evaporation of water from the reservoir.

Tributaries that enter Savery Creek and the Little Snake River below the High Savery dam would buffer the flow variations caused by reservoir operations. As a result, no significant monthly reductions in discharge are predicted to occur in the Little Snake River at Dixon (Table 4-7). However, Little Snake River flows at Dixon in August and September would be significantly increased partially through the contribution of irrigation return flows. The net average annual loss in stream flow from the Little Snake River at Dixon would be 2.6 percent. Farther downstream on the Snake River at Lily, no significant monthly decreases in streamflow are expected; however, modest but significant increases that are partially a result of irrigation return flows would occur in September and October (Table 4-7). The net average annual loss in streamflow from the Little Snake River at Lily with the High Savery dam and reservoir would be 3.2 percent.
### Table 4-6

**OUT-OF-BANK FLOWS IN SAVERY CREEK WITH THE SANDSTONE ALTERNATIVE**

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre-Construction</th>
<th>Post-Construction</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wren Bridge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of days</td>
<td>20</td>
<td>16</td>
<td>-4</td>
</tr>
<tr>
<td>Number of events</td>
<td>10</td>
<td>7</td>
<td>-3</td>
</tr>
<tr>
<td>Number of years with events</td>
<td>6</td>
<td>4</td>
<td>-2</td>
</tr>
<tr>
<td>Recurrence interval for years with events (years)</td>
<td>5.2</td>
<td>7.8</td>
<td>+2.6</td>
</tr>
<tr>
<td>Average number of events per year</td>
<td>0.32</td>
<td>0.23</td>
<td>-0.09</td>
</tr>
<tr>
<td>Earliest event</td>
<td>April 2</td>
<td>April 29</td>
<td>delayed 27 days</td>
</tr>
<tr>
<td>Latest event</td>
<td>May 30</td>
<td>May 31</td>
<td>delayed 1 day</td>
</tr>
<tr>
<td>Longest event (days)</td>
<td>5</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Average event length (days)</td>
<td>2.0</td>
<td>2.3</td>
<td>+0.3</td>
</tr>
</tbody>
</table>

| **Page Ranch** |                  |                   |        |
| Total number of days | 18               | 12               | -6     |
| Number of events     | 3                | 2                 | -1     |
| Number of years with events | 2          | 2                 | 0      |
| Recurrence interval for years with events (years) | 15.5        | 15.5              | 0      |
| Average number of events per year | 0.10     | 0.06              | -0.04  |
| Earliest event       | April 28         | May 1             | delayed 3 days |
| Latest event         | May 11           | May 11            | none   |
| Longest event (days) | 8                 | 7                 | -1     |
| Average event length (days) | 6.0       | 6.0               | 0      |

| **Thomas Ranch** |                  |                   |        |
| Total number of days | 13               | 8                 | -5     |
| Number of events     | 3                | 2                 | -1     |
| Number of years with events | 2          | 2                 | 0      |
| Recurrence interval for years with events (years) | 15.5        | 15.5              | 0      |
| Average number of events per year | 0.10     | 0.06              | -0.04  |
| Earliest event       | April 28         | May 2             | delayed 4 days |
| Latest event         | May 10           | May 10            | none   |
| Longest event (days) | 7                 | 7                 | 0      |
| Average event length (days) | 4.3       | 4.0               | -0.3   |

### Table 4-7

**AVERAGE CHANGES IN MONTHLY STREAM DISCHARGE CAUSED BY THE HIGH SAVERY ALTERNATIVE**

<table>
<thead>
<tr>
<th>Month</th>
<th>Baseline discharge (AF)</th>
<th>Change (AF)</th>
<th>Percent change</th>
<th>Baseline discharge (AF)</th>
<th>Change (AF)</th>
<th>Percent change</th>
<th>Baseline discharge (AF)</th>
<th>Change (AF)</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>744</td>
<td>-97</td>
<td>-13.0</td>
<td>4,646</td>
<td>-97</td>
<td>-2.1</td>
<td>5,352</td>
<td>-97</td>
<td>-1.8</td>
</tr>
<tr>
<td>February</td>
<td>816</td>
<td>-211*</td>
<td>-25.9</td>
<td>4,591</td>
<td>-211</td>
<td>-4.6</td>
<td>5,362</td>
<td>-210</td>
<td>-3.9</td>
</tr>
<tr>
<td>March</td>
<td>1,758</td>
<td>-1,039*</td>
<td>-59.1</td>
<td>9,710</td>
<td>-1,039</td>
<td>-10.7</td>
<td>12,721</td>
<td>-1,040</td>
<td>-8.2</td>
</tr>
<tr>
<td>April</td>
<td>6,628</td>
<td>-5,906*</td>
<td>-89.1</td>
<td>48,883</td>
<td>-5,905</td>
<td>-12.1</td>
<td>60,079</td>
<td>-5,905</td>
<td>-9.8</td>
</tr>
<tr>
<td>May</td>
<td>9,639</td>
<td>-5,356*</td>
<td>-55.6</td>
<td>124,929</td>
<td>-5,355</td>
<td>-4.3</td>
<td>130,801</td>
<td>-5,356</td>
<td>-4.1</td>
</tr>
<tr>
<td>June</td>
<td>4,581</td>
<td>-174</td>
<td>-3.8</td>
<td>85,018</td>
<td>-193</td>
<td>-0.2</td>
<td>89,944</td>
<td>-212</td>
<td>-0.2</td>
</tr>
<tr>
<td>July</td>
<td>962</td>
<td>2,917*</td>
<td>303</td>
<td>6,583</td>
<td>1,339</td>
<td>20.3</td>
<td>9,686</td>
<td>616</td>
<td>6.4</td>
</tr>
<tr>
<td>August</td>
<td>510</td>
<td>6,676*</td>
<td>1,309</td>
<td>999</td>
<td>2,901*</td>
<td>290.4</td>
<td>3,892</td>
<td>245</td>
<td>6.3</td>
</tr>
<tr>
<td>September</td>
<td>467</td>
<td>2,987*</td>
<td>640</td>
<td>903</td>
<td>1,023*</td>
<td>113.3</td>
<td>1,522</td>
<td>268*</td>
<td>17.6</td>
</tr>
<tr>
<td>October</td>
<td>792</td>
<td>-87</td>
<td>-11.0</td>
<td>1,966</td>
<td>81</td>
<td>4.1</td>
<td>3,939</td>
<td>891*</td>
<td>22.6</td>
</tr>
<tr>
<td>November</td>
<td>873</td>
<td>-203*</td>
<td>-23.3</td>
<td>5,335</td>
<td>-136</td>
<td>-2.5</td>
<td>6,485</td>
<td>99</td>
<td>1.5</td>
</tr>
<tr>
<td>December</td>
<td>791</td>
<td>-136*</td>
<td>-17.2</td>
<td>4,868</td>
<td>-135</td>
<td>-2.8</td>
<td>5,682</td>
<td>-135</td>
<td>-2.4</td>
</tr>
<tr>
<td>Annual</td>
<td>28,561</td>
<td>-628</td>
<td>-2.2</td>
<td>298,433</td>
<td>-7,730</td>
<td>-2.6</td>
<td>335,465</td>
<td>-10,836</td>
<td>-3.2</td>
</tr>
</tbody>
</table>

1. Positive values represent an increase in discharge, negative numbers represent a decrease in discharge. The analysis shown is for the without minimum pool configuration and assumed that the dead pool was already filled. Results for the with minimum pool configuration were essentially the same because the amounts of water released would be the same.

2. Location of discharge estimates is at the proposed dam site.

*The difference is a significant impact.

One mile below the High Savery dam, annual median discharge, flow, and maximum stream depth would be reduced 19; 11; and 45 percent, respectively (Table 4-8, Figure 4-5). During the growing season, however, median discharge, velocity, and maximum stream depth would be increased by 340; 124; and 55 percent, respectively. Farther downstream at the former USGS stream gage number 09255500 (“Upper Station”, see Figure 3-10), annual median discharge and maximum stream depth would increase by 14 and 4 percent, respectively (Table 4-8). Median discharge and water depth during the growing season increased 283 and 25 percent, respectively (Table 4-8). Flow velocity could not be estimated at the Upper Station because stream cross-section data were not available.
Annual Growing Season

Notes:
1. Flow depths estimated at Wyoming Game and Fish Department (WGF) cross section "Below HI-at fence." Stage-discharge relationship estimated from WGF data.
2. Flow depths derived from pre- and post-construction discharge estimates for this location for water years 1941-1971.
3. Growing season assumed to be months of May through September.
Table 4-8

MEDIAN\(^1\) DISCHARGE AND FLOW IN SAVERY CREEK WITH THE HIGH SAVERY ALTERNATIVE

<table>
<thead>
<tr>
<th>Location</th>
<th>Median Discharge (cfs)</th>
<th>Median Velocity (fps)(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Construction</td>
<td>Post-Construction</td>
</tr>
<tr>
<td>Below High Savery</td>
<td>Annual</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>Growing season</td>
<td>14.9</td>
</tr>
<tr>
<td>Upper Station</td>
<td>Annual</td>
<td>19.7</td>
</tr>
<tr>
<td></td>
<td>Growing season</td>
<td>19.0</td>
</tr>
</tbody>
</table>

1 The median is the value in a distribution where half of the observations are greater and half of the observation are less.
2 fps = feet per second.
3 For 1941 -1971, 11,322 total days.
4 Flow velocity for this site could not be calculated because cross-section data were not available.

The High Savery alternative would affect annual peak-day flows in Savery Creek. Below the dam and at the Upper Station (Table 4-2), modeling indicated the average annual peak-day flows would be reduced from 332 to 206 cfs and from 401 to 240 cfs, respectively (Table 4-9). The date of occurrence of peak-day flows would be delayed an average of 66 days. The maximum delay was 141 days (Table 4-9). Only one year in the 19-year period of record had no delay in the date of occurrence of annual peak flow. Flushing flows would still occur immediately below High Savery dam and reservoir during the spring peak flow period in some years. The confluence of several major tributaries, Little Savery, Big Sandstone, Little Sandstone, and Big Gulch creeks, temper the impact of the High Savery dam and reservoir on peak-day flows in lower Savery Creek. At Wren Bridge and the mouth of Savery Creek, the average annual peak-day flows would be reduced from 924 to 763 cfs and from 967 to 802 cfs, respectively. The date of occurrence of peak-day flows would be delayed an average of 3 days. The maximum delay was estimated to be 25 days (Table 4-9). Seventy-four percent of the years in the period of record had no change in the date of occurrence of annual peak flow.

The occurrence of out-of-bank flows in Savery Creek would be reduced with the High Savery dam. At the dam site and the Upper Station, the recurrence interval for years with out-of-bank flow events would increase from once every 10.3 years to once every 31.0 years; however, the average duration of each event would increase from 3.8 to 7.0 days (Table 4-10). The earliest occurrence of out-of-bank flows would also be pushed back from mid-April to early May. The latest occurrence of out-of-bank flows would still be in early May (Table 4-10). Late season
### Table 4-9

**ANNUAL PEAK-DAY FLOWS IN SAVERY CREEK WITH THE HIGH SAVERY ALTERNATIVE**

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre-Construction</th>
<th>Post-Construction</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Savery Dam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earliest date</td>
<td>April 1</td>
<td>April 27</td>
<td>delayed 26 days</td>
</tr>
<tr>
<td>Latest date</td>
<td>June 1</td>
<td>August 30</td>
<td>delayed 90 days</td>
</tr>
<tr>
<td>Delay in annual peak flow occurrence (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>--</td>
<td>--</td>
<td>-66</td>
</tr>
<tr>
<td>Maximum</td>
<td>--</td>
<td>--</td>
<td>-141</td>
</tr>
<tr>
<td>Minimum</td>
<td>--</td>
<td>--</td>
<td>0^1</td>
</tr>
<tr>
<td>Peak flows (cfs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>332</td>
<td>206</td>
<td>-126</td>
</tr>
<tr>
<td>Maximum^2</td>
<td>860</td>
<td>451</td>
<td>-621</td>
</tr>
<tr>
<td>Minimum^2</td>
<td>99</td>
<td>67</td>
<td>+10</td>
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<tr>
<td>Upper Station^3</td>
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<td></td>
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</tr>
<tr>
<td>Peak flows (cfs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>401</td>
<td>240</td>
<td>-161</td>
</tr>
<tr>
<td>Maximum^2</td>
<td>1,040</td>
<td>546</td>
<td>-740</td>
</tr>
<tr>
<td>Minimum^2</td>
<td>119</td>
<td>71</td>
<td>+10</td>
</tr>
<tr>
<td>Wren Bridge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earliest date</td>
<td>April 4</td>
<td>April 4</td>
<td>none</td>
</tr>
<tr>
<td>Latest date</td>
<td>June 1</td>
<td>June 11</td>
<td>delayed 10 days</td>
</tr>
<tr>
<td>Delay in annual peak flow occurrence (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>--</td>
<td>--</td>
<td>3</td>
</tr>
<tr>
<td>Maximum</td>
<td>--</td>
<td>--</td>
<td>25</td>
</tr>
<tr>
<td>Minimum</td>
<td>--</td>
<td>--</td>
<td>-16^1</td>
</tr>
<tr>
<td>Peak flows (cfs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>924</td>
<td>763</td>
<td>-160</td>
</tr>
<tr>
<td>Maximum^2</td>
<td>1,640</td>
<td>1,280</td>
<td>-682</td>
</tr>
<tr>
<td>Minimum^2</td>
<td>223</td>
<td>163</td>
<td>+10</td>
</tr>
<tr>
<td>Mouth of Savery Creek^4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak flows (cfs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>967</td>
<td>802</td>
<td>-165</td>
</tr>
<tr>
<td>Maximum^2</td>
<td>1,713</td>
<td>1,337</td>
<td>-713</td>
</tr>
<tr>
<td>Minimum^2</td>
<td>233</td>
<td>relative</td>
<td>+10</td>
</tr>
</tbody>
</table>

^1A “-” represents a decline and a “+” represents an increase relative to without-project conditions.

^2Maximum and minimum without and with project peak-day flows do not necessarily occur in the same year.

^3The dates of peak flows at the Upper Station are the same as at the High Savery Dam.

^4The dates of peak flows at the mouth of Savery Creek are the same as at Wren Bridge.

irrigation flows would not result in out-of-bank flows immediately below High Savery dam and reservoir. Farther downstream, at the Upper Station, the High Savery dam and reservoir would increase the average interval between years with out-of-banks flows from 2.8 to 3.9 years (Table 4-10). The duration of each event would remain approximately the same. The occurrence of the earliest event would be delayed from early April to early May; however, the latest event would still occur in the later half of June. The impacts on out-of-bank flows on lower Savery Creek

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre- Construction</th>
<th>Post- Construction</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Savery Dam</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of days</td>
<td>19</td>
<td>7</td>
<td>-12</td>
</tr>
<tr>
<td>Number of events</td>
<td>5</td>
<td>1</td>
<td>-4</td>
</tr>
<tr>
<td>Number of years</td>
<td>3</td>
<td>1</td>
<td>-2</td>
</tr>
<tr>
<td>Reoccurrence interval for years with events (years)</td>
<td>10.3</td>
<td>31.0</td>
<td>+20.7</td>
</tr>
<tr>
<td>Average number of events per year</td>
<td>0.16</td>
<td>0.03</td>
<td>-0.13</td>
</tr>
<tr>
<td>Earliest event</td>
<td>April 14</td>
<td>May 2</td>
<td>delayed 18 days</td>
</tr>
<tr>
<td>Latest event</td>
<td>May 8</td>
<td>May 8</td>
<td>none</td>
</tr>
<tr>
<td>Longest event (days)</td>
<td>8</td>
<td>7</td>
<td>-1</td>
</tr>
<tr>
<td>Average event length (days)</td>
<td>3.8</td>
<td>7.0</td>
<td>+3.2</td>
</tr>
<tr>
<td><strong>Upper Station</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of days</td>
<td>27</td>
<td>19</td>
<td>-8</td>
</tr>
<tr>
<td>Number of events</td>
<td>22</td>
<td>15</td>
<td>-7</td>
</tr>
<tr>
<td>Number of years with events</td>
<td>11</td>
<td>8</td>
<td>-3</td>
</tr>
<tr>
<td>Reoccurrence interval for years with events (years)</td>
<td>2.8</td>
<td>3.9</td>
<td>+1.1</td>
</tr>
<tr>
<td>Average number of events per year</td>
<td>0.71</td>
<td>0.48</td>
<td>-0.23</td>
</tr>
<tr>
<td>Earliest event</td>
<td>April 7</td>
<td>May 7</td>
<td>delayed 30 days</td>
</tr>
<tr>
<td>Latest event</td>
<td>June 18</td>
<td>June 23</td>
<td>delayed 5 days</td>
</tr>
<tr>
<td>Longest event (days)</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Average event length (days)</td>
<td>1.2</td>
<td>1.3</td>
<td>+0.1</td>
</tr>
</tbody>
</table>

(Wren Bridge, Page Ranch, Thomas Ranch) would be similar to those caused by the Sandstone alternative (see Table 4-6). Flows released for late season irrigation would remain within the natural channel of Savery Creek. Model results show that the quantity of flow in the 10, 25, 50 and 100 year floods at Dixon, Wyoming and Lily, Colorado with High Savery dam and reservoir in place are estimated to be changed an average of less than one percent.
4.3.1.2.3 Dutch Joe Dam and Reservoir. The Dutch Joe dam and reservoir would inundate a portion of Dutch Joe Creek, an intermittent tributary of the Little Snake River. The water supply for Dutch Joe reservoir would be diverted from Savery Creek and transported to the reservoir via a water delivery pipeline and canal facility.

Significant decreases in streamflow of 40 and 17 percent are predicted to occur during the months of March and April, respectively, as water is diverted from Savery Creek into the pipeline and canal. Like the other alternatives, stored water would be released in July, August, and September. Unlike the other alternatives, most of the water would not be returned to Savery Creek. Instead, the late-season supplemental irrigation water would be released into Dutch Joe Creek. As a result, average annual streamflow just below the diversion point on Savery Creek would be significantly reduced by 11,365 AF, or 16 percent (Table 4-11). Flow reductions farther downstream in Savery Creek would be somewhat less because approximately 1,000 AF of water would be delivered back to Savery Creek by pipeline. The flow regimen of Dutch Joe Creek would also be significantly changed because the intermittent flows that normally occur from mid-July through mid-September would be replaced by more constant flows. Water gained from

![Table 4-11](image)

AVERAGE CHANGES IN MONTHLY STREAM DISCHARGE CAUSED BY THE DUTCH JOE ALTERNATIVE

<table>
<thead>
<tr>
<th>Month</th>
<th>Savery Creek 2</th>
<th>Little Snake R. @ Dixon, WY</th>
<th>Little Snake R. @ Lily, CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline discharge (AF)</td>
<td>Change (AF)</td>
<td>Percent change</td>
</tr>
<tr>
<td>January</td>
<td>1,367</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>February</td>
<td>1,523</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>March</td>
<td>3,118</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>April</td>
<td>14,394</td>
<td>-5,680*</td>
<td>-39.5%</td>
</tr>
<tr>
<td>May</td>
<td>30,076</td>
<td>-5,088</td>
<td>-16.9%</td>
</tr>
<tr>
<td>June</td>
<td>14,553</td>
<td>-510</td>
<td>-3.5%</td>
</tr>
<tr>
<td>July</td>
<td>2,275</td>
<td>-63</td>
<td>-2.8%</td>
</tr>
<tr>
<td>August</td>
<td>659</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>September</td>
<td>610</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>October</td>
<td>1,133</td>
<td>-23</td>
<td>-2.0%</td>
</tr>
<tr>
<td>November</td>
<td>1,421</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>December</td>
<td>1,379</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Annual</td>
<td>72,508</td>
<td>-15.9</td>
<td>11,365*</td>
</tr>
</tbody>
</table>

1 Positive values represent an increase in discharge, negative numbers represent a decrease in discharge. The analysis assumed that the dead pool was already filled.
2 Location of discharge estimates is just below the diversion point on Savery Creek.
* The difference is a significant impact.

11,365*
tributaries below the diversion point on Savery Creek would reduce the relative loss caused by reservoir storage, and irrigation withdrawals would ultimately remove the extra flow caused by water releases from the reservoir. Therefore, in the Little Snake River at Dixon, operation of the Dutch Joe reservoir and diversion of water from Savery Creek would not significantly reduce monthly stream flows. Significant increases in streamflow would occur in July (19 percent) and August (280 percent). The average annual net loss in discharge at Dixon would be an insignificant 1.7 percent. Farther downstream on the Little Snake River at Lily, no significant reductions in monthly discharge are predicted. Significant increases in streamflow would occur in August (6 percent) and September (18 percent, Table 4-11). The average annual net loss at Lily, 2.7 percent, is not significant.

Compared to the Sandstone and High Savery alternatives, the Dutch Joe alternative would cause relatively minor impacts on peak-day flows. The earliest annual occurrence of peak flows would not be affected and the latest occurrence would be delayed by 3 days (Table 4-12). In most years, the date of peak flow would be the same with or without the project. The average and maximum delays would be 2 and 37 days, respectively. In Savery Creek, at the headgates of the Dolan Ditch and at its mouth, the Dutch Joe alternative would reduce average annual peak-day flows from 866 to 779 cfs and from 945 to 826 cfs, respectively (Table 4-12).

4.3.1.2.4 Water Conservation. Implementation of the water conservation alternative would involve changes in agricultural practices within the basin, improvements to irrigated lands, and rehabilitation of existing water delivery structures. These efforts would result in more efficient use of irrigation water. If irrigation demands were reduced, streamflow within Savery Creek and the Little Snake River would increase slightly in the spring and early summer. However, the water conservation alternative would not provide additional late-season supplemental irrigation water and, therefore, would not affect stream flow in summer or fall.

4.3.1.2.5 No-Action. The no-action alternative does not include development of structural water storage or delivery facilities, and would not alter the existing water resources. No changes would occur in the existing surface water resources or hydrology within the Savery Creek or Little Snake River basin.

4.3.1.3 Mitigation
Each of the water supply alternatives would decrease downstream flow primarily at a time when flow is most abundant (i.e., in spring). When flows are typically low (i.e., in summer), downstream flows would be increased (Sandstone and High Savery alternatives) or unaffected (Dutch Joe alternative). For most locations on Savery Creek, important qualitative features of stream hydrology necessary for the maintenance of stream and riparian habitats, such as peak stream flow in the spring and out-of-bank flow events, would remain. However, the High Savery alternative would delay most annual peak flows at the dam site and Upper Station until summer and out-of-bank flows just below the High Savery dam would become substantially more
Table 4-12

ANNUAL PEAK-DAY FLOWS IN SAVERY CREEK WITH THE DUTCH JOE ALTERNATIVE

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre-Construction</th>
<th>Post-Construction</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headgates of Dolan Ditch</td>
<td>Headgates of Dolan Ditch</td>
<td>Headgates of Dolan Ditch</td>
<td>Change</td>
</tr>
<tr>
<td>Date (April 4, April 4)</td>
<td>Headgates of Dolan Ditch</td>
<td>Headgates of Dolan Ditch</td>
<td>Change</td>
</tr>
<tr>
<td>Headgates of Dolan Ditch</td>
<td>Headgates of Dolan Ditch</td>
<td>Headgates of Dolan Ditch</td>
<td>Change</td>
</tr>
<tr>
<td>Date (April 4, April 4)</td>
<td>Headgates of Dolan Ditch</td>
<td>Headgates of Dolan Ditch</td>
<td>Change</td>
</tr>
<tr>
<td>Earliest date</td>
<td>April 4</td>
<td>April 4</td>
<td>none</td>
</tr>
<tr>
<td>Latest date</td>
<td>June 5</td>
<td>June 8</td>
<td>delayed 3 days</td>
</tr>
<tr>
<td>Delay in annual peak flow</td>
<td>--</td>
<td>--</td>
<td>2</td>
</tr>
<tr>
<td>occurrence (days)</td>
<td>--</td>
<td>--</td>
<td>37</td>
</tr>
<tr>
<td>Average</td>
<td>--</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>--</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Maximum</td>
<td>1,225</td>
<td>1,472</td>
<td>-100</td>
</tr>
<tr>
<td>Minimum</td>
<td>214</td>
<td>136</td>
<td>0</td>
</tr>
<tr>
<td>Peak flows (cfs)</td>
<td>866</td>
<td>779</td>
<td>-88</td>
</tr>
<tr>
<td>Maximum</td>
<td>1,225</td>
<td>1,472</td>
<td>-100</td>
</tr>
<tr>
<td>Minimum</td>
<td>214</td>
<td>136</td>
<td>0</td>
</tr>
<tr>
<td>Mouth of Savery Creek(^1)</td>
<td>Mouth of Savery Creek</td>
<td>Mouth of Savery Creek</td>
<td>Change</td>
</tr>
<tr>
<td>Average</td>
<td>945</td>
<td>826</td>
<td>-89</td>
</tr>
<tr>
<td>Maximum</td>
<td>1,713</td>
<td>1,613</td>
<td>-100</td>
</tr>
<tr>
<td>Minimum</td>
<td>233</td>
<td>148</td>
<td>0</td>
</tr>
<tr>
<td>Minimum (^2)</td>
<td>233</td>
<td>148</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^1\) A "-" represents a decline and a "+" represents an increase relative to without-project conditions.
\(^2\) Maximum and minimum without and with project peak-day flows do not necessarily occur in the same year.
\(^3\) The dates of peak flows at the mouth of Savery Creek are the same as at Dolan Ditch headgates.


Water conservation and the no-action alternatives would not result in significant changes in surface hydrology; therefore, no mitigation is proposed for these alternatives.

4.3.2 WATER QUALITY

According to Wyoming water quality regulations, Savery Creek and the Little Snake River are designated as Class II, coldwater game fisheries streams. Dutch Joe Creek is listed as a Class III stream (Wyoming Water Quality Standards, Chapter I, Appendix A). As such, these streams must meet water quality standards designed to allow for the following beneficial uses: protection of aquatic life, agricultural water supply, and industrial water supply. Class II waters must also meet the more stringent requirements for the protection of human health. Parameters of particular relevance to the release of water from reservoirs are temperature and dissolved oxygen (DO).
Discharges into Savery Creek or the Little Snake River should not change existing stream temperature more than 2 °F. For Dutch Joe Creek, the maximum temperature change allowable would be 4 °F (Wyoming Water Quality Standards, Chapter I, Section 25). For Savery Creek and the Little Snake River, the 7-day mean DO must be above 9.5 milligrams per liter (mg/l) with a 1-day minimum no less than 8.0 mg/l when the early life stages of salmonid fish are present. At other times, the 30-day average DO must be above 6.5 mg/l with a 7-day mean minimum of no less than 5.0 mg/l and a 1-day minimum of no less than 4.0 mg/l. For Dutch Joe Creek, the 7-day mean DO must be greater than 6.0 mg/l and the 1-day minimum must be greater than 5.0 mg/l when early life stages of fish are present. At other times, the 30-day mean DO must exceed 5.5 mg/l, the 7-day mean must exceed 4.0 mg/l, and the 1-day minimum must exceed 3.0 mg/l.

The State of Wyoming does not have specific numerical water quality standards for total dissolved solids (TDS, i.e., salinity). The State, however, is a member of the Colorado River Basin Salinity Control Forum and is a cooperator with other states in the Forum to maintain TDS levels in the Colorado River at or below 723 mg/l below Hoover Dam, 747 mg/l below Parker Dam, and 879 mg/l below Imperial Dam (Wyoming Water Quality Standards, Chapter VI, Section 3).

4.3.2.1 Methodologies and Significance Criteria
Existing water quality within the potential water supply streams was determined using data collected from Savery Creek near Savery, Wyoming, and the Little Snake River near Dixon, Wyoming, by USGS. Impacts to water quality were assessed based on the anticipated changes to water chemistry caused by reservoir storage and modeling results. Dissolved oxygen, pH, turbidity, temperature, plant nutrients (phosphorous and nitrogen) and selenium were evaluated. A reservoir model developed by the Corps was used to estimate water temperatures in and released from the Sandstone and High Savery reservoirs (WWCI 1996, 1997). Potential water quality problems from selenium or other trace elements were evaluated by reviewing existing literature (USGS 1991).

Impacts on TDS concentrations in the Little Snake River at Lily, Colorado, were estimated by calculating the mass of TDS in the various components of the hydraulic budget for the Little Snake River from Slater, Colorado, to Lily using methodology developed by SWEC (1987) for a prior version of the Sandstone dam and reservoir. The components of the hydraulic budget were inflows at Slater and from tributaries, diversions from the river, and irrigation return flows. The mass of TDS for each component was calculated as the TDS concentration times the flow rate of water. Flow rates were determined by the WIROS model. The TDS concentrations were based on monthly averages of USGS data collected from the Little Snake River at Slater and Lily in 1978 through 1984 and 1970 through 1982, respectively.

Waters within Savery Creek and the Little Snake River currently meet all Wyoming water quality standards (Section 3.3.3). Water quality impacts would be significant if a water supply alternative would cause State water quality standards to be exceeded. Although these standards are not
statutorily applicable to releases from reservoirs, by definition, exceedences could represent a threat to the health of humans, livestock, wildlife, or aquatic life (WDEQ 1990). Because efforts are currently underway to reduce salinity in the waters of the Colorado River basin, any increases in TDS would be counter to the goals of the Salinity Control Forum.

4.3.2.2 Impacts

Water quality differences within each reservoir and downstream of the dam may occur as a result of different reservoir configurations and operations (Table 4-13).

### Table 4-13

<table>
<thead>
<tr>
<th>RESERVOIR FEATURES RELATED TO WATER QUALITY</th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Pool</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimum Release to Impounded Stream</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi-level Outlet</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cold/Warm Water Mixed Release</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Release of Water with Low Dissolved Oxygen</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Spring Turnover</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Fall Turnover</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

4.3.2.2.1 Sandstone Dam and Reservoir. Construction of the Sandstone alternative could result in short-term adverse impacts on downstream water quality. During construction, earth moving activities would expose soils and increase the potential for soil erosion which could increase turbidity levels and suspended sediment concentrations in Savery Creek and the Little Snake River. Operation of the reservoir could result in some changes in downstream water turbidity and productivity. Some of the incoming nutrients and sediment would be trapped in the reservoir, resulting in decreased stream nutrient levels and sediment loads in water immediately below the reservoir. Because the water released from the reservoir would have a reduced sediment load, it would pick up sediment as it flows down Savery Creek and could change the downstream silt and sand substrates into a highly embedded, gravel and cobble substrate.

Water releases for supplemental irrigation would produce higher than normal flows in Savery Creek during mid-July through mid-September. These flows could contribute to bank erosion.
below the Sandstone dam and higher turbidity levels in lower Savery Creek and the Little Snake River. However, as water is diverted for irrigation and water velocity slows, the potential for bank erosion and increased turbidity levels would decrease. While increases in turbidity are expected to periodically occur, these increases would not differ from those that occur naturally as a result of spring run-off or summer storm events.

The 15,800-AF Sandstone dam and reservoir alternative would have a minimum pool with a surface area of approximately 160 acres. Dissolved oxygen concentrations within the reservoir are expected to be suitable for aquatic life during most of the year. The size of the reservoir is large enough that some water mixing would occur each spring during reservoir filling, delaying the onset of thermal stratification. Thermal modeling predicted the upper water levels of the reservoir would be between 60 and 65 °F and the lower water levels would be between 45 and 50 °F (WWCI 1996b).

Oxygen depletions from the deep water layer of the reservoir would depend on the rate of biological oxygen demand, the volume of the deep water layer, and the amount of time the reservoir is stratified. Biological oxygen demand is a function of water temperature and the amount of decomposable organic material on the bottom and in the deep water layer of the reservoir. The amount of organic material in the reservoir is a function of the amount of nutrients entering the reservoir from Savery Creek. Nutrient concentrations in Savery Creek water (Figure 3-6) are high enough to produce a moderate amount of biological material in the Sandstone reservoir, primarily in the form of algae. Under constant water level conditions, these nutrient concentrations could result in a depletion of DO in the deep water layer. Filling of the reservoir would likely delay the onset of thermal stratification. Irrigation releases, which would include deep water withdrawal, would likely eliminate the deep water layer before DO was depleted to levels below that needed to support aquatic life.

The 12,600-AF Sandstone dam and reservoir alternative would not have a minimum pool. During the fall and winter, the reservoir would be empty (except for a 100 AF dead pool). The reservoir would fill in the spring and early summer. Thermal stratification would occur during July and August. The lower layer of water would tend to be lower in DO content than the upper layer of the reservoir and Savery Creek. However, because thermal stratification would be of short duration, DO depletion and impacts on aquatic life would not be significant.

Thermal modeling (WWCI 1996b) indicated that the multi-level outlet structure proposed for both configurations of the Sandstone reservoir would be effective in releasing late-season supplemental irrigation water with a temperature between 55 and 65 °F as desired by WGFD. These temperatures would be below the historic average stream temperature for summer of 72 °F; however, abrupt changes in downstream water temperature in Savery Creek would not occur because most of the downstream flows would originate from the reservoir. Large temperature differences could occur where waters from two downstream tributaries, Loco Creek and Big...
Gulch Creek, enter Savery Creek. If this temperature difference is sufficiently large, fish could be discouraged from moving into or out of these tributaries.

The water released from the reservoir in summer would warm as it flows downstream. Assuming a release temperature of 65 °F, the water temperature in Savery Creek at its confluence with the Little Snake River would be approximately 71 °F (WGFD 1998a, included in Appendix C). This slight reduction in summer water temperature at the mouth of Savery Creek, from 72 to 71 °F would make the temperature in Savery Creek and the Little Snake River closer (Figure 3-6). If water was released at 55 °F, flow from the reservoir would reach the Little Snake River with a temperature of approximately 65 °F. In August, the discharge from Savery Creek would be approximately 115 cfs and flow in the Little Snake River would be approximately 35 cfs at 68 °F. Assuming rapid and complete mixing, the temperature in the Little Snake River would be lowered by about 2 °F, which is equal to the maximum temperature change allowable under Wyoming water quality regulations (Wyoming Water Quality Standards, Section 25).

The growth of algae (phytoplankton) in the reservoir would reduce nutrient concentrations in the water. The amount of algae produced would also tend to raise the pH and reduce calcium and carbonate concentrations in the water. This reduction in nutrient concentrations could reduce the growth of algae in Savery Creek below the reservoir. It is doubtful, however, that the reduction would be noticeable. In general, water quality changes would not impact aquatic life in Savery Creek.

Investigations by USGS (1991) described the selenium concentrations within the Savery Creek drainage basin. One area in the Little Savery Creek watershed near the Ketchum Buttes uranium deposits was identified as containing rocks with selenium concentrations ranging between 3.7 to 150 milligrams per kilogram (parts per million). This area is approximately 5.5 miles upstream of the proposed reservoir. Water samples collected from Savery Creek and its tributaries contained selenium concentrations near or below the detection limits. The highest recorded selenium concentration, 3 parts per billion (ppb), was in a sample taken immediately downstream of the Ketchum Buttes area and was below the water quality standard of 5 ppb for the protection of aquatic life (Wyoming Water Quality Standards, Appendix B).

All water samples within the Sandstone reservoir inundation area contained selenium levels at or below 1 ppb. Thus, selenium concentrations within the reservoir are not expected to be a issue because:

- The selenium in soils inundated by the reservoir is not readily soluble, therefore, substantial leaching of selenium into the reservoir is not expected
- Substantial sources of selenium concentrations in bedrock do not appear to occur in the area
Baseline concentrations of selenium in Savery Creek do not exceed EPA maximum contamination levels established for public drinking water.

The concentration of selenium in streamed samples in Savery Creek generally was less than in areas of Wyoming with potential selenium toxicity.

Water would have a relatively short residence time in the reservoir preventing selenium concentration by evaporation (USGS 1991).

No other trace elements are expected to exceed water quality standards within the reservoir. Sandstone reservoir is not expected to impact the presence or concentration of selenium and other trace elements in waters within Savery Creek or the Little Snake River.

The Little Snake River contributes approximately 77 percent of the sediment load to the Yampa River at Deerlodge Park, approximately 4.5 miles below their confluence (O’Brien 1987 in Hawkins and O’Brien 1997). Approximately 60 percent of the sediment load in the Yampa River at Deerlodge Park originates from tributaries between the Dixon and Lily gaging stations (Andrews 1978 in Hawkins and O’Brien 1997) which account for 66.4 percent of the Little Snake River watershed. Therefore, 17 percent of the sediment in the Yampa River comes from the remaining 33.6 percent of the Little Snake River basin (Table 4-14). The Sandstone dam would block the transport of sediment from 8.0 percent of the Little Snake River watershed. The Sandstone watershed is in the portion of the Little Snake watershed which contributes relatively little sediment to the Yampa River. Assuming the sediment contribution from this portion of the Little Snake River watershed is evenly distributed, the Sandstone dam would trap 4.0 percent of the sediment load currently in the lower Yampa River (Table 4-14).

<table>
<thead>
<tr>
<th>Portion of Little Snake River</th>
<th>Watershed Area mi²</th>
<th>Sediment Contribution (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole</td>
<td>4130</td>
<td>77</td>
</tr>
<tr>
<td>Dixon to Lily</td>
<td>2742</td>
<td>60</td>
</tr>
<tr>
<td>Remaining watershed</td>
<td>1388</td>
<td>17</td>
</tr>
<tr>
<td>Sandstone dam</td>
<td>330</td>
<td>4.0</td>
</tr>
<tr>
<td>High Savery dam</td>
<td>124</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The water collected in the Sandstone reservoir in spring would have a lower TDS than water in the Little Snake River in summer. The water released from the reservoir would initially lower the TDS in the Little Snake River just downstream of Savery Creek. As the released water flowed down the Little Snake River, it would be incrementally diverted and return flows from irrigation with higher concentration of TDS would enter the river. As a result, TDS concentrations in the Little Snake River would increase as the distance downstream from Savery Creek increased. Under average flow conditions, 9,932 AF of the 12,000 AF of water released in one year are estimated to be consumed by irrigation. Under average flow conditions, the average monthly
TDS concentration in the Little Snake River at Lily, Colorado would peak at 568 mg/l in September (Table 4-15). Total salt delivery to the Colorado River as a result of project operation is not anticipated to increase as a result of operation of this alternative; however, because the flow would be less, the average concentration of TDS would tend to be increased. Overall, changes in TDS concentration are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat.

<table>
<thead>
<tr>
<th>Condition</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average TDS in the Little Snake River (mg/l)</td>
<td>239</td>
<td>244</td>
<td>578</td>
<td>592</td>
<td>700</td>
<td>748</td>
<td>449</td>
<td>510</td>
</tr>
<tr>
<td>Average flow year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in TDS (mg/l)</td>
<td>6</td>
<td>-1</td>
<td>-22</td>
<td>-84</td>
<td>-148</td>
<td>219</td>
<td>116</td>
<td>-70</td>
</tr>
<tr>
<td>Total TDS (mg/l)</td>
<td>245</td>
<td>243</td>
<td>555</td>
<td>508</td>
<td>552</td>
<td>966</td>
<td>564</td>
<td>440</td>
</tr>
</tbody>
</table>

4.3.2.2 High Savery Dam and Reservoir. The High Savery water supply could have short-term impacts on downstream water quality similar to those described for the Sandstone alternative. Increases in turbidity caused by construction could occur. Scouring of stream sediments would occur as a result of water being released from the reservoir with reduced sediment loads. Periodic increases in erosion and turbidity associated with irrigation releases could also occur; however, this impact would not be noticeably different from naturally occurring flood events.

The High Savery reservoir would thermally stratify in the summer and the deep-water layer would have a lower temperature and could have decreased DO concentrations. To reduce the potential downstream impacts of this reservoir, the High Savery dam would have a multi-level outlet structure. Water releases would be made from multiple depths simultaneously so that poorly oxygenated or low temperature water could be mixed with oxygenated, warmer water. Thus, no reductions in DO concentration are expected within Savery Creek downstream of the High Savery dam.

The temperature of water released from the reservoir in summer would be 7 to 17 °F less than the historic average summer water temperature in Savery Creek. Abrupt changes in downstream water temperature in Savery Creek, however, would not occur because most of the downstream flows in summer would originate from the reservoir. Large temperature differences could occur where water from Little Savery Creek enters Savery Creek and could discourage fish from moving into or out of these tributaries. Farther downstream, where Bird Gulch, Coal Gulch,
Little Snake Supplemental Irrigation Water Supply Project

Haystack Draw, Hell Canyon, Big Sandstone, Little Sandstone, Loco, and Big Gulch creeks enter Savery Creek, the temperature in Savery Creek would have warmed to within 1 to 2 °F of the historic condition (WGFD 1998b, included in Appendix C).

Assuming the late-season supplemental irrigation water is released at a temperature of 55 °F, the water temperature in Savery Creek at its confluence with the Little Snake River would be approximately 71 °F (WGFD 1998b). This slight reduction in summer water temperature at the mouth of Savery Creek would bring the temperature of Savery Creek closer to the temperature of the Little Snake River (Figure 3-6). Therefore, water temperature in the Little Snake River would not be impacted by the High Savery water supply.

No potential sources of selenium or other trace elements occur within the drainage basins for the High Savery dam and reservoir. The Ketchum Buttes area discussed above for the Sandstone alternative is drained by a tributary which enters Savery Creek downstream of the High Savery site. No impacts to the water levels of selenium or other trace elements would result from this alternative. Other changes in downstream water quality caused by impoundment of the water would be similar in magnitude and impact to those caused by the Sandstone alternative.

The High Savery dam and reservoir would trap approximately 1.5 percent of the sediment load currently in the lower Yampa River (Table 4-14).

Like the Sandstone alternative, the increased use of water from the High Savery reservoir for irrigation would increase TDS concentrations in the lower Little Snake River. Under average flow conditions, the maximum TDS concentration at Lily, Colorado, would average 936 mg/l in October, an increase of 25 percent (Table 4-16). The maximum relative increase in TDS would be 27 percent in November. Total salt delivery to the Colorado River as a result of project operation is not anticipated to increase as a result of operation of this alternative; however, because the flow would be less, the average concentration of TDS would tend to be increased. Overall, changes in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat.

4.3.2.2.3 Dutch Joe Dam and Reservoir. Development of the Dutch Joe dam and reservoir would have short-term construction impacts similar to those previously described for the Sandstone and High Savery water supply alternatives.

Water to fill the Dutch Joe reservoir would be diverted from Savery Creek and conveyed to the reservoir via a new pipeline and canal facility. Because the diversion point is downstream of the Sandstone dam site, the water quality in Dutch Joe reservoir is expected to be similar to that of the Sandstone reservoir.
Table 4-16

<table>
<thead>
<tr>
<th>Condition</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average TDS in the Little Snake River (mg/l)</td>
<td>239</td>
<td>244</td>
<td>578</td>
<td>592</td>
<td>700</td>
<td>748</td>
<td>449</td>
<td>510</td>
</tr>
<tr>
<td>Average flow year Increase in TDS (mg/l)</td>
<td>6</td>
<td>-1</td>
<td>-21</td>
<td>-84</td>
<td>-148</td>
<td>188</td>
<td>122</td>
<td>-67</td>
</tr>
<tr>
<td>Total TDS (mg/l)</td>
<td>245</td>
<td>243</td>
<td>557</td>
<td>509</td>
<td>552</td>
<td>936</td>
<td>571</td>
<td>443</td>
</tr>
</tbody>
</table>

The Dutch Joe reservoir would be filled during the spring and become thermally stratified in the summer. Water would be released for late-season supplemental irrigation from the Dutch Joe reservoir through a multi-level outlet. Based on the thermal structure of the Sandstone and High Savery reservoirs (WGFD 1998a, b), Dutch Joe reservoir would release late-season supplemental irrigation water with a temperature between 45 and 65 °F depending on which ports in the outlet were opened. Opening the upper ports would release the warmest water and opening the lowest ports would release the coldest water. The released water would flow downstream 2 miles and would be oxygenated by turbulence and warmed 1 to 2 °F before entering the Little Snake River. Approximately 50 cfs would enter the Little Snake River at temperatures potentially ranging from approximately 47 to 67 °F. The water from the Dutch Joe reservoir would mix with approximately 200 cfs of 72 °F water in the Little Snake River. Assuming rapid and complete mixing, the temperature in the Little Snake River would be reduced by at most 5 °F. Under these conditions, the water released from the Dutch Joe reservoir would have to be greater than 62 °F to comply with the Wyoming Water Quality Standard for temperature change in a Class II coldwater stream (a maximum change in temperature of less than 2 °F). Thermal modeling indicated the multi-level outlet structure could release water between 55 and 65 °F (WWCI 1996b), which suggests an average release temperature of 60 °F. Because the average temperature of the lake would be less than 62 °F, it may not be possible to release all of the 12,000 acre-feet of water for late-season irrigation without exceeding the 2°F maximum temperature change standard in the Little Snake River during some portion of the release.

Because Dutch Joe Creek is an intermittent stream, no minimum releases would be made from the reservoir. Water would only be released downstream for late-season supplemental irrigation. Released water would likely have a minimal sediment load, resulting in erosional impacts to Dutch Joe Creek below the dam similar to those discussed for Savery Creek under the Sandstone and High Savery alternatives. No significant changes in turbidity are expected.

As discussed for the High Savery alternative, no changes in levels of selenium or other trace elements would occur because of the Dutch Joe alternative.
The Dutch Joe reservoir would trap sediment originating from the Dutch Joe Creek watershed above the dam and in the water diverted from Savery Creek. The Dutch Joe Creek watershed above the Dutch Joe dam is approximately 1 percent of the Little Snake River drainage basin. The water diverted from Savery Creek is approximately 15.9 percent of the flow in Savery Creek at the diversion point. The watershed above the diversion point comprises 8.0 percent of the Little Snake River watershed. Assuming the amount of sediment diverted from Savery Creek is proportional to the amount of water diverted, then the amount of sediment diverted from Savery Creek and trapped in the Dutch Joe reservoir would be the equivalent of 1.3 percent of the Little Snake River watershed. Combined with the sediment originating from the upper Dutch Joe Creek watershed, the Dutch Joe reservoir would trap the equivalent amount of sediment from 2.3 percent of the Little Snake River watershed. This portion of the Little Snake River watershed contributes 17 percent of the sediment in the lower Yampa River. Therefore, the Dutch Joe reservoir would trap 0.4 percent of the sediment which is currently in the lower Yampa River.

Like the previous alternatives, the increased use of water from the Dutch Joe reservoir for irrigation would increase TDS concentrations in the lower Little Snake River. Under average flow conditions, TDS at Lily, Colorado, would peak at an average 943 mg/l in October, an increase of 26 percent (Table 4-17). Total salt delivery to the Colorado River as a result of project operation is not anticipated to increase as a result of operation of this alternative; however, because the flow would be less, the average concentration of TDS would tend to be increased. As with the Sandstone and High Savery alternatives, the overall change in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat.

<table>
<thead>
<tr>
<th>Condition</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average TDS in the Little Snake River (mg/l)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>239</td>
<td>244</td>
<td>578</td>
<td>592</td>
<td>700</td>
<td>748</td>
<td>449</td>
<td>510</td>
</tr>
<tr>
<td>Average flow year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in TDS (mg/l)</td>
<td>6</td>
<td>-2</td>
<td>-21</td>
<td>-83</td>
<td>-148</td>
<td>195</td>
<td>117</td>
<td>-71</td>
</tr>
<tr>
<td>Total TDS (mg/l)</td>
<td>245</td>
<td>242</td>
<td>557</td>
<td>509</td>
<td>552</td>
<td>943</td>
<td>565</td>
<td>438</td>
</tr>
</tbody>
</table>

4.3.2.2.4 Water Conservation. The water conservation alternative could increase the effectiveness of water distribution and reduce the quantity of water diverted from streams for early- and mid-season irrigation. Less irrigation would mean less return flow of water with
Little Snake Supplemental Irrigation Water Supply Project  
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elevated TDS (i.e., salinity) to the Little Snake River. Thus, TDS concentrations in the Little Snake River could decrease. This impact would not be adverse.

4.3.2.2.5 No-Action. The no-action alternative would not change the existing water resources, therefore, no impacts on water quality would occur within the Little Snake River Basin.

4.3.2.3 Mitigation
For any of the dam and reservoir alternatives, an ES plan would be developed and implemented to minimize erosion, sedimentation, and increases in turbidity. The ES plan would include provisions for securing the site during the non-construction season and for preventing sedimentation and erosion of the stream banks and channel. Energy dissipating structures would be employed below the dam to reduce sediment scouring, stream bank erosion, and assure adequate DO concentrations through reaeration. The design and placement of these structures are not finalized. Preliminary plans, however, suggest about 10 low-water grade control structures would be placed in Savery Creek between the High Savery dam and Little Savery Creek.

As previously described, the release of water with low DO concentrations or unseasonable temperatures would be avoided by the Sandstone and High Savery dam and reservoir alternatives by the use of a multi-level outlet structure. Thus, no harmful downstream reductions in DO or temperature are expected in Savery Creek. The release temperature of late-season supplemental irrigation water from the Sandstone dam and reservoir would need to be above 55 °F to prevent significant temperature changes in the Little Snake River. A similar requirement is not necessary for the High Savery dam and reservoir because more than 30 miles of Savery Creek would enable water temperatures to warm so that changes in the Little Snake River would be less than 2 °F.

Energy dissipation structures in the tail race of the Dutch Joe dam outlet would protect Dutch Joe Creek from releases of water with low DO concentrations. A multi-level outlet would be necessary to prevent the Dutch Joe alternative from exceeding the allowable temperature change of 4 °F in the Little Snake River. Even with a multi-level outlet, water released from Dutch Joe reservoir in late July and August may still be cold enough to exceed the 2 °F temperature requirement at the confluence with the Little Snake River.

If there is a significant increase in the Colorado River system because of increased TDS from the project, a plan would be developed for water conservation to mitigate the salinity. The plan would likely be based on conserving irrigation water using methods such as replacing flood irrigation with sprinklers and planting alternative, low-water use crops. The specifics of this project would be given in the WWDC's application to the WDEQ for a Section 401 Water Quality Certification of the project. This certification is a necessary part of obtaining a Section 404 permit.

No mitigation is proposed for the water conservation or the no-action alternatives.
4.3.3 WATER USE
Water in the Little Snake River Basin is diverted for agricultural, municipal, and limited industrial purposes, and is primarily obtained from the Little Snake River. Irrigation is the primary water use within the basin. The proposed water supply alternatives would each provide approximately 12,000 AF of late-season supplemental irrigation water and would help reduce the late summer water shortages currently experienced by irrigators. The 12,000 AF of supplemental irrigation water supplied by the project would be available 8 out of 10 years, based on historical precipitation and runoff patterns.

Initial filling of any of the proposed reservoirs would be accomplished in one year, assuming average or above average spring runoff. In the event of a dry first year, existing water users with water rights senior to those of the proposed project would receive their allocations before a reservoir is filled. During subsequent times of limited stream flow, releases at least equal to inflow would be made for senior water rights holders. Once the project is fully operational, the Wyoming Water Development Commission (WWDC) would authorize the Savery-Little Snake Water Conservancy District (SLSWCD) to allocate the 12,000 AF of water provided by the project. Allocation would be to existing irrigators on a first-come-first-serve basis.

4.3.3.1 Methodologies and Significance Criteria
Any project impacts that would reduce the amount of water available for agricultural, municipal, or industrial uses to the point where reduced productivity, restricted use, or rationing occurred would be significant.

4.3.3.2 Impacts
4.3.3.2.1 Water Supply Alternatives. Development of the LSSIWSP would not impact existing diversions for municipal use. The City of Cheyenne, Wyoming, is the largest municipal user of water from the Little Snake River Basin. The City of Cheyenne diverts water from the Little Snake River basin via the Cheyenne Stage I and Stage II projects. Both projects divert water from the Little Snake River basin upstream of the confluence with Savery Creek. The towns of Baggs and Dixon, Wyoming, also obtain municipal water from the Little Snake River. Both towns hold valid water rights senior to those of any of the LSSIWSP alternatives. Thus, operation of the project would not impact municipal water use.

Currently, only a few industrial water users exist within the Little Snake River Basin. Development of any of the dam and reservoir alternatives would not diminish the supply available to users holding valid senior water rights.

The proposed project is designed to store snowmelt runoff water during the spring for release during the late summer. The project would result in more water being used for irrigation. However, municipal and industrial use would not be impacted. In fact, additional water in Savery Creek and the Little Snake River in the late summer would provide a more dependable water
supply for these uses. Because no reductions in water use would occur, no significant negative impact to water use would result from this project.

4.3.3.2.2 Water Conservation and No-Action. Implementation of the water conservation or no-action alternative would not alter the existing water uses. Thus, no impacts to existing water use within the Little Snake River basin would occur.

4.3.3.3 Mitigation
No mitigation is proposed for water use under any of the alternatives.

4.4 AIR QUALITY

The project area is currently “in attainment” for all criteria pollutants. Criteria pollutants include lead (Pb), particulate materials of 10 microns diameter or smaller (PM\textsubscript{10}), ozone (O\textsubscript{3}), sulfur dioxide (SO\textsubscript{2}), nitrogen oxides (NO\textsubscript{x}), and carbon monoxide (CO). Levels for these pollutants have been established to protect human health. No data have been recorded for these pollutants in the project area. However, because of the rural nature of the area and lack of industrial or commercial facilities, air quality in the project area is assumed to be good.

4.4.1 METHODOLOGIES AND SIGNIFICANCE CRITERIA
In evaluating the significance of project impacts to air quality, Prevention of Significant Deterioration (PSD) increments and significant impact levels were reviewed. Levels have been established for significant increases in criteria pollutants over ambient air (Table 4-18). Under these PSD levels, significant impacts to air quality would occur if these criteria are exceeded because of the project.

4.4.2 IMPACTS

4.4.2.1 Water Supply Alternatives
The water supply alternatives are not expected to have any long-term impacts on local or regional ambient air quality. Any long-term increases in fugitive dust or engine emissions from operation and maintenance personnel, recreation users, or local residents would be minimal.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging period</th>
<th>Significance criteria ((\mu\text{g/m}^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO\textsubscript{2}</td>
<td>Annual</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>24-hour</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3-hour</td>
<td>25</td>
</tr>
<tr>
<td>PM\textsubscript{10}</td>
<td>Annual</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>24-hour</td>
<td>5</td>
</tr>
<tr>
<td>NO\textsubscript{x}</td>
<td>Annual</td>
<td>1</td>
</tr>
<tr>
<td>CO</td>
<td>8-hour</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>1-hour</td>
<td>2000</td>
</tr>
</tbody>
</table>
Construction activities in the immediate vicinity of each water supply alternative would have a temporary effect on local ambient air quality. Increases in dust levels from excavation and vehicle traffic would temporarily increase PM$_{10}$ levels.

Diesel engine exhaust from construction equipment would temporarily increase NO$_x$, CO, and SO$_2$ concentrations. The actual decrease in ambient air quality and increase in PM$_{10}$, NO$_x$, CO, and SO$_2$ levels would depend on the particular construction activity being performed, the type and amount of construction equipment being used, the prevailing wind direction and speed, and the soil moisture conditions existing at the time. These pollutants could temporarily exceed PSD levels, thereby resulting in a significant impact to local ambient air quality.

**4.4.2.2 Water Conservation**

Construction activities for the water conservation alternative would be temporary and would have minimal impact on ambient air quality in the study area. These impacts would result from the use of on-farm equipment related to land leveling, planting of crops, fertilizing, and other normal agricultural activities. Minor, localized increases in dust and vehicle emissions would occur. However, no long-term, significant impacts would result.

**4.4.2.3 No-Action**

No construction or operational activities would be associated with this alternative. Therefore, the no-action alternative would not have any impact on ambient air quality in the project area.

**4.4.3 Mitigation**

Several measures would be implemented to reduce or prevent significant impacts to air quality. Dust levels generated during construction would be minimized by spraying water or other approved dust control chemicals on haul roads. Disturbed areas outside of the inundation zone would be revegetated. To minimize emissions, all construction vehicles would be maintained in good working conditions. Construction contractors would be required to comply with all local, state, and federal air pollution rules.

No mitigation is proposed with the water conservation or no-action alternatives for the protection of ambient air quality.

**4.5 Noise Quality**

Construction and operation activities associated with LSSIWSP could raise noise levels in the surrounding area. Noise sources during construction would include heavy construction equipment, blasting, and increased vehicular traffic to and from the construction site. Following project construction, most noise would come from operation and maintenance and recreation activities. Sensitive noise receptors could include residences, businesses, recreationists, livestock, and wildlife.
4.5.1 METHODOLOGIES AND SIGNIFICANCE CRITERIA
Increases in noise levels by an increment of 10 dBA would be noticed by most individuals. For the purposes of this analysis, the impact would be considered significant if permanent area residences were to experience an increase of 10 dBA or more above ambient noise levels.

Human activity and the noise associated with construction and operation and maintenance of the dam and reservoir and recreational activities have the potential to adversely impact area wildlife. Should increases in ambient noise result in significant redistribution or disturbance to wildlife, noise impacts would be considered significant.

4.5.2 IMPACTS

4.5.2.1 Water Supply Alternatives
No permanent residences occur within 2,000 feet of any of the proposed dam sites (Table 4-19), therefore, no residences would be impacted by changes in ambient noise levels.

Disruption of feeding, daily movement and territorial patterns, seasonal migration, and use of specific habitats by wildlife in or near the construction zone could occur as a result of construction noise. Active construction zones would be abandoned by most species, and overpopulation of some nearby habitats could occur. However, construction zones would be primarily restricted to the area of the dam, spillway, and nearby borrow areas. Most of the area within and around the reservoir would be relatively undisturbed by construction. Following completion of construction, some wildlife would return to use the habitat around the dam and spillway area.

After construction, increased noise levels in the vicinity of the dam would be caused by increased traffic attributable to periodic dam and reservoir operation and maintenance and possible recreational use. These increased noise levels would be intermittent and would occur mostly during the summer and fall months, outside the birthing, nesting, and wintering periods for most local wildlife. Wildlife species sensitive to mechanical and human noise sources, such as bobcat, mountain lion, black bear, pronghorn antelope, and elk, would likely avoid the reservoir area during the summer when human activity associated with the dam and reservoir would be greatest. Noise from reservoir operation and maintenance would be low level, localized, and primarily restricted to the summer months. Use of the project areas by noise sensitive species at this time would be limited. Impacts on wildlife for noise are not expected to be significant.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Residences</th>
<th>Other Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>High Savery</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Dutch Joe</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4-19
STRUCTURES AFFECTED BY TEMPORARY INCREASES IN NOISE LEVELS

4-43
Recreational activities would be primarily restricted to the reservoir and adjacent lands. These activities would include fishing, boating, hiking, and primitive camping. With the possible exception of the use of gasoline powered watercraft, these recreational activities generate only minimal noise and would not have significant impacts on local wildlife.

4.5.2.2 Water Conservation
Noise generated by on-farm water conservation activities such as land leveling, sprinkler installation, and reseeding would be the essentially the same as current-day agricultural activities. Some additional noise could temporarily be generated in construction zones along canal systems and at river diversion points. At a given time, noise from implementing the water conservation alternative would occur in only small scattered areas. No significant changes in ambient noise levels would result from this alternative.

4.5.2.3 No-Action
No construction or operational activities would be associated with the no-action alternative. No noise impacts to either human or wildlife populations in the project area would occur.

4.5.3 MITIGATION
Construction work periods near residences would be restricted to daytime hours. To prevent or reduce noise impacts to wintering wildlife, construction activities would not occur between November and May.

No mitigation is proposed for the water conservation or no-action alternatives.

4.6 BIOLOGICAL RESOURCES
A variety of biological resources in the Savery Creek and Little Snake River basins could be affected by the LSSIWSP. The assessment of impacts on these resources was supplemented by the FWS Biological Opinion (Appendix D) and by Fish and Wildlife Impacts Analysis and Proposed Mitigation reports prepared by WGFD (Appendix C).

4.6.1 VEGETATION
Permanent and temporary impacts to vegetation would result from the water supply alternatives or water conservation structures and systems. A dam and reservoir water supply would permanently eliminate some vegetation. Construction would temporarily disturb additional areas which be would revegetated.

4.6.1.1 Methodologies and Significance Criteria
Vegetation communities at each water supply location were assessed and mapped in August 1994 using topographic maps, false-color infrared aerial photography, and field surveys. The significance or insignificance of the impacts of the proposed water supply alternatives on vegetation communities was determined by evaluating the overall quality of the habitat, regional
abundance, acreage affected, and importance to wildlife. Significant impacts would occur if the vegetation lost was of high value to wildlife and relatively more abundant in the inundation zone than in the surrounding project area.

4.6.1.2 Impacts

The construction of any of the dam and reservoir alternatives would affect vegetation communities. The amount of each type of community lost (Table 4-20) varies with the size and location of the dam and reservoir. In general, the closer the water supply facility is to the headwater of the stream it impounds, the fewer types of vegetation communities would be affected (Table 4-20).

<table>
<thead>
<tr>
<th>Table 4-20</th>
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</thead>
<tbody>
<tr>
<td><strong>VEGETATION AND LAND COVER IN THE INUNDATION ZONES</strong>*&lt;br&gt;<em>(acres)</em></td>
</tr>
<tr>
<td><strong>Sandstone</strong>&lt;br&gt;w/min pool</td>
</tr>
<tr>
<td>Sagebrush Steppe</td>
</tr>
<tr>
<td>Grassland Meadow</td>
</tr>
<tr>
<td>Riparian Cottonwood</td>
</tr>
<tr>
<td>Riparian Willow/Alder</td>
</tr>
<tr>
<td>Aspen Forest</td>
</tr>
<tr>
<td>Fir/Aspen Forest</td>
</tr>
<tr>
<td>Wetlands</td>
</tr>
<tr>
<td>Creeks and Ponds</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

* Includes canal and pipeline to Dutch Joe Dam and Reservoir and back to Savery Creek

4.6.1.2.1 Sandstone Dam and Reservoir. Vegetation would be lost in the area covered by the dam and spillway and inundated by the reservoir (Figure 4-6). Approximately 126/117 (with/without minimum pool) acres of riparian cottonwood vegetation would be permanently inundated (Table 4-20). More acres of riparian cottonwood would be lost at the Sandstone site than at any of the other water supply alternatives. This community is of particular concern because cottonwoods are relatively uncommon in the project area and are considered valuable for wildlife in the region. Riparian cottonwood vegetation covers approximately 30 percent of the inundation zone but only about one percent of the Little Snake River drainage basin. The cottonwood population located within the Sandstone reservoir inundation zone consists almost entirely of large, mature individuals. This condition indicates the population is not effectively
reproducing. Under current land use and management, these trees would eventually die out and would not regenerate. Because of the scarcity of cottonwoods in the region, any premature loss of this community would be considered significant.

The Sandstone dam and reservoir would also impact more acres of aspen and fir/aspen community types than any of the other water supply alternatives. About 13/10 acres of aspen and 29/23 acres of fir/aspen forest would be inundated (Table 4-20). These vegetation communities occur in small tracts, scattered throughout the project area, specifically on higher elevations or on north-facing slopes. These communities are more common at higher elevations outside of the project area where they occur in large tracts. Aspen and fir communities are slightly less common in the Sandstone reservoir inundation zone than in the area surrounding the site where they provide 11 and 15 percent of the land cover, respectively (Table 3-2). Their loss would not be significant.

Thirty-six/thirty-three acres of grassland meadow and 8 acres of riparian willow/alder shrub lands would be inundated by the Sandstone dam and reservoir. Meadows cover large portions of the area around the Sandstone dam and reservoir, as well as upstream and downstream of the project area. The amount of grassland lost to the Sandstone water supply would not be significant. Small clumps of riparian willow/alder are scattered throughout the Savery Creek and Little Snake River valleys and are considered important to wildlife (WGFD 1998a). The loss of this riparian community, therefore, would be significant.

Additional impacts to vegetation would occur with the operation of the reservoir. The release of supplemental irrigation water from the reservoir would lower the water level in the reservoir 47/75 feet and expose 211/313 acres of mostly unvegetated land. The remaining growing season after the reservoir is drawn down would not be long enough to allow the re-establishment of vegetation. The fluctuating water level would also hinder the establishment of riparian vegetation around the reservoir shoreline.

In spring when the reservoir is filling, the magnitude and timing of peak downstream flow, stream depth, and level of the stream bank water table would be decreased or delayed. However, higher late-season flows would increase the average elevation of the stream bank water table. The year-long water supply for downstream, riparian vegetation would be more stable because the difference between spring and summer hydrologic conditions would be reduced. Plants which depend on a high water table in the spring could be reduced in number while species requiring a higher water table throughout the growing season could increase.

The release of water from the Sandstone reservoir, which is essentially free of sediment, could effect riparian vegetation immediately downstream of the dam. The sediment-free water would begin to reacquire sediments upon being released. The result could be increased bank erosion and channel down-cutting in Savery Creek below the dam. The length of Savery Creek below the Sandstone dam that could be affected by erosion and down-cutting has not been precisely...
determined; but, would probably not extend past the next major sediment contributing tributary, which is Big Gulch Creek, 2.8 miles downstream.

4.6.1.2.2 High Savery Dam and Reservoir. The High Savery dam and reservoir would eliminate some sagebrush steppe, grassland meadow, riparian willow/alder shrub land, and riparian cottonwood communities (Table 4-20 and Figure 4-7). Of these communities, less than 1 acre of riparian cottonwoods would be affected. However, as mentioned for the Sandstone alternative (Section 4.6.1.2.1), cottonwood vegetation is important because it is uncommon in the High Savery area and the region.

The High Savery dam and reservoir would impact about 147/126 acres of meadow. Meadow vegetation, however, is abundant and the loss of this community to the High Savery dam and reservoir would not be significant.

Current estimates indicate that about 52/45 acres of willow/alder riparian shrublands would be lost to the High Savery alternative. These riparian shrublands occur in scattered clumps throughout the High Savery area. Given the relatively high value of this community to wildlife (WGFD 1998a), the loss of these shrublands would be significant.

Because streamflow into the reservoir would not be affected, riparian plant communities upstream of the inundation zone would not be impacted. However, downstream riparian communities would experience lower streamflows than normal during reservoir filling in April and May. From mid-July through mid-September, downstream riparian plant communities would benefit from higher than normal streamflows and water table levels.

The release of water from the High Savery reservoir, which is essentially free of sediment, could increase bank erosion and channel down-cutting in Savery Creek below the dam. The length of Savery Creek below the Sandstone dam that could be affected by erosion and down-cutting has not been precisely determined, but would probably not extend past the next major sediment contributing tributary, which is Little Savery Creek, 4.7 miles downstream.

Water levels would vary widely in the High Savery reservoir. A 51/105-foot drop in water level would occur between mid-July and mid-September. This fluctuation would leave a 292/407-acre band of unvegetated land exposed at the end of the supplemental irrigation season. As discussed for the Sandstone dam and reservoir, plants would not have time to become established on the exposed land. The fluctuating water level would also hinder the establishment of riparian vegetation around the reservoir shoreline.

4.6.1.2.3 Dutch Joe Dam and Reservoir. Approximately 450 acres of land would be disturbed or inundated by the Dutch Joe water supply. Of this land, about 331 acres (Figure 4-8 and Table 4-20) is covered by sagebrush steppe. This community type is common in the region. The Dutch Joe site contains more sagebrush steppe than any of the other potential reservoir sites.
Scale 1" = 2000'

LEGEND

- Sagebrush Steppe
- Meadow
- Willow/Alder Shrubland
- Aspen/Antelope Bitterbrush

Figure 4-7
HIGH SAVERY IMPACTED VEGETATION
No riparian cottonwood community would be inundated by this alternative but 5.5 acres of riparian vegetation would be destroyed by the water delivery pipeline and canal. About 2.5 acres of the total riparian area contain cottonwoods. These cottonwoods occur in small clumps scattered along the canal, which reduces their value to wildlife. Mitigation for these riparian cottonwoods would occur; however, their loss would not represent a significant impact to the overall abundance or quality of the cottonwood communities in the Little Snake River region.

Thirty-four acres of meadow would be inundated by the Dutch Joe reservoir. As with the Sandstone and High Savery dams and reservoirs, loss of these communities would not impact their regional abundance.

Dutch Joe Creek is intermittent. Vegetation within the stream channel is supported by spring snowmelt flows and by intermittent summer rains. Water from these sources would still be available in the stream channel upstream and downstream of the dam to support the existing vegetation. Irrigation releases from Dutch Joe would provide water over a 60-day period when natural stream flows are at or near zero. The release of this nearly sediment-free water could cause bank erosion and channel down-cutting. Riparian vegetation along Dutch Joe Creek below the dam could be eroded away or deprived of water as the water table is lowered. Because Dutch Joe Creek has no tributaries, these effects could extent down to the Little Snake River.

The water level in the Dutch Joe reservoir would decline about 114 feet during the release of late-season supplemental irrigation water and expose 291 acres of unvegetated land. This area would not experience widespread revegetation because of the shortness of the remaining growing season after drawdown. This wide water level fluctuation would also prevent the establishment of riparian vegetation around the shoreline.

4.6.1.2.4 Water Conservation. Implementation of the water conservation alternative would result in temporary impacts to pastures and hay meadows. Land disturbance at these sites would result from the creation of terraces, land leveling, and the construction of improved water delivery and on-farm distribution systems. Yield improvements, however, would be limited to the gains that could be achieved through improved machinery efficiency and routing of water to desired pasture and hayfield locations. Because no valuable wildlife habitat would be lost, the impacts from water conservation on vegetation would not be significant.

4.6.1.2.5 No-Action. No impacts on vegetation would occur with the no-action alternative.

4.6.1.3 Mitigation
Mitigation would be necessary for riparian cottonwoods and willow/alder shrub lands lost to construction and inundation. Riparian cottonwoods would be mitigated by the protection and/or enhancement of lower quality cottonwood areas and/or creation of new cottonwood areas in the vicinity of the dam and reservoir. Protection would include diverting water to riparian zones, and removal of livestock grazing (by fencing) in areas where lower quality cottonwoods currently
exist. Enhancement would be similar to protection with the planting of additional seedlings. Creation would include planting seedlings, diverting water to riparian zones, and managing grazing to allow permanent establishment of cottonwood trees in areas where they do not currently occur. Mitigation for riparian cottonwoods would take place as close as possible to the dam site and on as few separate locations as possible. Replacement ratios of 2:1 for creation and 3:1 for enhancement have been proposed by WGFD (1998a,b). Mitigation ratios could also be adjusted based on the quality of the communities affected and on the existing conditions of the mitigation sites selected. The exact acreage of cottonwood and riparian shrub land communities to be created or enhanced would be developed in cooperation with WGFD and FWS.

lnundated riparian willow/alder shrub lands would be mitigated by the enhancement of existing willow/alder shrub lands in the Savery Creek basin at a 3:1 ratio (WGFD 1998b). Existing, low quality willow/alder shrub lands in the vicinity of the dam and reservoir would be enhanced by fencing to regulate cattle grazing. The Sandstone, High Savery, and Dutch Joe dams and reservoirs would require the enhancement of 24 and 156/135 and 16.5 acres of existing willow/alder community, respectively.

Impacts to downstream vegetation from bank erosion and channel down-cutting caused by the release of sediment-free water would be minimized by the installation of grade control structures in the stream below the dam for any of these alternatives. The purpose of the structures would be to reduce the velocity of the water and minimize its erosive force and subsequent impacts.

No mitigation for vegetation is proposed for the conservation and no-action alternatives.

4.6.2 WETLANDS
Wetlands are transitional communities between aquatic and terrestrial systems. They are found in small, scattered locations in close association with drainage ways throughout the project area.

4.6.2.1 Methodologies and Significance Criteria
To assess the potential impact of the proposed project, those wetlands that would be impacted by each water supply alternative were identified. Field surveys were conducted in July and September 1996 and July 1997 to determine the extent and type of wetlands located within and around the proposed inundation zone of each potential water supply alternative. Wetland determinations were conducted in accordance with the Corps’ Wetlands Delineation Manual (Environmental Laboratory 1987). For field investigation and mapping purposes, FWS National Wetland Inventory maps were consulted and color-infrared photography provided broad data. Potential wetland areas were evaluated using the three mandatory technical criteria: hydric soils, hydrophytic vegetation, and wetland hydrology. Only areas that met all three criteria were determined to be wetlands.

Any loss of wetlands would be a significant impact.
4.6.2.2 Impacts
Wetlands are determined by the presence of appropriate soils, plants, and hydrology. Changes to one or more of these criteria has the potential to impact the character of a wetland. The impoundment of natural drainage ways would alter the hydrology of the area below and immediately adjacent to the high water mark of the reservoir, and the area downstream of the dam.

4.6.2.2.1 Sandstone Dam and Reservoir. The Sandstone alternative would inundate approximately 24.8/24.3 acres of wetlands (Table 4-21). This amount represents approximately 6.7/7.4 percent of the total land area covered by this alternative. Just over half of wetlands impacted would be scrub/shrub wetlands dominated by alder and willow shrubs. Emergent wetlands are dominated by sedges, rushes, and bentgrass and would account for 10.4/10.2 acres of the wetland inundated. Less than one acre of forested wetlands would be lost (Figure 4-9).

<table>
<thead>
<tr>
<th>Wetland Type</th>
<th>Sandstone w/min pool</th>
<th>Sandstone w/o min pool</th>
<th>High Savery w/min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergent</td>
<td>10.4</td>
<td>10.2</td>
<td>9.5</td>
<td>7.5</td>
<td>3.2</td>
</tr>
<tr>
<td>Scrub/Shrub</td>
<td>13.5</td>
<td>13.3</td>
<td>6.5</td>
<td>5.8</td>
<td>0</td>
</tr>
<tr>
<td>Forested</td>
<td>0.9</td>
<td>0.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td><strong>24.8</strong></td>
<td><strong>24.3</strong></td>
<td><strong>16.0</strong></td>
<td><strong>13.3</strong></td>
<td><strong>3.2</strong></td>
</tr>
</tbody>
</table>

Wetlands along Savery Creek downstream of the Sandstone dam could be impacted by changes in stream flow regimen. Wetlands occur when soils are saturated for an extended period of time. The distribution of riparian wetlands along Savery Creek is likely limited by the magnitude of the summer low flows because only areas near the creek at this time experience saturated soil conditions for the duration necessary to form wetlands. The Sandstone water supply alternative would raise median water levels during the growing season 0.4 to 0.9 feet above existing levels (Figures 4-2 and 4-3). This increase would likely expand the area and duration of saturated soils along the 10-mile downstream reach of Savery Creek thereby increasing the area available for wetland development. The relative abundance of obligate hydrophytes (plants which require saturated soils) could increase in existing downstream wetlands along Savery Creek. Reduced or delayed high flows in February through May caused by the project would have little impact on existing wetlands because overbank flooding would still occur and the high flows at this time do not create the saturated soil conditions which make possible the existence of wetlands.
Note: Inundation zone is for the with-minimum-pool alternative
Wetlands located upstream of the reservoirs normal pool are not expected to be significantly impacted by backwater flooding. Water level fluctuations in this reservoir would be too rapid to change the character or functional value of existing upstream wetlands. This rapid water level fluctuation in spring and late summer would also prevent the formation of fringe wetlands around the shoreline.

New wetlands immediately downstream of the Sandstone dam and reservoir could develop from seepage from the dam. The reservoir would also increase hydraulic pressure in the underlying alluvial aquifer resulting in increased flow in downstream springs or new springs around which wetlands could form or expand.

Some existing riparian wetlands immediately downstream from the Sandstone dam and reservoir could be adversely impacted. Water released from the reservoir would be essentially free of bedload sediments and could down-cut the stream channel and erode the banks as sediments are reacquired. Some fringe wetlands could be eroded away and down-cutting could lower the elevation of the channel bottom thereby reducing the elevation of the local water table and the supply of water to riparian wetlands.

The loss of approximately 24/25 acres of wetlands through construction and operation of the Sandstone dam and reservoir would be significant. New wetlands created downstream of the Sandstone dam and reservoir can not be reliably predicted and would not be replacements for the wetlands lost to construction and inundation. The length of Savery Creek below the Sandstone dam that could be affected by erosion and down-cutting has not been precisely determined; but, would probably not extend past the next major sediment contributing tributary, which is Big Gulch Creek, 2.8 miles downstream.

4.6.2.2.2 High Savery Dam and Reservoir. The development of the High Savery dam and reservoir would result in the loss of 16.0/13.3 acres of jurisdictional wetlands (Table 4-21). Wetlands comprise approximately 3.3/3.2 percent of the area covered by the dam and reservoir. All of the wetlands are within the flood plain of High Savery Creek and its tributaries (Figure 4-10). The loss of these wetlands would be a significant impact.

The majority of the wetlands impacted by the High Savery alternative are emergent wetlands. This wetland type usually occurs as a fringe along Savery Creek and on terraces, point bars, and sandbars. These wetlands are dominated by sedges, rushes, and wetland grasses. Creek overflow and groundwater provide the necessary hydrology for the maintenance of these wetlands. Other emergent wetlands occur at small seeps where water filtering down from upslope areas provides the necessary hydrology. The remaining wetlands lost would be scrub/shrub wetlands dominated by willow and alder. These seasonally inundated wetlands are usually associated with stream oxbows formed when meander bends in Savery Creek are cutoff.
WETLANDS GREATER THAN 0.1 ACRE WITHIN THE HIGH SAVERY INUNDATION ZONE

Note: Inundation zone is for the with-minimum-pool alternative
The natural depressions created partially fill with sediments and existing topography prolongs water ponding to create the necessary wetland hydrology.

Operation of the High Savery dam and reservoir would increase downstream median stream depths in Savery Creek by 0.4 to 0.9 feet during the growing season (Figures 4-2, 4-3, and 4-4). New wetlands could develop downstream of the dam as a result of increased water availability, dam seepage, and increased artesian or spring flows. The relative abundance of obligate hydrophytes (plants which require saturated soils) could increase in existing downstream wetlands along Savery Creek. The potential for the High Savery water supply to develop suitable habitat for new downstream wetlands is greater than the Sandstone alternative because wetlands could develop along 41.5 miles of Savery Creek below the High Savery dam and reservoir. Reduced flows in Savery Creek during February through May would have little opportunity to impact wetlands because overbank floods would not be eliminated and high flows at this time do not create the saturated soil conditions which make possible the existence of wetlands. As with the Sandstone alternative, wetlands immediately downstream of the High Savery dam, possibly up to 4.7 miles downstream to the confluence of Savery Creek and Little Savery Creek, could be adversely impacted by erosion and down-cutting caused by the discharge of sediment-free water from the reservoir.

4.6.2.2.3 Dutch Joe Dam and Reservoir. A total of 3.2 acres of wetlands would be lost to the construction and operation of a reservoir on Dutch Joe Creek (Table 4-21 and Figure 4-11). These wetlands are classified as emergent and consist of narrow bands along Dutch Joe Creek. Although these wetlands account for only one percent of the land inundated, their loss is still a significant impact. No wetlands would be impacted by the construction of the water supply pipeline and canal facility.

The flow pattern in Dutch Joe Creek is intermittent. Periods of steady flow are currently limited to spring when the snow pack is melting. Releases for late-season supplemental irrigation from the Dutch Joe reservoir would add another period of steady flow to Dutch Joe Creek. These two periods would be separated by intermittent or no-flow conditions. It is unlikely that the increased flow would produce conditions favorable to the expansion of wetlands along Dutch Joe Creek. Water diverted from Savery Creek to fill the Dutch Joe Reservoir would decrease spring peak flows in Savery Creek below the diversion point. No impacts on summer low flows would occur (Table 4-11). It is unlikely, therefore, that the Dutch Joe dam and reservoir would have any impacts on wetlands along Savery Creek. Because releases from the Dutch Joe reservoir would be much larger than current summer flows and the water would be essentially free of sediments, considerable potential exists for channel down-cutting and bank erosion in Dutch Joe Creek from immediately below the dam to the Little Snake River.

4.6.2.2.4 Summary of Dam and Reservoir Alternatives. The Dutch Joe alternative would have the least impact on wetlands because only 3.2 acres of wetland would be lost to construction and inundation. The Sandstone water supply would have the greatest loss of wetlands, 24.8/24.3
acres, compared to 16.0/13.3 acres for the High Savery dam and reservoir. Reservoir releases would make above normal amounts of water available within the basin from mid-July through mid-September. This availability could increase wetland area along Savery Creek below the Sandstone and High Savery reservoirs. For each of the reservoir alternatives, erosion and channel down-cutting from the release of nearly sediment-free water could adversely impact downstream riparian wetlands in Savery Creek or Dutch Joe Creek. These impacts could extend downstream as far as the next significant source of streambed sediments. For any of the water supply alternatives, changes in the flow in the Little Snake River would probably be too small to affect wetlands along its banks.

4.6.2.2.5 Water Conservation. The impacts on wetlands by the water conservation alternative could be adverse and beneficial. Land leveling activities could incidentally fill some wetlands. Large-scale conversion of grassland to alfalfa pasture to conserve water could cause an initial increase in soil erosion and siltation of downstream wetlands. Reduced irrigation could de-water some wetlands currently incidentally maintained by current irrigation practices. Converting grassland to alfalfa pasture could reduce the amount of chemical runoff reaching wetlands because less fertilizer would be applied.

4.6.2.2.6 No-Action. The no-action alternative would not have any impact on wetlands.

4.6.2.3 Mitigation
For any dam and reservoir alternative selected, unavoidable, significant wetland losses would occur for which mitigation would be required. Impacts would be mitigated by the conversion of riparian or floodplain communities into wetlands, the enhancement of existing lower-quality wetlands, or both methods. Wetlands developed or enhanced would be the functional equivalents of those lost. The amount of wetlands created or enhanced would be based on the mitigation implemented and the overall net gain to the resource. Final wetland mitigation ratios would be negotiated between WWDC, the Corps, WGFD, and FWS and would depend on the quality of the proposed mitigation sites and probability of success.

To compensate for wetland losses caused by the Sandstone or High Savery water supply, a combination of wetland creation and enhancement would be implemented. Non-wetland areas within the floodplain of Savery Creek could be excavated to intercept the seasonally high water table or collect surface water runoff during snowmelt. These actions would provide the appropriate hydrology to create wetlands. Wetlands dominated by hydrophytes such as alder, willow, sedge, and rush could be created in this manner. Oxbows dominated by willow and alder which do not have appropriate soils or hydrology for classification as wetland could be converted to wetlands if sufficient water were diverted to these areas. Such diversion would be most practical downstream of the proposed Sandstone dam and reservoir where the floodplain is wider and water could be more easily manipulated. Existing emergent and scrub/shrub wetlands could be enhanced by the removal of grazing, irrigation, supplemental plantings, reestablishing flows to
oxbows, and manipulating water levels by managing beaver activity. To the maximum extent feasible, wetlands would be created or enhanced in the areas immediately downstream of the dam.

Diversion of sufficient water to sustain long-term wetland development would be difficult and expensive at the Dutch Joe site. Emergent wetlands would be developed or enhanced along Savery Creek as discussed above.

For all of the new reservoir alternatives, potential impacts to downstream wetlands caused by erosion and channel down-cutting would be avoided by the installation of grade control structures below the dam. These structures would reduce the velocity and the erosive force of the water released for supplemental late-season irrigation. These structures would also serve to divert water into areas where new wetlands would be created and where other riparian vegetation would be protected or enhanced.

The amount, if any, of wetlands impacted by water conservation activities cannot be determined at this point; however, it is anticipated to be small. No mitigative measures for wetlands are proposed for this alternative.

No mitigation is proposed for the no-action alternative.

4.6.3 WILDLIFE
Construction of any of the water supply alternatives would impact wildlife directly through mortality of individuals during reservoir filling and indirectly through habitat inundation or creation.

4.6.3.1 Methodology and Significance Criteria
The significance of habitat loss upon local wildlife species and populations is determined by the ability of each species to adjust to reservoir construction and operation. Species would adjust to reservoir construction and operation by moving into other areas of similar habitat, utilizing other habitats, or adapting to new conditions or habitats. If these changes are accomplished without substantial long-term reductions in population size or health, the impacts of the new dam and reservoir would not be significant. However, if reservoir construction and operation would result in a reduction in available habitat such that a species would experience noticeable long-term adverse effects to population or health, impacts to wildlife would be significant.

4.6.3.2 Impacts
In the reservoir inundation zone, many animal species use burrows for protection from the cold, heat, and predators. As the reservoir fills, these burrows would be flooded. Most individuals would escape to higher ground above the inundation zone. Individuals able to reach new habitat would initially be more vulnerable to predators or could suffer from exposure. The greatest losses would occur to species unable to avoid the rising water and to individuals using habitat types which would be locally eliminated by the reservoir.
Once the reservoir has filled, it would permanently remove or alter habitats for terrestrial wildlife. Individuals once occupying habitat within the inundated area would be forced into habitats already occupied by other individuals of the same or different species. Both the current and new residents of these areas would compete with each other for the resources present. Assuming these areas already are supporting the maximum number of individuals, resources would be insufficient to support the new arrivals and competition would be locally significant. Until populations are reestablished at lower levels, some individuals would be out-competed for resources. If adjacent habitats are not supporting the maximum number of individuals, little impact would occur unless the number of individuals moving into the area exceeded the capacity of the habitat.

Temporary impacts to wildlife would occur during the construction period. The presence of humans and operation of heavy equipment would disturb wildlife in the vicinity of construction activities. Wildlife in these areas would move away to escape these disturbances. This relocation could result in competition with wildlife already inhabiting adjacent areas. However, construction of a water supply reservoir would occur during the spring, summer, and early fall, when resources are most abundant. During the late fall and winter, after construction activities had ceased, displaced wildlife could return to vacated, undisturbed areas; lessening the overall stress on adjacent habitats and wildlife populations.

While some wildlife species can easily move into adjacent habitat and survive, some species may not be able to use adjacent habitats because those habitats are already occupied and the species are territorial (e.g. badgers, bobcats). Also, continued impacts after construction related to recreational use of the reservoir could include mortality of remaining wildlife from accidents with vehicles, fence entanglement, poaching, etc. Additionally, any development that might occur along with the proposed sites could result in an influx in winter recreationists which could directly impact wintering wildlife.

4.6.3.2.1 Sandstone Dam and Reservoir. The area disturbed or inundated by the Sandstone dam and reservoir would have the most types of wildlife habitats (i.e. vegetation communities) of the proposed water supply alternatives (Table 4-20). This alternative would inundate more riparian cottonwoods, aspen shrublands, and fir/aspen woodlands than the other water supply alternatives.

The Sandstone dam and reservoir would primarily inundate riparian cottonwood woodlands and sagebrush steppe (Table 4-20). Although of degraded quality because of grazing by livestock, the loss of the cottonwoods would be significant to area wildlife. This habitat type comprises only about one percent of the habitat available in the basin, but provides important habitat for a variety of species, such as nest sites for raptors and songbirds and crucial winter range and spring birthing areas for the local elk herd.

The Sandstone alternative would impact the least amount of sagebrush steppe and grassland meadow of any alternative (Table 4-20). These habitats are abundant in the area and their loss
would be much less significant than the loss of riparian cottonwoods and shrublands. Sagebrush steppe is by far the most abundant habitat type in the region. While its loss would reduce habitat for such species as pronghorn, jackrabbit, badger, and sage grouse, the loss of this habitat would not be significant.

Aspen and fir/aspen woodlands are common outside the project area, particularly within the nearby Medicine Bow National Forest. However, within the project area, these woodlands are uncommon and occur in small tracts at higher elevations. While it is not a particularly important habitat in the project area (Table 4-20), it does provide habitat for some species and increases the diversity of the area. Even so, loss of aspen and fir/aspen woodlands would not result in significant impacts to local wildlife.

The wildlife which would be most affected by construction of the Sandstone dam and reservoir would be those using riparian cottonwoods and willow/alders habitats for cover, foraging, and nesting. These species would include furbearers, songbirds, mule deer, elk, and raptors such as bald eagle, red-tailed hawk, long-eared owl, and great horned owl. Willow/alders, while not as valuable or uncommon as cottonwoods, is an important habitat and is not widely available. Loss of riparian willow/alders would be significant.

The Sandstone reservoir would inundate 370/330 acres of elk crucial winter range, the most crucial range of the water supply alternatives (Table 4-22). This alternative is the only one which would affect elk birthing areas, inundating approximately 172/153 acres. Mule deer and pronghorn seasonal ranges would also be inundated. Of these big game species, the greatest impact would be the loss of crucial winter range for elk. Crucial winter range areas are used by elk at much higher densities than other ranges and are important for the survival of individuals through the winter. Although this alternative would inundate only 370/330 acres of several thousand acres of crucial elk range in the Little Snake River Basin, this loss could have significant impacts on the ability of the local elk herd to survive the winter.

All three big game species migrate between summer and winter ranges through the Sandstone dam and reservoir area. Vegetation within the inundation pool would only be impacted around the dam area during construction. Because construction activities would be winding down during fall migration and just starting-up during the spring, human activity would be reduced during these migration periods and confined primarily to the dam site. Vegetation cover would still be present within most of the inundation pool during construction to provide cover for migrating big game. Following project construction, the area of the inundation pool and a short distance below the dam would be altered by the project. Vegetation cover above the inundation pool and below the dam and spillway would be largely unaffected by the project. Big game would be expected to continue to cross the areas which are currently within their migration corridors. Some mortality of big game species could occur from individuals falling through ice on the reservoir during early fall or spring. These losses should not impact the overall size of big game herds. The small size
Table 4-22

BIG GAME RANGES IN THE INUNDATION ZONES
(acres)

<table>
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<tr>
<th></th>
<th>Sandstone</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>w/min pool</td>
<td>w/o min pool</td>
<td>w/min pool</td>
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<tr>
<td>Elk Crucial(^1)</td>
<td>370</td>
<td>330</td>
<td>0</td>
</tr>
<tr>
<td>Elk Birthing(^1)</td>
<td>172</td>
<td>153</td>
<td>0</td>
</tr>
<tr>
<td>Elk Winter(^1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Elk Winter/Yearlong</td>
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<td>0</td>
<td>482</td>
</tr>
<tr>
<td>Mule Deer Crucial(^1)</td>
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<td>0</td>
<td>482</td>
</tr>
<tr>
<td>Mule Deer Winter/Yearlong</td>
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<td>194</td>
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<tr>
<td>Mule Deer Spring/Summer/Fall</td>
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<td>482</td>
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<tr>
<td>Pronghorn Crucial(^1)</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pronghorn Spring/Summer/Fall</td>
<td>370</td>
<td>330</td>
<td>482</td>
</tr>
</tbody>
</table>

\(^1\)Significant impact

of the reservoir pool, with a length of about 8,500 linear feet, and approximately 3,500 linear feet of mudflat at the time of fall and spring migration, is not expected to provide an insurmountable barrier to migrating big game. Most individuals would go around the reservoir. During most of the migration period, the reservoir would be ice-free, enabling migrating big game to swim across. However, several game trails follow Big and Little Sandstone Canyons. The steepness of the terrain around Savery Creek could make passing a reservoir at this site very difficult for migrating big game. Also, the reservoir “arms” created by the partial flooding of Big and Little Sandstone Canyons could cause a bottleneck for migrating big game.

The Sandstone dam and reservoir would be the largest body of water for approximately 50 miles in all directions. It could attract waterfowl, shorebirds, furbearers, semi-aquatic reptiles, amphibians, and the species which feed on them. A reservoir could provide a supply of water to wildlife for drinking and bathing. Mudflats would be expected to develop which could be used in late summer and fall by waterfowl, shorebirds, furbearers, amphibians, and the species which feed on them. However, the fluctuating water level in the reservoir would negate some of the possible benefits to wildlife, particularly for the Sandstone water supply alternative without a minimum pool.

The only known breeding population of Columbian sharp-tailed grouse in Wyoming is located in the area around Baggs and Savery, including the inundation zone for the Sandstone reservoir (WGFD 1998a). The Sandstone reservoir would inundate potential habitat for the Columbian
sharp-tailed grouse but would not affect any leks (courtship display and mating grounds) used by this rare species.

Lands purchased around the reservoir outside the inundation pool would be kept to a minimum. Little land adjacent to the reservoir would be open to the public for winter recreation. Increased stress on wintering big game from human activities is not anticipated because winter recreation is not expected to be significantly higher than current levels.

4.6.3.2.2 High Savery Dam and Reservoir. The High Savery alternative would inundate 482/420 acres of wildlife habitat (Table 4-20). This habitat would be composed primarily of sagebrush steppe and grassland meadow (Figures 4-6 and 4-8). Of the water supply alternatives, the High Savery dam and reservoir would inundate the most meadow and riparian willow/alder. Meadow is an important brood rearing habitat for grouse and comprises 10 percent of the 12-square mile area around the High Savery site (Table 3-2). The meadow that would be inundated at the site is in only fair condition because of grazing. Riparian willow/alder has high value to wildlife. The loss of this vegetation would be a significant adverse impact to wildlife.

The High Savery dam and reservoir would inundate winter/yearlong range for elk and spring/summer/fall range for mule deer and pronghorn; however, no crucial winter ranges would be affected (Table 4-22). Winter yearlong ranges are in the “high” mitigation category according to WGFD policy (WGFD 1999). Habitat in this category is important to sustain a community, population, or subpopulation, but can be reconstructed or enhanced where avoidance is not possible. The High Savery alternative would present a 1,500-foot (dead pool length of High Savery reservoir without a minimum pool at the end of irrigation season) to 12,000-foot (normal pool length for High Savery with a minimum pool) linear barrier that big game would have to migrate around or swim through. Even though some loss of big game could occur as a result of this barrier, no significant impacts are expected.

The High Savery reservoir would inundate potential habitat for the Columbian sharp-tailed grouse but would not affect any leks used by this rare species.

The High Savery reservoir would provide the same limited benefits to wildlife discussed for the Sandstone alternative.

4.6.3.2.3 Dutch Joe Dam and Reservoir. Of the 300 acres inundated by the Dutch Joe dam and reservoir, 261 acres would be sagebrush steppe and 34 acres would be grassland meadow (Figure 4-6). Both community types are common in the region. The loss of sagebrush steppe and grassland meadow at the Dutch Joe site would not impact most local wildlife. These areas are
currently in poor condition because of grazing and could not support the density of wildlife of other, higher quality areas. Wildlife in the Dutch Joe dam and reservoir area would be displaced to other areas in similar or better condition.

Construction of this alternative could have a significant affect on big game species. Elk winter range and crucial winter ranges for mule deer and pronghorn would be inundated at the Dutch Joe site (Table 4-13). Although these areas are currently in poor condition and provide less than optimal wintering habitat, they are important to wintering big game because they receive less snow and winter forage remains accessible. The loss of elk winter range would be significant. The loss of mule deer and pronghorn crucial winter range cannot be mitigated according to the following WGFD policy (WGFD 1999):

The Mitigation Policy of the Wyoming Game and Fish Commission categorizes crucial winter range as “vital”. According to Commission Policy, the vital category is the highest existing habitat classification in Wyoming. Habitat in this category directly limits a community, population, or subpopulation, and restoration or replacement may not be possible. Since a variety of factors are involved in the delineation of crucial winter range (climate, aspect, snow depth, forage, cover, etc.), there is no known way to create replacement habitat for crucial habitat which is lost. Commission policy directs the Wyoming Game and Fish Department to recommend no loss of functional crucial winter range.

Leks for Columbian sharp-tailed grouse have been documented in the vicinity of Dutch Joe Creek. These leks are located on the mesas around the creek (WGFD 1998a, Woolley 1998) and would not be disturbed by the Dutch Joe dam and reservoir.

The Dutch Joe reservoir would not have a minimum pool and would not provide year-round opportunities for wildlife. Seasonal opportunities for some species would result because of the body of water which would be present during spring and early summer. Mudflats would be expected to develop which could be used in late summer and fall by waterfowl, shorebirds, furbearers, amphibians, and the species that feed on them. However, any benefits to wildlife from this alternative would likely be of limited value.

4.6.3.2.4 Downstream Effects of Water Supply Alternatives. The reduction in peak flows during reservoir filling could reduce habitat for waterfowl, shorebirds, furbearers, reptiles, and amphibians during the early spring. Decreased habitat could reduce nesting and den areas for wetland species. This impact would likely be insignificant because it would occur prior to the growing season. However, summer habitat would be improved because releases for late-season supplemental irrigation from the reservoirs would provide additional water in Savery Creek, the Little Snake River, and assorted diversion canals. Increased habitat during the late-season supplemental irrigation water release period would provide better conditions for raising young
and for late-nesting birds. These impacts could improve the condition and subsequent winter survivorship of young-of-the-year and adults.

Minimum flows would not be released from the Dutch Joe dam and reservoir. As a result, only a minimal amount of habitat would be affected between the dam site and the Little Snake River. Minor reductions in habitat quality could occur for wetland species along Savery Creek below the Dutch Joe diversion point because springtime flow would be reduced while water is diverted from Savery Creek to fill the Dutch Joe reservoir. Overall, no significant impacts to downstream wildlife are expected from the Dutch Joe alternative.

4.6.3.2.5 Water Conservation. Implementation of the conservation alternative would have minimal impacts on wildlife. Construction activities associated with rehabilitation of irrigation delivery systems and improvements to pastures would temporarily displace wildlife because of land disturbance, noise, and human activity. Conversion of pasture and land leveling would temporarily reduce grassland habitat. Because improvements to pasture would likely occur in the spring, ground nesting birds including waterfowl, could be adversely affected. These impacts would only occur during initial construction, and would likely take place over several years as land conversion occurs.

More efficient usage of water and more level land would reduce the amount of water diverted onto pastures, potentially reducing the amount of saturation and pools present. This would reduce habitat for amphibians and insects upon which local amphibians, reptiles, furbearers, waterfowl, and shorebirds feed.

4.6.3.2.6 No-Action. The no-action alternative would not require any construction activities and would not change existing wildlife habitats. Overall, the no-action alternative would have no impacts, positive or negative, on local wildlife.

4.6.3.3 Mitigation
Various mitigation measures would be used to reduce the impacts of dam and reservoir construction and operation on wildlife. Seasonal restrictions on construction and public access would be implemented to limit disturbance of important wildlife areas such as nearby elk birthing areas, sage grouse leks, and wintering raptors sites. While it is inevitable that some individuals of small, ground dwelling species would be lost during reservoir filling, the number would be minimized by filling the reservoir in stages. This would result in slower inundation of habitats and allow more individuals to move and adjust to the rising water levels.

Creation and enhancement of habitats similar to those inundated would mitigate losses and provide suitable areas into which displaced individuals could easily move. In most cases, enhancement of areas similar to those habitats lost, if appropriately located, would be preferable to creation. These areas are already established and more capable of supporting additional
wildlife. Enhancement generally results in higher quality habitat in less time. However, crucial winter range for mule deer and pronghorn cannot be mitigated (WGFD 1999).

4.6.3.3.1 Sandstone Dam and Reservoir. In addition to previously described mitigation for vegetation communities (Section 4.6.1.3) and wetlands (Section 4.6.2.3), mitigation would be required for elk crucial winter range lost at the Sandstone dam and reservoir site. Because crucial winter range for elk is determined by elevation, cover availability, and forage, new areas for crucial winter range cannot be created. Mitigation would be accomplished by enhancing existing crucial winter range at a 3:1 ratio (WGFD 1998a). WWDC would purchase or acquire conservation easements on 1110/990 acres of existing crucial elk winter range in the vicinity of the proposed reservoir. This land would be managed to increase its value to elk by removal of cattle grazing, reseeding, irrigation, or prescribed burning. The exact management plan would depend on the existing conditions of the lands acquired.

4.6.3.3.2 High Savery Dam and Reservoir. Construction of the High Savery alternative would require mitigation for the loss of 482/420 acres of seasonal range for elk, mule deer, and pronghorn antelope. Mitigation would be accomplished by reducing cattle grazing on surrounding seasonal range or by habitat improvement (WGFD 1998b). Reducing cattle grazing would enhance these areas by leaving more forage for game and effectively replacing the range lost to inundation. The amount of seasonal range requiring mitigation would be the area inundated minus the amount of wetlands, riparian willow/alder, and riparian cottonwood habitats that would be mitigated separately (Sections 4.6.1.3 and 4.6.2.3). The amount of land for which mitigation would be required is 393/343 acres. These acres represent 103/90 animal unit months (AUM) of grazing by elk (WGFD 1997b). Mitigation would involve the purchase of a similar amount of AUM in the vicinity of the High Savery reservoir and reserving the grazing rights for big game.

Improvement techniques for big game habitat would include prescribed burns, herbicide treatments, cutting/chopping regeneration, seeding, planting shrubs and trees, and fencing (WGFD 1998b). The type(s) of improvement technique(s) selected would depend on the existing conditions of the area to be treated. Plans for habitat improvements would be made in consultation with WGFD.

4.6.3.3.3 Dutch Joe Dam and Reservoir. The loss of 450 acres of mule deer and crucial winter range and 125 acres of pronghorn antelope crucial winter range at the Dutch Joe dam and reservoir alternative cannot be mitigated. The purchase of or the acquisition of conservation easements on 300 acres of elk winter range and of 325 acres of pronghorn winter/yearlong range can be mitigated. These lands would be managed to enhance its relative value to wintering deer and antelope, thus effectively replacing the lost habitat. The exact management practices would depend on the existing condition of the mitigation site(s).
The Dutch Joe water supply pipeline and canal will affect approximately 150 acres of grassland meadow, riparian scrub/shrub, riparian cottonwood, sage brush steppe and irrigation meadow. The pipeline and canal crosses crucial big game winter range and migration corridors for elk, mule deer, and antelope. When full in the spring, the canal may present a barrier and hazard to migrating big game herds.

Mitigation for the pipeline and canal related impacts would occur simultaneously with mitigation for losses at the dam site. The canal would affect 5.5 acres of riparian scrub/shrub and riparian cottonwood habitat adjacent to Savery Creek. The riparian habitat would have to be mitigated at a 3:1 ratio. The WGFD has indicated that crucial winter range for mule deer and pronghorn cannot be successfully mitigated (WGFD 1999).

4.6.3.3.4 Water Conservation and No-Action. No mitigation is proposed for downstream impacts or for impacts resulting from the water conservation and no-action alternatives.

4.6.4 FISHERIES
Savery Creek and the Little Snake River provide habitat for a number of fish species. Development of a water supply could affect fisheries through changes in water quality, flow rates, and habitat.

4.6.4.1 Methodologies and Significance Criteria
Because fish tend to occupy predatory positions in aquatic food webs, they are sensitive to impacts on almost any part of their habitat. In Savery Creek, trout are the primary top predator; therefore, the quality of trout habitat is a reasonable indicator of the overall ecological health of this aquatic ecosystem. Measures designed to protect trout from the impacts of the water supply project would also benefit the other inhabitants of the stream.

The impacts to stream fisheries of inundating portions of Savery Creek and its tributaries were assessed in terms of trout habitat units. A habitat unit (HU) is defined as the amount of habitat quality that will support one pound of adult trout. Habitat quality in the affected streams was determined by WGFD (1998a, b) (Appendix C). The number of habitat units lost to inundation by a water supply alternative was calculated by multiplying the average HU per acre by the acres of stream inundated. The area of stream inundated was determined from the average width of the stream and the length of stream that would be covered. Impacts on HU as a result of changes in flow in Savery Creek downstream of a dam and reservoir were based on Habitat Quality Index (HQI) modeling conducted by WGFD (1998a,b). Impacts on downstream water temperature from reservoir releases were estimated using the RESTEMP model (Hydrologic Engineering Center 1997) to calculate the temperature of water released from the reservoir (WWCI 1996, 1997), and the SSTEMP model to predict the change in temperature as the water traveled down the creek (WGFD 1998a, b).
Reservoir construction and operation would eliminate some stream fishery habitat in the region. Project impacts would be significant if changes in water quality or flow regimen reduced habitat to the extent that the ability of the existing downstream and upstream fish species to survive and reproduce was threatened and opportunities for stream fishermen were reduced.

4.6.4.2 Impacts
During construction of a dam, stream flows would be altered and downstream areas could be subjected to increased turbidity and sedimentation. Increased turbidity and sedimentation may affect fish populations by:

- preventing successful development of fish eggs and larvae
- modifying natural movements and migrations
- reducing the abundance of food (i.e. macroinvertebrates)
- clogging and abrading of gills
- altering available habitat

Operation of a reservoir could result in subtle changes in downstream water quality. Nutrients from the upper reaches of the impounded streams would be trapped and retained in the reservoirs, resulting in decreased stream productivity below the reservoirs. Sediments would also be retained by the reservoir. Water released from the reservoir would initially pick up sediments and would transform downstream silt/sand substrates into armored gravel/cobble substrates. Such changes could decrease populations of benthic macroinvertebrates, which are an important food source for various fish species, and reduce suitable spawning habitat for fish.

Operation of a water supply would change downstream flow regimens. In general, flows would be reduced in the spring when flows are normally high, and increased in summer when flows are normally low. The increased summer flows could be beneficial to fisheries because additional fish habitat would be created. Reductions in flow for reservoir filling during the fall and winter would be slight because of prescribed minimum flow releases.

The impact of the water supply on downstream temperature would depend on the construction and operation of the reservoir outlet works. A reservoir with a single, low-level outlet would tend to release unseasonably cold water at the beginning of the late-season supplemental irrigation period and unseasonably warm water in the winter. A reservoir with a multi-level outlet would allow warm and cold water to be mixed, producing releases with a temperature that is appropriate or even optimal for the season.

4.6.4.2.1 Sandstone Dam and Reservoir. The Sandstone dam and reservoir would result in impacts to existing water quality (Section 4.3.2). Increased turbidity and sedimentation could reduce the ability of local fish and their food supply (macroinvertebrates) to survive. These changes in water quality, however, would be temporary.
The Sandstone dam and reservoir would inundate 7.1/6.4 miles of permanent streams. These stream reaches would represent a loss of 395/363 HU (Table 4-23).

<table>
<thead>
<tr>
<th>Table 4-23</th>
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<tr>
<td><strong>RESERVOIR CHARACTERISTICS RELATED TO FISHERIES</strong></td>
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<td>Area of Permanent Pool (acres)</td>
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<td>Stream Class</td>
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<td>Average Stream Width (feet)</td>
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<td>Permanent Streams Inundated <em>miles</em></td>
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<td><em>acres</em></td>
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<td>Habitat Units (HU) per Acre&lt;sup&gt;3&lt;/sup&gt;</td>
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<td>HUs Lost</td>
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<tr>
<td>Distance from Dam to LSR&lt;sup&gt;4&lt;/sup&gt; (miles)</td>
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<tr>
<td>HUs Gained Downstream</td>
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<sup>1</sup>Non-drainable dead pool.
<sup>2</sup>Dutch Joe Creek is intermittent and does not support a fishery.
<sup>3</sup>One Habitat Unit is the amount of habitat quality which will support one pound of trout.
<sup>4</sup>LSR = Little Snake River.

Operation of the Sandstone dam and reservoir would change the downstream flow regimen in Savery Creek. These changes would be essentially the same with or without a minimum pool. In late fall and winter (November through February), flow reductions in Savery Creek would average approximately 10 percent (Table 4-3). Depletions would be relatively low at this time because all inflows less than 24 cfs would be released. This time period does not correspond to spawning, egg development, growth and dispersal of juveniles, or the growth of adult fish. Wintertime reductions in stream flow, therefore, are not expected to significantly impact fish populations in Savery Creek. Farther downstream in the Little Snake River, winter flow depletions caused by the Sandstone dam and reservoir would be less than 5 percent (Table 4-3) and are not expected to impact fish.

Reservoir filling would occur primarily during March and April when runoff from spring snow melt has started and flows in Savery Creek exceeded 24 cfs. During an average runoff year, depletions in these months are projected to exceed 50 percent (Table 4-3). By May, reservoir filling would be nearly completed and stream flow is expected to increase from an average of 82 cfs in April to 420 cfs in May. As a result, the seasonal high flows, which are important for
maintaining stream habitat, would be retained. Flows in the Little Snake River during April and May would be reduced less than 20 percent.

The large stream flow depletions in Savery Creek during March and April could impact breeding habitat availability for fish species that spawn in early spring. However, no fish species are known to spawn in Savery Creek at that time (Annear 1998). With the reservoir, downstream flows would still decline from May through June. This decline is an important spawning cue for some local fish species, particularly the CRCT (WGFD 1998a).

Low summer flows and warm water temperatures have likely been major factors limiting fish populations in Savery Creek. Releases for irrigation from the Sandstone dam and reservoir would increase flow in Savery Creek an average of 330 percent in July, August, and September (Table 4-3). These increased flows would expand the amount of stream habitat available for fish and could result in a year-round increase in fish abundance. Based on HQI modeling of three sites downstream of the Sandstone dam, WGFD (1998a) projected the relationship between trout HU and summer flow. Summer flows would be increased by an average of 60 cfs, which would increase the amount of trout habitat in Savery Creek by an estimated 337 HU (Figure 4-12). This increase in habitat would replace most of the stream HUs lost to dam construction and inundation.

Part of the projected increase in HUs in Savery Creek as a result of the Sandstone dam and reservoir is from changes in water temperature. The average high temperature in Savery Creek, 72 degrees Fahrenheit (°F) occurs in July. This temperature is considered marginally high for the maintenance of a cold-water fishery (WGFD 1998a). Thermal modeling of the proposed reservoir indicated that all of the late-season supplemental irrigation water released from the reservoir would be between 55 and 65 °F (WWCI 1996b). Assuming the maximum release temperature of 65 °F, the temperature in the stream would be 70 °F at about 5 miles downstream of the dam and slightly more than 71 °F at the confluence with the Little Snake River (WGFD 1998a). The decrease in ambient stream temperature from 72 °F to between 55 and 71 °F would represent an improvement in the cold-water fishery habitat in Savery Creek.

Temperature modeling predicted that water temperatures in the Sandstone reservoir in the winter would range from 32 °F near the surface to 39 °F near the bottom (WWCI 1996b). During the winter, the multi-level outlet structure would be used to release the required minimum flows that were as cold as possible. It is important that winter water releases from the reservoir in this region freeze over promptly to prevent the formation of suspended ice crystals, known as frazil ice (WGFD 1998b). Frazil can coat the gills of fish and is particularly lethal to juvenile fish (Annear 1998).

The Sandstone dam and reservoir with a 159-acre minimum pool would provide the opportunity to develop a reservoir fishery. The resulting fish community would have a different species composition and would provide different recreational opportunities than are currently available on lower Savery Creek. Stream species (i.e. mottled sculpin, creek chub, speckled dace) that are not
Figure 4-12
CHANGES IN DOWNSTREAM HABITAT UNITS IN SAVERY CREEK WITH CHANGES IN FLOW

- Downstream habitat units (HU)
- HU lost - with minimum pool
-- HU lost - without minimum pool

Source: WGF 1997a,b
well suited for reservoir conditions would be displaced to upstream areas. Other species that are better suited for reservoir conditions (i.e. white sucker, redside shiners) would thrive. Rainbow trout, the primary gamefish in area streams, and brook trout would also be present in the reservoir. Interaction of the reservoir fish population with the existing upstream fish population could result in the alteration of the upstream fish community.

The minimum pool was evaluated as a rearing facility for CRCT (WGFD 1998b). Eggs taken from adult CRCT held in the reservoir would be fertilized and hatched in a hatchery. The resulting fry would be used to restore this native species to historic habitat within the Little Snake River basin. However, this use is not feasible. The upstream portion of the Savery Creek basin supports large numbers of brook and rainbow trout. The rainbow trout would need to be eliminated to prevent them from hybridizing with the genetically pure CRCT stocked in the reservoir. Brook trout would need to be eliminated because they would probably colonize the reservoir in large numbers and reduce the ability of the reservoir to support the needed number of CRCT. The large number of stream miles upstream from the reservoir would make such an eradication effort logistically impractical. Further limiting the Sandstone reservoir as a CRCT brood site is access. Good road access is necessary to all reservoir tributaries in June when eggs would be collected from CRCT that swim upstream to spawn. Access to these areas in limited by the lack of roads, steep terrain, and adverse weather conditions, such as snow, in most years. Therefore, a CRCT brood stock is not proposed for Sandstone Reservoir.

The Sandstone dam and reservoir without a minimum pool would retain only a 17-acre dead pool at the end of the late-season supplemental irrigation season. It is unlikely that this small pool could act as a holding area or source for a significant fishery. Therefore, non-nature fish control is not proposed above Sandstone Reservoir.

4.6.4.2.2 High Savery Dam and Reservoir. The impacts to fisheries from the High Savery dam and reservoir would be qualitatively the same as the Sandstone water supply alternative. Potential impacts from construction activities on water quality and aquatic organisms would be temporary and insignificant. The High Savery reservoir would inundate more stream, 8.4/7.4 miles, than the Sandstone reservoir. However, the loss of trout HUs, 143/130, would be less because the streams at the High Savery site are narrower and have lower habitat quality (Table 4-23).

Operation of the High Savery reservoir would change the flow regimen downstream of the dam. In late fall and winter (November through February), average flow in Savery Creek just below the dam would be reduced approximately 20 percent (Table 4-7). Flow reductions at this time would be relatively low because all inflows less than 12 cfs would be released. Wintertime reductions in flow are not expected to significantly impact fish populations in Savery Creek because this time period does not correspond to spawning, egg development, growth and dispersal of juveniles, or the growth of adult fish. Downstream in the Little Snake River, winter flow depletions caused by
operation of the High Savery dam and reservoir would be less than 5 percent (Table 4-7). These depletions are not expected to impact the existing Little Snake River fishery.

Reservoir filling would occur primarily during March and April once runoff from spring snow melt has started and flows in Savery Creek exceed 12 cfs. Average flow reductions just below the dam in these months are projected to exceed 50 percent (Table 4-7). By May, reservoir filling would be nearly completed and discharge is expected to increase from an average of approximately 12 cfs in April to 70 cfs in May and June. As a result, the seasonal high flows, which are important for maintaining stream habitat, would be retained. Average flows in the Little Snake River during April and May would be reduced less than 15 percent (Table 4-7).

The large flow reduction in Savery Creek during March and April could impact breeding habitat availability for fish species that spawn in early spring. However, no fish species are known to spawn in Savery Creek at that time (Annear 1998). With the reservoir, downstream flows would still decline from May through June.

Late-season supplemental irrigation releases from the High Savery reservoir would increase flow from July through September in Savery Creek just downstream of the dam an average of 650 percent (Table 4-7). These increased flows would expand the amount of steam habitat available for fish. Because historically low summer flows and high temperatures have likely been factors limiting fish populations in Savery Creek, increased flows could result in a year-round increase in fish abundance. Based on HQI modeling of five sites downstream of the High Savery dam, WGFD (1998b) projected the relationship between trout HU and summer flow (Figure 4-12). The High Savery alternative would increase summer flows by an average of 69 cfs and increase the amount of habitat in Savery Creek between the High Savery dam site and the Little Snake River by approximately 1,200 HU (Figure 4-12). This increase would nearly double the amount of existing HUs in Savery Creek and would exceed the amount of stream habitat units lost to inundation by a factor of about eight.

Part of the increase in HUs in Savery Creek is a result of changes in water temperature. The average high temperature in Savery Creek, 72°F, occurs in July. Thermal modeling of the reservoir indicated that maximum surface water temperature would be between 66 and 67 ºF and the maximum bottom temperature would be between 44 and 49 ºF (WWCI 1997b). Based on these temperature ranges and the use of a multi-level outlet, a sustainable release temperature of 58 ºF was calculated. The temperature in Savery Creek was predicted to be slightly more than 71 ºF at the confluence with the Little Snake River (WGFD 1998b). The decrease in ambient stream temperature from 72 ºF to between 58 and 71 ºF would represent an improvement in the cold-water fishery habitat in Savery Creek.

Water released from the reservoir in winter should freeze over promptly to prevent the formation of frazil ice which is harmful to fish (WGFD 1998b). Temperature modeling predicted that water temperatures in the winter would range from 32 ºF near the surface to 39 ºF near the bottom of
the High Savery reservoir (WWCI 1997b). During the winter, the multi-level outlet structure would be employed to release the required minimum flows that are as cold as possible. Because this water would rapidly freeze over, no significant impacts to fish from frazil ice are expected.

The High Savery dam and reservoir with a 174-acre minimum pool could provide a substantial benefit to stream fisheries throughout the Little Snake River basin by serving as a rearing and holding site for CRCT brood stock. To create this fishery, other game fish (i.e., brook, brown, and rainbow trout) would be removed from the streams in the inundations zone and as far upstream of the reservoir as possible before reservoir filling. This eradication would be necessary to prevent hybridization and competition with CRCT. Fish barriers would be placed just upstream of the reservoir on all major tributaries to contain fish in the reservoir and serve as collection sites for spawning CRCT. The fish removal would be done with a chemical that degrades rapidly in water and is toxic only to organisms with gills. Non-target, native fish, amphibian larvae, and invertebrate organisms would also be eradicated along with the non-native species. The invertebrate population would naturally re-colonize and native species would be re-introduced. No permits for the fish eradication would have to be obtained; however, WGFD would coordinate their efforts with the WDEQ. An environmental assessment would need to be prepared prior to fish eradication on streams flowing through BLM lands. In addition, the WGFD would have to secure the permission of landowners in the basin.

The CRCT in the High Savery reservoir would provide eggs to hatcheries for rearing and subsequent stocking. Fisheries managers at WGFD have identified an annual need for 300,000 eyed eggs for stream recovery stocking and angling (WGFD 1998b). Based on 850 eggs per female, 350 ripe female fish would be needed. Because 5 percent of apparently ripe females fish captured are not useable because their eggs are not fully developed, 370 female fish would have to be captured. When spawning trout are collected, males are caught 2 to 9 times more frequently than females because males spend more time at the spawning sites. Because male and female CRCT synchronize their spawning activities more closely than most trout, a capture rate of 3 males to 1 female was assumed. The capture of 370 female CRCT, therefore, would require the capture of approximately 1,480 adult fish. To maximize the genetic diversity of the brood population, make capturing the required number of fish feasible, and provide some fish for reservoir angling, the number of fish captured should not exceed 10 percent of the population. Thus, the population of CRCT in the High Savery reservoir should equal or exceed 14,800 (WGFD 1998b). Based on a Reservoir Quality Index analysis, the minimum pool size needed to support 14,800 CRCT at the High Savery site would be 5,724 AF (Figure 4-13). The proposed minimum pool for the High Savery dam and reservoir was sized to meet this need (Figure 4-13). A minimum pool of 20 percent of normal pool volume at this location would not have been large enough to support the desired number of CRCT.

The High Savery dam and reservoir without a minimum pool would retain only an 11-acre dead pool at the end of the irrigation season. This small pool could not act as a holding area for brood stock and would not be a source for a significant fishery.
Source: WGF 1998b
4.6.4.2.3 Dutch Joe Dam and Reservoir. The Dutch Joe dam and reservoir is not expected to result in any adverse impacts to fish populations in Dutch Joe Creek because Dutch Joe Creek is an intermittent stream that does not support a fishery. No minimum pool would be maintained in the Dutch Joe reservoir, nor would a minimum flow release plan for Dutch Joe Creek be implemented.

Cold water releases from reservoirs are a concern in the Colorado River basin because they have been implicated as one of several causes in the decline of some native fishes. Among these fishes are the federally-listed as endangered Colorado pikeminnow and humpback chub. Both of these species have been documented in the Little Snake River. As currently designed, water released from the Dutch Joe reservoir would be via a multi-level outlet structure. Initial releases for supplemental irrigation in the later half of July would likely be low in DO and have a temperature of approximately 45°F. The released water would flow downstream approximately 2 miles before entering the Little Snake River. During this transit, the water would be oxygenated by turbulence and warmed 1 to 2°F. This water, approximately 50 cfs at 47°F, would mix with approximately 200 cfs of 70°F water in the Little Snake River. Assuming rapid and complete mixing the temperature in the Little Snake River would be reduced approximately 5°F. This change would exceed Wyoming Water Quality Standards for temperature (Chapter I, Section 25). Fish for many miles of the Little Snake River downstream of Dutch Joe Creek would be subject to the influence of this unseasonably cold water.

The flow in Savery Creek would be reduced in the spring when water is diverted into the pipeline and canal facility to fill the Dutch Joe reservoir. The timing, magnitude, and potential impacts of this reduction would be essentially the same as for the Sandstone and High Savery dams and reservoirs. Unlike the other alternatives, the potential beneficial affects on the Savery Creek fisheries caused by increased flow in the summer months would not occur.

4.6.4.2.4 Summary of Reservoir Alternatives. The Sandstone and High Savery dams and reservoirs could result in adverse impacts to existing stream fisheries because of water quality degradation caused by construction activities, the elimination of stream habitat by inundation, downstream flow changes, and habitat degradation by streambed scouring. The Sandstone alternative would result in the greater adverse impact to stream fisheries because it would inundate a portion of Savery Creek with higher quality fish habitat.

Fisheries in Savery Creek would benefit from the Sandstone and High Savery alternatives because increased summer flows would increase the amount of downstream fish habitat. The game fish habitat increase projected for the Sandstone alternative would nearly equal that lost to inundation. The High Savery alternative, with 41.5 miles of creek between the dam and the Little Snake River, would produce approximately eight times more HUs than would be lost to inundation. Improvements in game fish habitat may also benefit non-game fish species. The High Savery alternative with a minimum pool could have an additional positive impact on game fisheries by
providing a refuge for maintaining genetically pure CRCT for use as brood stock in species
recovery efforts in the Little Snake River basin.

Decreases in flows in Savery Creek caused by filling the Sandstone or High Savery reservoirs are
not expected to adversely impact downstream fisheries. Depletions during low-flow periods
would be limited by a minimum flow requirement and depletions during high-flow periods would
still leave substantial amounts of water in the stream.

The Dutch Joe dam and reservoir would have no impact on fisheries in Dutch Joe Creek, but
could adversely impact fish in the Little Snake River because of low temperature water releases.
Impacts to Savery Creek from the Dutch Joe alternative are not expected to be adverse or
beneficial.

4.6.4.2.5 Water Conservation and No-Action. Implementation of these alternatives would not
result in any major construction in streams or alteration of existing stream fisheries. Thus, no
adverse impacts to area stream fisheries are expected under these alternatives. These alternatives
also would not provide any opportunities to enhance existing stream fisheries or to provide a
rearing site for CRCT brood stock.

4.6.4.3 Mitigation
For any of the reservoir alternatives, an ES plan would be devised and implemented. The ES plan
would include provisions for securing the site during the non-construction season, reducing
sedimentation, and minimizing stream bank and channel erosion. These measures would protect
downstream aquatic organisms, including fish, by limiting water quality degradation. Grade
control structures positioned below the dam would limit streambed habitat degradation caused by
scouring and down-cutting caused by high-volume, sediment-free reservoir releases of late-season
supplemental irrigation water. Stream bank erosion would be reduced by using stream bank
arming (riprap). Impacts to fish from rapid changes in water level downstream of the dam
would be minimized by phasing in changes in major water release rates, such as at the beginning
and end of the supplemental irrigation season, over 3-day periods (WGFD 1998a,b). All fishery
mitigation measures would be developed in cooperation with WGFD and FWS.

4.6.4.3.1 Sandstone Dam and Reservoir. The Sandstone dam would be operated to provide a
minimum release of the lesser of natural inflow or 24 cfs. This would minimize downstream
impacts in Savery Creek from low flows during the time when the reservoir is being refilled.

The Sandstone reservoir would inundate and eliminate 395/363 trout HUs. Much of this loss
would be offset by the creation of 337 HUs downstream of the reservoir as a result of increased
summer flows. The remaining lost HUs, 60/26, would be mitigated for by constructed
enhancements of stream habitat. Some habitat enhancement, however, could result as a by-
product of riparian mitigation activities for vegetation and wetland communities. For example,
keeping cattle out of the stream and riparian zone to encourage cottonwood and willow/alder
shrub development would also allow damaged stream banks to return to a more natural and beneficial condition for fish. If the Sandstone alternative is selected, a specific fisheries habitat mitigation plan would be developed in cooperation with WGF prior to project completion. The Sandstone alternative with a minimum pool could provide an additional type of fishery, a reservoir fishery, to the Savery Creek basin. However, WGF does not recognize the creation of reservoir fisheries as mitigation for stream fisheries losses.

Downstream impacts to fisheries from releases of low-temperature water would be avoided through the use of a multi-level outlet.

**4.6.4.3.2 High Savery Dam and Reservoir.** A minimum release of the lesser of natural inflow or 12 cfs would minimize adverse impacts on downstream fisheries by preventing the cessation of natural flow during filling of the High Savery reservoir. Impacts to downstream fish habitat from streambed scouring would be minimized by the installation of grade control and energy dissipation structures (these methods could include the use of rip-rap or other stream-bank armoring methods).

The High Savery dam and reservoir would inundate and eliminate 143/130 trout HUs. This loss would be offset by a ratio of over 8:1 by the creation of approximately 1,200 HUs downstream of the reservoir as a result of increased summer flows. In addition, the High Savery alternative with a minimum pool would provide a suitable site to rear genetically-pure CRCT which would be used in the recovery efforts for this species.

**4.6.4.3.3 Dutch Joe Dam and Reservoir** To protect the fisheries in lower Savery Creek from the effects of low flows, a minimum flow equal to the lesser of natural flow or 24 cfs would be by-passed around the diversion to the Dutch Joe reservoir. No mitigation for fisheries is planned for Dutch Joe Creek because no HUs would be lost. A multi-level release structure, which would blend warm and cold water as it was being released, would be installed to prevent temperature impacts on fish in the Little Snake River.

**4.6.4.3.4 Water Conservation and No-Action.** No mitigation for fisheries is proposed as part of the water conservation and no-action alternatives.

**4.6.5 THREATENED OR ENDANGERED SPECIES**

Six endangered, two threatened, and three candidate species and one species proposed for listing were identified by FWS as potentially being impacted by construction of a late-season supplemental water supply source (Table 3-6):

- Ute Ladies' Tresses Orchid
- Humpback Chub
- Bald Eagle
- Northern Goshawk
- Colorado Pikeminnow
- Razorback Sucker
- Peregrine Falcon
- Swift Fox
- Bonnytail
- Western Boreal Toad
- Mountain Plover
- Black-footed Ferret
The peregrine falcon was recently delisted by the FWS (1999). As a result, any mitigation proposed for the species would need to be revisited if project impacts on the species were determined to be significant. Since Section 7 Consultation with FWS under the ESA for the LSSIWSP was initiated with the peregrine as a listed species, the consultation process has been completed with the species in place.

4.6.5.1 Methodologies and Significance Criteria
The impact the project would have to each of these species depends on the occurrence of the species at the proposed site or in downstream aquatic environments, the presence of appropriate habitat at the site, and the relative amount of impacted habitat compared to the surrounding area. Information on the potential occurrence of these species and suitable habitat was obtained from WGFDM, FWS, literature review, and field investigations (Section 3.6.5). If the project would directly result in a loss of individuals or if the loss of habitat impacted the presence of the species in the area, the impact to that species would be considered significant.

4.6.5.2 Impacts
Of the 12 identified threatened or endangered species, only the terrestrial species actually or potentially occur at the dam and reservoir sites. For these species, the primary impact would be loss of habitat as a result of dam construction and inundation of land by the resulting reservoir. The four fish species listed do not occur in Savery Creek but do or could occur in potentially affected downstream reaches of the Little Snake River.

4.6.5.2.1 Sandstone Dam and Reservoir. The Ute ladies’ tresses orchid was not found during a 1994 survey of the Sandstone dam and reservoir site. This species would not be expected to occur in the area because the site’s elevation is considerably above that at which the orchids are found. Therefore, this alternative would not impact the Ute ladies’ tresses orchid.

A survey in 1994 also indicated western boreal toads currently do not occur in the project area. These toads would not be expected to occur here because the site is well below the lower limit (8,000 feet above mean sea-level) of their preferred elevation. Therefore, this alternative would not impact the western boreal toad.

Approximately 126/117 acres of mature riparian cottonwoods would be inundated by construction of this alternative (Table 4-24). This habitat could be used by bald eagles for nesting, feeding, perching, and roosting. Any trees in the inundation zone not cleared during construction would die shortly after the reservoir filled. At normal pool elevation in early summer, most cottonwood trees would be completely covered with water and eliminated as potential roost sites. Dead cottonwood trees in shallow areas of the lake would not be completely submerged and would still be useful to bald eagles for several decades. The loss of trees would require resident bald eagles to seek suitable roost areas at other locations. Additional dead trees would be exposed in the fall and winter, when the water level in the reservoir is lowest, and could be used by migrating and wintering bald eagles as feeding and perching sites.
Table 4-24

AMOUNT OF THREATENED AND ENDANGERED SPECIES HABITAT POTENTIALLY AFFECTED BY EACH WATER SUPPLY ALTERNATIVE (acres)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Sandstone Dam</th>
<th>High Savery</th>
<th>Dutch Joe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>w/min pool</td>
<td>w/o min pool</td>
<td>w/min pool</td>
</tr>
<tr>
<td>Bald Eagle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cottonwood</td>
<td>126</td>
<td>117</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Peregrine Falcon, Mountain Plover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sagebrush</td>
<td>111</td>
<td>95</td>
<td>247</td>
</tr>
<tr>
<td>Meadow</td>
<td>36</td>
<td>33</td>
<td>146</td>
</tr>
<tr>
<td>Total</td>
<td>147</td>
<td>128</td>
<td>393</td>
</tr>
<tr>
<td>Swift Fox, Black-footed Ferret</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sagebrush</td>
<td>111</td>
<td>95</td>
<td>247</td>
</tr>
<tr>
<td>Meadow</td>
<td>36</td>
<td>33</td>
<td>146</td>
</tr>
<tr>
<td>Total</td>
<td>147</td>
<td>128</td>
<td>393</td>
</tr>
</tbody>
</table>

Once constructed, the reservoir would provide the largest body of water in the area. The dam and reservoir with a minimum pool, in particular, could attract additional bald eagles to the area. The reservoir could attract migrating waterfowl and would have a year-round fishery which would provide foraging opportunities for bald eagles. The reservoir without a minimum pool would be unlikely to support a significant fishery for use by bald eagles. Once the reservoir was frozen in winter, the eagles would move to ice-free areas. Overall, the Sandstone dam and reservoir with a minimum pool could benefit bald eagles by providing additional foraging areas within the region. However, both reservoir configurations would cause a loss of roosting areas. Overall impacts from the Sandstone dam and reservoir are expected to be neutral for a reservoir with a minimum pool and slightly detrimental for one without a minimum pool.

Peregrine falcons may occur in the Sandstone dam and reservoir area as migrants. No peregrine falcons are known to nest in the area and suitable nest sites are not present. No peregrine falcons were observed during field investigations. The Sandstone dam and reservoir would inundate 147/128 acres of suitable foraging habitat (Table 4-24). The reservoir, particularly with a minimum pool, could attract and concentrate migratory waterfowl which are an important source of food for migrating peregrine falcons. Mitigation for lost elk crucial winter range would enhance more acres of sagebrush and meadow than would be inundated by the project. These enhancements would also likely benefit the falcon. The overall impact of the project on peregrine falcons would be positive because foraging opportunities would be increased.
Mountain plover and swift fox also use sagebrush and meadow vegetation communities. The amount of these communities lost to inundation by the Sandstone dam and reservoir would be insignificant because these communities cover 70 percent of the surrounding land. As with the peregrine falcon, the fox could benefit from the enhancement of elk crucial winter range. The overall impact from the Sandstone alternative on these species is expected to be at least neutral and possibly beneficial.

Black-footed ferrets do not occur in the project area because of the lack of prairie dog colonies. Therefore, they would not be impacted by the Sandstone alternative.

4.6.5.2.2 High Savery Dam and Reservoir. The High Savery site is at an elevation considerably higher than that at which Ute ladies' tresses orchids are known to occur. A 1994 survey of the site failed to find any of these orchids. Because of the absence of this species at the site, the High Savery alternative would not impact Ute ladies' tresses.

Less than 1 acre of riparian cottonwood trees would be inundated by the High Savery dam and reservoir (Table 4-24). The general lack of appropriate roosting and nesting habitat suggests that bald eagles would be unlikely to use the High Savery site for foraging or breeding. Although the construction of a reservoir at this site could create a fishery or attract waterfowl, the lack of roosting sites makes it unlikely that the eagle would extensively use these resources. Therefore, the High Savery alternative would not impact bald eagles.

Peregrine falcons may occur in the High Savery dam and reservoir area as migrants. However, peregrine falcons are not known to nest in the area and suitable nest sites are not present. No peregrine falcons were observed during field investigations. The High Savery reservoir would inundate 393/296 acres of suitable peregrine falcon foraging habitat (Table 4-15). The new reservoir, particularly with a minimum pool, could attract and concentrate migratory waterfowl which are an important source of food for migrating peregrine falcons. Mitigation for lost elk, mule deer, and pronghorn antelope seasonal range would enhance sagebrush and meadow habitat which could also benefit the peregrine falcon. The overall project impact on peregrine falcons could be positive because of the enhancement of foraging opportunities.

Mountain plover and swift fox also use the sagebrush and meadow vegetation communities. The amount of these communities lost to construction and inundation by the High Savery dam and reservoir would be insignificant because these communities cover 80 percent of the surrounding land (Table 4-24). As with the peregrine falcon, the plover and the fox could benefit from the enhancement of big game seasonal range. The overall impact from the High Savery alternative on these species is expected to be at least neutral and possibly beneficial.

Black-footed ferrets do not occur in the project area because of the lack of prairie dog colonies. Therefore, they would not be impacted by the High Savery alternative.
4.6.5.2.3 Dutch Joe Dam and Reservoir.
The Dutch Joe site is at an elevation higher than that at which Ute ladies’ tresses orchids are known to occur. No orchids were found there during a 1994 survey. Because of the absence of this species at the site, the Dutch Joe alternative would not impact Ute ladies’ tresses orchid.

No riparian cottonwoods that could serve as suitable nesting and roosting areas for bald eagles would be disturbed by construction or inundated by the Dutch Joe dam and reservoir (Table 4-24). The lack of appropriate roosting and nesting habitat suggests that bald eagles would be unlikely to use the Dutch Joe reservoir for foraging or nesting. About one acre of riparian cottonwoods would be lost by development of the water supply pipeline and canal facility. These cottonwoods are of little value to bald eagles because the trees are distributed among numerous small clumps and are not located in the vicinity of habitat particularly suited to bald eagles. Overall, the Dutch Joe water supply alternative would not impact bald eagles.

Peregrine falcons may occur in the Dutch Joe dam and reservoir area as migrants. However, peregrine falcons are not known to nest in the area and suitable nest sites are not present. No peregrine falcons were observed during field investigations. The Dutch Joe reservoir would inundate 296 acres of suitable foraging habitat (Table 4-24). The reservoir could also attract and concentrate migratory waterfowl upon which falcons could prey. In addition, the mitigation of lost mule deer and pronghorn antelope crucial winter range would enhance sagebrush and meadow habitat which could increase foraging opportunities for peregrine falcon. The overall project impact on peregrine falcons could be positive.

Mountain plover, and swift fox also use the sagebrush and meadow vegetation communities. The amount of these communities lost to construction of and inundation by the Dutch Joe dam and reservoir would be insignificant considering these communities cover 99 percent of the surrounding land. As with the peregrine falcon and fox could benefit from the enhancement of mule deer and pronghorn antelope crucial winter range. The overall impact from the Dutch Joe alternative on these species is expected to be at least neutral and possibly beneficial.

Black-footed ferrets do not occur in the project area because of the lack of prairie dog colonies. Therefore, they would not be impacted by the Dutch Joe alternative:

4.6.5.2.4 Downstream Effects from Water Supply Alternatives. The proposed project is not expected to have adverse thermal impacts on the federally endangered Colorado pikeminnow, humpback chub, razorback sucker, or bonytail. The Sandstone or High Savery alternatives would not impact these fish because the temperature of water entering the Little Snake River from Savery Creek would be nearly the same as historic conditions. As currently designed, the Dutch Joe dam and reservoir would release unseasonably cold water into the Little Snake River at the beginning of the late-season irrigation period. The reduced water temperature is unlikely to affect the Colorado pikeminnow, razorback sucker, bonytail, or humpback chub because these species
occur far enough downstream from Dutch Joe Creek for natural warming to return the cold water to near normal temperature before it reaches them.

The reservoir alternative would affect other aspects of the downstream riverine environment. Flow in the Little Snake River and farther downstream would be depleted on an annual basis as more water is diverted for irrigation. Peak flows, which typically occur in the spring, would be reduced in intensity and summer base flows would be increased. Sediment transport in the rivers would be reduced. Each of these changes, though relatively small in magnitude (i.e., less than 10 percent of existing conditions), could impact the four endangered fish species through cumulative impacts on rivers which have already been substantially degraded by water control projects. Spawning behavior would be disrupted if the typical hydrologic cycle of high spring flows and low summer flows is changed. The formation and maintenance of spawning and nursery habitats would be impaired by changes in flow regimen and reductions in sediment transport. Increases in summer base flow and reductions in sediment loads would favor non-native fishes which compete with and prey upon the endangered, native fishes.

Sediment yield to the lower Little Snake and Yampa Rivers resulting from sediment storage in any of the reservoirs is not expected to have a significant impact on the habitat of any of the endangered species downstream from the project. The small decrease in flows attributable to the project in the Little Snake River and the Lily, Colorado gage is likely unmeasurable. The error inherent in the sampling equipment is greater than the change in stream flow resulting from operation of the project. Changes in stream flow in the Yampa River through Dinosaur National Monument would be even less detectable than the lower Little Snake. Further, the unmeasurable flow reduction in the Yampa would be unlikely to cause any noticeable reduction in the sediment transport ability of the stream. The annual discharge of the Yampa below the confluence of the Little Snake river is 1,545,621 acre-feet while the annual discharge of the Little Snake measured at Lily, Colorado, just above the confluence with the Yampa is 420,039 acre-feet. Therefore, the Little Snake provides 37 percent of the annual flow of the Yampa in Dinosaur National Monument. Project operation would result in annual flow reductions of about 2 percent in the Yampa below the Little Snake Confluence. This reduction in flow is not measurable. The effects, if any, of this flow and sediment reduction on the spawning, rearing, or adult habitat of any of the endangered species in Dinosaur National Monument, or further downstream, cannot be determined. However, it is the official opinion of the FWS that any depletions jeopardize the continued existence of the endangered fish species. The water depletion charge that will be paid to the Upper Colorado River Endangered Fish Recovery Program as stipulated in the Biological Opinion has been determined to be adequate to mitigate all of the anticipated impacts to the endangered species.

Under the Colorado River Recovery Program, any depletion of flow to the Colorado River or its tributaries, including the Yampa, Green, and Little Snake rivers, is considered a jeopardy to the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. Because operation of this project would result in an annual flow depletion in the Little
Snake River, the project is considered to have a significant impact on these four fish. For the purpose of consultation on impacts to these species caused by river flow depletion in Wyoming, Colorado, and Utah, FWS calculated an annual depletion in the Little Snake River of 7,724 AF (Jennings 1998). This amount differs from other depletion estimates given in this EIS (e.g., 10,800 AF at Lily, Colorado for the High Savery alternative) because FWS does not consider conveyance losses or losses from the use of irrigation return flows to be depletions (Felley 1998, Jennings 1998).

4.6.5.2.5 Water Conservation and No-Action. No federally threatened or endangered species would be affected by implementation of the conservation or no-action alternatives.

4.6.5.3 Mitigation

4.6.5.3.1 Dam and Reservoir Alternatives. No mitigation would be necessary for the Ute ladies’ tresses orchid, western boreal toad, and black-footed ferret because these species do not occur at any of the proposed dam and reservoir sites. For the peregrine falcon, northern goshawk, and swift fox, the preferred habitat that would be lost is very common in the project area and would be offset by enhancement of habitat intended to mitigate lost crucial winter or seasonal ranges for elk. The loss of crucial winter range for mule deer and pronghorn antelope are not mitigatable (WGFD 1999). Mountain plovers are adapted to short grass conditions and to coexist with large, hoofed mammals. No shortage of this habitat (i.e., over-grazed rangeland and cattle) exists in the immediate vicinity of any of the dam and reservoir alternatives. Mitigation for lost mountain plover habitat would not be necessary. Mitigation for bald eagle habitat would be required for the Sandstone and High Savery alternatives and would consist of the replacement or enhancement of cottonwood riparian habitat as described in Section 4.6.1.3. Mitigation for bald eagle habitat at the Dutch Joe site would not be necessary because no bald eagle habitat would be lost.

4.6.5.3.2 Downstream Impacts. Since settlement by Euroamericans, flows and water quality in rivers in the Colorado River basin have been extensively modified by damming and water withdrawals. Although some of these changes have been individually insignificant, the cumulative impacts have raised concerns for fish and wildlife which depend on these rivers for their existence. The LSSIWSP would cause a depletion of 7,724 AF for which mitigation would be required. This depletion, along with changes in flow regimen and water quality, would represent additional incremental changes in the historic hydrology of the Colorado River system. To help prevent further deterioration in the Little Snake River and other rivers in the Upper Colorado River basin, the depletion caused by this project would be mitigated by a monetary contribution to the Colorado River Recovery Program.

4.6.5.3.3 Water Conservation and No-Action. No mitigation is proposed for either of these alternatives.
4.6.6 SPECIES OF SPECIAL CONCERN
Nine species of special concern were identified that could be affected by the water supply alternatives (Table 3-7):

- Weber's Ipomopsis
- Flannelmouth Sucker
- Ferruginous Hawk
- Bluehead Sucker
- Colorado River Cutthroat Trout
- Black Tern
- Roundtail Chub
- White-faced Ibis
- Long-billed Curlew

4.6.6.1 Methodologies and Significance Criteria
Information from WGFD and FWS was used to determine the occurrence and habitat of species of special concern within the affected areas. If the project could result in the loss of individuals of a species of special concern or reduce the quantity or quality of suitable habitat, the impact to that species would be significant.

4.6.6.2 Impacts
Of the nine potentially impacted species of special concern, the bluehead sucker, flannelmouth sucker, CRCT, and white-faced ibis have been documented to occur at or near one or more of the alternative sites. The roundtail chub is known to exist downstream of the project area in the Little Snake River. Suitable habitat exists in the project area for Weber’s ipomopsis, ferruginous hawk, black tern and long-billed curlew. These species could occur at one or more of the alternative sites.

4.6.6.2.1 Sandstone Dam and Reservoir. Suitable potential habitat for all nine of the species of special concern occurs at the proposed Sandstone dam and reservoir site. However, only the bluehead sucker, flannelmouth sucker, Colorado River cutthroat trout, and white-faced ibis have been documented to occur on or near the site. The observations of white-faced ibis in the vicinity of the Sandstone alternative have been limited to seasonally migrating flocks.

Potential habitat for Weber’s ipomopsis, sagebrush steppe and grassland meadows, occurs in the Sandstone inundation area (Table 4-25). This area, however, is outside the range of elevation where this species has typically been found. Therefore, the Sandstone water supply alternative would not impact this species.

The bluehead sucker was widely distributed in the Savery Creek basin in the 1950s (Kanaly and Williams 1958). More recent surveys of the same area, however, failed to collect bluehead suckers (FWS 1994, 1998a; Wheeler 1997) which suggests the fish has been extirpated from the basin. The bluehead sucker is known to inhabit the Little Snake River. The Sandstone dam and reservoir would inundate 7.1/6.4 miles of permanent streams which contains potential habitat for the bluehead sucker. This development would block upstream and downstream movements and make areas upstream of the reservoir inaccessible to individuals in the lower portions of Savery Creek and the Little Snake River. Therefore, transportation around the dam would be necessary to re-establish bluehead suckers in the upper portions of Savery Creek.
Table 4-25

AMOUNT OF HABITAT FOR TERRESTRIAL SPECIES OF SPECIAL CONCERN POTENTIALLY AFFECTED BY EACH WATER SUPPLY ALTERNATIVE (acres)

<table>
<thead>
<tr>
<th>Species</th>
<th>Sandstone Dam w/min pool</th>
<th>Sandstone Dam w/o min pool</th>
<th>High Savery w/min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weber's Ipomopsis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sagebrush</td>
<td>111</td>
<td>95</td>
<td>247</td>
<td>217</td>
<td>261</td>
</tr>
<tr>
<td>Meadow</td>
<td>36</td>
<td>33</td>
<td>146</td>
<td>126</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>147</td>
<td>128</td>
<td>393</td>
<td>343</td>
<td>296</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sagebrush</td>
<td>111</td>
<td>95</td>
<td>247</td>
<td>217</td>
<td>261</td>
</tr>
<tr>
<td>Meadow</td>
<td>36</td>
<td>33</td>
<td>146</td>
<td>126</td>
<td>35</td>
</tr>
<tr>
<td>Cottonwood</td>
<td>126</td>
<td>117</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>273</td>
<td>245</td>
<td>394</td>
<td>344</td>
<td>296</td>
</tr>
<tr>
<td>White-faced Ibis, Black Tern, Long-billed Curlew</td>
<td>25</td>
<td>24</td>
<td>16</td>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>

Releases of water for late-season supplemental irrigation would tend to improve habitat for bluehead suckers by creating additional areas of moderate to fast current. Coldwater releases from reservoirs have been implicated in the wide-spread decline of this species' populations. The Sandstone alternative would not contribute to this problem because the dam would be equipped with a multi-level outlet works, which would allow the release of water with seasonable temperatures. In general, the Sandstone dam and reservoir would have minimal impacts on downstream habitats as a result of flow or water temperature changes and no impact on upstream habitats. Therefore, the Sandstone water supply alternative would not impact bluehead suckers in Savery Creek even if they were present, or in the Little Snake River. The presence of the Sandstone dam and reservoir would not be an impediment to the future colonization of lower Savery Creek by bluehead suckers from the Little Snake River.

The roundtail chub has not been conclusively demonstrated to exist in Savery Creek. Recent surveys (WGFD 1994, 1998a) did not find any of these chubs in Savery Creek or in the Little Snake River. Therefore, the Sandstone dam and reservoir would probably have no impact on roundtail chub.

The flannelmouth sucker occurs at the location of the Sandstone dam and reservoir and in Savery Creek and the Little Snake River downstream of the project area (WGFD 1994, 1998a). The impacts on the flannelmouth sucker from the Sandstone alternative would be similar to that experience by the bluehead sucker. The flannelmouth sucker, however, is more of a generalist in
its habitat requirements and, therefore, would be expected to be less sensitive than the bluehead sucker to changes caused by the project. The impacts of flow reductions in Savery Creek and the Little Snake River on flannelmouth sucker habitat would be minimal because these reductions would occur when normal flows are greatest. Releases for late-season irrigation would benefit flannelmouth suckers by increasing habitat quantity when flows are typically at their lowest. Flannelmouth suckers would not be affected by water temperature changes because the Sandstone dam would not release unseasonably warm or cold water. With the possible exception of blocking upstream and downstream movement, the Sandstone dam and reservoir would have no impact on flannelmouth suckers.

CRCT are not known to occur in Savery Creek in the vicinity of the proposed Sandstone dam and reservoir. Their closest occurrence is in Hell Canyon Creek, which joins Savery Creek approximately one mile above the proposed Sandstone reservoir. Hell Canyon Creek would not be directly affected by inundation. However, the number of rainbow trout in Savery Creek would likely increase if the Sandstone reservoir with a minimum pool were constructed. It could be necessary to construct a fish barrier at the mouth of Hell Canyon Creek to prevent rainbow trout from moving upstream and hybridizing with the Hell Canyon Creek CRCT. The release of water for late-season irrigation is predicted to create nearly as much trout habitat downstream of the dam as would be lost to inundation. This increase in downstream habitat would improve the chances for successful re-introduction of CRCT into the main-stem of Savery Creek.

Ferruginous hawks may use habitat within the inundation zone of the Sandstone reservoir. The primary impact of the Sandstone dam and reservoir on this species would be the loss of 126/117 acres of riparian cottonwoods which could be used for foraging and nesting habitat (Table 4-25). Large stands of riparian cottonwoods are uncommon in the area, and their loss could significantly affect the amount of nesting and foraging habitat for ferruginous hawks on Savery Creek. The Sandstone alternative would also inundate 111/95 acres of sagebrush and 36/33 acres of meadow (Table 4-25) which are foraging areas for the ferruginous hawk. However, sagebrush and meadow foraging habitat is abundant throughout the area and its loss would not affect the ferruginous hawk.

The Sandstone dam and reservoir would impact 25/24 acres of wetlands (Table 4-25) which could be habitat for white-faced ibis, black tern, and long-billed curlew. However, the use of these wetlands by these species has not been documented. Therefore, the Sandstone alternative would probably not adversely impact the white-faced ibis, black tern, or long-billed curlew. The mudflats created when the reservoir is drawn down in late-summer could provide additional foraging habitat for the long-billed curlew.

4.6.6.2.2 High Savery Dam and Reservoir. Only the flannelmouth sucker, CRCT, and white-faced ibis have been documented to occur on or near the proposed High Savery dam and reservoir site. The observations of white-faced ibis in the vicinity of the High Savery site have been limited to seasonally migrating flocks.
Sagebrush steppe and meadow grasslands, potential suitable habitats for Weber’s ipomopsis, occur in the High Savery project area (Table 4-25). Weber’s ipomopsis, however, is not expected to occur here because the area is outside the range of elevation where this species has typically been found. Therefore, the High Savery alternative would not impact this species.

The High Savery dam and reservoir would inundate 8.4/7.4 miles of permanent streams which contain potential habitat for the bluehead suckers. Otherwise, the potential impacts to bluehead suckers from the High Savery dam and reservoir would be the same as from the Sandstone dam and reservoir.

As stated earlier, recent surveys (WGFD 1994, 1998a) did not find roundtail chubs in Savery Creek or in the Little Snake River. Therefore, the High Savery reservoir would probably have no impact on roundtail chub.

The flannelmouth sucker occurs in streams at the location of the High Savery dam and reservoir and in Savery Creek and the Little Snake River downstream of the project area (WGFD 1994, 1998a,b). The impacts on the flannelmouth sucker from the High Savery alternative would be the same as from the Sandstone dam and reservoir.

The release of water for late-season irrigation is predicted to create approximately eight times more trout habitat in Savery Creek downstream of the dam than would be lost by inundation. This increase in trout habitat would improve the chances for successful re-introduction of CRCT into the main-stem of Savery Creek. With a minimum pool, the High Savery alternative could serve as a site where isolated, genetically pure, stocks of CRCT could be reared. Offspring from these fish would be stocked into streams throughout the Little Snake River basin as part of the recovery program for this species (WGFD 1998b). The High Savery dam and reservoir, therefore, could have positive impacts on CRCT.

Ferruginous hawks would not be expected to nest at this site because of the near absence of cottonwood trees. The primary impact of the High Savery dam and reservoir on this species would be the loss of foraging habitat in the form of 247/217 acres of sagebrush and 146/126 acres of meadow (Table 4-25). Because foraging habitat is abundant and hawks are capable of foraging over large areas, the loss of this habitat by developing the High Savery water supply alternative would likely have little affect on ferruginous hawks.

The loss of 16/13 acres of wetlands in the High Savery reservoir inundation zone would probably not significantly impact white-faced ibis, black tern, and long-billed curlew because use of these wetlands by these species has not been documented.

4.6.6.2.3 Dutch Joe Dam and Reservoir. Vegetation community types compatible with Weber’s ipomopsis exist within the dam and reservoir area. However, this species has not been observed in the vicinity of the Dutch Joe alternative and the water supply pipeline and canal
facility and is not expected to occur here because the area is outside the range of elevation where this species has typically been found. Therefore, no impacts on Weber’s ipomopsis from the Dutch Joe alternative are expected.

The fish species of special concern; bluehead sucker, roundtail chub, flannelmouth sucker, and CRCT, do not occur at the Dutch Joe site because Dutch Joe Creek is an intermittent stream which does not support a fishery. However, initial releases of late-season supplemental irrigation water could reduce the water temperature in the Little Snake River by about 5 °F. While these cold temperatures would be reduced through the use of a multi-level outlet structure, the potential temperature reduction could have a detrimental affect on bluehead sucker, roundtail chub, and flannelmouth sucker.

Ferruginous hawks may currently forage over the 331 acres of sagebrush steppe and 109 acres of meadow that would be disturbed or inundated by the dam and reservoir and pipeline and canal (Table 4-25). However, no suitable nesting habitat for this species occurs on the site. The loss of forage habitat is not expected to significantly affect this species because hawks are capable of foraging over large areas and similar habitat covers 99 percent of the land around the reservoir site. Therefore, no impacts on ferruginous hawks from the Dutch Joe alternative are expected.

The Dutch Joe site contains about 3 acres of wetlands which could serve as potential nesting and foraging habitat for white-faced ibis, black terns, and long-billed curlews (Table 4-25). Loss of these wetlands would probably not impact these species because more extensive tracts of wetlands exist elsewhere in the project area. Also, the use of wetlands in the project area by these species has not been documented. Therefore, white-faced ibis, black terns, and long-billed curlews would not be impacted by the Dutch Joe dam and reservoir.

4.6.6.2.4 Water Conservation and No-Action. The conservation alternative would result in some leveling of land used for hay fields or pasture. These areas would not constitute important habitat for species of special concern. The no-action alternative would not affect terrestrial or aquatic habitats in the project areas. Species of special concern, therefore, would not be affected by these alternatives.

4.6.6.3 Mitigation

4.6.6.3.1 Dam and Reservoir Alternatives. Important habitats for terrestrial species of special concern requiring mitigation include riparian cottonwoods, riparian willow/alder shrublands, and wetlands. Mitigation for these habitats would include acquisition, enhancement, and creation of similar areas as discussed in Sections 4.6.1.3 and 4.6.2.3. Ferruginous hawks could also benefit from improvements to sagebrush steppe and grassland meadows as a result of mitigation of big game ranges (Section 4.6.3.3).
Mitigative measures relating to the protection of aquatic species of special concern would include those designed to protect surface hydrology, water quality, and fisheries. These measures are discussed in Sections 4.3.1.3, 4.3.2.3, and 4.6.4.3 and include a minimum flow release, multi-level outlet, energy dissipations structures, and increased summer flow in Savery Creek.

**4.6.6.3.2 Conservation and No-Action Alternatives.** No mitigation is proposed for either of these alternatives.

### 4.7 SOCIOECONOMICS

The construction and operation of a new dam and reservoir would have both positive and negative impacts from a social and economic perspective. The construction phase would take approximately two years and would create some short-term employment in the area. However, little new long-term employment would be created because the operation and maintenance of a reservoir would not require a full-time staff. The construction of a reservoir would take grazed land out of use while providing supplemental irrigation water to make cropped lands more productive. Changes in land use could have some impacts on public finances, depending on how much private land would be taken off the tax roles. Lost property tax revenues would not be made up by the state because Wyoming does not make payments in lieu of taxes.

**4.7.1 METHODOLOGIES AND SIGNIFICANCE CRITERIA**

Existing social and economic conditions and trends within the project region were documented and impacts caused by the project were evaluated. Based on existing conditions and trends, project impacts would be significant if changes in the social and economic environment of the area would exceed the ability of the area to absorb the change.

**4.7.2 POPULATION**

**4.7.2.1 Dam and Reservoir Alternatives**

The primary effect on population would be a temporary increase from the influx of the construction work force. Construction is expected to take two years for any of the alternatives and would occur only during May through November. The peak work force expected at any single site would be approximately 60 to 80 people. While this work force represents 20 to 25 percent of the combined population of Baggs and Dixon, Wyoming, it is less than 0.5 percent of the 1994 estimated population in the region of the project which includes Rawlins, Wyoming, and Craig, Colorado (see Section 4.7.4 for more information on employment). The project work force would likely be composed of both local and non-local personnel. Non-local workers would be distributed throughout the area, with some residing locally in the Baggs area and others commuting from Craig, Rawlins, or other localities. Even if all of the workers came from outside of the study area, the addition would not offset the overall annual loss in population experienced in these areas over the last decade (Table 3-10).
Because the alternatives would not require a full-time operating staff, no direct impact on long-term, permanent population would occur as a result of project operations. While some minor, short-term, seasonal increases in regional population would occur, these increases would not constitute a significant impact to regional population.

4.7.2.2 Water Conservation
Water conservation would involve limited construction on a local basis. Local labor would likely be used for any construction associated with this alternative. No increase in population would be expected as a result of the water conservation alternative.

4.7.2.3 No-Action
The no-action alternative would not require any construction or result in any change in the availability of water for agriculture or recreation. Consequently, this alternative would not impact the regional population.

4.7.3 LAND USE

4.7.3.1 Dam and Reservoir Alternatives
The development of a dam and reservoir would alter the current land use of the inundated area and other lands immediately adjacent to the reservoir. The land may be either state, federal, or privately owned. The total land required by the dams and reservoirs ranges from 330 acres for Sandstone without a minimum pool to 482 acres for High Savery with a minimum pool. The Sandstone alternative consists entirely of private land, whereas the other alternative sites contain public and private lands (Table 4-26). The land use in each area is primarily rangeland with some pasture.

4.7.3.1.1 Sandstone Dam and Reservoir. The Sandstone dam and reservoir would require at least 370/330 acres of private land. The majority of this land consists of various types of rangeland (Section 4.6.1). The affect of the loss of rangeland and pasture would be minimal because approximately 1 and 2.5 million acres of such lands exist in Moffat County, Colorado, and Carbon County, Wyoming, respectively. No significant change in land use would result from the implementation of this alternative.

The project would provide a source of supplemental water to irrigate existing pasture and hayfields in the Little Snake River valley. The additional irrigation would improve the quality of the pasture and the quantity of hay and other crops produced. Therefore, the benefit of the project would be an increase in agricultural production in the valley without increasing the amount of land in pasture and hay production.

4.7.3.1.2 High Savery Dam and Reservoir. This alternative would require the acquisition of at least 482/420 acres of federal, state, and private land. The total amount of private land affected would be 367/320 acres (Table 4-26). The total amount of pasture included in the area would be
146/126 acres. As described above, the impact of the loss of this land would be minimal compared to the total acres of pasture and rangeland in Carbon and Moffat counties. This alternative would provide the same benefits to agriculture as the Sandstone dam and reservoir. No significant impacts to land use would result from this alternative.

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Sandstone with min pool</th>
<th>Sandstone w/o min pool</th>
<th>High Savery with min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>State of Wyoming</td>
<td>0</td>
<td>0</td>
<td>87</td>
<td>79</td>
<td>147</td>
</tr>
<tr>
<td>Private</td>
<td>370</td>
<td>330</td>
<td>368</td>
<td>320</td>
<td>303</td>
</tr>
<tr>
<td>Total</td>
<td>370</td>
<td>330</td>
<td>482</td>
<td>420</td>
<td>450</td>
</tr>
</tbody>
</table>

4.7.3.1.3 Dutch Joe Dam and Reservoir. This alternative would require the acquisition of at least 450 acres of land. Of this total, 303 acres would be private land (Table 4-26). Approximately 78 acres are currently used for pasture. The loss of this land would have minimal impacts, whereas the late-season supplemental irrigation water provided by the project would increase agricultural production in the Little Snake River valley. No significant impacts to land use would result from this alternative.

4.7.3.2 Water Conservation.
Water conservation would not require the acquisition of any public or private lands. Likewise, no pasture or grazing land would be removed from use. With conservation, irrigators in the Little Snake River valley could irrigate land more efficiently. The probability and frequency that all irrigators would receive their appropriated quantity of irrigation water would increase. This benefit would only accrue during times when adequate flows occur in the streams. Conservation could not provide additional water during the late-summer when the irrigation water is most needed for hayfields or irrigated pastures. Significant changes in overall land use in the area are not expected from the implementation of the conservation alternative.

4.7.3.3 No-Action
The no-action alternative would not lead to any changes in existing land use, nor would it provide any benefits to ranchers.
4.7.4 EMPLOYMENT AND INCOME

4.7.4.1 Water Supply Alternatives
The construction and operation of a dam and reservoir would provide benefits in terms of jobs and income within the study area. Most of the employment benefits would stem from the construction phase, while both construction and operation would contribute to local income. The purchase of materials, fuel, food, and services by construction workers and visitors to the reservoir would also contribute to the local income. These purchases would be distributed throughout the region, resulting in only minor increases in any one area or sector of the economy. Some of these expenditures would go to suppliers outside the project area and would have no impact on local income and retail sales.

Construction of any of the proposed water supply alternatives would take approximately two years. The construction season would be limited by weather conditions and wildlife considerations to May through November. Construction would involve clearing, grading, embankment and concrete work, road paving, and other related activities. Separate crews would perform the different tasks. The number of workers required for each reservoir varies roughly by the size of the dam (Table 4-27). Some opportunity for the employment of local labor would occur as a result of the influx of non-local construction workers. These opportunities would likely occur in the service areas, including restaurants, hotels, service stations, and grocery stores. However, these jobs would be temporary and seasonal. No significant short-term changes in permanent employment would occur.

<table>
<thead>
<tr>
<th>Table 4-27</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESTIMATED PEAK WORK FORCE FOR EACH ALTERNATIVE</td>
</tr>
<tr>
<td>Sandy Stone</td>
</tr>
<tr>
<td>with min pool</td>
</tr>
<tr>
<td>Workers</td>
</tr>
</tbody>
</table>

The long-term economic benefit from operation of the reservoirs would stem from the increased income earned by irrigators as well as recreation-related expenditures in the area. All of the reservoir water supply alternatives would be designed to provide 12,000 AF of water for late-season supplemental irrigation. The annual benefit for irrigation water in the Little Snake River Basin is estimated to be $19.75/AF in direct benefits from increased crop production and $15.78/AF from indirect benefits to other sectors of the economy (WWCI 1991, adjusted to 1999 dollars). Based on these estimates, the late-season supplemental irrigation water would result in an annual economic benefits of $426,400. This benefit would more than offset the loss of agricultural production caused by the inundation of unirrigated rangeland by the water supply alternatives. Using a direct agricultural production value of $6.00 per acre and indirect benefits of $4.80 per acre for unirrigated land (WWCI 1991, adjusted to 1999 dollars) and the amounts of
sagebrush steppe and grassland meadow inundated by each dam and reservoir alternative (Table 4-20), lost production value would be $1,600/$1,400 for the Sandstone alternative, $4,200/$3,700 for the High Savery alternative, and $3,200 for the Dutch Joe alternative.

Recreational expenditures would vary by dam and reservoir alternative because recreation is related to reservoir location, the surface acres of the reservoir, and the existence of a minimum pool. The Sandstone and High Savery reservoirs may or may not have minimum pools. Dutch Joe would not have a minimum pool. Reservoir alternatives without a minimum pool would essentially be dry by the end of the summer irrigation period. Recreational facilities at the sites would potentially consist of boat access and some limited camping and picnicking facilities. Reservoir alternatives without minimum pools are expected to have much lower recreational use (see Section 4.9 for a detailed discussion of the effect on recreation). The total value of the project to the local economy would range from approximately $469,000 to $573,800 per year (Table 4-28).

<table>
<thead>
<tr>
<th>Table 4-28</th>
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</thead>
<tbody>
<tr>
<td><strong>ANNUAL ECONOMIC VALUE FOR EACH ALTERNATIVE</strong>¹</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Gain</td>
</tr>
<tr>
<td>Loss</td>
</tr>
<tr>
<td>Net</td>
</tr>
<tr>
<td>Recreation²</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

¹1999 dollars.
²See Section 4.9.2 and Table 4-18.

Disposable income resulting from the project would be spent throughout the region, in part because of the lack of services in the Baggs area and the remote nature of the region. Therefore, while the project would result in economic growth to the surrounding area, the actual growth for a specific local town or county would not be significant.

4.7.4.2 Water Conservation

Under this alternative, landowners would change their agricultural practices and undertake activities such as land leveling, lining on-farm canals, and installing sprinkler systems. Most of the labor involved would be performed by the landowners, their employees, or other local labor. Therefore, this alternative would not result in appreciable additional employment. Water saved by conservation would need to be used for irrigation of additional cropland or pasture if additional
income is to be realized. Conservation could provide at most savings of 20 to 50 percent. The resulting annual increase in income then would be 20 to 50 percent of the amount generated by a new water supply or $85,300 to $213,200. However, conservation measures would be expensive to implement on a large scale. Additionally, conservation would not provide any benefit during late summer, which is the time period of current shortages, because no water is available to conserve. Water conservation would not provide any recreation benefits. This alternative would have no significant impact on employment and income in the area.

4.7.4.3 No-Action
No employment, agricultural or recreational benefit would result from implementation of the no-action alternative. Current practices and trends would be expected to continue. No significant impacts to employment would result.

4.7.5 HOUSING
The two issues related to housing are the potential loss of housing in the water supply inundation zone and the demand for housing that could accompany the construction and operation of the water supply alternative.

4.7.5.1 Water Supply Alternatives
No residences or farm buildings are located within the boundaries of any of the potential dams and reservoirs. The only buildings that would have to be relocated or demolished would be two cabins within the Sandstone dam and reservoir area. These cabins are used for short-term stays by visitors on trail rides or hunting trips offered by a local rancher.

During construction, the influx of non-local workers would increase the demand for temporary housing such as rental property, motels, or recreational vehicle parks. This demand would be spread over the entire region and would include the towns of Savery, Dixon, Baggs, Rawlins, and Craig. Workers would likely reside as much as 100 miles from the project site, reducing the overall demand on housing in any given locality. The expenditures by workers would be a benefit to the local rental market, which has been declining over the last decade. Adequate rental property would be available within the region to accommodate construction workers because of this decline. Construction of the water supply project would have a short-term positive impacts on rental property by reducing excess capacity.

The recreational use of potential reservoirs could contribute to the demand for motels, recreational vehicle parks, and campgrounds. It is also possible that the reservoirs could attract residential development. Purchase of property for the reservoirs could leave remainders on which their current use (e.g. ranching) would no longer be economically feasible. These lands could be subdivided and sold to parties interested in developing country homes of seasonally retreats. The increased income from agriculture and recreation could prevent some of the decline in population and subsequent excess housing capacity that has been accumulating in the region. No significant impacts on existing housing would result from operation of a water supply alternative.
4.7.5.2 Water Conservation
Implementation of water conservation measures would not require the removal of any houses or other buildings. This alternative would not lead to any additional housing demand related to construction or operation. No significant impacts would result from this alternative.

4.7.5.3 No-Action
Under the no-action scenario, no housing or other buildings would be removed and no additional demand for housing would occur. The high vacancy rate in housing would be expected to continue. The no-action alternative would have no significant impacts on area housing.

4.7.6 COMMUNITY SERVICES AND FACILITIES

4.7.6.1 Water Supply Alternatives
The addition of 62 to 86 workers to the project area would impose minimal, if any, increase in demand on local services facilities. Construction and recreation activities could lead to accidents that would require emergency medical services. Adequate hospital facilities are present within the region to accommodate any additional injuries caused by construction or the slight, temporary increase in population.

Some additional police patrol of the water supply alternative facilities could be required. The existing police force for Carbon County should be able to accommodate the additional patrols and police services associated with project construction and operation.

Few workers would be likely to enroll children in the local schools because of the seasonal timing of the construction. Should workers’ families relocate to the area during construction, area schools and churches should be adequate to accommodate them. Excess classroom facilities are present, therefore, small increases in enrollment would not cause overcrowding in schools.

The construction and operation of a reservoir would result in an increase in traffic on the roads that lead to the individual sites. Because both workers and recreation users would come from different communities in the area, the traffic would be spread over the local and state roads in Carbon and Moffat counties. The increase in vehicle trips on any particular road would be negligible. Depending on the alternative, 3 to 10 miles of unimproved dirt roads leading to the site would be improved to all-weather gravel roads.

As discussed earlier, population increases would be nominal and distributed throughout the region. Therefore, a negligible increase would occur in the demand for drinking water and wastewater treatment facilities. The construction of a reservoir could improve the availability or reliability of water supplies for the towns of Baggs and Dixon. Up to 200 AF of water could be available from a new reservoir to these communities. In addition, the release of water during the late summer would improve the reliability of the water supply facilities along the Little Snake River.
4.7.6.2 Water Conservation
This alternative would not attract additional workers or any additional visitors for recreation. Therefore, no increase in demand on public services and facilities would occur. Water conservation would not result in any additional stream flows during the late summer for municipal use. The local communities would not benefit from the additional 200 AF of water or late-summer releases that the proposed project would provide. No significant impacts to public services and facilities would occur.

4.7.6.3 No-Action
The no-action alternative would not result in any increased demands on public services or facilities, nor would it provide any additional water for municipal use. No significant impacts to public services and facilities would occur.

4.7.7 PUBLIC FINANCE

4.7.7.1 Water Supply Alternatives
The construction of a water supply dam and reservoir would require the acquisition of some federal, state, or private lands depending on the site (Table 4-17). Because the project would be state-owned, private lands acquired for the dam and reservoir would be removed from local tax rolls. This removal would reduce local and county property tax revenues because the State of Wyoming does not make payments in lieu of taxes. Agricultural lands account for only approximately three percent of the assessed value of Carbon County. The loss of 153 to 370 acres of pasture (Table 4-26) from the tax roles would have a negligible impact on tax revenue in the county. On the other hand, the value of the land surrounding the reservoir and the 13,900 acres that would receive the late-season supplemental irrigation water could increase. The overall increase in the tax base would likely more than offset the tax loss related to the removal of lands from the tax roles for a water supply reservoir.

Construction and operation and maintenance of a reservoir would result in increased retail sales and fuel tax revenues. As discussed under employment and income, the estimated annual recreation-related expenditures would amount to between $91,400 and $281,800 per year. Because the dam and reservoir alternatives would not significantly increase demands on public services and facilities, public expenditures would also not be increased. The net result of the construction of a reservoir would be a benefit to local and county finances.

4.7.7.2 Water Conservation
The implementation of water conservation measures would not result in the removal of any lands from the tax rolls. Conservation measures would possibly increase the value of irrigated lands, but not as much as additional water supplies. No additional revenues from recreation-related expenditures would accrue and no additional local or county public spending would occur as a result of the water conservation alternative.
4.7.7.3 No-Action
This alternative would have no impact on tax revenues or public expenditures in Carbon County.

4.7.8 MITIGATION
No adverse or significant impacts to any of the above socioeconomic parameters would result from construction of a water supply alternative. Therefore, no mitigation is proposed.

4.8 CULTURAL RESOURCES

The LSSIWSP has the potential to impact cultural resources in several ways. Construction, inundation, or erosion could destroy sites and prevent the recovery of culturally significant or historically important information. Pedestrian activities could damage the integrity of prehistoric sites and reduce their scientific value. The nearby presence of a dam and reservoir could alter the character of historic sites.

4.8.1 METHODOLOGIES AND SIGNIFICANCE CRITERIA
Existing information was reviewed to determine if any known cultural resources were present within any of the proposed dam and reservoir areas. A Class III cultural resource inventory was performed for each potential water supply. Surveys were conducted in accordance with the Secretary of the Interior’s *Standards and Guidelines for Archeology and Historic Preservation* (48 FR 44716-44742), and the Wyoming State Historic Preservation Office (SHPO). All of the sites were evaluated or are awaiting evaluation for their potential listing on the National Register of Historic Places (NRHP). The criteria used to determine the inclusion of a site on the NRHP is in accordance with the Department of the Interior’s regulations 36 CFR 60.4:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that (a) are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or (d) that have yielded or may be likely to yield information important in history or prehistory.

Impacts to cultural resources would be considered adverse if the project would damage or destroy any sites eligible for the NRHP.
4.8.2 IMPACTS
Among the three dam and reservoir alternatives, a total of 36 sites and 11 isolated finds were found. Fourteen of the sites are considered to be eligible for listing on the NRHP or are unevaluated and have been recommended for further testing to determine their NRHP eligibility (Quick and Light 1995, Seacat and Latham 1997). Eleven of these sites were evaluated archaeologically against the NRHP criteria (Latham 1999). Many of the prehistoric sites at the High Savery dam and reservoir were also evaluated by ethnographic research (Deaver and Walker-Kuntz 1999). Based on those observations, five sites (48CR92, 48CR5844, 48CR6912, 48CR6913, and 48CR7108) were determined to be eligible for listing on the NRHP.

4.8.2.1 Sandstone Dam and Reservoir
The proposed Sandstone dam and reservoir alternative would adversely affect three sites which are identified as being eligible for the NRHP or are unevaluated and have been recommended for further testing to determine their NRHP eligibility (Table 4-29). The two eligible sites are 48CR4265 and 48CR1181. Site 48CR4265 is prehistoric and site 48CR1181 is historic. Both eligible sites are located within the proposed inundation zone. The unevaulated site (48CR3600) is the historic Boyer Ranch. It would require additional research or testing to determine its NRHP eligibility. It is located immediately below the proposed location of the dam. Should this alternative be chosen, construction of the dam could adversely effect this site if it is determined NRHP eligible.

<table>
<thead>
<tr>
<th>Prehistoric Sites</th>
<th>Historic Sites</th>
<th>Multi-component Sites</th>
<th>Isolated Finds</th>
<th>Eligible or Unevaluated Sites with Potential for NRHP Listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>High Savery</td>
<td>16</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Dutch Joe</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

4.8.2.2 High Savery Dam and Reservoir
Construction and operation of the High Savery alternative would adversely affect 5 sites which have been determined as NRHP eligible (Table 4-29). These sites are located within or near the inundation zone of the High Savery reservoir and have been evaluated for listing on the NRHP. Periodic or permanent inundation, wave action, erosion, or increased traffic associated with recreational use could functionally destroy these sites. The prehistoric components of all five sites (48CR92, 48CR6912, 48CR6913, 48CR7108, and 48CR5844) are eligible for the NRHP (Latham 1999). The historic components are not eligible for the NRHP (Latham 1999).
4.8.2.3 Dutch Joe Dam and Reservoir
The reservoir portion (area of inundation) of this alternative contains no cultural resources that are eligible or potentially eligible for NRHP (Table 4-29). No further archaeological work would be required at this site.

4.8.2.4 Water Conservation and No-Action
The water conservation alternative would largely continue current agricultural practices and irrigation measures within the basin. Additional tilling and/or excavation of soils for conservation practices such as land leveling would occur on land that had previously been disturbed. Therefore, no additional impacts to cultural resources are expected under the water conservation alternative. Under the no-action alternative, agricultural practices, including irrigation, would remain the same. Therefore, no additional impacts to cultural resources are expected under the no-action alternative.

4.8.3 MITIGATION
The Sandstone and High Savery dam and reservoir sites contain significant cultural resources potentially eligible for the NRHP. Therefore, construction of either of these alternatives could have significant adverse impacts on cultural resources. To obtain concurrence for construction from SHPO, eligibility for the NRHP would be determined for impacted sites currently considered unevaluated. Should any of the sites prove eligible for the NRHP, a Treatment Plan(s) would have to be developed and approved prior to any disturbance of the site(s).

The Sandstone dam and reservoir alternative contains two sites (48CR1181 and 48CR4265) which would require the development, submittal, approval, and execution of a Treatment Plan(s) prior to any site disturbance. Additionally, site number 48CR3600 is currently unevaluated and would require evaluation of its eligibility for inclusion on the NRHP prior to any disturbance to the site. Should 48CR3600 prove eligible for the NRHP a Treatment Plan would have to be developed and approved prior to any disturbance of the site.

Archaeological sites located within the construction and inundation zones of the High Savery dam and reservoir are eligible for inclusion on the NRHP. Prior to any disturbance to the sites, a Treatment Plan(s) would have to be developed and approved.

No mitigation for cultural resources would be necessary for the Dutch Joe dam and reservoir, water conservation, or no-action alternatives.

4.9 RECREATION
Although recreation is not a primary purpose of these water supply alternatives, the creation of a dam and reservoir would provide some additional recreation opportunities to the area.
4.9.1 METHODOLOGIES AND SIGNIFICANCE CRITERIA

The recreational opportunities present in Carbon County and the needs in Wyoming and Colorado were determined based on review of the State Comprehensive Outdoor Recreation Plans (SCORP) for Wyoming and Colorado. Recreational opportunities lost and provided by the project were compared to the recreational opportunities and needs listed in the SCORPs. Project impacts would be considered significant if recreational opportunities in the area were reduced, or if unique state or regional recreational opportunities were eliminated.

Recreational use of the three proposed water supply alternatives was estimated based on visitation information obtained from WGFD and the Wyoming State Parks and Historic Sites Department (WSPHS). Recreational use of smaller reservoirs in south-central Wyoming by fishermen was estimated to be about 10 visitor-days per surface acre of water per year (WGFD 1995). An additional 10 visitor-days per surface acre per year for other recreational activities is typical of reservoirs in the general study area. Because the proposed dams and reservoirs would contain a significant amount of water during only about half of the recreational season, total calculated annual use days were divided in half. For the alternatives without a minimum pool, the annual visitor use days were further cut by half because the lack of a fishery would result in the absence of fishermen. The average recreational use of streams in Wyoming is estimated to be 24 visitor-days per mile per year (WGFD 1995, Corps 1988). Included in this estimate would be many miles of high quality fishing streams which attract a large number of anglers. For Savery Creek and its tributaries, the estimate of visitor-days per mile was cut in half because gamefish in these streams are currently sparse. The visitor-days per mile was further cut in half because 90 percent of Savery Creek, from the upstream end of the High Savery reservoir to the Little Snake River, is on private lands. Private ownership, and few all-weather roads along the stream, limit access to the stream and reduces recreational use. In the portions of Savery Creek where the fishery would be improved by late-season water releases for supplemental irrigation (WGFD 1998a, b), the estimated visitor-day use rate was increased by 50 percent. This analysis assumes that land use along Savery Creek would remain essentially unchanged and, in particular, that recreational outfitters would not lease lands downstream of the reservoir.

The economic impact of recreation from visitor expenditures was based on $61.12 per visitor-day (WGFD 1998a, adjusted to 1999 dollars). This value is based on all types of recreational activities including fishing, boating, hiking, sight-seeing, etc., and from travel-related expenditures such as food, lodging, fuel, and camping supplies. However, because most recreational use of the water supply facility would be by local residents (see below) who would not have to travel far or require lodging, the per visitor-day value was reduced to $30.56.

4.9.2 IMPACTS

4.9.2.1 General Impacts
Project construction and operation would eliminate areas for various types of recreation. Inundation of streams and surrounding public land would reduce the area available for stream
fishing, hunting, camping, and nature studies. However, the alternative dam and reservoir sites are primarily privately owned. Recreational use of these lands is generally restricted to the land owners, their families, and guests. The abundance of public land and sparse population within the region tend to reduce the recreational use of any given area by distributing recreation over a wide area.

A new water supply would provide additional flat-water recreational opportunities for local area residents in south-central Wyoming and north-central Colorado. However, no additional demand for flat-water recreation was identified in either the Wyoming or Colorado SCORPs. Recreational use of this new resource would be at the expense of other regional reservoirs or recreational use areas. The local economy would benefit because less money would leave the area for the other regional reservoirs.

The project would eliminate stretches of free-flowing stream which provide opportunities for stream fishing. However, stream fishing opportunities are abundant in the project area. The impoundment of Class III or Class V free-flowing trout streams would not significantly impact the availability of stream fishing opportunities in the region. Maintenance of a minimum pool could create a reservoir fishery and provide an additional type of fishing experience to the local area.

The new water supply would both eliminate and provide opportunities for hunting and other land-oriented recreation. The disturbance or inundation of state lands would eliminate areas currently open to the public for hunting. Private land, currently not accessible to the public, would be purchased as part of the project as a buffer around any reservoir and for mitigation areas. This land would be open to public access. The land acquired around any reservoir, however, would be minimal and not all lands used for mitigation of wildlife ranges would necessarily be purchased by WWDC and made public. Overall, project construction would probably not have a significant impact on the area available for hunting.

The loss of crucial winter range could reduce the overall populations of big game and the opportunities for hunters to harvest these species. Big game hunting is an important local and regional recreational activity. However, mitigation of elk winter range (Section 4.6.3.3) would prevent declines in elk populations; the loss of crucial winter range for mule deer and pronghorn cannot be mitigated. Therefore, the opportunities to harvest these species could be impacted depending on the alternative selected.

The dam and reservoir alternatives would not alleviate any of the recreational deficiencies identified in the Wyoming SCORP for Carbon County (Chapter 3, Section 3.9). However, the opportunities provided by the water supplies would not deviate from the types of recreation the SCORP identified as desirable.

4.9.2.2 Sandstone Dam and Reservoir
The Sandstone dam and reservoir would inundate about 7.1/6.4 miles of fishable streams. Using the estimate of 6 visitor-use days per mile per year, about 43/38 visitor-days would be lost annually. Using an average economic value of $30.56 per visitor-day, the annual economic loss caused by stream inundation would be $1,300/$1,200 (Table 4-30). The late-season releases would also improve fisheries in 10 miles of Savery Creek downstream of the dam. This improvement could attract an additional 3 visitor-use days per mile for an economic gain of $900 per year.

<table>
<thead>
<tr>
<th>Recreation</th>
<th>Sandstone w/min pool</th>
<th>Sandstone w/o min pool</th>
<th>High Savery w/min pool</th>
<th>High Savery w/o min pool</th>
<th>Dutch Joe no min pool</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stream-Based</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount inundated (miles)</td>
<td>7.1</td>
<td>6.4</td>
<td>8.7</td>
<td>7.8</td>
<td>4.4</td>
</tr>
<tr>
<td>Visitor use-days/mile lost</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>0³</td>
</tr>
<tr>
<td>Value lost²</td>
<td>$1,300</td>
<td>$1,200</td>
<td>$1,600</td>
<td>$1,400</td>
<td>$0</td>
</tr>
<tr>
<td>Amount improved (miles)</td>
<td>10</td>
<td>10</td>
<td>41</td>
<td>41</td>
<td>0³</td>
</tr>
<tr>
<td>Visitor use-days/mile gained</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0³</td>
</tr>
<tr>
<td>Value gained²</td>
<td>$900</td>
<td>$900</td>
<td>$3,800</td>
<td>$3,800</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Lake-Based</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Surface area (acres)</td>
<td>370</td>
<td>330</td>
<td>482</td>
<td>420</td>
<td>300</td>
</tr>
<tr>
<td>Visitor use-days/acre gained</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Value gained²</td>
<td>$113,100</td>
<td>$50,400</td>
<td>$147,300</td>
<td>$64,200</td>
<td>$45,800</td>
</tr>
<tr>
<td><strong>Net Value</strong></td>
<td>$112,700</td>
<td>$50,100</td>
<td>$149,500</td>
<td>$66,600</td>
<td>$45,800</td>
</tr>
</tbody>
</table>

1Stream is intermittent and has no fishery.
2Based on $30.56 per visitor use day.

The water supply would have a maximum pool of approximately 370/330 acres of surface water. Water quality in the proposed reservoir is projected to be good and access to the reservoir would be provided by an all-weather road and a boat ramp. Using an average recreational use rate of 10/5 visitor-days per reservoir surface acre, recreational use of the Sandstone reservoir is estimated to total approximately 3,700/1,650 visitor-days per year. An annual economic benefit of about $113,100/$50,400 would be expected. The annual net economic benefit from recreation for the Sandstone dam and reservoir (reservoir and stream gains minus stream losses) would be $112,700/$50,100 (Table 4-30).

4.9.2.3 High Savery Dam and Reservoir
Approximately 8.7/7.8 miles of fishable stream would be inundated by the High Savery dam and reservoir and along with it approximately 52/49 visitor-days of stream-based recreation use would

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be lost. This decline in visitation would equate to an economic loss of $1,600/$1,400, annually (Table 4-30). The late-season releases would also improve fisheries in 41 miles of Savery Creek downstream of the dam. This improvement could attract an additional 3 visitor-use days per mile for an economic gain of $3,800 per year.

The High Savery reservoir would have a surface area of 482/420 acres. Water quality in the proposed reservoir is projected to be good and access to the reservoir would be provided by an all-weather road and a boat ramp. Predicted annual recreational use is about 4,820/2,100 visitor-days. The estimated annual economic benefit would be $147,300/$64,200 (Table 4-30). The expected net annual economic benefit from recreation at the High Savery water supply alternative would be $149,500/$66,600.

Actual recreation use and value of High Savery reservoir are contingent upon management of the reservoir CRCT fishery as a brood source. Angling recreation may be restricted because of the need to protect the CRCT populations.

4.9.2.4 Dutch Joe Dam and Reservoir
About 4.4 miles of intermittent streams would be lost by inundation with construction of the Dutch Joe dam and reservoir. Because Dutch Joe is and would remain an intermittent stream, very little if any stream-based recreation use would be lost or gained.

Three hundred acres of water surface would be provided by this alternative. No minimum pool would be included in Dutch Joe reservoir. Recreation use of Dutch Joe reservoir is estimated to total approximately 1,500 visitor use days annually for an annual economic benefit of approximately $45,800 (Table 4-30).

4.9.2.5 Water Conservation and No-Action
No existing recreational opportunities would be affected and no new recreational facilities would be created as a result of the conservation or no-action alternatives.

4.9.3 MITIGATION

4.9.3.1 Sandstone and High Savery Dams and Reservoirs
Several mitigation measures designed to provide, facilitate, and protect recreational use would be implemented. For the larger versions of the dams and reservoirs, maintenance of a minimum pool would provide lake fishing opportunities that would offset the loss of stream fishing opportunities caused by inundation. The WWDC, coordinating with the WGFD, would develop a stocking program for the Sandstone reservoir to provide a suitable fishery. Boat ramps and primitive camping, picnicking, and restroom facilities would be provided. Minimum flow releases and releases for late-season supplemental irrigation from the Sandstone or High Savery dams and reservoirs would protect and enhance stream fishing opportunities in Savery Creek (Section 4.6.4.3). The acquisition and enhancement of existing elk crucial winter range (Section 4.6.3.3)
would prevent long-term reductions in area elk populations and related impacts to hunting activities and could provide additional public land for hunting.

4.9.3.2 Dutch Joe Dam and Reservoir
Because of the intermittent nature of the stream inundated and the lack of a minimum pool, no significant adverse impacts to water-based recreation are expected from the Dutch Joe water supply alternative. The loss of existing mule deer and pronghorn antelope crucial winter range, as described in Section 4.6.3.3, would result in long-term reductions in area mule deer and pronghorn populations and related impacts to hunting activities.

4.9.3.3 Conservation or No-Action Alternatives
Because no impacts to recreation would result from the water conservation or no-action alternatives, no mitigation is proposed for these alternatives.

4.10 VISUAL AND AESTHETIC RESOURCES

The main elements of visual character are landscape character, visual variety, and deviation from landscape character. These elements combine to create a variety of landscapes. Impact to visual character is a function of how the project changes these aspects of the landscape.

4.10.1 METHODOLOGIES AND SIGNIFICANCE CRITERIA
Landscape management deals with the visual harmony or disharmony of the components of the landscape, including the topography, vegetation, land use, and any human intrusions. The basic concepts considered are landscape character, visual variety, and deviations from the landscape character (U.S. Department of Agriculture 1973). Landscape character is the overall visual impression resulting from the visual features created by the area topography, vegetation, and land use. Visual variety concerns the different features within the landscape. Visual variety is considered appealing, whereas visual continuity is considered monotonous. Impacts on the landscape generally result when human alterations to the topography, vegetation, or land use contrast with the natural character of an area. In general, strong contrast with these components results in visual disharmony, while changes that conform to the existing visual components are less noticeable.

Significant visual impacts would result if the LSSIWSP would create visual disharmony. Such disharmony would result from either dramatic changes in the visual character of the viewseshed, a reduction in visual variety, or sharply contrasting deviation. Visual impacts would be significant if the visual disharmony created would be viewed by large numbers of people, alter current points of recognized scenic value, or alter state or federally designated scenic areas.
4.10.2 IMPACTS

4.10.2.1 Water Supply Alternatives
The construction of a new dam and reservoir would impact all components of landscape character by adding a dam to the landscape, removing some vegetation, and changing the water element from stream to lake. Although the dam structures for all of the water supply alternatives would create visual contrast in the landscape, the Sandstone dam would present the greatest contrast because it would be constructed of roller-compacted concrete. The High Savery and Dutch Joe reservoirs would be impounded by earthen dams. These dams would be covered by rock and grass and would present less of a contrast to the natural character of the area. In either case, the proposed dams would not represent a strong contrast with the surrounding hills. The land use of the inundation zone would change from grazing to water-based recreation. However, this change would not result in a disharmonious contrast with the surrounding area.

In the immediate vicinity of the reservoir, water would replace vegetation as the dominant visual element when the water level in the reservoir is near normal pool elevation. The predominant vegetation at the sites and within their viewsheds would be sagebrush. The addition of a large water body to the landscape would be considered an improvement to the aesthetics of the landscape at any of the sites because it would add variety to the area.

When the reservoir is low, or dry, the formerly inundated hillsides would be bare. At that time, the aesthetics would be reduced relative to when the reservoir is full. The exposed land would contrast with the adjacent water and vegetated slopes. Because the majority of people would visit the reservoir when full, relatively few people would see the exposed land at the Sandstone or Dutch Joe reservoirs. The exposed land associated with the High Savery reservoir would be visible to travelers on the county road which trends north to south just east of the upstream end of the reservoir (Figure 4-7).

No areas designated as scenic by state or federal agencies are located in the area, therefore, none would be impacted by this project.

Impacts to the visual character of the area would result from this project. However, these impacts would generally be considered positive because of the introduction of variety into the landscape. Overall, no significant adverse impacts to the visual character of the area would result from the project.

4.10.2.2 Water Conservation
The land use and irrigation improvements that would help conserve water would have little effect on the landscape of the area. Although some lands would be cleared or leveled, the reduction in the aesthetic character of the landscape would not be noticeable to most people.
4.10.2.3 No-Action
This alternative would not change landscape and visual character or create large deviations from surrounding landscape character. Therefore, the no-action alternative would have no effect on the aesthetics of the area.

4.10.3 MITIGATION
The WGFD recommends that mitigation for wetlands, riparian vegetation, and big game ranges be performed in one contiguous block of land just downstream from the dam (WGFD 1998a,b). This concept would help to offset some of the visual impacts caused by exposed mudflats when water level in the reservoir is low.

4.11 UNAVOIDABLE ADVERSE IMPACTS
The construction and operation of a dam and reservoir water supply for the LSSIWSP would have unavoidable adverse impacts (though not necessarily significant) that could not be completely mitigated. Some impacts would be common to all of the dam and reservoir alternatives while others would be specific to individual alternatives.

4.11.1 GENERAL IMPACTS
Construction and operation of any of the water supply alternatives would result in the following unavoidable adverse:

- Sedimentation and turbidity in the affected stream would temporarily increase during construction of the dam.
- Natural construction materials obtained from borrow sites would be lost for other uses. Mineral exploration would be precluded in the area of the dam and in the inundation zone of the reservoir.
- Discharge of sediment-free water would result in scouring effects for some distance downstream from the reservoir.
- Salinity would be increased in the lower Little Snake River during July through November.
- Construction would result in a temporary decrease in air quality in the immediate project area.
- Noise in the immediate project area would be temporarily increased during construction.
• Terrestrial insects, reptiles, and mammals would be displaced to other areas, or lost, as the dam is constructed and the reservoir is filled.

• The use of the inundated land for cattle grazing and other agricultural production would be lost.

• Archaeological, cultural, and historic remains not protected or recovered by mitigative measures would be subject to inundation, erosion, and vandalism.

• Unvegetated land exposed during the late summer through early spring would be vulnerable to erosion.

4.11.2 SPECIFIC IMPACTS
In addition to generalized impacts, each alternative would result in specific unavoidable adverse impacts.

4.11.2.1 Sandstone Dam and Reservoir

• Stream flows in Savery Creek downstream of the dam would be reduced during the spring high-flow period. The average maximum monthly depletion would be approximately 139 cfs in April, which represents a 63 percent reduction in normal flow at the dam site. Maximum depletion of the Little Snake River at Dixon would be a similar amount but would represent only a 17 percent reduction in flow. The average annual amount of water lost from the Little Snake River would be 9,580 AF.

• For the alternative with a minimum pool, 370 acres of wildlife habitat would be lost, including 126 acres of riparian cottonwood, 42 acres of fir and fir/aspen woodlands, 8 acres of willow/alder shrubland, 36 acres of meadow, 111 acres of sagebrush steppe, 22 acres of open water, and 25 acres of wetlands. A correspondingly smaller amount of habitat would be lost for the 330-acre version without a minimum pool.

• 370/330 and 172/153 acres of elk crucial and birthing habitat, respectively, would be lost by inundation.

• A total of 7.1/6.4 miles of Class III permanently flowing and 2.0/1.9 miles of Class IV intermittent stream habitat would be lost by inundation.

• 395/363 HU for trout production would be lost by inundation.

• Fish movement along the length of Savery Creek would be blocked by the dam. Upstream fish populations would be isolated.
Potential stream fishing opportunities would be lost on 7.1/6.4 miles of free-flowing stream.

9.1/8.3 miles of stream visual setting would be eliminated.

**4.11.2.2 High Savery Dam and Reservoir**
- Stream flows in Savery Creek would be reduced during spring high-flow periods. The maximum average monthly depletion would be approximately 99 cfs in April, which represents an 89 percent reduction in normal flow at the dam site. Maximum depletion of the Little Snake River at Dixon would be a similar amount but would represent only a 12 percent reduction in flow. The average annual amount of water lost from the Little Snake River would be 10,836 AF.

- For the alternative with a minimum pool, 482 acres of wildlife habitat would be lost, including less than 1 acre of cottonwood woodlands, 52 acres of willow/alder shrubland, 146 acres of meadow, 247 acres of sagebrush steppe, 20 acres of open water, and 16 acres of wetlands. Proportionally smaller amounts of these habitats would be lost for the 420-acre version without a minimum pool.

- 482/420 acres of elk winter/yearlong, mule deer spring/summer/fall, and pronghorn antelope spring/summer/fall ranges would be lost by inundation.

- Approximately 8.4/7.4 miles of Class III permanently flowing and 2.3/2.0 miles of Class IV intermittent stream habitat would be eliminated by inundation.

- 143/130 HU for trout production would be lost by inundation.

- Fish movement along the length of Savery Creek would be blocked by the dam. Upstream fish populations would be isolated.

- Potential stream fishing opportunities would be lost on 8.4/7.4 miles of free-flowing stream.

- 10.7/9.4 miles of stream visual setting would be eliminated.

**4.11.2.3 Dutch Joe Dam and Reservoir**
- Stream flows in Savery Creek would be depleted during spring high-flow periods. The maximum average monthly depletion would be approximately 96 cfs in April which represents a 40 percent reduction in normal flow at the diversion point. Maximum depletion of the Little Snake River at Dixon would be a similar amount but would represent only a 12 percent reduction in flow. The average annual of the amount of water lost from the Little Snake River would be 9,114 AF.
As currently designed with only a deepwater release, water temperature downstream of the reservoir would, at times, be decreased or increased relative to seasonal norms.

Four hundred and fifty acres of wildlife habitat would be lost including 109 acres of meadow, 331 acres of sagebrush steppe, 2 acres of open water and 3.2 acres of wetlands.

Four hundred and fifty acres and 125 acres of mule deer and pronghorn antelope crucial winter range, respectively, would be lost by inundation; this loss is not mitigable.

Approximately 4.4 miles of Class IV intermittent stream habitat would be eliminated in Dutch Joe Creek.

4.4 miles of stream visual setting would be eliminated.

**4.12 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY**

The water supply alternatives identified in this EIS would have varying degrees of effect on the use of resources and productivity. The proposed dam and reservoir would provide a dependable, long-term water supply for late-season supplemental irrigation and municipal purposes. Long-term agricultural productivity would be increased by the additional water available later in the growing season. Project facilities would be developed to provide opportunities for lake-based recreation activities. Aquatic and riparian ecosystems could benefit from increased streamflow during the summer growing season. Increased agricultural productivity and lake-based recreation would provide long-term economic gains to the region.

Short-term resource commitments include the manpower and construction equipment required for the duration of construction activities. Some vegetation would be removed in areas that would not to be inundated. This loss would represent a short-term commitment of resources until revegetation occurs. Associated with this vegetation removal would be some soil loss through erosion, a decrease in soil moisture, and the displacement of wildlife through loss of habitat. Suitable habitat adjacent to the project site would be temporarily lost to those wildlife species that are intolerant of construction activity.

Short-term gains in productivity would include a temporary economic stimulation in nearby towns and in the construction industry. Cultural survey requirements would lead to the identification and possible recovery of cultural and archaeological artifacts from NRHP eligible sites. This anthropological activity could contribute to the cultural understanding of the area.
Long-term commitments of resources would include the conversion of project area lands from agricultural uses to project purposes. Undisturbed land converted to project uses would result in a long-term loss of wildlife habitat. Current habitat resource utilization patterns would be modified by the presence of the reservoir and access roads. Animals such as mule deer, elk, and pronghorn antelope could alter migration routes and reproductive habits as a result of the project. Populations of fish adapted to a stream environment would be replaced by those species supported by a lake environment. Cultural and mineral resources left under the dam and reservoir would be lost for the duration of the project or eliminated.

4.13 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Any of the proposed dams and reservoirs would permanently change the natural land contours of the affected creek area. Clearing, cuts, fills, and borrow extraction would result in modifications to the landscape. Some soils would be lost during construction because of erosion. Improved access to the area would permanently alter the opportunity for remote area recreational uses. Revenues generated from grazing leases and grazing rights on lands and easements purchased for the project would be lost.

Construction and operation would result in the permanent committed to the project of building materials and supplies, such as borrow material, steel, and concrete.

Energy expended on the project would not be available for other uses. Petroleum-based products, including gasoline, diesel fuel, lubricants, and antifreeze, would be consumed during construction. Operation and maintenance of the project facilities would also require the commitment of lesser amounts of energy. The project would result in a commitment of manpower. Considerable efforts and funds have already been expended on planning and design of the project.

Approximately 370/330 acres of wildlife habitat would be irretrievably committed by the Sandstone alternative, 482/420 acres by the High Savery alternative, and 450 acres by the Dutch Joe alternative. Existing terrestrial habitat would be converted to an aquatic ecosystem. In addition, some natural stream environment would be converted to a reservoir ecosystem. The clearing of vegetation and imposition of project features would cause a readjustment in the wildlife carrying capacity of the area. When the reservoir begins to fill, some small mammals and reptiles would be unable to relocate quickly enough to survive.

Unrecovered archaeological and historical resources would be irretrievably lost.
4.14 CUMULATIVE IMPACTS

Cumulative impacts are those effects on resources from the proposed action or alternative added to the effects on those same resources from the past, present, and reasonably foreseeable actions of others.

4.14.1 SUMMARY OF INCREMENTAL IMPACTS

The primary impacts of the water supply alternatives for LSSIWSP would be the direct loss of terrestrial habitat at the dam and reservoir sites and changes in streamflow in Savery Creek and downstream in the Little Snake, Yampa, and Green rivers in the Upper Colorado River Basin. The amount of land inundated would range from 330 to 482 acres. Depending on the alternative, the vegetation communities that would be inundated include sagebrush steppe, meadow grassland, riparian cottonwood, riparian willow/alder, aspen and fir/aspen forests, and emergent, scrub/shrub, and forested wetlands. All of these communities are of less than optimal quality for wildlife because of cattle grazing. The Sandstone and Dutch Joe sites are within crucial winter ranges for elk, mule deer, and pronghorn antelope. The wetland and riparian communities and big game ranges would be mitigated by creation of new communities of the same type or the enhancement of existing communities; crucial winter range for mule deer and pronghorn cannot be mitigated.

The dam and reservoir alternatives would reduce flow in Savery Creek and the Little Snake River during the spring when flow is typically high and increase flow downstream in late-summer when flow is historically low. Water released in the summer would be diverted for irrigation during its transit downstream. The net result would be a depletion of flow in the Little Snake River and all other rivers downstream. FWS has calculated the annual depletion to be 7,724 AF. This depletion would occur primarily in the spring when streamflows are typically highest. The Little Snake River is habitat for the federally-endangered Colorado pikeminnow and humpback chub. The endangered razorback sucker and bonytail are in the Yampa and Green rivers, respectively. The flow depletion would be mitigated by a monetary contribution to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. These monies will be used to: conduct research into determining flow needs, acquire water rights, restore habitat, control non-native fish, conserve genetic integrity through development of refugia and operation of propagation facilities, monitor existing populations and the impacts of the recovery efforts, and increase public awareness (FWS 1996).

The Sandstone and High Savery water supply alternatives could be built with minimum pools. WGFD would manage these minimum pools of High Savery Reservoir to provide a refuge for rearing genetically pure brood stock for CRCT. Offspring from these fish would be used to rehabilitate CRCT populations in the Little Snake River Basin. If successful, this program could prevent the consideration of CRCT for federal listing as threatened or endangered. Establishing a CRCT brood stock in Sandstone Reservoir is not feasible and the minimum pool would be used to support a recreational fishery. These two alternatives would also provide improvements to
downstream habitat, particularly for trout, in the form of reduced water temperature and increased flows during the summer. If built as currently designed, the Dutch Joe alternative could deliver unseasonably cold water to the Little Snake River at the beginning of the late-season supplemental irrigation season.

4.14.2 IMPACTS FROM PAST AND PRESENT ACTIONS
The land cover at and in the vicinity of the proposed dam and reservoir water supply alternatives has been substantially affected by past and present human activity. The principle land use is cattle grazing. To improve rangeland, some sagebrush steppe has been burned or sprayed with herbicides, and seeded with drought tolerant grasses. Overgrazing has changed the plant species composition of rangelands and the physical structure of these habitats by the selective removal of the more palatable species or life stages of plants. The lack of restrictions on cattle movement has also resulted in the degradation of riparian and wetland communities. The effects of these actions has been to reduce the quality of the habitat for native fauna and increase erosion. Initially, the construction of one of the water supply alternatives would continue the trend in the destruction or degradation of native terrestrial habitats. Mitigation measures, however, would offset the losses through the enhancement of existing habitat of the creation of replacement habitat.

Water resources in the project area have been and are currently being impacted by human activity. Water quality in Savery Creek is degraded because of increased erosion and cattle wallowing in the stream. The natural flow in the lower portion of Savery Creek has been reduced because of the diversion of water for irrigation. These impacts are common to all of the rivers which include Savery Creek in their watersheds. Water quantity in the Little Snake River has been further impacted by the Cheyenne Stage I and Stage II water supply projects. These projects annually divert approximately 20,000 AF of water for municipal use from the upper Little Snake River, across the Continental Divide, into the North Platte River watershed. Like the proposed LSSIWSP, the Cheyenne Stage I and Stage II projects divert water in the spring during the peak runoff period to avoid direct impacts during spawning and summer low flow periods.

Other water projects in the Colorado River Basin have had significant impacts on water quantity, water quality, and native fisheries. Numerous large dams and reservoirs constructed in the Colorado River basin for water supply, hydropower, and recreation have resulted in the depletion of flows in the Colorado to the point where relatively little flow now reaches the Gulf of Mexico. The historic seasonal flow patterns in the Colorado River of spring floods and summer low flows have largely been replaced by daily cycles regimented by the needs for hydroelectricity. These changes in flow patterns and the interruption of bed load sediment transport have changed the physical structure of downstream riverine habitats by replacing sand-bottom habitat with armored cobble habitat and preventing the maintenance of sand and gravel bars. Releases of water from the bottoms of these reservoirs have locally eliminated the seasonal cycles of temperature and turbidity downstream of the dams and replaced them with steady releases of clear, cold water. In addition, fish movements were blocked, riverine habitats were replaced by lake habitats, and non-native gamefish were widely introduced. Native fishes were not adapted to these conditions and
their numbers have suffered accordingly. Large volume releases from Lake Powell in 1997 were
the beginnings of an attempt to restore a more natural hydrologic regimen in the Colorado River.

With the project, annual peak flows in Savery Creek would still occur in spring, annual low flows
would continue to occur in the summer, and the water temperature in the Little Snake River
would not be changed. This project would, however, contribute to the continuing depletion of
flow in the Colorado River system. The mitigation of upland, riparian, and wetland habitats
proposed for this project should also result in improvements to water quality and aquatic habitats
in Savery Creek.

4.14.3 IMPACTS FROM OTHER FUTURE ACTIONS

WWDC is planning to develop a series of 34 stock reservoirs within the Colorado River
watershed (Carnevale 1998). Each of these reservoirs would have a capacity of less than 10 AF.
Annual cumulative flow depletions from these ponds would be approximately 600 AF, primarily
attributable to evaporation (Anderson 1998).

The LSRWCD is implementing the Savery Creek Watershed Improvement Project in 1998. This
project is designed to reduce non-point source degradation of water quality in Savery Creek
through improvements to rangeland, riparian, and aquatic habitats (Hicks 1998). The efforts of
this project would complement the mitigation activities proposed for LSSIWSP.

The populations of Carbon County and the small towns in the vicinity of the LSSIWSP have been
decreasing or stable. The proposed water supply project is not likely to reverse that trend.
Therefore, no major changes in land use caused by commercial or residential development are
anticipated to occur in southern Carbon or northern Moffat counties in the foreseeable future.

4.14.4 SIGNIFICANCE OF CUMULATIVE IMPACTS

The mitigation proposed for the loss of vegetation communities and wildlife ranges caused by
LSSIWSP would complement the rangeland improvement efforts being conducted by the Little
Snake River Conservation District. Construction of the High Savery reservoir with a minimum
pool would have a highly significant, positive, cumulative impact on WGFD’s efforts to restore
CRCT in Wyoming by providing a site for rearing genetically pure brood stock. The dam and
reservoir alternatives, however, would result in a depletion of flow in the Little Snake River.
Flow depletions have been identified as a factor contributing to the decline of native fish species in
the Colorado River system and maintenance of flows is a central goal in the recovery plan for the
endangered Colorado pikeminnow, razorback sucker, bonytail, and humpback chub (FWS 1996).
The proposed water supply alternatives; therefore, would have a significant, adverse, cumulative
impact on flows in the Upper Colorado River Basin.
CHAPTER 5
COORDINATION AND PUBLIC INVOLVEMENT

5.1 INTRODUCTION

The National Environmental Policy Act (NEPA) requires federal agencies to follow a process of environmental analysis, consultation, disclosure, and public involvement when taking actions such as construction, funding, or permitting of projects. The process is intended to identify the significant impacts to the human environment and provide an opportunity for interested individuals, organizations, and government agencies to participate in the analysis and to be informed of the proposed action and its effects. For actions with a high probability of significant adverse environmental impact, the centerpiece of NEPA analysis is the Environmental Impact Statement (EIS). Although the Little Snake Supplemental Irrigation Water Supply Project (LSSIWSP) would be constructed without federal funding, federal action would be required for issuance of a permit pursuant to Section 404 of the Clean Water Act. This permit regulates the placement of dredge or fill materials in waters of the United States. In this case, fill material would be placed in Savery Creek or Dutch Joe Creek to create a dam or diversion structure. The U.S. Army Corps of Engineers (Corps) is the federal agency responsible for the administration of Section 404 and serves as the agency responsible for conducting the NEPA process for the LSSIWSP. On June 4, 1994, the Corps published a Notice of Intent in the Federal Register to prepare an EIS for the LSSIWSP.

5.2 PUBLIC INVOLVEMENT

The initial mechanism for public participation in NEPA is the scoping process. The purpose of scoping is to identify significant environmental issues that require study, sort out insignificant issues, and thereby focus the scope of the environmental document. High priority was given to public involvement from the early stages of this project. A thorough program was prepared to provide information and to receive input from residents in the communities where the proposed action would be carried out. The public involvement plan included public meetings, informational handouts, publication of public meeting notices, and media releases and briefings. In addition, public comment was solicited on the Draft EIS and the Section 404 permit application.

5.2.1 PUBLIC MEETING NOTICES

Notices for the public scoping meeting were published in the following newspapers:

- Rock Springs Daily Rocket-Miner        July 6, 1994
- Wyoming Tribune Eagle                July 6, 1994
5.2.2 PUBLIC SCOPING MEETING
A public scoping meeting held in the multipurpose room of the Little Snake River School in Baggs, Wyoming, on July 13, 1994 was attended by approximately 75 people. Attendees were given handouts which included a project description, discussion of project purpose and need, and a list and map of alternative reservoir sites. After a brief introduction to the project by the Corps, the attendees were organized into small discussion groups. Each group was facilitated by a representative of the Corps, U.S. Fish and Wildlife Service (FWS), Wyoming Game and Fish Department (WGFD), or Burns & McDonnell, Inc (B&McD). The main issues raised at the meeting involved the need for the project and the environmental effects of flooding a large area. Other issues were economic benefits, recreational uses, riparian water rights, and irrigation impacts. At the end of the meeting, the Corps outlined the schedule for the EIS and invited the public to submit additional written comments by August 15, 1994.

5.2.3 DRAFT EIS
Comments received from the public and government agencies as a result of the scoping meetings were used to tailor the content of the EIS so that issues specific to this project and the potentially affected population were addressed. Examples of issues raised by the public and government agencies were the use of groundwater as a source of late-season irrigation water, impacts of selenium from the Ketchum Buttes area, and impacts on specific threatened, endangered, and state species of special concern (See Appendix F for a detailed list of issues.).

Notices of availability of the Draft EIS (DEIS) and public meeting were published in the Federal Register and in area newspapers. These notices informed the public that the DEIS was available for review, where it could be viewed, and when and where the public meeting would be held. The public was also invited to submit written comments on the DEIS until October 5, 1998. Copies of the DEIS and requests to submit written comments by October 5, 1998 were also sent to the cooperating agencies.

5.2.4 404 PUBLIC NOTICE
The notice of Wyoming Water Development Commission’s (WWDC) application for a Section 404 permit were published in area newspapers. These notices included a statement that the application was available for public inspection, locations where the public could view the application, where and when the hearing would be held, and an invitation to the public to submit written comments.

5.2.5 COMBINED PUBLIC MEETING AND SECTION 404 HEARING
Combined public meetings for the DEIS and public hearings for the Section 404 permit were be held shortly after the DEIS was made available for review. These combined public meetings were scheduled for September 23, 1998 in Baggs, Wyoming, September 29, 1998 in Rawlins,
Wyoming, and September 30, 1998 in Cheyenne, Wyoming. The purpose of these meetings were to:

- present the conclusions of the DEIS and Section 404 application to the public
- provide an opportunity for the public to comment.

5.2.6 FINAL EIS
Comments on the Draft EIS received from the public and the cooperating government agencies have been addressed in the Final EIS (FEIS). A Notice of Availability will be published in the Federal Register and the Final EIS distributed. After 30 days, a Record of Decision will be prepared and issued. If the Corps approves WWDC’s Section 404 permit application, the Corps will issue the Section 404 permit and construction of the project can begin.

5.3 AGENCY COORDINATION

5.3.1 SCOPING MEETINGS
The project kick-off meeting for the LSSIWSP Third-Party EIS was held at the B&McD Denver office on May 25, 1994. Attendees included representatives from the Corps, WWDC, U.S. Environmental Protection Agency (EPA), and FWS. The meeting was held in two sessions. A morning session was held with B&McD and WWDC to discuss the role of the third-party contractor and coordination with WWDC. The afternoon session included the Corps, EPA, and FWS and covered the scope of work and coordination of future agency and public meetings.

On July 13, 1994, WWDC conducted a site visit for the cooperating agencies and other interested parties. Parties in attendance included representatives from the Corps, WWDC, B&McD, EPA, WGFD, FWS, and the Little Snake River Conservation District (LSRCD). Sites visited included:

- Lower Willow Creek
- Upper Willow Creek
- Pot Hook
- Upper Slater Creek
- Middle Battle Creek
- Sandstone
- Old Upper Savery
- Big Gulch
- High Savery
- Dutch Joe

These sites were selected because they had the greatest potential to remain primary alternative reservoir sites. These visits were intended to give agency personnel and interested parties the opportunity to view the various sites and their natural attributes. Issues raised during the site visit included impacts from inundation, minimum flow releases, and dam construction issues.

An additional agency scoping meeting was held on July 14, 1994 in Cheyenne, Wyoming. The meeting convened at 1:00 pm in the Capital Building. Agencies in attendance included representatives from the Corps, WWDC, B&McD, Wyoming State Engineer’s Office, Wyoming Attorney General’s Office, WGFD, USGS, and FWS. The purpose of the meeting was to provide agencies the opportunity to express their concerns and identify issues they believed needed to be
addressed in the EIS. Issues identified included downstream impacts on federally-listed endangered fish species and state species of special concern, impacts on wildlife from construction activities, dam safety, and possible accumulation of trace metals in the reservoir.

On July 25, 1994, representatives from B&McD and WWDC met with WGFD in the morning and with FWS in the afternoon to discuss wildlife and fisheries issues within the proposed project area. The main concerns were elk and deer crucial winter range for the herds that use the geographic area from Baggs to Sarasota, Wyoming, and winter in the Little Snake Valley Complex near Rawlins. Impacts to threatened and endangered species were also discussed at these meetings.

5.3.2 PROJECT MEETINGS AND OTHER COMMUNICATIONS
Meetings among the Corps, WWDC, B&McD, EPA and cooperating agencies were held on November 29, 1994; March 22, 1995; August 22, 1995; February 1, 1996; November 19, 1996; January 27, 1997; March 19, 1997; January 20, 1998, June 22, 1998, and August 12, 1999 to discuss and resolve questions concerning preparation of the EIS and related procedures. Meetings, as a form of inter-agency coordination, were supplemented with frequent telephone (person-to-person and conference) and facsimile communications.

5.3.3 FORMAL CONSULTATIONS
During the course of preparing the EIS, state and federal agencies provided necessary data for assessing impacts to sensitive habitats, wildlife, and fisheries, and for planning mitigation. The FWS was consulted, as required by Section 7 of the Endangered Species Act, for their concurrence on the likely impacts to federally listed threatened or endangered species and their recommendations for mitigation. Analyses of impacts and mitigation for fish and wildlife were conducted by WGFD for each of the three final alternatives. The State Historic Preservation Officer in Wyoming was consulted, pursuant to Section 106 of the National Historic Preservation Act of 1966, for concurrence regarding the affects on cultural resources at the sites and potential mitigation.

5.3.4 REVIEW OF EIS CHAPTERS AND DOCUMENTS
The chapters of the EIS and supporting documents were reviewed for technical content, scientific rigor, accuracy, completeness, and consistency by the project sponsor, the lead agency, the third-party contractor, and the cooperating agencies. The Corps provided final technical and other quality reviews and is responsible for the content of the EIS.

5.3.4.1 EIS Chapters
Each principal chapter of the DEIS was subjected to a sequential review and revision process before being incorporated into the DEIS. The first review was by the Corps and WWDC. After their comments were addressed, each chapter was submitted to the cooperating agencies (Table 5-1) for review and comment. Final revisions were made under the direction of the Corps.
Table 5-1

COOPERATING AGENCIES

| Federal | U.S. Environmental Protection Agency, Region 8  
|         | U.S. Fish and Wildlife Service, Wyoming and Colorado offices  
|         | Bureau of Land Management, Rawlins District  
|         | U.S. Geological Survey  
|         | U.S. Forest Service  
| Wyoming | Environmental Quality Department  
|         | Game and Fish Department  
|         | State Engineer’s Office  
|         | State Historic Preservation Office  
| Colorado | State Engineer’s Office  
|         | Division of Wildlife  
| Local | Little Snake River Conservation District  
|         | Savery-Little Snake Water Conservancy District  

5.3.4.2 Supporting Documents

A number of studies in support of the EIS were performed by the third-party contractor and other organizations (Table 5-2). These studies were independently reviewed by the Corps for technical adequacy.

5.4 ISSUES IDENTIFIED THROUGH THE SCOPING PROCESS

Based on public and agency comments received, 162 issues were identified. Of these, 124 issues were considered significant and appropriate to include in the EIS. Thirty-eight issues were considered beyond the scope of the EIS. Major issues raised that were considered within the scope of the EIS included:

- the use of groundwater or conservation as an alternative to a reservoir
- the suitability of the geology at the Sandstone site for a dam
- the impacts of changes in the flow regimen in Savery Creek
- the high quality of habitat that would be lost if the Sandstone alternative were developed
- impacts on and mitigation for fish and big game habitat
Table 5-2

EIS SUPPORTING DOCUMENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Organization</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1 Cultural Resources Inventory of the Sandstone Dam and Reservoir Alternative</td>
<td>J. Tyler</td>
<td>Frontier Archaeology</td>
<td>1995</td>
</tr>
<tr>
<td>Class III Cultural Resources Inventory of the High Savery Alternative</td>
<td>K. Quick and P. Light</td>
<td>Frontier Archaeology</td>
<td>1995</td>
</tr>
<tr>
<td>Class III Cultural Resources Inventory of the Dutch Joe Alternative</td>
<td>K. Quick and R. Rosenberg</td>
<td>Frontier Archaeology</td>
<td>1995</td>
</tr>
<tr>
<td>Computer Modeling Study of the Water Temperature Within and Releases from the Proposed Sandstone and Dutch Joe Reservoirs</td>
<td>T. Hanlin and P. Rechard</td>
<td>Western Water Consultants, Inc.</td>
<td>1996</td>
</tr>
<tr>
<td>Cost estimates for the Sandstone, High Savery and Dutch Joe alternatives (3 reports)</td>
<td>V. Anderson</td>
<td>States West Water Resources Corporation</td>
<td>1997</td>
</tr>
</tbody>
</table>
Table 5-2

EIS SUPPORTING DOCUMENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Organization</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native American Consultation Concerning Cultural Resources in the Little Snake Supplemental Irrigation Water Supply Project High Savery Alternative.</td>
<td>S. Deaver and P. Walker-Kuntz</td>
<td>Ethioscience, Inc.</td>
<td>1999</td>
</tr>
</tbody>
</table>

- impacts on federally-listed threatened or endangered species and state species of special concern
- impacts to local land owners
- economic and ecological cost-benefit ratio
- recreation benefits from a new reservoir
- loss of an aesthetically pleasing tract of land at the Sandstone site.

The public and agency scoping process and the specific issues identified are detailed in the Scoping Summary (Appendix F).

5.5 EIS PREPARATION TEAM

An interdisciplinary team of qualified federal and state government personnel and consultants was responsible for the preparation of the LSSIWSP EIS.

5.5.1 FEDERAL LEAD AGENCY
The U.S. Army Corps of Engineers, Omaha District was the lead federal agency for this project. The Corps was the lead agency because the project would require issuance by this agency, pursuant to Section 404 of the Clean Water Act, of a permit to place fill material in waters of the
Little Snake Supplemental Irrigation Water Supply Project

United States. The lead agency operated out of the Omaha District office, Omaha, Nebraska. The Corps staff who contributed to the EIS are listed in Table 5-3.

Table 5-3

<table>
<thead>
<tr>
<th>Name</th>
<th>Education and Discipline</th>
<th>Years Experience and Expertise</th>
<th>EIS Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richard Gordon</td>
<td>MS Sanitary Engineering, BS Civil Engineering</td>
<td>24, EIS studies and engineering</td>
<td>EIS/404 oversight</td>
</tr>
<tr>
<td>Candace Gorton</td>
<td>Graduate work in EIS Studies, BS Biology</td>
<td>13, EIS studies and biology</td>
<td>EIS study director</td>
</tr>
<tr>
<td>Patsy Freeman</td>
<td>BS Biology</td>
<td>5, EIS studies</td>
<td>EIS technical manager</td>
</tr>
<tr>
<td>Rodney Schwartz</td>
<td>BS Mechanical Engineering, MS MPA</td>
<td>5, EIS studies; 30, engineering</td>
<td>404 project manager</td>
</tr>
<tr>
<td>Chandler Peter</td>
<td>BS Biology</td>
<td>11, wetlands ecology and environmental studies</td>
<td>404 field review manager</td>
</tr>
<tr>
<td>Diane Karnish</td>
<td>Graduate work in Economic Studies, BBA Management, BS Economics</td>
<td>9, economics</td>
<td>Economist</td>
</tr>
<tr>
<td>Doug Pendrell</td>
<td>BS Geology</td>
<td>24, geologic studies and investigations</td>
<td>Hydrogeology review</td>
</tr>
<tr>
<td>Sandra Barnum</td>
<td>MA Museum Science, MA Anthropology, BS Sociology/Anthropology</td>
<td>13, archeology</td>
<td>Archeologist</td>
</tr>
<tr>
<td>Michael Kelly</td>
<td>MS Civil Engineering, BS Civil Engineering</td>
<td>25, civil engineering and dam safety</td>
<td>Dam safety</td>
</tr>
</tbody>
</table>

5.5.2 APPLICANT

The Wyoming Water Development Commission is the sponsor of the LSSIWSP. It is their application for a dredge and fill permit which triggered the preparation of the EIS. The staff at WWDC who contributed to the EIS are listed in Table 5-4.

5.5.3 THIRD-PARTY CONTRACTOR

Burns and McDonnell, Inc., Kansas City, Missouri, was the third-party consultant which had primary responsibility for preparation of the EIS. The contributors and their role and expertise are listed in Table 5-5.
5.5.4 ADDITIONAL CONSULTANTS
Additional expertise was brought to bear on the project in the areas of archaeology, hydrology, and reservoir design and construction. These consultants and their credentials are listed in Table 5-6.

Table 5-4

<table>
<thead>
<tr>
<th>Name</th>
<th>Education and Discipline</th>
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<tbody>
<tr>
<td>Mike Besson</td>
<td>BA Secondary Education, BS Civil Engineering</td>
<td>21, water resources engineering</td>
<td>EIS oversight, technical review, project funding</td>
</tr>
<tr>
<td>Mike Carnevale</td>
<td>MS Zoology, BS Fisheries Biology</td>
<td>21, fisheries biology, water quality, environmental planning</td>
<td>Project manager</td>
</tr>
<tr>
<td>Phil Ogle</td>
<td>BS Wildlife Mgmt., MS Range Science</td>
<td>25, environmental and water resource planning</td>
<td>Project manager</td>
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Table 5-5

<table>
<thead>
<tr>
<th>Name</th>
<th>Education and Discipline</th>
<th>Years Experience and Expertise</th>
<th>EIS Role</th>
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<tbody>
<tr>
<td>Robert Sholl</td>
<td>MS Botany, BS Botany</td>
<td>29, environmental impact analysis</td>
<td>Third party EIS oversight, quality assurance, scoping</td>
</tr>
<tr>
<td>Fred Pinkney</td>
<td>PhD Plant Ecology and Statistics, MS Range Ecology, BS Range Science</td>
<td>29, environmental impact analysis and water resources studies, NEPA compliance</td>
<td>Third party EIS manager, agency liaison, quality assurance</td>
</tr>
<tr>
<td>Greg Howick</td>
<td>PhD Biology, MS Zoology, BA Biology</td>
<td>21, limnology and aquatic ecology</td>
<td>Assistant EIS manager, aquatic ecology, limnology</td>
</tr>
<tr>
<td>Steve Thornhill</td>
<td>MS Biology, BS Biology</td>
<td>9, wildlife ecology, environmental assessment</td>
<td>Wildlife, threatened or endangered species</td>
</tr>
<tr>
<td>Frank Norman</td>
<td>MA Botany, BS Systematics and Ecology</td>
<td>9, wetland ecology</td>
<td>Wetland delineation and mitigation</td>
</tr>
<tr>
<td>Doug Mitchell</td>
<td>MS Biology, BS Biology</td>
<td>9, fisheries biology, environmental permitting</td>
<td>Fisheries biology</td>
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</table>
Table 5-5
EIS PREPARES AT BURNS & MCDONNELL, INC.

<table>
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<th>Years Experience and Expertise</th>
<th>EIS Role</th>
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<tbody>
<tr>
<td>Gene Foster</td>
<td>MS Water Resources Engineering, BS Civil Engineering</td>
<td>20, hydrologic analysis, facilities siting, permitting</td>
<td>Hydrology</td>
</tr>
<tr>
<td>Cyril Welter</td>
<td>Graduate studies in Landscape Architecture, MS Urban and Regional Planning, BA Economics</td>
<td>21, socioeconomic impact analysis, environmental assessment</td>
<td>Socioeconomics, quality assurance</td>
</tr>
<tr>
<td>Mary Latham</td>
<td>MA Anthropology, BA History and Government</td>
<td>9, cultural resources management</td>
<td>Cultural resources surveys and evaluation</td>
</tr>
<tr>
<td>Todd Seacat</td>
<td>MA Anthropology, BA Anthropology</td>
<td>6, cultural resources surveys, testing, and mitigation</td>
<td>Cultural resources surveys and evaluation</td>
</tr>
<tr>
<td>John Dunham</td>
<td>PhD Geography, MS Geography, BA Geography</td>
<td>6, Geographic Information Systems (GIS), remote sensing, site analysis and modeling</td>
<td>GIS, mapping</td>
</tr>
<tr>
<td>Ryan Boyce</td>
<td>MA Geography (pending), BA Environmental Studies</td>
<td>4, GIS and remote sensing</td>
<td>GIS, mapping</td>
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Table 5-6
OTHER EIS CONTRIBUTORS

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<tr>
<th>Organization Name</th>
<th>Education and Discipline</th>
<th>Years Experience and Expertise</th>
<th>EIS Role</th>
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<tbody>
<tr>
<td>Western Water Consultants, Inc.</td>
<td>MS Civil Engineering, BS Civil Engineering</td>
<td>11, Water supply systems planning, hydrologic analysis and engineering.</td>
<td>Hydrology modeling, reservoir design</td>
</tr>
<tr>
<td>Todd Hanlin</td>
<td></td>
<td></td>
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<tr>
<td>Paul Rechard</td>
<td>MS Civil Engineering, BS Civil Engineering</td>
<td>41, Water rights, water resources planning and development</td>
<td>Hydrology modeling, reservoir design</td>
</tr>
<tr>
<td>States West Water Resources Corporation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victor Anderson</td>
<td>MS Hydraulics, BS Civil Engineering</td>
<td>26, water resources design</td>
<td>Construction cost estimation</td>
</tr>
<tr>
<td>Wyoming Game and Fish Department</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thomas Annear</td>
<td>MS Aquatic Ecology, BS Fisheries Biology</td>
<td>20, instream flow studies and fisheries management</td>
<td>Fisheries impact analysis</td>
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Table 5-6

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Education and Discipline</th>
<th>Years Experience and Expertise</th>
<th>EIS Role</th>
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<tbody>
<tr>
<td>Gary Butler</td>
<td>MS Range Management, BS Wildlife Management</td>
<td>29, wildlife habitat development</td>
<td>Wildlife mitigation analysis</td>
</tr>
<tr>
<td>Tom Collins</td>
<td>MS Environmental Physiology, BS Wildlife/Fisheries Management</td>
<td>24, wildlife impact assessment</td>
<td>Impact and mitigation report coordinator, policy and mitigation analysis</td>
</tr>
<tr>
<td>Pat Deibert</td>
<td>PhD Wildlife Ecology, MS Biology, BA Ecology</td>
<td>14, wildlife ecology and impact assessment</td>
<td>Wildlife impact analysis</td>
</tr>
<tr>
<td>Grant Frost</td>
<td>MS and BS Wildlife and Range Resources</td>
<td>6, geographic information systems</td>
<td>Field collection of wildlife data, mitigation analysis, report preparation</td>
</tr>
<tr>
<td>Frontier Archaeology</td>
<td>BA Anthropology, BA Geology</td>
<td>9, archeological surveying and testing, geology of Rocky Mountains region</td>
<td>Cultural resources surveys and evaluation, report preparation</td>
</tr>
<tr>
<td>James Tyler</td>
<td>BA History</td>
<td>10, archeological surveying and testing</td>
<td>Cultural resources surveys and evaluation, report preparation</td>
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<tr>
<td>Robert Rosenberg(^1)</td>
<td>not available</td>
<td>not available</td>
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<tr>
<td>Patrick Light(^1)</td>
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<td>Cultural resources surveys and evaluation, report preparation</td>
</tr>
<tr>
<td>James Welch</td>
<td>MA Public Archaeology</td>
<td>12, cultural resources inventories, testing and excavation, NRHP evaluation</td>
<td>Archaeology project management</td>
</tr>
<tr>
<td>Wyoming Geological Survey</td>
<td>BS Geology</td>
<td>26, geology, geological hazards</td>
<td>Earthquake evaluation</td>
</tr>
</tbody>
</table>

\(^1\)This company is no longer in business, the current whereabouts of the individual is unknown, information on his credentials could not be obtained.
OTHER CONTRIBUTORS

The following individuals contributed information to the EIS as personal communications through telephone or written contact:

- Breadheof, R. WGFD, Cheyenne, Wyoming
- Brockman, S. FWS, Cheyenne, Wyoming
- Carroll, D. U.S. Forest Service, Medicine Bow/Routt National Forest, Brush Creek-Hyden District, Saratoga, Wyoming
- Chick, N. Colorado Department of Health, Denver, Colorado
- Corn, S. USGS, Division of Biological Resources, Fort Collins, Colorado
- Hauff, J. Wyoming State Parks and Historic Sites, Cheyenne, Wyoming
- Hicks, L. Little Snake River Conservation District, Baggs, Wyoming
- Jackson, L. U.S. Bureau of Land Management, Rawlins, Wyoming
- Jennings, M. FWS, Cheyenne, Wyoming
- Kotter, K. U.S. Bureau of Land Management, Rawlins, Wyoming
- Oedekoven, O. WGFD, Cheyenne, Wyoming
- Schick, B. Wyoming Department of Environmental Quality, Air Quality Division, Cheyenne, Wyoming
- Stockdale, R. Wyoming State Engineer’s Office, Cheyenne, Wyoming
- Vigil, N. Natural Resources Conservation Service, Carbon County, Wyoming
- White, J. WGFD, Cheyenne, Wyoming.

5.6 COMMENTS RECEIVED ON THE DEIS AND RESPONSES

The comment period for the DEIS was open from January 25 through March 26, 1999. The Little Snake Review Conservation District requested and received an extension to submit their comments by April 26, 1999. The EPA requested and received an extension to submit their comments by May 10, 1999. By the end of the comment period, the Corps had received a total of 34 written comments from federal, state, and local agencies; special interest groups; and individuals or families. These letters and the Corps’ responses to these comments are attached on the following pages. The transcripts of the public hearings can be found in Appendix H.

5.6.1 LETTERS

The Corps received written comments from three federal agencies, seven state agencies, one local agency, two special interest groups, and 17 individuals or families.
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1. An extensive channel scour/deposition analysis was not completed for any of the alternatives. Channel scour/deposition is a function of water velocity and substrate size. (Rosgen 1996). Velocity is primarily a function of channel slope and roughness (Simons and Senturk 1977). To estimate the amount of scour/deposition that will occur requires a considerable amount of channel morphology measurements including:

   a. Substrate size analysis,
   b. Stream bank materials analysis,
   c. Stream bank vegetative cover analysis,
   d. Channel slope,
   e. Channel length,
   f. Channel sinuosity,
   g. Water velocities, and
   h. Water surface elevations.

   These parameters must be measured at numerous locations for several miles downstream from the dam at several flows. Modeling is then performed to calculate the impact of the flow changes on the selected reaches. This is a time consuming and very costly undertaking that is traditionally deferred until final design of the dam when the applicant is certain that all the necessary permits and approvals will be issued.

   The scour/deposition analysis will be completed in final design of the dam. The study will determine the location and type of structures that will be required to mitigate the impacts of reservoir operation on the stream channel below the dam. These mitigation measures will be designed and constructed to the satisfaction of the Corps in consultation with the FWS, the WGFD, and the LSRCD.

   Hydrology analyses completed by Burns & McDonnell and Western Water Consultants for the WWDC were extensively reviewed by the Corps and are included in the EIS. Table 4-7 of the EIS presents changes in monthly stream discharge caused by development of the High Savery alternative. Table 4-9 shows the expected changes to peak flows caused by dam operation at several locations downstream on Savery Creek. Except for the reach from the proposed dam to the confluence with Little Savery Creek, a distance of approximately three stream miles, project operations will not dramatically change the existing peak flow characteristics of Savery Creek. The frequency and duration of peak flows in Savery Creek at the dam site is affected by the project with the frequency decreasing along with number of days these flows occur (Table 4-10).

   Presently, the substrate of the Savery Creek channel downstream from the proposed High Savery Reservoir consists of well-armored cobble and gravel. Water velocities in the...
channel downstream from the proposed High Savery Dam to the confluence of Little Savery Creek are not expected to change and on average will probably decrease. Expected late summer discharges of 50 to 110 cfs from reservoir storage, coupled with bypasses of natural inflow to holders of senior water rights, are below average spring discharges of 155 cfs (which will be reduced). Channel forming flows occurring under natural conditions are considerably higher. Therefore, normal operating flows should not increase the rate of channel erosion and are expected to have little impact on channel scour.

Livestock grazing has impacted the channel of Savery Creek below the proposed dam. In addition, construction and maintenance of irrigation diversions has resulted in additional channel destabilization. These impacts have increased lateral (bank) erosion and down cutting, retarded willow and cottonwood regeneration, and decreased channel sinuosity. These effects persist for some distance downstream in Savery Creek to the upper reaches of Sandstone Canyon.

Although the diminished sediment load in Savery Creek in the reach from the proposed High Savery Dam to the confluence with Little Savery Creek may result in stream bank erosion, these impacts will be offset by implementation of the following measures:

A. The reduction in the average stream flow during the high runoff months of April and May will reduce the transport capability of the Savery Creek in this reach.

B. The increase in the average stream flow during the low flow months of July and August (during the growing season) will provide additional opportunity for growth of bank stabilizing riparian vegetation.

C. Bank protection, grade control, and improvements to irrigation diversions and canals are planned for this reach. These improvements are intended to prevent further stream bank erosion and provide a better environment for riparian plant growth. Final design of these structures will occur when the WWDC is reasonably certain they will receive a permit for the project. At present, structures for grade control, irrigation diversions, and bank protection will be designed concurrently with final design of the reservoir. Construction of these facilities will be completed prior to operation of the dam. Money will be set aside in an account dedicated to maintain and improve grade control, bank protection, and mitigation facilities. The Corps and other appropriate agencies will review the design of these facilities.

D. The FWS and WGFD have insisted that this area from the dam downstream to the confluence of Little Savery Creek be protected from livestock grazing but not...
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height and duration of base flows. Both quantitative and qualitative changes to the plant community may occur. Despite the existence of an extensive literature on the effects of reservoir operations on downstream wetland and riparian plant communities, there is very little discussion of this. Riparian vegetation is extremely valuable to wildlife in the arid West, and impacts must be clearly described in the FEIS.

Specific Comments

Section 3.2.4.3: Structural Geology

Page 3-7: The statement that the mapped faults in the area "have shown no signs of activity in the last 1,000,000 years" needs a reference or scientific evidence to support the conclusion.

Section 3.2.5: Seismicity

Page 3-8: The Stone and Webster Engineering Company Report, which determines that the maximum probable earthquake on the Wasatch fault would result in onsite effects similar to a Richter Scale (RS) magnitude of 5.0, is an unpublished report. Therefore, the FEIS should contain much more extensive supporting information to substantiate this statement.

The statement, "The magnitude of the seismic activity has historically averaged about 4.0 RS [Richter scale]," is not clear. Does this mean that the largest possible event directly beneath the proposed dam site could be M=4.0; or, is this M=4.0 event considered to be the random, background event that is typically used in most modern seismic hazard assessments? If the latter, then the magnitude is too small. Most contemporary seismic hazard assessments would use a considerably larger magnitude earthquake for a random background event in this part of Wyoming.

The statement, "Faults in the project area show no evidence of movement for the last 1,000,000 years. These faults are considered stable with a low probability of future movement (U.S.G. 1994)," are difficult to rigorously evaluate without access to the Stone and Worster Engineering Report. The FEIS should be modified to contain much more extensive documentation supporting these statements.

Section 3.2.6: Mass Movements

A reference is needed for the conclusion that large mass movements in the study area were initiated about 10,000 years ago at the end of the last glacial period.

Little Snake Supplemental Irrigation Water Supply Project

(Continuation of response 1)

used for riparian mitigation. WWDC may not be able to protect the entire area, especially private lands, from grazing. It is the intent of the WWDC to work with local landowners to protect Savery Creek and the riparian area; however, private landowners will have to be willing cooperators. Wording that describes how streambank protection will be achieved will be incorporated as a 404 permit condition.

Some changes to the stream resulting from operation of the dam and installation of mitigation measures would be desirable. A narrower, deeper channel with better streambank cover and cooler water should significantly improve fish habitat below the dam.

2. See above response to comment # 1. The seasonal hydrograph will be flattened and out-of-bank flow events will decrease. The impact this will have on the stream channel is difficult to determine. At present, out-of-bank flows occur approximately once every 10 years in the reach immediately below the proposed High Savery Dam. After construction of the dam, out of bank flows are predicted to occur only once every 31 years. The impacts from the changed hydrology will be offset by implementation of the mitigation program and carefully monitored. In the event unforeseen impacts occur, the WWDC has agreed to set money aside in an escrow account to correct the problem in a timely manner.

3. Grade control and bank protection structures are planned to maintain the existing channel morphology and could be designed to regulate and control out-of-bank flows. The volume of summer storage releases (discharges in the range of 50 to 110 cfs) will have little impact on channel scour as these flows are well below channel forming (flood) flows. There will be no riparian habitat monitoring per se. However, the stream channel and grade control structures will be monitored for the life of the project to ensure the structures are functioning as designed and the stream channel is being maintained. An escrow account will be set up by the WWDC to rectify unforeseen problems that may arise. Solutions for repairing unforeseen environmental degradation resulting from the project will be implemented in consultation with the WWDC, Corps, FWS, WGFD, and affected landowners.

4. A complete review of earthquake activity in the region of High Savery Reservoir is presented in Appendix B. James C. Case of the Wyoming Geological Survey prepared the summary of earthquake in the project area. The report involved an extensive literature search. The document reports that approximately 238 earthquakes have occurred within 150 miles of the Little Snake Supplemental Irrigation Water Supply Project and the region has had a moderate level of seismicity compared to the rest of the state.
5. A complete review of earthquake activity in the region of High Savery Reservoir is presented in Appendix B. The following quotation from the report has been included in the FEIS:

- Damaging earthquakes have occurred and will continue to occur in south central Wyoming. A maximum credible random earthquake of magnitude 6.25 is postulated for the area. In addition, exposed active fault systems, within 100 miles of the project area, are capable of generating earthquakes in the magnitude 6.5 - 7.0 range.

- The largest peak acceleration projected for the project area is 15%g. That acceleration is derived from placing a random magnitude 6.25 earthquake at 15 kilometers from the sites under consideration. That acceleration is similar to the 14%g acceleration that is derived from the 2,500-year probabilistic analysis (2% probability of exceedance in 50 years). Exposed active faults, within 100 miles of the project area, are not expected to generate peak horizontal accelerations in excess of 1.5%g at the project area. This is because the Faults are so distant from the sites under construction.

- Based upon the methods of analysis utilized in this report, it is recommended that a peak horizontal acceleration of 15%g be considered for all dam sites in the Little Snake Supplemental Irrigation Water Supply Project Area. The design acceleration will be larger, depending on the factor of safety utilized. If a factor of safety of 1.3 is used, which is common for some types of construction, then an acceleration of 20%g should be considered in the design of the dam.

6. Your comment has been acknowledged and the text modified to reflect your concern. Please also see Section 4.2.5.
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Recent movements and the slope failures, at rates as much as 4 feet per year, at the surface are attributed to destabilizing the base of the slope by erosion. The EIS should consider the fact that inundation of an active landslide by water in a reservoir might increase erosion at the toe or might increase the pore pressure on the lower part of the slip plane, and ultimately result in greater instability and more rapid movement.

Section 4.2.4.2.1: Water Alternatives (Seismicity Section)

Page 4-6: The DEIS cites an out-of-date source of information (Algermissen et al., 1982) to establish the maximum horizontal bedrock acceleration and earthquake probabilities for the study area. This 16-year old report has been superseded by analyses that contain much more robust information and rigorous methodologies. The most comprehensive analysis is reported by:


The report, seismic hazard maps, and comprehensive information is currently available on the World-Wide Web at the following URL:


Page 4-7: Again, the design parameters listed in paragraph 6 are based on information in the Stone and Webster Report and cannot be evaluated based on information contained in the DEIS.

Section 4.2.5.3: Mitigation (of mass movements)

Page 4-8: This section contains a description of stabilization plans that would be implemented "in the event that more movement of a slide occurs than anticipated." The DEIS fails to define what amount of movement is really anticipated and at what point the mitigation measures would be applied. This information is needed in the mitigation plan.

Page 3-38: Ute Ladies'-tresses Orchid: This threatened plant is now also known to occur in Laramie County, Wyoming.

Page 3-38: Northern Goshawk: On June 23, 1998, the Fish and Wildlife Service (Service) completed a status review and issued a "not warranted" 12-month finding for the northern goshawk. Therefore, there is no need to address impacts to this species under Section 3.6.5. "Threatened, endangered, and candidate species."
Page 4-38. Sediment Transport: Sediment transport is a function of both sediment supply and sediment transport capacity, which in turn is directly related to the volume, velocity, and duration of flow. Though the High Savery Dam would trap only 1.5 percent (or 4 percent) of the sediment contributed to the Yampa River sediment load, it may have a much greater impact on sediment transport through attenuation of flood flows. Discussion should be added to reflect this.

Page 4-39. Vegetation Impacts: While some downstream riparian plant communities may benefit from higher than normal streamflows, some will not. Changes in the seral processes and dominant riparian plant communities are likely. Alterations to the natural hydrograph due to project operation (reduced spring peak and increased base flows) are likely to inhibit the establishment and recruitment of cottonwood and willow seedlings. Discussion similar to that on page 4-69 ("Operation of a water supply would change downstream flow regimes") should be included here to identify possible impacts.

Changes in channel morphology are unknown at this time. Changes in sediment transport due to dam operation may be caused by higher base flows as well as sediment-free water released from the dam. No analyses of changes in sediment transport have been carried out, and conclusions that effects of project operation "... would probably not extend past the next major sediment-contributing tributary..." are speculative. In the absence of detailed hydrologic studies, careful monitoring of channel changes will be necessary after the project is completed and should be required. The discussion on page 4-53 ("Impacts to downstream vegetation from bank erosion...") acknowledges this. Such a monitoring program should include placement and annual monitoring of permanent channel cross-sections below the dam for several miles and annual quantitative comparisons of aerial photos. This program should be begun at the earliest opportunity to document baseline rates of channel change for comparison with post-project changes.

Page 4-40. Black-footed Ferret: The statement, "... the only known population of black-footed ferrets is in northwestern Wyoming" is incorrect. While the population near Meeteete, Wyoming, was the last known wild population, the last individuals from this population were removed from the wild and a highly successful captive breeding program has been undertaken. Now, successful reintroductions have been carried out in Montana and South Dakota while Wyoming ferrets persist from the initial reintroductions in the Shirley Basin.

Page 4-41. Table 4-14: Statements in the text referencing Table 4-14 and the Table are contradictory. Will high Savery trap 4 percent or 1.5 percent of Yampa River sediment load?

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12. The information on the Black Footed Ferret has been noted. The EIS has been modified as necessary.

13. The listed value of four percent (4%) is in error. The reservoir will actually trap 1.5 percent of the Savery Creek sediment load. Erosion below the reservoir could be somewhat offset as the sediment transport capacity of the stream is diminished by reduced stream flows. Channel scour estimates and mitigation measures will be refined in final design of the project as discussed in response #1.

14. Attenuation of flood flows would be insignificant. The table below shows the magnitude of the decrease in stream flow attributable to operation of the High Savery Dam.

### Table 1.

<table>
<thead>
<tr>
<th>Gage Location</th>
<th>Flood Recurrence Interval</th>
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<tr>
<td></td>
<td>10 years</td>
</tr>
<tr>
<td>Dixon, WY, pre-dam</td>
<td>6,834 cfs</td>
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<tr>
<td>Dixon, WY, post-dam</td>
<td>6,776 cfs</td>
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<td>Dixon, WY, change in</td>
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<tr>
<td>Lily, CO, pre-dam</td>
<td>8,399 cfs</td>
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<tr>
<td>Lily, CO, post-dam</td>
<td>8,298 cfs</td>
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<tr>
<td>Lily, CO, change in</td>
<td>-1.20%</td>
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</table>

This table shows the reduction of flood flows at Lily, Colorado and Dixon, Wyoming, is insignificant and un-measurable. For instance, the 10 year flood flow measured at the Dixon gage on the Little Snake River would only be reduced by 58 cfs (-0.85 percent) – an impact that could not be measured in the field. This information has been added to the EIS.

15. Late season stream flows, maintained by releases from the project, will benefit most species of riparian plants below the reservoir. As seen in the table included in response #14 above, scouring flows (i.e. flows in the neighborhood of the 50 to 100 year recurrence intervals) that enable cottonwood recruitment and some species of willow would not be measurably diminished by reservoir operations.

16. The stream channel and grade control structures below the reservoir will be monitored for the life of the project to ensure the structures are functioning as designed and the stream...
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Page 4-52. Mitigation: "Protection" as a form of mitigation is not being considered. Rather, enhancement through improved livestock management to reduce browsing of seedlings and saplings will be the main method of riparian mitigation. While this may seem like protection, enhancement is a more appropriate term to describe this mitigation method. Furthermore, there has been no discussion of planting seedlings as a method of creating riparian habitat, and we strongly prefer establishing new cottonwood and willow stands through natural regeneration.

Mitigation of willow/alder shrub lands inundated by the project should be mitigated at 3:1 if achieved prior to project construction or 4:1 if achieved concurrent with project construction to fully offset project impacts. Where riparian mitigation will occur on Savery Creek below the High Savery Dam, we prefer it to be located at least 2 miles below the dam to minimize its vulnerability to drastic channel changes which may be induced by project operation. Text on page 4-53 should be changed to reflect these concerns.

Page 4-56. Mitigation: We discourage the mitigation of wetland impacts by the conversion of riparian or floodplain communities to wetlands. Riparian habitat is as valuable as wetlands. Therefore, loss of riparian habitat through conversion to wetlands could itself require mitigation.

Page 4-66. Downstream Effects: Discussion of possible negative impacts of altering the hydrograph on channel morphology and cottonwood/willow establishment should be included here.

Pages 4-73 and 4-75. Colorado River Cutthroat Trout: The discussion of elimination of undesirable fish species above the Sandstone site should be repeated for the High Savery site, where it is more likely to be carried out. Details of the impacts of fish removal on nontarget species, water quality, and other resources should be included in the FEIS.

Page 4-75. Minimum Fisheries Pool: While the minimum pool will benefit stream fisheries, it is more important to stress the benefit of this project element for improving the status of the Colorado River cutthroat trout. Lack of brood stock for reintroductions is a real impediment to efforts to conserve this species and avoid the necessity of its future listing as threatened or endangered under the Endangered Species Act.

Page 4-79. Threatened or Endangered Species: The above comments on threatened and endangered species also apply here.

Page 4-103. Recreation Impacts: The High Savery Dam and Reservoir would remove approximately 1 mile of Savery Creek with public fishing access through

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(Continuation of response 16)

channel is being maintained. The monitoring program will be stipulated in the 404 permit and will be implemented by the WWDC.

17. The EIS has been changed to reflect that riparian mitigation will involve enhancement, not protection.

18. Mitigation for riparian scrub/shrub wetland losses will be completed at a 3:1 ratio as described in the Mitigation plan presented in Appendix E. This is in accordance with FWS, Region 6, Wetland Mitigation Policy Guidance, August 1977.

19. The mitigation plan presented in Appendix E has been revised to eliminate areas within existing riparian zones from consideration as wetland mitigation sites unless the sites are able to be significantly enhanced.

20. Possible negative impacts to the stream channel and riparian plant communities immediately downstream from the reservoir could include channel down cutting, lateral erosion (bank erosion and channel widening), less channel scouring and sandbar formation. If down cutting does occur, recruitment of willow/cottonwood would be reduced or eliminated and desiccation of riparian soils (and vegetation) could occur.

Given the currently existing gravel composition of the substrate, down cutting below the reservoir could include channel down cutting, lateral erosion (bank erosion and channel widening), less channel scouring and sandbar formation. If down cutting does occur, recruitment of willow/cottonwood would be reduced or eliminated and desiccation of riparian soils (and vegetation) could occur.

21. Non-native fish control will only occur above High Savery Reservoir. The watershed above the Sandstone Dam and Reservoir is too large to effectively control existing populations of non-native fish. The text of the EIS has been rewritten to more clearly describe this situation.
APPENDIX H, CONCEPTUAL MITIGATION PLAN

General Comments

The previously mentioned lack of information on downstream effects of reservoir operation makes mitigation planning difficult for two reasons. First, without this understanding no accurate assessment of project impacts on fish and wildlife habitat is possible, so the amount of mitigation acres necessary remains unknown. Second, locating mitigation sites below the dam is risky without the understanding of possible hydraulic and hydrologic changes to the stream that could adversely affect these sites.

The key component to successful mitigation of project impacts is monitoring and maintenance of the mitigation sites. This mitigation plan is conceptually sound but much more detail must be provided on monitoring techniques and maintenance responsibility. Because riparian impacts will be mitigated largely through enhancement, careful monitoring and management of these sites will be necessary to gain and document the necessary improvements. A detailed monitoring plan should be developed for the final EIS. Representatives of the U.S. Fish and Wildlife Service (FWS) need to be involved in this planning effort.

Specific Comments

Page 3. Site Selection: To reiterate, we do not support conversion of riparian habitat to create wetlands for mitigation purposes. This will unnecessarily increase the riparian mitigation requirements.

Page 4. Design Criteria: The effectiveness of digging to ground water to create wetlands is questionable given possible changes in ground water hydrology due to project operation. Should the channel cut deeper or the bed shift, these wetlands would fail to develop. Should the water table be elevated by higher base flows, too much open water would be present. Some understanding and discussion of these changes at mitigation sites should be included.

The purpose of check structures on Savery Creek is not to "stabilize" the stream but to attempt to maintain the natural dynamic equilibrium of the channel movement through energy-dissipating structures.

Page 6. Monitoring and Reporting: Copies of annual reports also should be provided to FWS's Wyoming Field Office.

22. We do not believe that the minimum pool will directly benefit stream fisheries. Fish traps will be constructed on the three tributaries upstream from the reservoir to prevent migration of reservoir fishes to upstream habitats. Therefore the reservoir will not directly improve upstream fisheries. Some fish may escape from the reservoir through the outlet works, which will benefit Savery Creek downstream from the dam. We agree with your comments regarding the benefits of the minimum pool to Colorado River Cutthroat trout (CRCT) described in this comment. Stream fisheries will indirectly benefit from accelerated restoration of CRCT in the watershed above the reservoir and elsewhere throughout its native habitat.

23. Your comment on Threatened and Endangered Species has been used to revise the EIS as appropriate.

24. The loss of 2 miles of stream fishing access on public land resulting from inundation or burial under the dam is insignificant and will be offset by improvement of the water quality, and the stream channel below the reservoir. Data collected by the WFGD and biologists from Burns & McDonnell indicate the area is seasonally used by brook, rainbow, brown and occasional CRCT. Warm water temperatures in the summer probably force most game fish to migrate to more suitable habitat. In addition, the area is somewhat inaccessible and better fishing is currently available within a 20-mile radius. The loss of this 2 mile of stream fishing access will be more than offset by improvements to fishery habitat, anticipated increases of game fish biomass, and improved access to more than 2 miles of stream on state and federal land below the dam. Further, additional angling access may be made available through acquisition of lands for mitigation.

25. While we understand your concerns, precise determination of impacts to riparian areas downstream from the proposed dam sites are almost impossible to predict. Therefore, the stream channel and grade control structures below the reservoir will be monitored for the life of the project to ensure the structures are functioning as designed and the stream channel is being maintained. The monitoring program will be stipulated in the 404 permit and will be implemented by the WWDC. Mitigation wetlands are planned to be developed on areas outside of riparian zones. Vegetative cover at these sites currently consists of sagebrush, dry land grasses, or irrigated meadows. The sites will be leveled, bermmed, and provided with a reliable water supply that does not require active management. Since these sites will be located outside riparian habitats, no impact by future changes to the physical character of the stream (primarily down-cutting) would occur. Riparian mitigation areas would be protected from livestock grazing and enhanced by construction and maintenance of grade control structures.

26. We concur. The monitoring plan has been included in the EIS as appropriate in the Monitoring and Mitigation Plan presented in Appendix E.
27. We concur. Please see response #25.

28. We concur. Please see response #25.

29. While we generally concur with the comment, some reaches of Savery Creek are actively down cutting under the existing baseline conditions, perhaps as a result of the 1984 flood or channel alterations. The grade control structures may stabilize a channel already in disequilibrium.

30. We concur. This stipulation has been added to the Monitoring and Mitigation Plan in Appendix E.
Page 7. Riparian Mitigation: Though the Wyoming Game and Fish Department (WGFD) recommended mitigation of riparian habitat at 2:1, we believe that mitigation through enhancement of existing riparian habitat must occur at a minimum of 4:1 for concurrent enhancement or 3:1 for advance enhancement. Thus, a minimum of 159 acres will be needed for riparian mitigation and up to 212 acres may be necessary.

Page 8. Site Selection: We concur with the objections of WGFD. Riparian areas between the dam and Little Savery Creek are the most likely to undergo unpredictable changes due to project operation. Wetlands and riparian areas in this reach should be protected to avoid increased project impacts and mitigation requirements, but due to this vulnerability they cannot be relied upon as mitigation sites. While we may be able to accept placement of a small portion of the riparian mitigation sites between the dam and the mouth of Little Savery Creek, we prefer the bulk of the acreage to be located further from the dam, where channel instability is likely to be less and thus threats to the mitigation sites from scouring or dewatering reduced.

Furthermore, to fully document project impacts, monitoring of channel changes (i.e., permanent cross-sections and before-and-after aerial photo interpretation) should be conducted. To be effective, this monitoring should be in place as soon as possible to document baseline conditions of channel change.

We agree that the best disposition of mitigation lands would be through fee-title transfer to WGFD. They are the only State agency with the sole and specific mission of protecting and managing the fish and wildlife resources in question. We do not agree that, should this occur, monitoring and maintenance should be the sole responsibility of WGFD. Acceptable mitigation of project impacts is part of the project (hence inclusion of "Appendix 6" in the EIS) and is therefore at least the partial responsibility of the project proponent, Wyoming Water Development Commission (WWDC). Any maintenance or monitoring necessary to achieve mitigation goals also must be the responsibility of WWDC. The best way to ensure that this mitigation is successfully completed once the project is operating is through the establishment of a trust account by WWDC to pay for such activities. Finally, we believe that lease agreements less than the 30-year life-of-project are not acceptable vehicles for mitigation of project impacts.

Page 9. Design Criteria: If grazing is to be allowed in riparian mitigation areas, it should only be used as a management tool for improving riparian habitat condition. The FWS also should be included in development of any such grazing management plan.
Ms. Candace M. Thomas

Page 9. Monitoring and Maintenance: Mitigation of riparian habitat is proposed to be done by enhancing existing habitat through livestock management or complete rest. To ensure that adequate enhancement has occurred, some minimum level of monitoring must be carried out. This monitoring will be considered complete once a predetermined desired condition is reached and documentation is provided to the FWS. A process similar to that outlined on page 6 for wetland mitigation monitoring and reporting should be included here.

Page 12. Stream Stabilization: Drop structures taller than 18 inches may cause problems. The high energy differential existing above and below such structures could cause rapid head-cutting and channel instability if the structure is flanked by high flows. Drop structures taller than 18 inches should be avoided.

Thank you for the opportunity to comment on this project.

Sincerely,

Robert F. Stewart
Regional Environmental Officer

36. We agree that monitoring must be part of the mitigation package. The monitoring plan presented in Appendix E will be a condition of the 404 permit. The goals or desired condition that will be achieved has been developed in cooperation with the appropriate federal, state, and local agencies.

37. The actual height of each grade control structure will be a design consideration. The placement and design of the grade control structures will prevent rapid head cutting and channel and streambank instability and will be specified as a condition of the Section 404 permit. Permit conditions will be developed in cooperation with the appropriate federal, state, and local agencies.
Ms. Candace M. Thomas  
Chief, Environmental Analysis Branch  
U.S. Army Corps of Engineers  
215 North 17th Street  
Omaha, Nebraska 68102-4978

Dear Ms. Thomas:

The following comments were received after our internal review deadline and hereby supplement the comments provided to you in our letter of September 29, concerning the Draft Environmental Impact Statement (DEIS) for the proposed Little Snake Supplemental Irrigation Water Supply Project (project) in Carbon County, Wyoming.

General Comments

The document notes (e.g., pages 5-6, 5-7, and 4-15 through 4-27) that peak monthly streamflow in the Little Snake River could be reduced by 10-14 percent or more by various project alternatives. We expect that the reduction in daily flows could be even higher, though the DEIS does not address daily flows. At least two U.S. Fish and Wildlife Service (FWS) publications state that for recovery of the endangered fish, peak spring flows in the Yampa River system should not be decreased from whatever the natural hydrograph provides. These publications (Tyus and Karp 1989 is cited in the DEIS) are:


Natural sediment regimes in the Yampa River Basin are important for maintaining geomorphic habitats for the endangered fishes. Modification of sediment transport processes could render certain critical habitats (e.g., spawning areas) less amenable for endangered fishes. The DEIS provides entailments to water under the conditions and terms of the Colorado River Compact while providing for the recovery of four species of endangered fish. The Biological Opinion originally presented in Appendix D of the DEIS was prepared by the FWS in compliance with Section 7 of the Endangered Species Act of 1973 as amended. The document presents reasonable and prudent alternatives to mitigate the impact of the proposed project and considered the effects of all of the anticipated impacts on the endangered fish.

Peak daily flows could be greater or less than monthly flows. Assuming that the monthly peak flow is an average of the peak daily flows, then some daily flows are expected to be higher and some lower than the average.

The two references cited were funded through the Recovery Program and the recommendations contained therein are the opinions of the authors and not necessarily the policy of the recovery program or the FWS. The reports completed through the Recovery Program are intended to be used as guidance for recovery efforts. The small decrease in flows of the Little Snake River at the Lily, Colorado, gage (and smaller decrease in the Yampa River through Dinosaur National Monument) would be unlikely to cause any significant effects on the spawning, rearing, or adult habitat of any of the endangered species (see response #13 and 14 to the Interior Department letter dated September 29, 1998).

The depletion charge that will be paid to the FWS as stipulated in the Biological Opinion in Appendix D is in full compliance with the provisions of the Recovery Program and has been determined to be adequate to mitigate all of the anticipated impacts to the endangered species.

2. We concur that a reduction in sediment yield could have an adverse impact on fishery habitat. However, sediment yield to the lower Little Snake and Yampa Rivers resulting from sediment storage in any of the reservoirs is not expected to have a significant impact on the habitat of any of the endangered species downstream from the project. The small decrease in flows attributable to the project in the Little Snake River at the Lily, Colorado, gage is likely unmeasurable. The error inherent in the sampling equipment is greater than the change in stream flow resulting from operation of the project. Changes in stream flow in the Yampa River through Dinosaur National Monument would be even less measurable than the lower Little Snake. Further, the unmeasurable flow reduction in the Yampa would be unlikely to cause any noticeable reduction in the sediment transport ability of the stream. The annual discharge of the Yampa below the confluence of the Little Snake River is 1,545,621 acre-feet while the annual discharge of the Little Snake River is 1,150,621 acre-feet.
As a would be pertinent to assessment of project impacts on endangered fishes example regarding life history, the
A great deal of scientific research has been conducted and published on the endangered fishes and above the confluence with the Yampa. The DEIS should be amended to more closely assess the potential of this project to contribute to problems associated with elevated pH in the Yampa and Little Snake Rivers.

The DEIS also notes that total dissolved solids (TDS) in the Little Snake River will increase with any of the alternatives, as much as 200-242 percent just above the confluence with the Yampa (pages 4-35 through 4-39). The DEIS further notes that such increases represent a significant impact (page 4-34). The DEIS does not adequately address impacts of this increase on endangered fishes nor does it reasonably identify mitigative measures (page 4-40) for this adverse impact.

A great deal of scientific research has been conducted and published on endangered fishes and river geomorphology in the Green River Basin (including the Yampa and Little Snake Rivers) in recent years. The DEIS and the Biological Assessment in Appendix D apparently reviewed and considered very few of these. We recommend that you especially review:


As a result, the document does not include critical new information which would be pertinent to assessment of project impacts on endangered fishes in the Little Snake, Yampa, and Green Rivers. Even the life history descriptions (pages 3-35 through 3-37) need to be revised with updated information. As an example regarding life history, the DEIS fails to note that flooding of

Little Snake Supplemental Irrigation Water Supply Project  Final Environmental Impact Statement

(Continuation of response 2)

measured at Lily, Colorado, just above the confluence with the Yampa is 420,039 acre-feet. Therefore, the Little Snake provides 37 percent of the annual flow of the Yampa in Dinosaur National Monument. Project operation would result in annual flow reductions of about 2 percent in the Yampa below the Little Snake Confluence. This reduction in flow is not measurable. The effects, if any, of this flow and sediment reduction on the spawning, rearing, or adult habitat of any of the endangered species in Dinosaur National Monument, or further downstream, cannot be determined. However, it is the official opinion of the FWS that any depletions jeopardize the continued existence of the endangered fish species. The water depletion charge that will be paid to the Upper Colorado River Endangered Fish Recovery Program as stipulated in the Biological Opinion has been determined to be adequate to mitigate all of the anticipated impacts to the endangered species.

The EIS has been revised to reflect this additional discussion.

3. We were not aware this is a problem in the Little Snake River as historic water quality monitoring at the Savery Creek near Savery and the Little Snake River near Baggs do not reflect a historical increase in pH levels in the Little Snake River. See response #2 above.

4. The original model used to estimate the effect of project operation on total dissolved solids (TDS) levels in the Little Snake River was an extremely conservative mass balance equation. More accurate and detailed modeling was completed after comments were received on the draft EIS. This model showed that the maximum concentration of salts at Lily, Colorado are expected to increase approximately 25 percent in the fall. Total salt delivery to the Yampa River will not increase because of return flows from irrigation. Changes in TDS concentrations are seasonal and temporary; they do not represent a change that would adversely alter the quality of the existing stream. Increased salinity on the four species of endangered fish has not been adequately studied. The TDS levels that are predicted at the downstream areas where the endangered species are found are not anticipated to be detrimental to the species. The depletion charge that will be paid to the FWS and stipulated in the Biological Opinion has been determined to be adequate to mitigate all of the anticipated impacts to the endangered fish species.

5. The water depletion charge that is stipulated in the Biological Opinion and will be paid to the Upper Colorado River Endangered Fish recovery Program will be used to offset impacts caused by the project to the endangered fish species. The FWS considered the most recent data and reports when formulating the "reasonable and prudent measures" to offset impacts to endangered species detailed in the Biological Opinion.
riverside bottomlands is now regarded as a critical component of recovery for razorback sucker. Any further depletions in peak flows reduce the extent and duration of such inundation and may further diminish the possibility of recovery.

The DEIS and Biological Assessment (Appendix D) make general statements that the proposed project may adversely affect endangered fishes in downstream reaches (e.g., page 4-84). The DEIS should be amended, through a more thorough literature search and consultation with endangered fish biologists and geomorphologists, to more adequately address the concerns described above.

The DEIS notes that one of the benefits of the proposed project would be flat water recreation; it also notes that surveys of local and regional populations indicate very little demand for such recreation. The DEIS also states that there would be an annual drawdown in any of the alternative reservoirs of about 50 vertical feet. We recommend that the DEIS be amended to note that even if the demand existed for additional flat water recreation, the annual drawdown would make any of the alternative reservoirs rather unpleasant for recreational use.

The DEIS fails to adequately address the cumulative impacts of the proposed project on river geomorphology. It also fails to assess potential adverse impacts on the resources (including endangered fish) in Dinosaur National Monument. Congress has affirmed (16 U.S.C. Sections 1 and 1a) that resources in a unit of the National Park system are of exceedingly high public value and should be maintained in an "unimpaired" state for the enjoyment of future generations.

Specific Comments

Pages 4-87 and 4-88: The document states that roundtail chubs have not been found in recent surveys of the Little Snake River and that the proposed project alternatives will therefore have no adverse impacts on this species (pages 4-87 and 4-88). On the contrary, roundtail chubs are relatively common in reaches of the Little Snake River just downstream into Colorado (John Hawkins, Larval Fish Laboratory, Colorado State University, pers. comm.). It appears that the Little Snake River may actually be a stronghold for this species; alteration of flows by the proposed project may make the Little Snake less amenable for roundtail chubs and more amenable for nonnative fishes.

Pages 4-107 through 4-110: The DEIS lists unavoidable adverse impacts of a dam and reservoir. We suggest that several other items need to be added, all of which may contribute to adverse impacts on endangered fish and their

6. The FWS has been a cooperating agency in the development of this EIS. As such they were constantly updated on the status of the environmental studies, attended meetings where preliminary findings were discussed, and received draft work products prior to review by the general public. The FWS has issued a Biological Opinion in compliance with Section 7 of the Endangered Species Act which is included as Appendix D. The Opinion considered all of the available research and reports that have been compiled on the Yampa, Little Snake Rivers for the Recovery Program with respect to the anticipated project impacts. The deletion charge that will be paid to the Recovery Program and stipulated in the Biological Opinion has been determined to be adequate to mitigate all of the anticipated impacts to the endangered species.

7. Flat-water recreation is a secondary benefit -. and not a project purpose. At the end of the irrigation season, flat-water recreation at any of the alternatives may be made more difficult and less aesthetically pleasing because of the expected annual reservoir drawdowns of approximately 50 feet or more. The total calculated annual usages were reduced due to the reservoirs containing a reasonable amount of water during about half of the recreational season (Section 4.9.1). The project has an expected life of 100 years and the need (or desire) for flat-water recreation will probably increase at some time during the usable life of the project.

8. Impacts to endangered fish in Dinosaur National Monument are almost certainly unmeasurable. The mitigation measures stipulated in the Biological Opinion prepared by the FWS have been determined to be adequate to mitigate all of the anticipated impacts to the endangered species. Please see our previous responses to 2, 3, 4, 5, and 6 above.

9. Roundtail chub are common in the Little Snake River downstream from Dixon to the confluence of the Yampa River. Because the timing of the peak hydrograph will not be affected by this project, roundtail chub spawning, rearing, and adult habitat is not expected to be significantly altered by this project. The predominance of native fishes and relative paucity of non-natives in the Little Snake River may be caused by extreme fluctuations in the hydrograph under existing baseline conditions. These conditions may favor native species by impeding upstream migration of non-natives and may result in wide seasonal and diurnal stream temperature variations that are intolerable to non-native species. The project will not significantly modify the extreme fluctuations in the annual hydrograph that currently exist.

10. Impacts to endangered fish in Dinosaur National Monument are almost certainly unmeasurable. The mitigation measures stipulated in the Biological Opinion prepared by the FWS have been determined to be adequate to mitigate all of the anticipated impacts to the endangered species. Please see our previous responses to 2, 3, and 4 above.
Ms. Candace M. Thomas

Habitats. These include altered peak and base flows in the Little Snake and Yampa Rivers; altered sediment transport processes, perhaps even into the Yampa River; altered water quality (e.g., TDS and pH); and the potential for increases in nonnative fish populations in the Little Snake River.

Thank you for the opportunity to provide these additional comments on this project.

Sincerely,

Robert F. Stewart
Regional Environmental Officer

(Continuation of response 10)

Monitoring changes to stream flow and water quality may be completed through the Integrated Standardized Monitoring Plan (ISMP) implemented through the Recovery Program. These issues are also addressed in the monitoring plan presented in Appendix E. Given the existing database, any further modeling of changes to sediment yield, at this time would be speculative and acquisition of statistically valid data would take many years.
Ms. Candace M. Thomas  
Chief, Environmental Analysis Branch  
Planning Division  
U.S. Army Engineer District, Omaha  
215 North 17th Street  
Omaha, Nebraska 68102-4978

Dear Ms. Thomas:

Thank you for the opportunity to review the Draft EIS for the Little Snake River Supplemental Irrigation Project. Our comments are as follows.

GENERAL

The Bureau of Land Management has not received an application for a Right-of-Way for the project or any of its components. We are aware of a consultant being retained to prepare and submit an application, however, none has been submitted as of this date. It appears that this EIS will be adequate for our purposes in responding to an application when one is received. It seems that a decision was made to omit discussion of Cheyenne Stage II mitigation requirements from many places where we feel it might warrant mention.

SPECIFIC COMMENTS

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<tr>
<th>Section</th>
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<tr>
<td>8-1</td>
<td>1</td>
<td>ROW application has not been received</td>
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<td>2.3</td>
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<td>To describe the screening process as beginning in 1995 begs the question of what was going on from 1988 till then?</td>
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<tr>
<td>3.7.3</td>
<td>1</td>
<td>None of the BLM land in the project area is leased. It is all permitted. There is a difference.</td>
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<td>3.2</td>
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<td>3.12</td>
<td>TABLE</td>
<td>The land ownership presentation here is not consistent with Table 4-26. In all cases, maintaining the separation of federal, state, private would be preferable to varying combinations of those.</td>
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Bureau of Land Management

General Comment: Your general comment regarding the right-of-way (ROW) application is well taken and we agree that it is good to have the EIS as backup for the application. We understand the WWDC will apply for a ROW when they know the final project configuration of the project and the full extent to which BLM lands will be impacted. When the Stage II project was permitted, the Corps assessed all of the impacts associated with that project. Through hydrologic modeling, the Corps determined that depletions to stream flows in the Little Snake Drainage resulting from operation of the Stage II project would not impact irrigators in the basin. Therefore, in this EIS, mitigation for the Stage II project was not considered as a purpose. Further, the mitigation stipulated for the Stage II project has been, or is being, completed to the satisfaction of the Corps.

1. We agree. The ROW application will be filed by the WWDC when the mitigation plan has been finished and accepted by the Corps.

2. Scoping and screening for the Little Snake Supplemental Water Supply Project began in 1994. A prior project (Sandstone Dam and Reservoir) proposed by the WWDC in the late 1980s was designed to yield a much larger quantity of water (32,000 acre-feet of yield for industrial and agricultural water uses). The project presently under consideration will only provide 12,000 acre-feet of water for a supplemental, late season agricultural water supply.

3. We concur. Revisions have been made to the EIS to reflect the difference.

4. The description of the table has been changed to read: Percent of land surface covered with each vegetation type.

5. We concur. Revisions have been made to the EIS as appropriate.
This distinction between AUM’s and public land values has been further described in the EIS.
Ms. Patsy Freeman  
U.S. Army Corps of Engineers  
Omaha District  
215 North 17th Street  
Omaha, NE 68102

Re: Little Snake Supplemental Irrigation Water Supply, Draft Environmental Impact Statement (DEIS)

Dear Ms. Freeman:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, the Region VIII office of the Environmental Protection Agency (EPA) has reviewed the DEIS for the Little Snake Supplemental Irrigation Water Supply. EPA offers the following comments for your consideration as you complete the Final Environmental Impact Statement (FEIS) and your decision making process.

We need to point out a NEPA procedural concern that we seem to have missed in our review of previous documents. Draft versions of Chapters 1 and 2 which we reviewed previously did not include the project description as stated today. In particular, the inclusion of the minimum pool in High Savery Reservoir for purposes of restoring Colorado River Cutthroat trout (CRCT) to the Little Snake River drainage was overlooked. This would be a major program in and of itself, with many direct and indirect impacts resulting throughout the entire Little Snake River drainage. For example, would the CRCT re-initiation program require the poisioning of all the salmonid streams and lakes in the drainage to attempt the successful re-introduction of the CRCT? It appears to EPA that the inclusion of the conservation pool in this project for CRCT restoration purposes is the major federal action precipitating the restoration of the CRCT in the Little Snake River Drainage. As such, the FEIS needs to document the impacts of, and alternatives to, this action. It appears this item should be treated the same as the recreation pool previously proposed and we are sorry we missed this significant issue during the brief review period for the most recent draft versions of Chapters 3 and 4.

After consideration of the complete document, EPA recommends that another alternative be considered in the FEIS. The DEIS does a good job of documenting the various approaches to water conservation, and indicates that water conservation cannot be truly implemented without a storage reservoir. The FEIS should look at the alternative of Dutch Joe Reservoir being constructed to the maximum feasible size for the locality and the minimum pool created via improved irrigation conservation. With storage available, a 20% increase in irrigation efficiency

1. The alternatives evaluated and screened in Chapter 2 represent all reasonable options available in the Little Snake River basin capable of delivering alone, or in combination, 12,000 acre-feet of supplemental irrigation water 8 out of 10 years to the Savery-Little Snake River Conservancy District. No other benefits were considered until after the alternative screening presented in Chapter 2 was completed. The project purpose was reviewed, revised, and accepted by the cooperating agencies prior to drafting Chapters 3 - 6 of the EIS.

The reasonable alternatives evaluated in detail in Chapters 3 and 4 thoroughly discussed the secondary benefits and impacts of providing additional storage in some of the reservoir alternatives to provide other benefits. Providing storage beyond the 12,000 acre-feet needed for irrigation was only considered to be viable if the incremental impacts of the additional reservoir capacity were mitigable and relatively small. This approach is consistent with the process used for the Tie Hack Reservoir EIS in Wyoming. The provision of conservation pools for recreation, sport fisheries, and a brood stock refuge for Colorado River Cutthroat Trout (CRCT) were viewed as secondary benefits that could be provided by some alternatives. These potential secondary benefits were not considered to be project purposes.

The need for establishment of recreation pools and facilities was evaluated in the early phases of EIS preparation. Studies conducted by Burns & McDonell determined that there was insufficient regional recreational need to justify their inclusion as a federal purpose.

Of the alternatives evaluated, only two (High Savery Reservoir and Sandstone Reservoir with minimum pools) would have the potential to provide sufficient habitat to serve as CRCT brood stock maintenance facilities. However, only High Savery offers a minimal opportunity for colonization by non-native salmonids to support the numbers of adult brood stock the WGFD feels is needed to meet their goals for propagation and restoration of the species. The WGFD, in cooperation with the states of Colorado and Utah, intends to restore as much CRCT habitat as possible, and reintroduce as many CRCT as needed to maintain their genetic integrity. WGFD also intends to restore as much habitat as needed to prevent further decline of CRCT in Wyoming.

With or without a CRCT brood stock maintenance pool in High Savery Reservoir, WGFD's restoration efforts will continue. However, the efforts to expand the current range of the CRCT into suitable, historical habitat and to increase existing populations will be accelerated if High Savery Reservoir is constructed an a CRCT brood stock refuge is established.
should be attainable. This approach would also readily accommodate the water quality mitigation referenced on page 4-40 of the DEIS, and result in an alternative with fewer aquatic impacts, with less mitigation costs, than the High Savery alternative. If the conservation pool can be used for maintenance of the CRCT brood stock, another potential project benefit would be attained. If a Dutch Joe conservation pool is not suitable for CRCT, the pool could be used for some type of limited recreation.

EPA is also concerned with the lack of finalization of the mitigation plans contained in the DEIS. The issues to be resolved need to be clearly displayed in the FEIS. In particular the water quality mitigation envisioned to resolve the increase in TDS needs to be portrayed in the EIS so that the ultimate irrigation users, as well as the other readers, understand its implications.

Based on the concerns stated above, the comments contained in the enclosed detailed comments, and the procedures EPA uses to evaluate the potential effects of proposed actions and the adequacy of the information in the DEIS, the High Savery with Colorado River Cutthroat Trout storage alternative identified as the preferred alternative in the DEIS for the Little Snake Supplemental Irrigation Water Supply will be listed in the Federal Register in the Category EO-2. This means that EPA’s review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. We are also concerned that the DEIS does not document the social and environmental issues associated with implementation of the proposed Colorado River Cutthroat Trout recovery program within the drainage. Based on our review of the alternative, we believe that Dutch Joe alternative is the most appropriate alternative to improving crop yields with less impact to aquatic systems in the area. EPA will list the Dutch Joe alternative in the Federal Register in the Category EO, lack of objections.

We have enclosed detailed comments for your consideration in preparation of the Final EIS. If you have remarks or questions concerning EPA’s comments, please feel free to contact Dave Ruiter at the above address or at 303/312-6794.

Sincerely,

[Signature]

Cynthia Cody, Chief
NEPA Unit
Ecosystem Protection Program

enclosure:

cc: Mike Bonson, WWDC, Cheyenne

(Continuation of response 1)

All CRCT reintroduction efforts currently require compliance with federal, state, local land use and environmental laws. As such, restoration actions may require permits from a number of agencies including the U.S. Forest Service, Bureau of Land Management, Wyoming Department of Environmental Quality, and other state/federal agencies. These approvals would still be needed if a brood stock maintenance facility is established in High Savery Reservoir.

The re-introduction program would not require the eradication of non-native salmonids from all streams and lakes in the Little Snake River drainage. In some cases, elimination of non-native salmonids may be impossible, too expensive, or even too damaging to important recreational fisheries. In other cases, eradication of non-natives may not be needed because reintroduction and supplemental stocking of CRCT may be sufficient to maintain viable and genetically diverse populations.

Because the success of establishing a CRCT brood stock in High Savery Reservoir cannot be assessed at this time, the magnitude of the restoration program cannot be addressed. Further, because CRCT restoration efforts are ongoing at this time under the terms of an existing plan approved by the U.S. Forest Service, Bureau of Land Management, State of Wyoming, State of Utah, and State of Colorado (presented in Appendix C), this action is considered to be outside the scope of this EIS.

2. The hydrology modeling for the proposed project assumed that the canals and water delivery systems that serve the Little Snake River Conservancy District are already operating at 100 percent efficiency. This is an extremely conservative assumption. We realize that actual efficiency is far less than 100 percent. If an assumption was made that conveyance efficiency was less than 100 percent, the need for supplemental irrigation water in excess of 12,000 acre-feet of supplemental irrigation water to the confluence of Savery Creek with the Little Snake River. The only irrigation water losses that were assumed were those that occurred in Savery Creek from the reservoir to the confluence of Savery Creek. Any losses from that point downstream will mean that less water will reach irrigated fields. As noted in Section 2.4.2 of the EIS, the WWDC has invested $2.7 million in improvements to canals and diversions to improve their efficiency and reduce water losses. However, additional lining of canals or conversion to sprinkler irrigation will have detrimental effects on wetlands that will have to be mitigated. Irrigation water runoff from the end of fields, ponding on irrigated meadows and pastures, and seepage from ditches into borrow or low-lying areas have resulted in the creation of many acres of wetlands. These man made wetlands are evident on aerial photos. More efficient irrigation practices (sprinklers, land leveling, etc.) or canal lining would dry up many of these areas. Significant wetland losses resulting from canal lining and improved on-farm water delivery systems have been documented for the Big Sandy Salinity Control.
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(Continuation of response 2)

Program near Farson, WY (National Resource Conservation Service), the Shoshone Irrigation District Canal Improvements Project, near Powell, WY (Bureau of Reclamation), and the recently completed Greybull Valley Dam EIS (Bureau of Land Management).

We concur that Chapters 1 and 2 of the EIS clearly explain that conservation alone cannot provide late season irrigation water. As you know, the reason conservation was carried forward past Chapter 2 was because of public concern that it be fully evaluated as part of the process of full disclosure, not because it passed the screening in Chapter 2.

Further, conservation in conjunction with Dutch Joe Reservoir is not a viable alternative because Dutch Joe is currently designed to maximize the dam site with a yield of 12,000 acre feet and the reservoir site is too small to provide a minimum pool and still completely meet the project purpose. Even with conservation, 12,000 acre-feet of yield is still needed and the site is too small to provide both the supplemental irrigation water storage and a minimum pool.

Additionally, the need for a supplemental, late season irrigation water supply exceeds the 12,000 acre-feet the proposed project would provide. The need for 12,000 acre feet was derived from the amount of water that would have been made available to agriculture from the Sandstone Reservoir proposal in the late 1980s and was based on the amount of land that was being irrigated in the valley at that time. Approximately 15,000 acres of land are currently being irrigated that could be served by the project. However, an assumption was made that not all of the irrigators would wish to purchase storage water for late season use. Little Snake River valley irrigators have expressed interest in purchasing more than 13,000 acre-feet of water that would be available 8 out of 10 years from the proposed project.

Even if Dutch Joe Reservoir were capable of providing a minimum pool for CRCT brood stock or other recreation, keeping undesirable fish species out of the supply canal and hence the reservoir may be difficult as fish screens do not work on eggs, larval fish, fry, and fingerlings. Therefore, the reservoir may be overtaken by non-native suckers or other species damaging its value for recreation or CRCT brood stock. In addition, capture of adult CRCT in spawning or pre-spawning condition may be difficult because there is no perennial inlet stream and the supply canal may not be in operation during the CRCT migration season. A minimum pool significantly in excess of 20% of the reservoir capacity may be needed to ensure over winter survival of salmonids.
3. Conceptual mitigation plans have always been acceptable for evaluating alternatives in a DEIS. A final mitigation plan is presented in Appendix E of this final EIS. The EPA will have the opportunity to review and comment on proposed conditions of the section 404 permit including requirements for monitoring and mitigation.

Mitigation (if any) for salinity impacts will be dictated by the Wyoming Department of Environmental Quality as part of their Section 401 certification of the proposed section 404 Permit and will ensure that water quality standards are not violated. Generally, most salinity problems are caused by water leaching through naturally saline subsoil or capillary movement upward from water percolating from saline bedrock formations underlying irrigation projects. That is not the case with the Savery-Little Snake Conservancy District. Years of irrigation on project lands have already leached most soluble salts from the soil. With the High Savery alternative, the maximum concentration of salts in the Little Snake River at Lily, Colorado are predicted to increase approximately 25 percent in the fall. Total salt deliveries to the Yampa River will not increase due to return flows from irrigation. Changes in TDS concentrations are seasonal and temporary; they do not represent a change that would adversely alter the quality of the existing stream habitat. Tables 4-15, 4-16, and 4-17 as presented in the DEIS were wrong and have been corrected in the FEIS.

4. Your concerns have been addressed in the responses to comments 1 through 3 above and 5 through 20 that follow. However, we believe that the Dutch Joe Reservoir has serious environmental impacts that were addressed in the DEIS. The WGFD has stated in their mitigation report to the WWDC (incorporated into this EIS as Appendix C) and reiterated in their comment letter to the Corps on this EIS that impacts to crucial big game winter range are difficult to mitigate. In their mitigation guidelines, the WGFD assigns the same ecological importance to crucial big game winter range and wetlands and notes that crucial big game winter range cannot be created. The only mitigation that can be done to offset the impacts to this resource is to enhance other winter range in poor condition. In their comments on the DEIS submitted on September 29, 1998, the WGFD clearly states:

Of all the sites, The High Savery site results in no loss of crucial winter range for big game. Losses of these habitats are unmitigable. There appears to be zero potential for successfully mitigating losses of wetland and riparian habitats associated with the High Savery site.
EPA Region VIII Detailed Comments on the
Little Snake Supplemental Irrigation Water Supply,
Draft Environmental Impact Statement

Summary page 4 - The discussion indicates that the reservoir was sized to assure that a minimum flow of 12 CFS, or the natural flow, which ever is less, is maintained. How much of the reservoir pool is set aside for this use? Why is storage needed if the minimum flow is never more than the inflow?

The project now presents the desire for a 5,724 AF minimum pool to provide habitat for the Colorado River cutthroat trout (CRCT), rather than the previous request for a minimum pool for recreation. This proposal raises several issues.

First, why was protection for CRCT selected rather than some other sensitive species in the drainage, such as flannelmouth sucker. The DEIS (page 3-43) indicates that little is known about flannelmouth sucker spawning habitat. WGFD information indicates that it is possible that Savery Creek is used as flannelmouth spawning habitat. It would seem logical that at least a discussion of why CRCT preservation is being emphasized rather than flannelmouth sucker preservation, especially since the proposed reservoir has no adverse effects on CRCT habitat. It appears that the proposed plan is to manage the downstream reaches of Savery Creek for CRCT. It is likely that this management preference would select against flannelmouth suckers. The rationale needs to be clearly presented for selecting against the native species which currently exists in the reservoir area and downstream, in favor of the native species which does not exist in either the reservoir area or downstream.

Second, it is especially important to analyze the impacts of the proposed non-CRCT removal program on the entire aquatic community of Savery Creek. This program is apparently necessary to make the CRCT proposal successful. This information needs to include the expected success of the program, and what will happen if it is not successful.

Thirdly, the rationale for the selection of the minimum pool size needs to be clearly presented. It appears that the AF value was based on how many fish are necessary to restore CRCT to the Little Snake River drainage. This would be a major program in and of itself, with many direct and indirect impacts resulting throughout the entire Little Snake River drainage. For example, would the CRCT re-initiation program require the poisoning of all the salmonid streams and lakes in the drainage to attempt the successful re-introduction of the CRCT? It appears to EPA that the inclusion of the conservation pool in this project is the major federal action leading to restoration of the CRCT in the Little Snake River Drainage. As such, the DEIS needs to be modified to document the impacts, and alternatives, of this action.

What would happen if the pool was only 3,000 AF? What will happen if the pool is not available every year? It does not seem reasonable to conclude that the operator will not have to empty the pool for some operational or emergency reason during the life of the project.

Summary Page 10 - The discussion of "areas of controversy" indicates on the one hand that
evaluation of the state appropriation process (e.g. how the project is funded) is not a factor in the federal decision process concerning permit issuance. However, in the subsequent paragraph (and elsewhere in the document) the discussion points out that one of the drawbacks of the Dutch Joe alternative is that it costs 20% more than the proposed alternative. EPA believes that NEPA requires the lead agency to clearly address all controversial areas, even if the lead agency has concluded that the area of controversy is moot to the agency itself. The NEPA document needs to inform all interested parties of both sides of the controversial issues in a complete and objective manner. While the Corps may conclude the funding controversies are not part of the Corps review process, the Corps should document why funding controversies are not part of the Corps review. The funding controversies are part of the controversy concerning the project and the NEPA document needs to be prepared for all readers, not just the Corps decisionmaker.

An extensive alternatives analysis, to include cost analysis, was conducted for this project and many alternatives were rejected based on costs. The conclusion of that analysis was that all the remaining alternatives were reasonably comparable from a cost perspective. While there may be a difference in cost of the remaining alternatives this should not be considered a "drawback" for any specific alternative. Especially if the Corps has concluded that the funding mechanisms of the state are not appropriate for review. Table 2-4 of the DEIS indicates the cost comparison does not include mitigation costs. Mitigation costs for the High Savery alternative would be expected to be much higher than the Dutch Joe alternative. Other costs which do not appear to be included in the High Savery project costs are costs associated with preparation and operation of the Reservoir drainage basin for the Colorado River Cutthroat Trout. If costs are to be used for alternative selection, an equal cost comparison needs to be made.

Page 2-8 - It is not clear why the alternative descriptions include a multi-level release for the Sandstone and High Savery alternatives but not the Dutch Joe alternative. The alternatives should be treated equally.

Page 2-14 - The wetland impact (approximately two acres) for the Dutch Joe alternative is different than indicated in Table 2-5 (3.2 acres). The values in the text and tables need to be made consistent throughout the document.

Page 4-73 - The discussion of using Sandstone Reservoir for a Colorado River Cutthroat Trout brood stock facility list several reasons why this is not practical at the Sandstone site. However, the discussion of the same issue for the High Savery site seems to ignore the same issues that made the Sandstone site impractical. This inconsistency needs to be resolved. For example, if it is "logistically impractical" to eradicate the stream above Sandstone Reservoir, how is it logistically practical to eradicate enough salmonid streams in the entire Little Snake River Drainage to utilize the annual demand of 300,000 eyed eggs.

Page 4-77 - The Dutch Joe fisheries discussion implies that the cold water releases would adversely impact endangered fish. However, the endangered species discussion on page 4-83 the discussion indicates the lowered temperatures are unlikely to affect the endangered species. This inconsistency needs to be resolved.

8. While we understand your concerns, we and the WGFD believe that removal of non-native fish species and reintroduction of native species will provide a positive benefit to the ecosystem of the Savery Creek drainage upstream from the High Savery Reservoir. Restoration of native species is a high priority of the WGFD and the State of Wyoming. Elimination of non-native rainbow trout will remove the most detrimental competitor (and a species that interbreeds with) CRCT. Eradication (or control) of non-native white sucker from the Savery Creek drainage upstream from the proposed High Savery Reservoir should improve the status of relatively rare native bluehead and flannelmouth suckers which will be reintroduced after non-native fish removal has been completed. Only in the tributaries of Savery Creek upstream from the reservoir will all species of fish be eradicated. The native and non-native fish communities in the remainder of Savery Creek and its tributaries below the dam will not be affected.

9. The report from the WGFD in Appendix C presents a detailed description of how the minimum pool was calculated and the justification for maintaining 14,640 adult CRCT brood stock in the reservoir. Please also see the responses to comments #1 and #6 above.

10. Please see Table 22 in Appendix C. Using interpolation, a 3,000 acre foot minimum pool in the reservoir would support 11,466 adult CRCT. However, 11,466 is not justified on the basis of genetics, CRCT recovery goals, or biology as presented in Appendix C. Our responses to comments #1 and #6 above also provide insight or are applicable to this issue.

11. Cost is an important criteria for determining feasibility of alternatives but the source of project financing is not. In addition, benefit/cost data is not a concern to the Corps in their consideration of projects that are financed with non-federal dollars. The Corps leaves the decision of whether or not the project is a good investment up to the project proponent, which in this case is the Wyoming Water Development Commission. However, selecting a project that is the most cost effective along with other variables such as technical feasibility and impacts to aquatic, environmental, and social resources is certainly factored into the decision whether or not to issue a permit.

12. Cost per acre-foot was one tool used to screen alternatives in Chapter 2 of the EIS. Had the cost per acre-foot threshold been set too low, all alternatives except for High Savery Dam and Reservoir would have been eliminated from consideration after Chapter 2 of the EIS. The threshold criteria was an arbitrary number (2 times the cost of the least costly alternative). The criteria was intended to bring several reasonable alternatives forward for evaluation in Chapters 3 and 4. Like the evaluation of impacts, it was never intended that cost would not be considered later in the permitting process. We need to keep in mind, that the 404(b)(1) Showing is the applicants opportunity to convince the Corps that their preferred alternative described in the EIS is the least damaging practicable alternative.
Mitigation costs for each of the reservoir alternatives were estimated by the WGFD, presented in Appendix C of the DEIS, and are summarized in the table below. The mitigation costs for High Savery dam increased as a result of the riparian land mitigation ratio increasing from 2:1 for enhancement to 3:1 as a result of further analysis by the FWS. Mitigation costs may change somewhat during the design phase of the project.

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Sandstone (w/min pool)</th>
<th>Dutch Joe (w/min pool)</th>
<th>High Savery (w/min pool)</th>
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</table>

The relative cost of mitigation is highest for the two Sandstone options and considerably lower for the Dutch Joe and High Savery alternatives. The WGFD has estimated that mitigation for either of the two High Savery options is less than the Dutch Joe alternative. As previously discussed, provision of a pool to provided maintenance habitat for adult CRCT brood stock is a secondary project benefit that High Savery Dam and Reservoir is capable of providing - not a primary project purpose.

13. Dutch Joe Reservoir was not originally designed with a multi-level outlet because Dutch Joe Creek below the dam was incapable of supporting a fishery. However, this oversight has been corrected and a multi-level outlet works added to the design because of anticipated water quality impacts to the Little Snake River (temperature) resulting from a single outlet near the bottom of the reservoir. The revised design resulted in an increase of $750,000 in the estimated construction cost of Dutch Joe Reservoir. The estimated construction costs of Dutch Joe Reservoir has been revised upward to $37.8 million.

14. We concur. The correct figure is 3.2 acres. This has been corrected in the FEIS.

15. The watershed of Savery Creek upstream from the Sandstone site is approximately 330 square miles. The watershed upstream from the High Savery site is 107 square miles. Therefore, the watershed above Sandstone is 3.24 times larger than the watershed above High Savery. Major perennial tributaries that confluence with Savery Creek above the Sandstone site but below the High Savery site support reproducing non-native catostomid
Page 4-97 - The public finance section concludes that the value of land surrounding the proposed reservoir would increase. The rationale for this needs to be presented. If this land is going to be developed, the impacts of that development need to be included as they are directly related to reservoir construction and are reasonably foreseeable.

This section concludes that economic benefits would accrue to local and county finances. For this document to present a complete and objective analysis, the information should include a detailed cost/benefit analysis. Since this has been raised during the scoping process, and is a point of contention, the NEPA document needs to address it.

Page 4-105 - The recreational mitigation section indicates that recreational facilities & stocking programs would be developed for the preferred alternative. This conflicts with the discussion that the preferred alternative would be used for Colorado River Cutthroat Trout brood stock. This conflict needs to be resolved and the document modified.

Page 4-112 - The incremental impact discussion indicates that Sandstone Reservoir would be used for Colorado River Cutthroat Trout brood stock. The main body of the DEIS (page 4-73) indicates this would not be possible. This conflict needs to be resolved.

16. As a result of analyses discussed in response #13 above, a multi-level outlet has been added to Dutch Joe dam and reservoir. Except for flow depletions, no endangered fish species would be directly affected by these releases from Dutch Joe dam.

17. Obviously, the value of the land surrounding the reservoir will increase because the proposed impoundment will increase recreational opportunities and improve the aesthetics of the site. Water is the focal point of outdoor recreation and is attractive to visitors and developers alike. The State of Wyoming is planning to acquire the lands around the reservoir or obtain a scenic easement to prevent development. The existing landowner has not indicated he would like to develop any lands around the reservoir. However, isolation of some parcels may limit the value of some lands surrounding the reservoir for agricultural operations. Any analysis of future development would be speculative.

18. Please see Table 4-28. The project will result in increased crop production resulting in additional revenue realized from increased sales of agricultural commodities. Land values are expected to increase as a result of more attractive recreational opportunities, improvement of Savery Creek as a fishery downstream from the reservoir to the confluence of the Little Snake River, and increased agricultural productivity. Portions of Carbon County nearest to the reservoir may see an increase in recreational visitor days.

Because no federal funds are involved in the planning, design or construction of this project, the financial viability of the proposal has to be determined by the applicant. As a result, a benefit/cost analysis is not needed and is not a criteria for evaluation of this project. The Corps has traditionally left the decision of whether or not the project is a good investment up to the project proponent (in this case the WWDC). Please see the response to #11 above.

19. The High Savery Reservoir would provide water based recreation opportunities in addition to serving as a CRCT brood stock refuge. The same activities that would occur at Sandstone would also be compatible with the management of High Savery. However, some restrictions may apply to protect the CRCT brood stock.

20. Sandstone Dam and Reservoir would be a recreational fishery supporting naturally reproducing rainbow trout, brown trout, brook trout, and CRCT that are expected to drift in from upstream areas. However, periodic stocking of other salmonids may be needed to
supplement natural recruitment. Sandstone Reservoir is not as feasible as a CRCT brood stock facility because of competition from other salmonids that probably cannot be removed from the Savery Creek watershed above the dam. The EIS has been revised to clarify this issue.
Dear Colonel Volz:

We have reviewed the information contained in your September 1, 1998 Public Notice concerning the proposed Little Snake Supplemental Irrigation Water Supply Project on Little Savery Creek, Carbon County, Wyoming. The Environmental Protection Agency (EPA) has participated in National Environmental Policy Act (NEPA) and Clean Water Act (CWA) Section 404 procedures since initiation of this supplemental irrigation project in the 1980's. We provide the following comments based on our review of all the information developed during that process, with the focus of our comments towards the proposed action described in your Public Notice and the alternatives contained in the Draft Environmental Impacts Statement (DEIS). We have enclosed a copy of our DEIS comments for your review and consideration during the 404 review for the subject project.

This project has a long history of concern and controversy about the purpose and need for the project and the development of alternatives to assure that the least damaging practicable alternative is selected, if a permit should be issued. As you are aware, the selection of the basic (or overall) project purpose is the basis for development of alternatives under both the CWA Section 404 Guidelines (Guidelines) and NEPA. Without a clear, consistent, statement of project purpose, the design of alternatives, and the subsequent decision on the least damaging practicable alternative, is not possible. In the Public Notice, and the DEIS, the Corps has presented the project purpose as: "to provide 12,000 AF of late-season irrigation water 8 out of 10 years to lands in the Little Snake River Basin over a project life-span of 100 years." EPA agrees that an additional late-season supply of water would improve the economic viability of irrigated agriculture in the Basin. We point out that the selection of the 12,000 AF as the required supply is based on the currently irrigated acreage, not necessarily on current irrigation demand. We have heard that some irrigators within the valley may not want to participate in the project, should it be built.

We have carefully read and reread EPA's comment regarding this issue. The DEIS is clear on this matter and we are not sure anything further could be said to clarify the discussion. Sections 1.3 and 1.4 of the DEIS (Pages 1-7 and 1-8) step through the rational used to justify the need for this volume of water. The only additional argument that could be added is irrigators in the Savery - Little Snake River Conservancy District have indicated a willingness to purchase at least 13,000 acre feet of project water. The WWDC has also discussed with the Corps, the idea that construction would not begin until the irrigators had signed contracts to purchase at least 80 percent of the project yield.
We have also questioned, through the NEPA process, the rationale for selection of the "8 out of 10 years" design criterion. To date the NEPA documents have not provided such rationale. This type of review is important from the perspective of selecting the least damaging practicable alternative. For example the environmental tradeoffs between meeting the demand 8 out of 10 years need to be compared to meeting the demand at a lesser, or greater, frequency.

The Corps also needs to consider the enforceability of the proposed permit conditions. For example, the Public Notice and the DEIS indicate that the water will not be used to irrigate lands that are not currently irrigated. EPA agrees with this requirement because the DEIS did not analyze the impacts of opening new lands to irrigation, or irrigating lands that have been irrigated in the past but are not currently irrigated. The Corps needs to develop permit conditions to assure that this requirement is implemented for the life of the project (stated in the Public Notice to be 100 years). The Public Notice also indicates that the 3,724 AF conservation pool would be "inviolable." Apparently this condition stems from the 4 May 1998 Wyoming Fish and Game report which documents the conservation pool necessary for maintenance of the recommended cutthroat trout. EPA does not believe that this condition would be enforceable, as it is highly likely that some type of project maintenance or emergency will occur within the 100 years life of the project that will require the pool to be drawn down. Since inclusion of this increased conservation pool results in increased project impacts beyond those that would result from the least damaging practicable alternative to meet the basic project purpose, there needs to be detailed documentation explaining what will happen if the value cannot be maintained.

The proposed project also occurs in a drainage with a large floodplain, and will highly modify the downstream aquatic and terrestrial community and the ability of the stream to naturally interact and adjust with its floodplain for many miles. The extensive mitigation proposed to prevent project induced adverse channel modifications do not occur is indicative of the floodplain values of Savery Creek and its downstream reaches. Conversely, the floodplain of the Dutch Joe alternative is a minor feature of the landscape. The Corps needs to assure that the selected alternative complies with the direction contained at 33 C.F.R. 320.4().

We have also reviewed the applicant prepared 404(b)(1) showing (Showing) attached to the public notice and provide the following comments for your consideration. The Purpose and Need discussion of the Showing indicates a demand for 13,000 AF of water in the project area rather than 12,000 AF as stated in the public notice. The Showing also implies that the inclusion of the Indiana minimum pool would allow attainment of 12,000 AF of supply in 8 out of 10 years as well as minimum downstream instream flows. This applicant's view of the project seems to conflict with that presented in the DEIS and the public notice. Should the project purpose change because of these statements by the applicant, significant changes in the alternatives, an impact analysis will be required.

The remainder of the Showing is a discussion of the alternatives selection process and results. The applicants conclude with a request that the Corps "exercise flexibility guidance" during the permit decision process. Presumably this is in reference to Regulatory Guidance Letter 93-2. If the Corps has some other type of "guidance" related to "flexibility" we would appreciate the opportunity to review that guidance, and comment if necessary, prior to a permit decision. If

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2. A firm yield of eight of 10 years is standard WDDC policy for agricultural water supply projects. Unlike municipal and industrial projects where a firm yield is required, agricultural projects simply cannot afford the additional costs involved in providing a firm yield. High Savery Reservoir has an 80 percent chance of providing an annual firm yield of 12,000 AF.

The decision by the WDDC to build a reservoir that would provide a firm yield eight out of 10 years was based upon economics. In order to meet irrigation needs 100 percent of the time, the High Savery Reservoir would have to be sized considerably larger than 22,433 acre feet. The additional cost would have been prohibitive. A smaller reservoir, sized to provide 12,000 acre feet less than eight out of 10 years would have been almost as large as the proposed project. Had the reservoir been sized to deliver 12,000 acre feet of water less than eight out of 10 years, the water supply would be insufficient to provide the economic certainty needed by the irrigators.

3. The Corps concurs that it needs to develop permit conditions which will ensure that only existing irrigation lands will benefit from the proposed storage of late season irrigation water.

In Wyoming, when the term inviolate is used, it refers to the normal reservoir operation. The pool is inviolate as it relates to normal annual operation. However, if the dam were deemed unsafe due to structural or other maintenance issues, the dam must be drained as ordered by the Wyoming State Engineer's Office of Dam Safety. The Project Sponsor would have no choice but to empty the facility and undertake the required maintenance to satisfy the Dam Safety officials.

The minimum pool would be encroached upon only for repairs to the dam and appurtenances. Repairs that require draining to dead pool storage are not expected to be needed for decades. In the event the pool is drained to perform repairs to the dam, WGF would attempt to capture as many CRCT as possible for transfer to other facilities.

33 CFR 320.4() deals strictly with floodplains. The Corps, however, is charged under 33 CFR 320.1(a) to consider all factors relevant to the proposal including impacts to the floodplain.

4. A detailed discussion of the expected impacts of the project on all of the relevant factors is presented in the FEIS. The FEIS reflects that a thorough public interest review has been conducted and the EIS has discussed all of the factors considered to be relevant to the evaluation of this proposal. Consistent with 33 CFR 320.4(a)(1), the 404(b)(1) (including 33 CFR 320.4()) showing discusses by the applicant factors which are also relevant to the proposal.
5. The applicant has attempted to present a detailed discussion of the expected impacts of the project in the 404(b)(1) showing. Although the amount of water that could be justified is larger than the need determined in Chapter 1, the applicant believes the current amount, 12,000 acre-feet, is adequately justified based on the project budget (legislative appropriation) and historical precedence.

The 404(b)(1) Showing was included in the public notice to give the applicant an opportunity to defend their selection of the preferred alternative (High Savery Dam with a minimum pool). The Showing presents the opinions of the applicant and the arguments presented in the document are not necessarily criteria that the Corps will use to evaluate this project. Although three reservoir alternatives (High Savery, Sandstone, and Dutch Joe) cleared screening in Chapter 2 and were thoroughly evaluated in Chapters 3 and 4, there are significant environmental impact, public good, and cost differences between them. Perhaps the applicant would not have stressed the difference in cost between the High Savery and Dutch Joe alternatives if the environmental impacts were overwhelmingly greater and the public benefits considerably less for their preferred alternative. However, the facts indicate otherwise.

We have heard no support for constructing Dutch Joe Reservoir from anyone outside of the EPA. Detractors and supporters alike of the primary project purpose have indicated that if a project must be built, High Savery is the best alternative. There is no support for Dutch Joe Reservoir among the other cooperating agencies.

Although the Dutch Joe alternative has fewer impacts to aquatic resources, there are impacts to other important resources that also must be considered. The loss of crucial big game winter range is, in the words of WGFD, "unmitigatable". Even if acceptable mitigation for big game winter range could be completed, the WGFD has estimated the total cost of mitigating the Dutch Joe project would be 37% more than the High Savery alternative. A mitigation plan to replace the wetland and other aquatic resources that will be destroyed by the proposed High Savery Dam and Reservoir has been developed with the cooperation of the FWS and the WGFD. The project sponsor has agreed to sufficient safeguards to ensure successful implementation and maintenance of the mitigation for the life of the project. We believe that mitigation completed for WWDC projects during the past 12 years has been adequate and effective. After discussing the issue of mitigation for big game winter range with the WGFD, we concur in their assessment that in this case, the loss and questionable mitigation of 300 acres of crucial big game winter range is more environmentally damaging than the loss of 16 acres of mitigatable wetlands.

Dutch Joe would provide no opportunity for recreation, enhancement of in-stream flows, or stream channel stabilization through mitigation measures and late season flow enhancement. We believe that given the cost of the project, the provision of these
the applicant is referring to the Flexibility MOA there seems to be a misinterpretation of the purpose of the MOA. The purpose of the flexibility MOA is to clarify the appropriate level of information needed for a permit decision. In short terms, if there are minor impacts there does not need to be a detailed alternatives search or review. That is not the case in this project. The applicant has developed a very detailed, and appropriate, alternatives analysis. Many alternatives have been reviewed, and a reasonable array has been portrayed in detail in the DEIS. It does not appear that the "flexibility guidance" the applicant seeks applies to this project, or, if it does apply, the applicant has met its direction by completing the detailed alternatives analysis.

Another portion of the Flexibility MOA indicates that an alternatives analysis need not consider alternatives that are substantially greater than the costs associated with the particular type of project. The showing has addressed costs in the alternatives analysis and concluded that several alternatives should be eliminated because they were too costly. The showing then concludes that the remaining alternatives are practicable from a cost, logistics and technology perspective. Again it appears that the applicant has met the direction of the flexibility MOA.

In the summary the Showing requests that the Corps consider that the Dutch Joe alternative is not the best and wisest use of "Public Funds" and therefore the Corps should permit the High Savery alternative. In the DEIS the Corps has indicated that evaluation of how the State allocates its funds is not a factor to be considered during the permit decision process. EPA would point out that the cost figures used in the Showing and the DEIS do not appear to include the costs of mitigation. Based on the amount of impact difference between the two alternatives it is likely that the mitigation costs for the High Savery alternative will be much higher than those for the Dutch Joe alternative. It is not clear how the project costs related to the Colorado River Cutthroat restoration portion of the project are allocated. Presumably they would be part of the comparative project cost analysis as the results are being claimed as a project benefit.

While the Showing does not clearly present the argument that the loss of crucial big game winter range under the Dutch Joe alternative "offsets" the loss of wetland acreage under the High Savery alternative, some Corps staff have indicated they believe this to be the case. The 404(b)(1) guidelines, and the Flexibility MOA, recognize the need to consider "other significant adverse environmental consequences." We point out that the guidelines do not make it mandatory to select the High Savery alternative just because the Dutch Joe alternative has "other significant adverse environmental consequences." Rather, as the preamble indicates, this allows the consideration of damages to other ecosystems in deciding whether there is a better alternative. Logically, this consideration should evaluate the context and severity of the various impacts. There does not appear to have been any analysis of this aspect of the issue. While crucial big game winter range would be lost, this is not put into the context of how this loss would impact big game, nor how this loss could be avoided/compensated. The DEIS indicates that the winter range is in very poor condition, and implies that mitigation would be relatively simple via restoration of other poor condition winter range in the immediate area. If this amount of degraded winter range only supports a few animals, one could suggest that the Dutch Joe alternative would provide the project benefit of allowing improvement of currently poor. This project benefit would not be at the expense of the increased loss of wetland acres, of higher vegetative quality, at the High Savery site. It would appear from the DEIS, and the experience

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(Continuation of response 5)

secondary benefits is important to the people of Wyoming and necessary for sustaining public support for the project.

The project purpose as stated will not change. The additional benefits mentioned in the applicants 404(b)(1) showing are not part of the projects purpose and need but are considered secondary benefits.

6. We concur, the Corps has no flexibility guidance other than Regulatory Guidance Letter 93-2.

7. We concur that the applicant has met the direction of the flexibility of the MOA in the detailed alternative analysis presented in the 404(b)(1) showing. We also note the detailed alternative analysis presented in the FEIS meets both the NEPA and 404(b)(1) guidelines.

8. The cost figures presented below show the mitigation costs for the High Savery alternative are $484,600.00 less than the mitigation costs for the Dutch Joe alternative.

The costs of the CRCT program were not considered because the program will proceed even if the High Savery project is not constructed. Therefore, the CRCT recovery program is not considered a project purpose but instead is a secondary benefit.

Presented below are the average mitigation costs for each project calculated by the WFGD and presented in Appendix C of the FEIS. These are estimated capital costs for land acquisition and construction of all mitigation needed for the three reservoir alternatives evaluated in Chapters 3 and 4 of the FEIS. Operation costs are not included. However, it is reasonable to assume that operation will be proportional to the capital cost of mitigation.

<p>| ESTIMATED CAPITAL COSTS FOR MITIGATION OF THE THREE RESERVOIR ALTERNATIVES EVALUATED IN CHAPTERS 3 AND 4 OF THE EIS |
|---------------------------------------------------------------|-----------------|-----------------|-----------------|</p>
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5-42
with wetland mitigation success rates, that it is more likely that the winter range mitigation could be accomplished than the wetland mitigation. Simply removing grazing for all, or portions, of the year could result in major improvement in native vegetation condition and subsequent winter range.

One other issue which needs to be examined in detail by the Corps is the water quality implications of the proposed project. A portion of Savery Creek is currently listed by the State as a water body which will require further evaluation to determine whether or not a new Total Maximum Daily Load will be necessary. The impacts of either alternative on this issue need to be resolved prior to permit issuance.

As mentioned above we have enclosed detailed comments developed for the DEIS that should also be considered in the 404(b)(1) evaluation. If you have remarks or questions concerning EPA’s comments, please feel free to contact Dave Ruiter at the above address or at 303/312-6794.

Sincerely,

James E. Luey, Ph.D.,
Chief, Planning and Technical Unit
Ecosystems Protection Program

enclosure:

cc: Mike Besson, WWDC, Cheyenne

9. Big game winter range mitigation is not simply a matter of restoration via the improvement of winter range that is in poor condition. The WGFD has determined that losses of big game winter range are not mitigatable. The big game winter range that would be impacted by the construction and operation of the Dutch Joe alternative has been determined to be essential to the viability of the mule deer and pronghorn antelope populations in this area. According to the WGFD (personal communications with Tom Collins, Mark Frowned, and Bill Wichers), crucial big game winter range is found where it is because of a number of factors including:

Proximity to summer and year long ranges. Migrating deer, antelope, and elk are not able to relocate from summer to winter pastures over an unlimited area.

Historic use. Big game utilize traditional migration routes. Locating replacement winter range outside of areas that have been historically used will benefit the herds that are impacted by the project.

Forage. The forage must be appropriate for species that is using it. For instance, grass would be appropriate winter forage for elk but would provide little or no benefit for mule deer. The soil type, elevation, slope aspect, and precipitation characteristics all influence the quality, quantity, and type of vegetation found on the site.

Climatic conditions. Relatively mild winter conditions characterize much crucial big game range. Areas that receive little snow (or are cleared by wind) allow forage to be available to wintering big game.

Lack of human disturbance. Winter is a stressful time of year for wintering herds. Disturbance by human activities can stress animals and further weaken them.

10. We concur. This issue was not addressed as well as it could have been in the DEIS. The Wyoming Department of Environmental Quality also brought this up in their comments on the DEIS. Savery Creek is currently under evaluation because high sediment and fecal coliform loads may be impairing use attainment. This impairment has been caused by improper livestock grazing practices throughout the watershed.

Further, historic channelization to protect headgates and hay fields has impacted channel stability. As a result, under existing, baseline conditions, the channel is actively eroding. The LSRCD is attempting to correct these past abuses with an aggressive, voluntary program to create upland livestock water facilities, improve livestock distribution, and control livestock use in wetlands and riparian areas.

The construction and operation of the High Savery or Sandstone Dams will not further contribute to the problem. In fact, of the three alternatives, High Savery Dam will...
probably have the greatest benefit for improvement of water quality. The proposed reservoir is located higher in the watershed than the other alternatives and riparian lands downstream will benefit from attenuation of flood flows and higher summer water flows. Sediment and fecal coliform loading will be reduced through implementation of mitigation measures, and protecting riparian areas and stream channels from livestock grazing.

The dam will trap most of the sediment load being transported down Savery Creek upstream from the reservoir. Erosion of fine sediment from the channel of this reach may cause some changes to Savery Creek immediately below the proposed reservoir but these will be mitigated by constructing bank protection and grade control structures in the channel immediately below the reservoir to the confluence of Little Savery Creek. Below that point on Savery Creek, the stream channel and riparian areas will be carefully monitored for the life of the project, and grade control will be constructed as needed, to prevent erosion caused by reservoir operation. In addition, The WWDC will work with landowners and the Little Snake River Conservation District to prevent bank erosion caused by livestock hoof action in the reach from the outlet of the reservoir to the confluence of Little Savery Creek. Grazing around the reservoir will carefully regulated to ensure that ground cover is adequate to prevent erosion. Vehicle access to shore side and stream side areas in the vicinity of, and upstream from, the reservoir will be controlled better than they are presently.

Further, an additional 32 acres of land will have to be acquired and converted for wetland mitigation. The mitigation areas will be fenced and livestock grazing will not be allowed. The wetland mitigation can be designed to trap sediments eroding from surrounding uplands and to serve as natural water treatment facilities. Finally, 159 acres of existing riparian area will acquired for mitigation, these area will be improved by stabilizing stream channels and removing or significantly curtailing livestock grazing. As in the case of wetland mitigation, sediments will be trapped and the improved condition of the riparian community will serve as a natural water purification system.
September 14, 1998

Ms. Candace M. Thomas
Chief, Environmental Analysis Branch
Planning Division
U.S. Army Engineer District, Omaha
215 North 17th St.
Omaha, Nebraska 68102-4978

Re: Draft Environmental Impact Statement (DEIS)
404 Permit for Wyoming Water Development commission (WWDC)
Little Snake Supplemental Irrigation Water Supply Project

Dear Ms. Thomas:

The Colorado Division of Water Resources has reviewed the DEIS referenced above with regard to potential impacts to water resources, water rights and water resource administration within Colorado.

The projected depletions of the three alternatives on downstream flows in Little Snake River and the Yampa River drainage could potentially deplete flow and adversely impact water rights in Colorado. To assure there is no depletions to Colorado water rights, storage upstream should only occur when water rights downstream in Colorado are satisfied, or at least not calling for water in priority. In short, the project should not be operated in any way that impacts or abrogates the priority system within Colorado. Additionally, it must be incumbent only on Wyoming to provide water to downstream uses impacted by the project.

Sincerely,

Chuck Roberts
Professor Engineer III

cc: Hal D. Simpson, State Engineer
    Jack Byers, Assistant State Engineer
    Bob Piaska, Division Engineer
September 24, 1998

Ms. Patsy Freeman
U.S. Army Corps of Engineers, Omaha District
215 North 17th Street
Omaha, NE 68102

RR: DEIS, Little Snake Supplemental Irrigation Water Supply

Dear Ms. Freeman:

Chris Abornathy of the Water Quality Division reviewed the DEIS and provided the following comments:

The DEIS states in Chapter 4, Section 4.3.2.1 that "Waters within Savery Creek and the Little Snake River currently meet all Wyoming water quality standards." The DEQ currently lists segments of Savery Creek and Little Snake River as water quality limited and needing a Total Maximum Daily Load (TMDL). Savery Creek downstream of the proposed project site is listed as impaired due to silt. The Little Snake River, as a formally, is listed as impaired until the Town of Dixon's wastewater treatment plant has received an updated NPDES discharge permit for wastewater discharge.

The proposed project is likely to affect the hydrologic regime of the streams mentioned above. The DEQ/WQD is not certain at this time how the modified hydrologic flow associated with the proposed project will affect the water quality limitations of these stream segments. We would like to see this item addressed in the final EIS.

1. The information provided by the Department in comment 1 has been incorporated into the EIS as appropriate. The operation of the proposed High Savery or Sandstone project could alter and improve the water quality in Savery Creek by reducing the sediment load downstream from the dam. Additional improvements could occur as mitigation efforts to stabilize the stream channel and adjacent riparian areas are implemented.

2. The modified hydrologic regime and implementation of mitigation measures that will exist with the High Savery dam and reservoir in place will probably improve water quality. Discussions of this issue in section 4.3.2.2. of the EIS have been expanded.

Savery Creek is currently under evaluation by the Department because high sediment and fecal coliform loading in stream flows may be impairing use attainment. This impairment has been caused by improper livestock grazing practices throughout the watershed. Further, historic channelization to protect headgates and hay fields has also impacted channel stability. As a result, under existing baseline conditions, the channel is actively eroding. The Little Snake River Conservation District is attempting to help correct these past abuses with an aggressive, voluntary program to create upland livestock water facilities, improve livestock distribution, and control livestock use in wetlands and riparian areas.

The construction and operation of the High Savery or Sandstone Dams will not contribute to the problem. In fact, of the three alternatives, High Savery Dam will probably have the greatest benefit for improvement of water quality. The proposed reservoir is located farther upstream in the watershed than the other alternatives. Riparian lands downstream of High Savery Dam will benefit from the attenuation of flood flows and higher summer flows especially in the late summer. Sediment and fecal coliform loading will be reduced through implementation of mitigation measures, by protecting riparian areas and stream channels from livestock grazing.

The dam will act as a trap for most of the sediment load being transported downstream of Savery Creek. Erosion of fine sediment from the channel immediately below High Savery Dam may cause some changes to Savery Creek immediately downstream of the proposed reservoir. These changes will be mitigated by the construction of bank protection and grade control structures in the channel immediately below the reservoir to the confluence of Little Savery Creek. Below that point on Savery Creek, the stream channel and riparian areas will be carefully monitored for the life of the project. Grade control structures will be constructed as needed, to prevent erosion caused by reservoir operation. Grazing around the reservoir will carefully be regulated to ensure that mitigation plans are effective.

Vehicle access to the reservoir...
Mr. Abernathy has also included a map indicating DLQ stream classification, and impaired segments for the project area.

Thank you for the opportunity to comment.

Sincerely,

[Signature]

Dennis Hennyx
Director
Department of Environmental Quality

Little Snake Supplemental Irrigation Water Supply Project Final Environmental Impact Statement

(Continuation of response 2)

...shoreline and the stream banks both upstream and downstream of the reservoir will be more controlled.

Further, an additional 32 acres of land will have to be acquired for mitigation and wetlands created. These mitigation areas will be fenced and livestock grazing will not be allowed. Wetland created will be designed to trap sediments eroding from surrounding uplands and will serve as natural water treatment facilities. An additional 160 acres of existing riparian area will also be acquired for mitigation, and enhanced through the stabilization of stream channels and the removal or significant curtailment of livestock grazing. As with the wetland mitigation effort, upslope sediments will be trapped and the improved condition of the riparian community will serve as a natural water purification system.
Little Snake Supplemental Irrigation Water Supply Project Draft Environmental Impact Statement

Wyoming Division of Cultural Resources

1. Close coordination was maintained with the Wyoming State Historic Preservation Office while the Section 106 process was implemented. New material presented in the 1998 and 1999 cultural resource investigations has been presented in a separate report to the Wyoming SHPO. The SHPO will be provided every opportunity to review the studies and draft reports as they are being completed and as they become available.

2. Please see response to Comment 1 above. The final cultural resource report describing the sites identified in Comment 2 was presented to the SHPO for review in September 1999. The SHPO was asked to review the report at that time, and to provide any recommendations concerning their potential eligibility and the need for additional testing. As stated above, information derived from the new studies has been incorporated into the EIS.
3. Native American issue analysis and consultation was initiated in 1995. An ethnographic investigation has been completed. The results of both the consultation process and the ethnographic study are included in the report submitted to the SHPO for review and comment. The confidence with which the previous studies conducted in the area are viewed will also be discussed in the EIS. Please also see discussion in following paragraph.

The cultural resource investigations performed at the Sandstone Dam and Reservoir site were completed over 12 years ago by Frontier Archaeology personnel. The personnel who conducted the survey at this alternative project location have a reputation for reliability, and it is unlikely that any archaeological sites were missed. The Frontier Archaeology personnel that performed the later work at the High Savery and Dutch Joe sites were different from those individuals surveying 12 years ago. Subsequent experience has proven the work of this team to be of poor quality. However, the probability that additional significant cultural resource sites would occur at the Dutch Joe site would be low considering the existing terrain, slope, aspect, elevation, and general location. In the event Dutch Joe Dam and Reservoir were permitted by the Corps, additional on-the-ground surveys would have to be complete.

4. The nature of the High Savery site will undoubtedly change if construction and operation is implemented. Some sites will be nearly permanently inundated, a few others will be subjected to fluctuating reservoir water levels, and still others will lie above the high water line. The EIS includes discussions of these effects and the potential opportunities for mitigating these impacts. An acceptable treatment plan containing the appropriate mitigation strategies will be developed in concert with the affected native Americans, state and federal agencies, and individuals.
Wyoming Water Development Commission

September 30, 1998

Subject: Little Snake Supplemental Irrigation Water Supply, Draft Environmental Impact Statement

Gentlemen:

The Wyoming Water Development Commission (WWDC) is the state agency sponsoring the above referenced project. Since 1985, the WWDC has been investigating the feasibility of constructing a water storage project to provide ranchers in the Little Snake River Valley with a supplemental, late season irrigation water supply. In June of 1994, the U.S. Army Corps of Engineers began preparing a Draft Environmental Impact Statement (DEIS) for a project that would provide the Savery-Little Snake River Conservancy District with a water supply yielding 12,000 acre feet of supplemental irrigation water 8 out of 10 years. We believe the careful and thorough analysis of alternatives completed as part of the National Environmental Policy Act (NEPA) review has resulted in the unmistakable conclusion that a 22,433 acre foot reservoir at the High Savery site is the least costly alternative that meets the project needs, best minimizes environmental and ecological impacts, and provides the greatest amount of secondary benefits for wildlife and recreation.

A Section 404(b)(1) Showing was prepared by the WWDC and is presented in Appendix L of the DEIS. The 404(b)(1) Showing summarizes the reasons the WWDC believes that the 22,433 acre foot High Savery Reservoir alternative is the least environmentally damaging practicable alternative, providing the greatest benefits to the State of Wyoming, and is the least costly project that was evaluated.

The WWDC appreciates the input and assistance provided by the Corps of Engineers and the cooperating agencies during the analyses and drafting of the DEIS. We believe the process mandated by NEPA has resulted in the selection of the best possible alternative. The WWDC requests timely issuance of a 404 permit for the 22,433 acre foot High Savery Dam and Reservoir.

Sincerely,

[Signature]
Lawrence M. Beason
Director
LM/3142/110
Wyoming State Clearinghouse
Office of Federal Land Policy
ATTN: Julie Hamilton
Herschler Building, 3SW
Cheyenne, WY 82002

Dear Ms. Hamilton:

The staff of the Wyoming Game and Fish Department has reviewed the Draft Environmental Impact Statement for the Little Snake Supplemental Irrigation Water Supply in Carbon County. We offer the following comments.

General Comments - The High Savery Reservoir Site has the potential for development of a brood stock of Colorado River cutthroat trout needed for regional restoration efforts for this native species. We have worked closely with the Wyoming Water Development Commission to designate a minimum pool of 5,724 acre feet for the production of approximately 14,600 adult Colorado River cutthroat trout. This is a significant conservation action, one deserving positive consideration as pertains to the assessment of project alternatives. Reservoir operations need to be developed that strictly prevent violation of any minimum pool established for Colorado River cutthroat trout.

Of all the sites, the High Savery site results in no loss of crucial winter range for big game. Losses of these habitats are unmitigable. There appears good potential for successfully mitigating losses of wetland and riparian habitats associated with the High Savery site.

Habitat Mitigation-Vegetation Treatment - Habitat mitigation for big game is suggested for all alternatives. Mitigation could include the creation or enhancement of lost vegetative communities. One suggested mitigation alternative is the improvement of existing winter range elsewhere so more big game can use the improved sites. In most cases, vegetative improvements to big game habitat require treatments that set the

1. We are certainly aware of the close coordination between WGFD and WWDC to develop a minimum pool for brood stock to assist in the regional restoration efforts of the Colorado River cutthroat trout. Your desire to maintain the minimum pool as inviolate is noted. We would envision this requirement to be an operational feature agreed to by the WGFD, the WWDC, and any other partners involved in the operation of the proposed High Savery Dam and Reservoir.

2. We recognize the WGFD's opinion that crucial winter range is not mitigatable and that opportunities for wetland and riparian mitigation exist near the site of the proposed High Savery Dam and Reservoir. These concepts are identified in the EIS.

3. Your desire to mitigate big game habitat through creation or enhancement is noted and was evaluated as part of the review and revision of the DEIS. Habitat improvement work efforts completed by the LSRCD should also be reviewed and used where appropriate.
vegetation back successively to improve vigor and nutritional value. While those treatments may improve spring and summer forage immediately, they also reduce shrub availability during winter for many years. The Department urges caution in assuming the net habitat gain from this technique without a consideration of seasonal big game habitat needs.

Wildlife Displacement - The document suggests that some wildlife will be displaced by construction activities, but will return after construction is completed. While some wildlife species can easily move into adjacent habitats and survive, some species may not be able to use adjacent habitats because those habitats are already occupied and the species are territorial (e.g., badgers, bobcats). Also, continued impacts after construction related to recreational use of the reservoir could include mortality of remaining wildlife from accidents with vehicles, fence entanglement, poisoning, etc. Additionally, any development that might occur along with any of the proposed sites could result in an influx in winter recreationists which could directly impact wintering wildlife.

Dutch Joe Alternative - This alternative is said to displace few wintering mule deer Department data suggest this site is actually important winter and transition range for a portion of the Baggs herd. In addition, Dutch Joe would contribute to cumulative impacts in that area that include oil/gas activity and sagebrush control projects. After the dam and reservoir is built, and the site is made accessible to the public, ice anglers and their vehicles would cause disturbance to big game on crucial winter range at the Dutch Joe site.

Sandstone Alternative - Big game migration could be impacted more than suggested by the Sandstone Reservoir alternative. Several game trails follow Big and Little Sandstone Canyons (observed during January elk classification flights). The steepness of the terrain around Savery Creek could make passing a reservoir at this site very difficult for migrating big game. Also, the reservoir "arms" created by the partial flooding of Big and Little Sandstone Canyons could cause a bottleneck for migrating big game.

Conceptual Mitigation Plan - Appendix H.

General Comments - Ramp-up of flows also described elsewhere in the document as "phasing in changes in major water releases over a 3-day period" will be important in preventing further destabilization of stream banks. A rapid evacuation or constant fluctuation in stream elevation will only act to severely erode stream banks causing further loss of riparian habitat. Therefore, ramping (or phasing) of discharges must be incorporated into not only the reservoir operation plan but the mitigation plan.

Monitoring and Reporting (Page 6) - We have jointly developed a monitoring plan with the Little Snake River Conservation District. Monitoring techniques and sites will depend somewhat on where mitigation is implemented, but we are in agreement in terms of implementing objectives and techniques. We have provided a brief description of these in the Wyoming Water Development Commission for their review.

4. We recognize that some wildlife species may not be able to occupy adjacent habitats during construction and that operational and recreational activities that result may keep some species or individuals from moving back into the dam and reservoir area following construction. We concur that additional wildlife mortality could occur as human activity in the area increases during dam and reservoir operation. This information is included in the EIS.

5. The concern that the Dutch Joe Dam and Reservoir site is an important winter and transition range for a portion of the Baggs herd was a factor in selection of High Savery Dam and Reservoir as the WWDC preferred alternative. We concur that other activities have resulted in effecting the mule deer habitat in the Dutch Joe area. We do not concur with the potential increased use of Dutch Joe Dam and Reservoir during the winter for ice fishing since no minimum pool is proposed and no fishery would likely exist. The EIS has been reviewed to make sure the above information is included.

6. The information concerning the game trails along Big and Little Sandstone Creeks, the steepness of the terrain and its potential impact to big game passing a reservoir, and potential bottlenecks created along Big and Little Sandstone Creek canyons has been added to the EIS as appropriate.

7. We also concur that the phasing of flows up and down over a 3-day period is important to maintaining stream bank stability. We also concur that the concept should be included in the project mitigation plan and the reservoir operation plan.

8. The monitoring and mitigation plan was prepared by the WWDC in cooperation with and using input from the Corps and other state, local, and federal agencies.
Objectives and Site Selection, 3rd paragraph, Page 8 - We continue to object to the consideration of the "tailwaters reach" (that area upstream from Little Savery Creek Confluence to the proposed dam site) as a riparian habitat mitigation area. This entire reach should be managed to avoid further project impacts. The hydrologic changes resulting from the elimination of bedload and fine sediment from this reach will interrupt stream channel and riparian development processes. Intensive management actions will be required to simply maintain riparian habitat values for life of the project impacts.

Thank you for the opportunity to comment.

Sincerely,

Bill Wichers
DEPUTY DIRECTOR

We are aware of the concerns expressed relative to the use of the tailwater area between the dam and the confluence with Little Savery Creek for project mitigation. This issue has been raised by both the WGFD and the FWS. As a result, the tailwater area below the High Savery Dam has been dropped from further consideration as a potential mitigation area.
MEMORANDUM

September 23, 1998

TO: Julie Hamilton, Wyoming State Clearinghouse

FROM: Gary B. Glass, P.G., State Geologist

SUBJECT: Draft Environmental Impact Statement for the Little Snake Supplemental Irrigation Water Supply Project (State Identifier 98-140)

In regard to what was called the "deep groundwater" alternative, why were no other formations than the Browns Park Formation considered in the evaluation of this alternative? The discussion of this alternative is on page 2-4 and pages A-5 and A-9 in Appendix A. There may be areas where one well could produce from multiple formations.

We disagree with the conclusion in Table 2-5 on page 2-18, which states that there are no seismicity impacts on the three water alternatives. While seismicity is discussed in more detail on page 3-8, that discussion only considers historic seismicity, and even that discussion is incomplete. Most dam sitings also include a discussion of "random" or "flooding basin" earthquakes, and some include a probabilistic seismic hazard assessment. A random earthquake in this area of Wyoming would most likely have a magnitude of 6.25. As an example, a magnitude 6.25 earthquake located 15 kilometers from the dam would generate horizontal accelerations in the 1.5 g range.

The U.S. Geological Survey has completed a new probabilistic seismic hazard assessment for the United States and Wyoming. The assessment indicates that there is a 10% probability of exceeding a ground acceleration of 4% g in 50 years, a 5% probability of exceeding a ground acceleration of 8% g in 50 years.

1. A number of aquifers were evaluated and rejected because of anticipated water quality concerns. Extensive oil and gas drilling has occurred in the area and there is a considerable amount of water quality data available from drilling logs and other records.

2. None of the alternatives would increase or decrease the likelihood of earthquakes in the area. Any of the dam alternatives will be constructed to withstand the calculated highest magnitude earthquakes that may be encountered in the area. The earthquake magnitudes and ground acceleration factors were determined by the Wyoming Geological Survey.

3. The EIS has been changed to reflect the data presented in the Appendix B.
and a 2% probability of exceeding a ground acceleration of 14% g 16% g in 50 years.

We are willing to assist in the preparation of a seismic hazards assessment and a revised analysis of seismicity and seismic potential for this area.

In regard to landslides, Sections 3.2.4.5 and 3.2.4.6 (pages 3-7 and 3-8) and Section 4.2.5.2.2 (page 4-8) indicate that no major landslides have been identified in the vicinity of the High Savery alternative. While "major landslides" is not defined, our Preliminary Landslide Maps, which are referenced in Section 4.2.5.2.2, show landslides mapped in that area from aerial photography. In fact, the maps show a block slide complex near the High Savery dam site (map enclosed). Has there been a field assessment that determined that these landslides are not present or are insignificant? If not, the document's conclusions regarding landslides need to be modified.

In regard to mineral resources, this area of Wyoming may contain diamond-bearing rocks as well as some zelite-bearing rocks. To date, however, there have been no documented diamonds or zeolites found.

Uranium occurrences and abandoned mines are found within the Ketchum Butte mining area in T15N, R85W. The Tertiary units in this area are enriched in uranium and related elements. These areas drain into Savery Creek.

As a final comment, there is a lot of geologic information in this report, which bears on the siting of dams, but none of the preparers of this document are identified as licensed professional geologists in Wyoming. Licensed professional geologists should be identified as such. While the State did not require licensure prior to July 1, 1997, Wyoming Statutes 33-41-101 through 33-41-121 have been amended to now require the licensing of all geologists practicing before the public in Wyoming. This legislation as well as legislation going back to 1991 also requires the signing and sealing of geologic work prepared by or under the supervision of licensed professional geologists.

If there are questions on our comments, please direct them to the appropriate geologist on my staff or to me. Dan Hausel can address diamond-related comments, Ray Harris is our expert on zeolites and uranium, and Jim Case handles seismity and

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4. This offer was accepted. James C. Case of the Wyoming Geological Survey completed Appendix B and the new data has been used to revise the EIS.

5. Based upon field assessments, we acknowledge the presence of landslides in the vicinity of High Savery Dam. However, these slides will be removed and the area excavated to bedrock for the embankment and principal spillway. Therefore, these landslides will not affect the dam, reservoir or any appurtenant structures or facilities.

6. Your comment is acknowledged. The reservoir will not impact any known diamond bearing rocks.

7. Your comment is acknowledged. Water turnover in the reservoir is expected to prevent concentration of Uranium or any other metals in the reservoir impoundment.

8. Your comment is noted. Where appropriate, licensed geologists are identified.
landslides. Questions on the Wyoming Geologist's Practice Act may be directed to me or to the Wyoming Board of Professional Geologists, which has the same mailing address as ours.
Office of Federal Land Policy

Patsy Freeman
U.S. Army Corps of Engineers, Omaha District
215 North 17th St.
Omaha, NE 68102

October 5, 1998

RE: Draft Environmental Impact Statement, Little Snake Supplemental Irrigation Water Supply

Dear Ms. Freeman:

State of Wyoming agencies have reviewed the referenced document, in accordance with State Clearinghouse procedures. The State supports the preferred alternative, the High Savery location.

We have some concerns with outdated or absent information in this document, which should be addressed in the final EIS. Landslide activity in the area has not been documented in the draft EIS. The seismic hazard assessment information in the draft EIS is not current, and seismic hazards will need to be addressed in the final EIS. The water quality discussion needs to reflect comments in the attached letter from the Wyoming Department of Environmental Quality. As well, the final EIS discussion should address how the project's modified hydrologic flows will affect water quality in stream segments referenced in their letter. Cultural resource information needs to be updated for the final EIS, and Native American consultations and the recently-recommended ethnographic study should be addressed in this document.

Additionally, we recommend that sampling of discharges be incorporated into the mitigation plans, as well as into the reservoir operation plan. We also recommend that the Wyoming Water Development Commission consult with the Wyoming Game & Fish Department about their concerns with using the "tailings reach" area for riparian habitat mitigation, and with big game winter habitat vegetation protection.

Specific technical comments are detailed in the attached letters from the Wyoming Game & Fish Department, Wyoming Water Development Commission, the State Historic Preservation Office, Wyoming Geological Survey, and Wyoming Department of Environmental Quality.

1. See responses to other letters submitted by Wyoming State agencies.
2. See response to letter submitted by the WGFD. These items will be incorporated into the 404 permit as conditions.
3. See responses to other letters submitted by Wyoming State agencies.
Again, if the above concerns are addressed in the final EIS and operation/mitigation plans, the State of Wyoming is supportive of the High Savery Reservoir alternative. As such, we encourage the Army Corps of Engineers to process the 404(d) permit as quickly as possible upon closure of that public comment period.

We commend the U.S. Army Corps of Engineers and the cooperating agencies for their obviously extensive efforts to produce this document. Though admittedly time consuming, your collaborative process appears to have produced an alternative that is generating little disagreement. With the few exceptions noted above, the comprehensive scientific information compiled in this draft EIS provides a sound basis for decision-making.

Thank you for this opportunity to comment.

Sincerely,

Conrad Lass
Director

Little Snake Supplemental Irrigation Water Supply Project
Final Environmental Impact Statement

4. Concerns raised by other state agencies have been addressed in the final EIS and will be considered when the 404 permit is drafted.

Dear Candidate:

Please accept this copy of my comment as part of the official record in accordance with the National Environmental Policy Act (NEPA) pursuant to the draft Environmental Impact Statement (DEIS) for the proposed dam and reservoir on Savvy Creek in Carbon County, Wyoming.

I support and endorse that the Army Corps of Engineers in your Record of Decision authorizes a Clean Water Act section 404 permit for the construction of the High Savvy Dam (22,432 ac feet) with a minimum pool.

Careful review of the DEIS indicates minimum environmental impacts associated with this project. A 2.6 and 3.2 average change in monthly stream discharge rate at Dose, WY and Lily, CO show the minimal impacts associated with this project. The DEIS indicates a substantial improvement to the trout fisheries for 41 miles of Savvy Creek. The DEIS also shows a positive net gain in fisheries with the minimum pool which would contain 14,000 Colorado River Cutthroat Trout (CRCT). The High Savvy reservoir provides for expansion and enhancement of this trout species which is considered sensitive. It also provides protection to this species and may assist in the recovery and eliminate the potential listing of this trout species as a Threatened and Endangered Species. Substantial recreational opportunities will exist with the authorization and construction of this project. Increased water based recreational opportunities were identified as a need in the local area. However, no economic benefits was attributed to increased recreation. While the DEIS attempted to address socioeconomic associated with the High Savvy Project it failed to capture the true benefits to the community. Late season irrigation water will result in more suitable agriculture commodity production. Stabilization of the agriculture in the Little Snake Watershed also provides environmental protection in areas like crucial big game winter range, habitat for threatened and endangered species, protection of water quality, and maintenance and distribution of wildlife populations. It is well documented that these environmental benefits are lost when agriculture is replaced by urbanization of the land.

Increased salinity was identified as a significant negative impact associated with this project. The assumption of significant increase are unjustified and not based on scientific evaluation or credible data. Irrigated lands in the Little Snake River Watershed District are underlain by the alluvial aquifer of the Little Snake River. After 50 to 120 years of flood irrigation all soluble salts contained in these soils have been leached through the aquifer. The 12,000 feet of late season irrigation water is to be applied to grounds with existing irrigation water rights. A simple soil column water leaching test would verify no increase in salinity in the Little Snake River. Until positive test results can determine otherwise the Corps should be that no significant increases in salinity will occur. The other area of inadequacy in the DEIS was in the Section on, "Arrest of Controversy" page 5-10. The DEIS provides an inaccurate portrayal on the issue of cost, environmental consequences, and tax payer subsidy to a small number of agricultural producers. This section does not contain the enabling legislation for the project by the Wyoming Legislature, nor the state designated purpose and need. Neither does this section identify that this state funded project is for mitigating the loss of water from the Little Snake River associated with the City of Chugwater's stage I and II diversion projects. Any discussion in the DEIS about controversy is one sided and prejudiced against this community with out inclusion of the commitment and purpose of this project or outlined by Wyoming Legislature.

I appreciate the opportunity to provide comments on this project that will have overall significant benefit to my community. I hope you incorporate my suggestions as noted on the final DEIS and issue a permit for the High Savvy Dam and Reservoir Project.

Sincerely,

George Salisbury

Name

Date 1/2

Address

Little Snake Supplemental Irrigation Water Supply Project  Final Environmental Impact Statement

George Salisbury

1. Your comment is noted.

2. The recreation study presented in Section 3.9 of the FEIS concluded "...the proposed development of the LSSWSP could potentially provide basic recreation opportunities in the form of fishing and perhaps picnicking. These opportunities, though limited, would more than likely satisfy the recreation needs for a small, localized population of users. The LSSWSP would attract some visitors from the local area, but probably few, if any, from the surrounding region. Local recreation demand for additional camping, boating, water skiing and swimming opportunities can best be met at existing facilities such as Hog Park Reservoir and larger lakes and reservoirs surrounding the project area."

Please also refer to Section 3.3.4, Water Quality; Section 3.6.3, Wildlife; and Section 3.6.5, Threatened, Endangered, and Candidate Species.

3. Your comment is noted. These benefits are difficult to quantify. Please refer to Section 3.3.4, Water Quality; Section 3.6.3, Wildlife; and Section 3.6.5, Threatened, Endangered, and Candidate Species.

4. We concur. The revised modeling shows that the maximum TDS concentrations at Lily, Colorado, would increase about 25 percent in October and 27 percent in November under average flow conditions. The total salt delivery to the Colorado River as a result of project operation is not anticipated to increase as a result of operation of the High Savvy alternative; however, because the flow would be less, the average concentration of TDS would tend to be increased. Overall, changes in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat.

5. Your concern is noted. The Corps is constrained by NEPA to evaluate the project on the basis of primary need (supplemental, late-season irrigation water). Other project benefits are considered secondary to the primary purpose and are considered in light of the project to meet the primary purpose(s). Mitigation for previous project impacts was determined not to be a legitimate federal project purpose.
To Whom it May Concern:

1. This High Severy Dam would replace the water taken in Stage II by the City of Cheyenne, that has never been mitigated. The dam was authorized in the 1970’s.

2. Construction of this dam will restore the ponds and riparian areas in the local valley that have been dried up for lack of late irrigation water.

I appreciate the opportunity to comment.

Sincerely,

George Shelly

Past 5 term (20 yr)
County Commissioner and State Legislator

Pine County, Co., Wy.

6. Mitigation for previous project impacts was determined not to be a legitimate Federal project purpose.

7. The benefits and impacts to areas downstream from the reservoir are discussed in Chapters 3 and 4 of the EIS. There will be positive and negative impacts to riparian areas associated with the project.
Dear Candace:

Please accept this copy of my comments as part of the official record in accordance with the National Environmental Policy Act (NEPA) and the draft Environmental Impact Statement (DEIS) for the proposed dam and reservoir on Savery Creek in Carbon County, Wyoming. I support and endorse the Army Corps of Engineers in your Record of Decision to authorize a Clean Water Act section 404 permit for the construction of the High Savery Dam (23,413 ac-ft) with a minimum pool.

Careful review of the DEIS indicates minimum environmental impacts associated with this project. A 2.6 and 3.2 average change in monthly stream discharge rate at Dixon, WY and Lily, CO show the minimal impacts associated with this project. The DEIS indicates a substantial improvement to the trout fisheries for 41 miles of Savery Creek. The DEIS also shows a positive net gain in fisheries with the minimum pool which would contain over 14,000 Colorado River Cutthroat Trout (CRCT). The High Savery reservoir provides for expansion and enhancement of this trout species which is considered sensitive. It also provides protection to this species and may assist in the recovery and colonization of the potential listing of this trout species as a Threatened and Endangered Species. Substantial recreational opportunities will exist with the authorization and construction of this project. Increased water based recreational opportunities were identified as a need in the local area. However, no economic benefit was attributed to increased recreation. While the DEIS attempted to address socioeconomic associated with the High Savery project it failed to capture the true benefits to the community. Last season irrigation water will result in more stable agriculture commodity production. Stabilization of the agriculture in the Little Snake Watershed also provides environmental protection in areas like crucial big game winter range, habitat for threatened and endangered species, protection of water quality, and maintenance and distribution of wildlife populations. It is well documented that these environmental benefits are lost when agriculture is replaced by urbanization of the land.

Increased salinity was identified as a significant negative impact associated with this project. The assumption of significant increase are unjustified and not based on scientific evaluation or credible data. Irrigated lands in the Little Snake River Water Conservancy District are underlain by the alluvial aquifer of the Little Snake River. After 50 to 120 years of flood irrigation all soluble salts contained in these soils have been leached through the aquifer. The 12,000 feet of late season irrigation water is to be collected by gravity to create irrigation water rights. Simple soil column water testing would verify no increase in salinity in the Little Snake River. Until positive test results can determine otherwise the assumption should be that no significant increases in salinity will occur. The other area of inadequacy in the DEIS is in the Section on "Areas of Controversy" page 5-10. The DEIS provides an inaccurate portrayal on the issue of cost, environmental consequences, and tax payer subsidy to a small number of agricultural producers. This section does not contain the enabling legislation for the project by the Wyoming Legislature, nor the state designated purpose and need. Neither does this section identify that the state funded project is for mitigating the loss of water from the Little Snake River associated with the City of Cheyenne's stage I and II diversion projects. Any discussion in the DEIS about controversy is one sided and prejudice against this community with out inclusion of the commitment and purpose of this project as outlined by Wyoming Legislature. I appreciate the opportunity to provide comments on this project that will have overall significant benefit to my community. I hope you incorporate my suggestions and concerns in the final EIS and issue a permit for the High Savery Dam and Reservoir Project.

Sincerely,

[Signature]

Laura Salisbury

5-63
Dear Candidate:

Please accept this copy of my comment as part of the official record in accordance with the National Environmental Policy Act (NEPA) pursuant to the draft Environmental Impact Statement (DEIS) for the proposed dam and reservoir on Savery Creek in Carbon County, Wyoming.

I support and endorse the Army Corps of Engineers in your Record of Decision authorize a Change Water Act section 404 permit for the construction of the High Savery Dam (32,413 ac-feet) with a minimum pool.

Careful review of the DEIS indicates minimum environmental impacts associated with this project. A 2.6 and 3.2 average change in monthly stream discharge at Dixon, WY and Lily, CO show the minimal impacts associated with this project. The DEIS indicates a substantial improvement to the trout fisheries for 41 miles of Savery Creek. The DEIS also shows a positive gain in fisheries with the minimum pool which would contain over 14,000 Colorado River Cutthroat Trout (CRCT). The High Savery reservoir provides for expansion and enhancement of this trout species which is considered sensitive. It also provides protection to this species and may assist in the recovery and eliminate the potential listing of this trout species as a Threatened and Endangered Species. Substantial recreational opportunities will exist with the authorization and construction of this project. Increased water based recreational opportunities were identified as a need in the local area. However, no economic benefit was attributed to increased recreation. While the DEIS attempted to address socioeconomic associated with the High Savery project it failed to capture the true benefits to the community. Late season irrigation water will result in more stable agriculture commodity production. Stabilization of the agriculture in the Little Snake Watershed also provides environmental protection in areas like crucial big game winter ranges, habitat for threatened and endangered species, protection of water quality, and maintenance and distribution of wildlife populations. It is well documented that these environmental benefits are lost when agriculture is replaced by urbanization of the land.

Increased salinity was identified as a significant negative impact associated with this project. The assumption of significant increase are unjustified and not based on scientific evaluation or credible data. Irrigated lands in the Little Snake River Water Conservancy District are underlain by the alluvial aquifer of the Little Snake River. After 50 to 120 years of flood irrigation all soluble salts contained in these soils have been leached through the aquifer. The 12,000 feet of late season irrigation water is to be applied to grounds with existing irrigation water rights. A simple soil column water leaching test would verify no increase in salinity in the Little Snake River. Until positive test results can determine otherwise then the assumption should be that no significant increase in salinity will occur. The other area of inadequacy in the DEIS was in the Section on "Areas of Controversy" page 3-10. The DEIS provides an inaccurate portrayal of the issue of cost, environmental consequences, and tax payer subsidy to a small number of agricultural producers. This section does not contain the enabling legislation for the project by the Wyoming Legislature, nor is the designated purpose. Neither does this section identify that this state funded project is for mitigating the loss of water from the Little Snake River associated with the City of Cheyenne's past and diversions projects. Any discussion in the DEIS about controversy is one sided and prejudice against this community with our inclusion of the commitment and purpose of this project as outlined by Wyoming Legislature.

I appreciate the opportunity to provide comments on this project that will have overall significant benefits to my community. I hope you incorporate my suggestion and concerns in the final EIS and issue a permit for the High Savery Dam and Reservoir Project.

Sincerely

Roy Jones

Name

Address

Little Snake Supplemental Irrigation Water Supply Project

Final Environmental Impact Statement

Roy Jones

1 - 5. See above.
Dear Candace:

Please accept this copy of my comment as part of the official record in accordance with the National Environmental Policy Act (NEPA) pursuant to the draft Environmental Impact Statement (DEIS) for the proposed dam and reservoir on Savery Creek in Carbon County, Wyoming.

I support and endorse that the Army Corps of Engineers in your Record of Decision authorize a Clean Water Act section 404 permit for the construction of the High Savery Dam (22,413 acre-feet) with a minimum pool.

Careful review of the DEIS indicates minimum environmental impacts associated with this project. A 2.6 and 3.2 average change in monthly stream discharge rate at Dixon, WY and Lily, CO show the minimal impacts associated with this project. The DEIS indicates a substantial improvement to the trout fisheries for 41 miles of Savery Creek. The DEIS also shows a positive net gain in fisheries with the minimum pool which would contain over 14,000 Colorado River Cutthroat Trout (CRCT). The High Savery reservoir provides for expansion and enhancement of this trout species which is considered sensitive. It also provides protection to this species and may assist in the recovery and eliminate the potential listing of this trout species as a Threatened and Endangered Species. Substantial recreational opportunities will exist with the authorization and construction of this project. Increased water based recreational opportunities were identified as a need in the local area. However, no economic benefit was attributed to increased recreation. While the DEIS attempted to address socioeconomic associated with the High Savery project it failed to capture the true benefits to the community.

Late season irrigation water will result in more stable agriculture commodity production. Stabilization of the agriculture in the Little Snake Watershed also provides environmental protection in areas like crucial big game winter range, habitat for threatened and endangered species, protection of water quality, and maintenance and distribution of wildlife populations. It is well documented that these environmental benefits are lost when agriculture is replaced by urbanization of the land.

Increased salinity was identified as a significant negative impact associated with this project. The assumption of significant increase are unjustified and not based on scientific evaluation or credible data. Irrigated lands in the Little Snake River Water Conservancy District are underlain by the alluvial aquifer of the Little Snake River. After 50 to 130 years of flood irrigation all soluble salts contained in these soils have been leached through the aquifer. The 12,000 feet of late season irrigation water is to be applied to grounds with existing irrigation water rights. A simple soil column water leaching test would verify no increase in salinity in the Little Snake River. Until positive test results can determine otherwise then the assumption should be that no significant increase in salinity will occur. The other area of inadequacy in the DEIS was in the Sections on "Areas of Controversy" page 5-10. The DEIS provides an inaccurate portrayal of the issue of cost, environmental consequences, and tax payer subsidy to a small number of agricultural producers. This section does not contain the enabling legislation for the project by the Wyoming Legislature, nor the state designated purpose and need. Neither does this section identify that this state-funded project is for mitigating the loss of water from the Little Snake River associated with the City of Cheyenne's Stage I and II diversions projects. Any discussion in the DEIS about controversy is one-sided and prejudice against this community with not inclusion of the commitment and purpose of this project as outlined by Wyoming Legislature.

I appreciate the opportunity to provide comments on this project that have overall significant benefit to my community. I hope you incorporate my suggestion and consider in the final EIS and issue a permit for the High Savery Dam and Reservoir Project.

Sincerely,

[Signature]

[Name]

[Address]

[Date: 8/23/98]
September 20, 1998

Candace M. Thomas
Chief, Environmental Analysis Branch, Planning Division
U.S. Army Engineer District, Omaha
215 North 17th Street
Omaha, Nebraska 68102-4978

Dear Ms. Thomas:

This letter is in response to the Draft Environmental Impact Statement (DEIS) for a proposed dam and reservoir on Savery Creek in Carbon County, Wyoming. My father-in-law, Richard W. Raught, owned a ranch in the region impacted by this DEIS. He died in February 1998 but I am commenting on the DEIS as successor trustee to his estate due to concerns about how construction of the project will affect prior water rights.

The legal description of our property in Carbon County follows:

- Township 12 North, Range 90 West of the 6th P.M., Carbon County, Wyoming
  Section 9: E1/2NW1/4, SW1/4NW1/4, NW1/4SW1/4, S1/2S1/2, NE1/4SW1/4
- Township 14 North, Range 90 West of the 6th P.M., Carbon County, Wyoming
  Section 24: Lots 2 and 3 (S1/2NE1/4), SE1/4, SE1/4NW1/4, NE1/4SW1/4
- Township 13 North, Range 89 West of the 6th P.M., Carbon County, Wyoming
  Section 9: N1/2N1/2
  Section 10: N1/2NW1/4

The Warranty Deed provides us title to this property "together with all improvements thereon situated with all water and water rights, all ditch and ditch rights, reservoir and reservoir rights". We are also shareholders in the First Mesa Ditch Company. While the issue of the project's impact on existing water rights was raised in the public participation process (see Appendix L, page 5), there was insufficient detail included in the DEIS to understand the process for ensuring protection of existing rights. Protection of water and ditch rights is crucial issues to the ranchers in the area and should not be glossed over.

The final EIS should include additional details on this issue, and protection of these water and ditch rights should be a condition of any permits issued for the project.

Sincerely,

Deborah L. Raught
6007 Rapid Creek Court
Kingwood, TX 77345-1953

Little Snake Supplemental Irrigation Water Supply Project
Final Environmental Impact Statement

1. Water rights are protected under Wyoming Water Law and the Upper Colorado River Compact and are regulated in accordance with their priority date and legal entitlement. Water storage in any of the reservoir alternatives must be in priority. The dam will be operated to ensure that all water rights senior to the reservoir will be satisfied prior to filling.
The need for Supplemental Irrigation Water has now been established in this area. My field crew harvesting our recent grow was rain. It would have been "nice" to have a little more water, but not at the cost of carving up the land more controls, lots of wetlands, wildlife habitat, etc. how not to replace stream fisheries with reservoir fishing & the stream could be enhanced or stocked at a fraction of the reservoir cost. The hay production & growing was at a record high in this area. This year: Nobody has ever seen so much hay or such good growing conditions. All of the crops in the area have been pre-wetted over corn, soybeans, and hay. The need more water will not affect the costs on building the proposed dam is properly underestimated. It also knows that if we don't have enough water in place, it is not used to grow timber, or grapes or all crops or hay because there is no water which is having the growing season is not going to be extended, and water is going to water will benefit.

Joyce Saer

1. The need for at least 12,000 acre feet of supplemental storage has been documented by the Black and Veatch (1984) study. This need has been reviewed by the Corps and has been determined to be valid.

2. Any unavoidable impacts will be mitigated including loss of wetlands, stream fishing, and wildlife habitat. Improvements will be installed to promote stream channel stability and improve stream fishery habitat.

3. Hay production fluctuates with weather conditions and rainfall in the Little Snake River Valley. The reservoir will better ensure a reliable late season water supply to enable adequate hay production on a more regular basis.

4. The cost estimates were prepared by registered professional engineers working for States West Water Resources Corporation and reviewed by Burns and McDonnell and COE engineers. The cost estimates have been determined to be reasonable are based on the best available data and estimation methods.

5. Crops that will be improved by the supplemental late season water supply include grass hay, alfalfa, small grains, and pasture. The length of the growing season will not be improved. However, existing crops that are currently limited by the lack of late season water will benefit.
6. Alfalfa is more susceptible to winter kill if it receives inadequate water in the late season. In addition, in even the best situations, alfalfa needs to be replanted every 4-7 years.
Stream improvements will be installed to mitigate anticipated impacts of dam construction and operation. These improvements will promote stream channel stability and improve stream fishery habitat. Private landowners may undertake stream improvement activities on their streams with permission of the U.S. Army Corps of Engineers.

7. Noted.

8. You comment is acknowledged.
Dear Candidate:

Please accept this copy of my comments as part of the official record in accordance with the National Environmental Policy Act (NEPA) pursuant to the draft Environmental Impact Statement (DEIS) for the proposed dam and reservoir on Savery Creek in Carbon County, Wyoming.

I support and endorse that the Army Corps of Engineers in your Record of Decision authorize a Clean Water Act section 404 permit for the construction of the High Savery Dam (22,433 ac feet) with a minimum pool.

Careful review of the DEIS indicates minimum environmental impacts associated with this project. A 2.6 and 3.2 average change in monthly stream discharge rate at Dixon, WY and Lily, CO show the minimal impacts associated with this project. The DEIS indicates a substantial improvement to the trout fisheries for 41 miles of Savery Creek. The DEIS also shows a positive net gain in fisheries with the minimum pool which would contain over 14,000 Colorado River Cutthroat Trout (CORT). The High Savery reservoir provides for expansion and enhancement of this trout species which is considered sensitive. It also provides protection to this species and may assist in the recovery and eliminate the potential listing of this trout species as a Threatened and Endangered Species. Substantial recreational opportunities will exist with the authorization and construction of this project. Increased water based recreational opportunities were identified as a need in the local area. However, no economic benefit was attributed to increased recreation. While the DEIS attempted to address socioeconomic associated with the High Savery project it failed to capture the true benefit to the community. Late season irrigation water will result in more stable agriculture commodity production. Stabilization of the agriculture in the Little Snake Watershed also provides environmental protection in areas like crucial big game winter ranges...habitat for threatened and endangered species, protection of water quality, and maintenance and distribution of wildlife populations. It is well documented that these environmental benefits are lost when agriculture is replaced by urbanization of the land.

Increased salinity was identified as a significant negative impact associated with this project. The assumption of significant increase are unjustified and not based on scientific evaluation or credible data. Irrigated lands in the Little Snake River Water Conservancy District are underlain by the alluvial aquifer of the Little Snake River. After 50 to 120 years of flood irrigation all soluble salts contained in these soils have been leached through the aquifer. The 15,000 feet of late season irrigation water is to be applied to grounds with existing irrigation water rights. A simple soil column water leaching test would verify no increase in salinity in the Little Snake River. Until positive test results can determine otherwise the assumption should be that no significant increase in salinity will occur. The other area of inadequacy in the DEIS was in the Section on "Areas of Controversy" page 5-10. The DEIS provides an inaccurate portrayal on the issue of cost, environmental consequences, and tax payer subsidy to a small number of agricultural producers. This section does not contain the enabling legislation for the project by the Wyoming Legislature, nor the state designated purpose and need. Neither does this section identify that this state funded project is for mitigating the loss of water from the Little Snake River associated with the City of Cheyenne's stage I and II diversion projects. Any discussion in the DEIS about controversy is one sided and prejudice against this community with out inclusion of the commitment and purpose of this project as outlined by Wyoming Legislature.

I appreciate the opportunity to provide comments on this project that will have overall significant benefit to my community. I hope you incorporate my comments into the Final EIS and issue a permit for the High Savery Dam and Reservoir Project.

Sincerely,

[Handwritten Note]

[Handwritten Name]

[Handwritten Address]

[Handwritten Comment]

[Handwritten Date]
Little Snake Supplemental Irrigation Water Supply Project

Final Environmental Impact Statement

Jack Parkhurst

1. Noted. The Corps is constrained by NEPA to evaluate the project on the basis of primary need (supplemental, late season irrigation water). Other project benefits are considered secondary to the primary purpose and are considered in light of the project to meet the primary purpose(s). Mitigation for previous project impacts was determined not to be a legitimate federal project purpose.

2. Noted.

3. Project financing and cost of operation is not under the jurisdiction of the Corps. This matter is the responsibility of the State of Wyoming. Flood control benefits associated with any of the alternatives are minimal.

4. Your comment is noted. Please see the response to your first comment.

5. Your support for the High Savery alternative is noted.

6. See response to your third comment.

---

Thank you for listening, I am,  
Jack Parkhurst

P.O. Box 115  
Enochment, Wyoming 82038

As a private citizen and also as a Director of the Carbon County Coalition for Stabilized Economic Development

5-70
October 9, 1998

Patsy Freeman
Army Corps of Engineers
Omaha District
215 N. 17th St
Omaha, NE 68102

Dear Ms. Freeman,

The Rawlins-Carbon County Chamber of Commerce has read some of the information published in the Rawlins Daily Times regarding the High Savery Reservoir, and we wish to comment on this project at this time.

Our board has determined that it does support this project, recognizing that the High Savery Reservoir will be of economic benefit to all of Carbon County, especially for our Little Snake River Valley agricultural community. We also feel this project will be an added recreational resource.

All of the environmental concerns have been addressed, and we do feel it is time that this project be moved forward to completion.

Sincerely,

Harry J. Lovato
President
Little Snake Supplemental Irrigation Water Supply Project

COMMENT SHEET

I feel it would be preferable to use the non-structural alternative of conservation to reach the desired end result from this project. This method would be less destructive to the landscape, not interfere with grazing and would not disrupt wildlife habitat. I am aware that you have eliminated this alternative, but I think that it should be reconsidered.

The questions that I have about the Dam project are: 1. Has the flow of water from this shed ever been calibrated to see if there is actually enough water to fill this dam? 2. Are there enough ranchers benefiting from this project to make it feasible? 3. Who will pay for the operation and maintenance of this project? 4. How will the water flow be maintained for 30+ miles to reach the few ranchers that actually want this late season irrigation? 5. Is the 25% water loss justifiable? 6. What will happen to the fish population above the dam? I have heard that all the fish will be killed and only cut-throat will be allowed. How does this affect the stocked fishing ponds that are above this project? And how many years of non-fishing will there be because of this cut-throat project? 7. Regarding recreation, who would maintain the area for the people that would use it-recreation facilities, trash facilities, roads into the area. For the short period of time that this can be used for recreation, it doesn't seem feasible.

It seems that the 30 million dollars plus all of the OM costs for this project could be more wisely spent, and the non-structural conservation alternative seems better, and if not that, no-action at all. I certainly hope that this is not a political project, and was designed for the good of the entire state, not for a few people.

Thank you for your time.

(If you need more room, please continue on the back of this sheet)

Name: Nancy L. Malone, Trustee  Representing: Peter Hansen Ranch Trust

Mailing address: 2762 B W. Riverwalk Circle

City, State, Zip Code: Litchfield, Colorado 81124

Please place this comment sheet in the box provided or mail your comments to

Patsy Freeman  OR  Rodney Schwartz
US Army Corps of Engineers  US Army Corps of Engineers
CENWO-PD-M  CENWO-OR
215 North 17th Street  215 North 17th Street
Omaha, Nebraska 68102-4978  Omaha, Nebraska 68102-4978

1. Conservation alone does not provide Little Snake River Valley irrigators with late season irrigation water. The last paragraph of Section 2.4.2. of the Final EIS summarizes why conservation is not a feasible alternative for providing late season supplemental irrigation water to Little Snake River Valley irrigators.

2. The yield of the reservoir was calculated using widely accepted hydrologic modeling techniques. Conservative assumptions and a conservative model were used to calculate the yield.

3. Evaluation of project financing, the economic value of benefits, and cost of operation is outside the jurisdiction of the Corps when evaluating projects for the issuance of 404 permits. These matters are left to the discretion of the State of Wyoming to determine if the project is a good investment. This is a demand for 15,000 AF of more than would be provided by the High Savery reservoir (12,000 AF) (Section 1.3 on Purpose & Need).

4. The water released from the reservoir for use by downstream irrigators will be protected by Wyoming Water Law and regulated by the Wyoming State Engineer.

5. Water loss has been taken into consideration for sizing the reservoir and determining reservoir release volumes.

6. Stocking fish in the State of Wyoming is regulated by the WGFD. Prior to all stocking of private ponds and streams, a permit must be obtained from the WGFD. Fishing for Colorado River Cutthroat Trout in the reservoir will also be regulated by the WGFD. Fishing seasons, creel limits, and gear restrictions will be based upon the success of the developing the necessary brood stock and obtaining the number of eggs needed to implement the recovery program. Fishing in High Savery reservoir may be restricted for a period of time until the CRCT fishery matures.

7. Management of the area would be the responsibility of the WWDC and may be contracted to other parties.

8. Project financing, anticipated benefits, and cost of operation is outside the jurisdiction of the Corps when evaluating projects for the issuance of 404 permits. These matters are left to the discretion of the State of Wyoming to determine if the project is a good investment.

5-72
Little Snake Supplemental Irrigation Water Supply Project

Final Environmental Impact Statement

Katherine W. Morehead

1. Your comment is noted. Project financing, anticipated benefits, and the cost of project operation is outside the jurisdiction of the Corps when evaluating projects for the issuance of 404 permits. These matters are left to the discretion of the State of Wyoming to determine if the project is a good investment.

2. The water will be affordable to the irrigators. See comment #1. Crops that will be improved by the supplemental late season water supply include grass hay, alfalfa, small grains, and pasture. The length of the growing season will not be improved. However, existing crops that are currently limited by the lack of late season water will benefit.

3. Mitigation for previous project impacts was determined not to be a legitimate federal project purpose. A recreation survey was completed which concluded adequate water dependent recreational opportunities do exist at other locations in the project vicinity.

4. The EIS has evaluated all alternatives in an objective manner.

Thank you.

Yours truly,

Katherine W. Morehead

Dear Ms Freeman:

Let us not suppose, just because 24 people in Baggs held up their hands in support of the Upper Savery Dam, and half a dozen in Rawlins, that there is universal support for a dam on Savery Creek at all. While it is a lesser of evils, being far less environmentally damaging than the sandstone site, the Upper Savery site still represents a huge investment, with very minimal return.

The number of irrigators who would benefit is small, and their benefits would be small. Since the last crop of hay is harvested before the end of August, late season water would basically be going for irrigated pasture. Late season water is not going to suddenly result in sugar beets or corn being grown in the Little Snake River Valley's harsh climate. Furthermore, few ranchers would afford to pay the tariff for expensive, metered irrigation water.

This project is often marketed as being mitigation for the Cheyenne diversion projects. In fact, it was part of an ambitious project on Cheyenne's part for further diversion of the headwaters. The Stage I and II diversions have had minimal impact on the basin. The earlier stages did create Hog Park Reservoir, which is a popular recreation spot in the summer, and the existence of Hog Park, and Seminole Dam near Rawlins, as well as several natural lakes, suggests that there are already adequate opportunities for water recreation in the area.

Please continue to evaluate any storage development on Savery Creek on its very questionable merits, and not on perceived public support.

Box 25
Savery WY 82332
October 7, 1998

Patsy Freeman
Army Corps of Engineers, Omaha District
215 N. 17th Street
Omaha NE 68102

Yours truly,

Katherine W. Morehead
ATTN: PATSY FREEMAN  
U.S. ARMY CORPS OF ENGINEERS  
Fax: 402-221-6886

FROM: A. W. MALONE  
P.O. BOX 2756  
AVON, CO 81620

SUBJECT: Little Snake Supplemental Irrigation Water Supply Project / HIGH SAVERY DAM

As a family member of the Peter Hansen Ranch I am sending comments on the proposed construction of the High Savery Dam in Carbon County, Wyoming. Our ranch is located on the upper part of Savery Creek and I have been involved out there for over 35 years. My concerns over the construction of this dam are:

1. The projected flow of the Savery used to calculate the viability of the dam is inaccurate and inflated. I don't believe there has ever been any serious measurement of streamflows on the Savery or Dirtyman Creek drainages. The numbers presented in the feasibility study do not match our family's nearly 100 years of experience out there.

2. The Game and Fish Department plans to reintroduce native cutthroat trout above the dam. If, because of less than expected streamflows into the reservoir, the reestablished fish population becomes endangered, our senior water rights could be preempted by the Game and Fish Department.

3. It appears that the site selection for this reservoir has not been wholly objective. Strong political influence may have been exerted by individuals in a position to gain financially from the selection of the Savery site versus the Sandstone site and I would urge careful review of all assumptions and estimates used in the decision making process.

Thank you for your time.

A. W. MALONE
My family have owned and lived on the Petar Hansen Ranch, located about two miles above the proposed High Savery Dam since 1905. We have several senior water rights on the East Fork and Dirty Man Fork, Savery Creek.

I am 67 years old and spent my entire life on the ranch during the summer since I was born, when I was younger. I owned sheep and cattle and raised them. Because of this experience, I feel I qualify somewhat as an expert on the environment and business of this area.

I have studied the Little Snake River Supplemental Irrigation Water Supply Draft Environmental Impact Statement 1988 and Appendices. Based on this I have comments on the validity and accuracy of the studies of the High Savery Dam and comments of other issues I believe have not been addressed. It is my considered opinion there can be no determination made of building this dam until these points are considered and assurances are made to the proper parties that their future water rights are assured and its use will not be withheld.

1. Between 1938 and now, I have observed water levels flowing in the upper East Fork that in several cases are much less than reported for flows recorded in the appendices. These figures are the bases to determine the amount of water that will be available for storage. Based on my observations, I cannot agree with your determinations. There should be new and more complete studies presented to prove the dam is feasible because of the availability of water.

2. Probably since the state was formed and for sure from 1840 until sometime during 1970 there have been no state of the art flow measuring equipment on either the East Fork or the Dirty Man Fork of the Savery above the dam site that I have observed. There have been attempts from time to time with a stick in the water to try to get a general idea how much water was flowing, however these methods are lacking the accuracy needed to substantiate the published figures in the above mentioned Draft.

3. The CPM of water per 70 acres the Banner and group recalculated to represent the needs of the down stream irrigators is much less than what the upstream irrigators need because of the higher elevation.

4. There was no mention of the fish we called Grayling in the draft. Is this fish now extinct? If not what are the consequences for this fish?

5. My Grandmother and Mother have conveyed to me that when they moved out in 1905, there were what they called Cutthroat fish and also what they called Natives, which I am told are Cutthroat Brook trout cross breeds. However, this was before the eastern "Brook" trout was introduced into the East Fork of the Savery. Could these "Natives" be a resident fish, along with the Cutthroat? Why is the Game and Fish Commission considering killing these fish to save the Cutthroat? It seems they have lived and thrived with each other until the late thirties, when cattle replaced the sheepe. When the cattle came the Cutthroats started to disappear in this East Fork and all of its tributaries, not because of Rainbow or Brook trout introduction.
6. What will happen when the water level in the fall and the dam is drained down for the downstream irrigators? Will the Game and Fish Commission prohibit upstream water users from using their lawful water rights in order to keep a minimal storage in the High Savery Dam? There should be published assurances that this will not happen. If this cannot be done, then the dam should not be built.

7. My family has been constantly expanding their water needs. We are planning to file for expanded water usage of up to 8 CFT. Will the building of the dam prevent us from gaining this additional water? If so, do not think the dam should be constructed.

8. How is the dam water to be administered? The present plan is a nightmare. Most of the signed up users have no need for this water.

9. The ditch will have to be lined in order for any water to reach the users. Is the published loss permissible? This cost and loss alone will cause the irrigation district yearly funds to make the dam unfeasible.

In summary, why were the upstream water users not informed or consulted during all of the planning that has gone on with the High Savery Dam? I feel this has been unfair because of the potential negative consequences on our ranching and recreation operations.

Something of interest. Did you know that the waters of the dam will cover the bones of President Teddy Roosevelt's famous San Juan horse he left to die in Wyoming. I can show you the spot if you are interested.

If you have any questions, please contact me.

Thank you for allowing this input for your consideration.

Name: Raymond B Larsen, Representing: Peter Hansen Ranch Trust as member
Mailing address: 608th 11th Street
City, State, Zip Code: Rawlins Wyoming 82301
Telephone 307-328-1342, Fax 307-328-1346

Please place this comment sheet in the box provided or mail your comments to
Patsy Freeman OR
US Army Corps of Engineers
CENWO-PD-M
215 North 17th Street
Omaha, Nebraska 68102-4978

Rodney Schwartz
US Army Corps of Engineers
CENWO-D0-K
215 North 17th Street
Omaha, Nebraska 68102-4978

Little Snake Supplemental Irrigation Water Supply Project

6. Wyoming State law will protect senior water rights holders. Wyoming water rights cannot be preempted by the WGFD.

7. Water rights are granted in accordance with Wyoming Law. If you applied for and were granted additional water rights, your rights would be regulated in priority.

8. The dam will operate in accordance with Wyoming Water law for the benefit of the minimum pool and those who purchase storage water for supplemental irrigation.

9. Water loss has been taken into consideration for sizing the reservoir and determining reservoir release volumes.

10. Public notices of Scoping meetings and hearings were published in local newspapers and posted in local government offices in Rawlins and Baggs. In addition, the Savery-Little Snake Conservancy District and the Little Snake River Conservation District were notified of meetings.

11. Your comment is noted.
Candance Thomas, Chie'
Army Co~
Planning Office
Omaha, NE
215 North 17th Street
Omaha, NE 68102-4978

Dear Chie':

October 4, 1998

I am writing regarding the public comment period on the Savory Creek dam and reservoir project being considered for Carbon County, WY.

As members of the public who have lived and worked in Wyoming since the 1960's, we are known to be interested parties. In fact, one of our staff people gave testimony on a S-444 dam proposal at a public meeting in the 1960's. However, no written scoping notice or notice of the availability of the Little Snake EIS was sent to us as individuals or to our environments groups. We had to call and request a copy of the DEIS after learning about the project from a newspaper article in our state paper. Having only recently received the EIS and Appendices, we see that these documents are extensive and that they will require more than a cursory examination before we can comment intelligently on the proposal.

Thus, we are writing to request the comment period be extended for an additional 30 days from the October 12th deadlines we have been given. Wyoming citizens have been in turmoil over this project since the original "Savory Pot Hook" ideas started surfacing more than 35 years ago. We believe it is appropriate for the Army Corp of Engineers to allow a maximum (not a minimum) public comment period for a project of such a controversial nature, particularly one known to involve very significant environmental impacts.

Although I assume it will be published in the Federal Register, I would appreciate, if at all possible, being notified of the new date as soon as you have set it. Also, please add us to your permanent mailing list to receive scoping statements regarding projects affecting water supplies and wetlands in Wyoming. Thank you for considering these requests.

Sincerely,

[Signature]

Leila Stanfield
Little Snake Supplemental Irrigation Water Supply Project

COMMENT SHEET

I am not familiar with due diligence. Your project seems interesting. I think it should be expanded. I would like to see more details.

(If you need more room, please continue on the back of this sheet.)

Name: Frank H. Charles
Representing: POCO

Mailing address: 123 Main St, PO Box 123
City, State, Zip Code: 12345, NE 68102

Please place this comment sheet in the box provided or mail your comments to:

Patsy Freeman
US Army Corps of Engineers
CENWO-PD-M
215 North 17th Street
Omaha, Nebraska 68102-4978

Rodney Schwartz
US Army Corps of Engineers
CENWO-OD-R
215 North 17th Street
Omaha, Nebraska 68102-4978

Frank H. Charles

1. Evaluation of project financing, anticipated benefits, and cost of operation is outside jurisdiction of the Corps when considering a permit action. These financial matters are left to the discretion of the State of Wyoming to determine if the project is a good investment.

2. The need for at least 12,000 acre feet of supplemental storage has been documented by the Black and Veatch (1984) study. This need has been reviewed by the Corps and has been determined to be valid.

3. Project financing, anticipated benefits, and cost of operation is not under the jurisdiction of the Corps. These matters are left to the discretion of the State of Wyoming to determine who pays for what.

4. In-stream flows below the High Savery and Sandstone Dam alternatives were proposed and described in the DEIS. In-stream flows below the proposed Sandstone Dam will be 24 cfs or natural inflow, whichever is less. In-stream flows below the proposed High Savery Dam will be 12 cfs or natural inflow, whichever is less.

5. When the reservoir does not fill, the irrigators will be shorted and crop yields may be affected.

6. Crops that will be improved by the supplemental late season water supply include grass hay, alfalfa, small grains, and pasture. The length of the growing season will not be improved. However, existing crops that are currently limited by the lack of late season water will benefit. Project financing, anticipated benefits, and cost of operation is not under the jurisdiction of the Corps. These matters are left to the discretion of the State of Wyoming to determine if the project is a good investment.
Transcript of Comments by Frank H. Charles

I am not against storing water but have strong points against this project
(1) With all the money spent on study of the project there is no way it is cost effective
(2) 12000 feet of water is not enough to fill the needs of the valley
(3) Irrigators shall not have to pay for the fisheries or recreational part of the project
(4) There is no water in this project for instream flow
(5) If it doesn’t fill 2 years out of 10 the two years it doesn’t fill are the 2 years the irrigators need the water the most
(6) At present prices there is no money to pay for the water and at this altitude and crop raised in the valley it would always be a close line on paying for it
Little Snake Supplemental Irrigation Water Supply Project

COMMENTSHEET

My husband is the third generation of our family ranching association. We privately own most of the surface to be inundated by High Sandy Reservoir. The reservoir will make our property inaccessible. We are not opposed to Wyoming keeping the water in the Snake River valley; getting the irrigation water promised them.

We are not interested in a monetary buy out but in seeing our replaced average especially access to County Road 401 as this is essential to our livestock operation. The reservoir will terminate our access from our land to County Road 601 south across parking areas. It don't seem this was addressed properly in the EIS. Our ranching environment is being severely affected.

(If you need more room, please continue on the back of this sheet.)

Name: Colleen Stratton Representing: Sandstone Ranches

Mailing address: P.O. Box 816

City, State, Zip Code: Rawlins, Wyo. 82321

Please place this comment sheet in the box provided or mail your comments to:

Patsy Freeman OR Rodney Schwartz
US Army Corps of Engineers US Army Corps of Engineers
CENWO-PD-M CENWO-OD-R
215 North 17th Street 215 North 17th Street
Omaha, Nebraska 68102-4978 Omaha, Nebraska 68102-4978
U. S. Army Corps of Engineers,
Omaha District,
Regulatory Branch
P.O. Box 5
Omaha, Nebraska
68101-0050
Re. High Savery Dam

Dear Sirs:

Thank you for this opportunity to comment on the proposed High Savery Dam. First I would like to comment that, I think it is time for the Corps to encourage, perhaps through policy, the very viable alternative to surface impoundments, ground water storage. Riparian improvement projects have demonstrated the ability to greatly increase ground water storage with huge benefits to a myriad of interests, such as habitat for wild and domestic species, without the often devastating effects of surface impoundments.

Nevertheless, the High Savery Dam is a better alternative than the Sandstone Dam proposal, which I strongly oppose. While developing a brood pond for Colorado Cutthroat Trout adds a more palatable dimension and a specific beneficial use to this project, I would like to see several guarantees in place to guarantee the integrity and sincerity of those intentions if you approve the permit.

Erosion and the resulting sedimentation from a variety of users should be prevented by carefully designing the way the public uses the facility and the area around the facility.

Once the objectives of the fishery are met, fishing could be allowed, but motorized boats and other motorized recreational devises should be banned from the reservoir. Boats, canoes or rafts with paddles would be acceptable. Access to the lake should be controlled with carefully designed parking lots for vehicles and camping. And, only foot access for fishing should be allowed beyond the parking lots with no camping allowed out of the specifically developed campgrounds.

Building the dam should be contingent upon obtaining a one-mile in all directions, conservation easement on the surface lands surrounding the Reservoir. Within this easement, all terrain vehicles should be banned.

The reservoir should not be the site of a recreational subdivision. There is ample evidence about what occurs around a reservoir when extensive housing developments occur.

The area within this easement and the attendant AUM’s should be primarily managed for wildlife habitat. Not only would this serve as mitigation for the lands inundated by the dam, but special projects could also benefit other species in addition to the cutthroat trout, such as waterfowl. Since agriculture is the primary beneficiary of the reservoir, it is not unreasonable to mitigate in this manner.

Barbara W. Parsons

1. Groundwater alternatives were considered as an alternative to dams. None of the aquifers were capable of yielding the amount of water needed to supply the volume of water needed to provide the irrigators with supplemental irrigation water. Alluvial aquifer recharge and storage would not provide the volume of water at the time of year needed for crop growth.

2. Noted.


4. The terms and conditions of recreational use and the placement of roads and facilities will be determined through discussions with the WWDC, the WGFD, and the Corps.

5. See response to #4.

6. See response to #4.

7. See response to #4.

8. See response to #4.
On state lands this may require buying up any existing, grazing permit time, then buying the state lands or grazing rights from the state. If the state board is unwilling to protect these lands, the dam should not be built.

Any future livestock grazing within the conservation easement should be done on a very limited basis, and only if all affected agencies, such as Wyoming Game and Fish, U.S. Fish and Wildlife, BLM, Conservation Districts, and operating CRM's agree that the wildlife, fish, and conservation objectives are being met.

Spring releases, when late winter snow pack measurements indicate the existence of excess water, should coincide with historic time, date, and duration of normal pre-dam flows.

Also, it would probably be wiser to add sediment, fine sand and gravel below the dam on a semi-annual basis to maintain the alluvial function of Savery Creek, rather than constructing 40 artificial grade control structures to prevent scour once the sediment and bed load are removed. (Although, maybe both should be done.) Addition of sediment and bed load material is becoming a standard practice in California to restore Salmon streams below dams.

I don't feel the EIS adequately addressed a number of areas.

(1) A conservation easement to protect the integrity of the project.
(2) The effects of the annually produced tons of salinity.
(3) The effects of the fluctuating water levels during the year.
(4) The habitat mitigation plan.
(5) The growth inducing and indirect impacts a reservoir will effect.

Again, thank you for this opportunity to comment.

Barbara W. Parsons
319 W. Larsen
Rawlins, Wyoming 82301
Dear Ms. Thomas:

I am submitting the following comments regarding the Draft Environmental Impact Statement (DEIS) for the proposed Little Snake Supplemental Irrigation Water Supply project in Carbon County, Wyoming. My comments are mainly directed at the impact to the fisheries in the potentially affected drainages. I would like to point out that the document (DEIS) was not readily available outside of the project area and I only received a copy last week, so I have not been able to conduct a thorough review of its contents. However, I do appreciate your quick response in getting me copy of the DEIS.

In general there appear to be several contradictory conclusions or assumptions made considering impacts to the fisheries resources in the project area. For example, in the Abstract on the very first page of the document it is stated that, "(flows from) the reservoir would scour a portion of the stream bottom downstream of the dam." Additionally, on Page 60 of the Game and Fish Department's Revised Report in the Appendices section of the document, there is a considerable amount of information suggesting that the potential for fish habitat below the reservoir "do not appear favorable." Also on Page 60 it is stated that widening and downcutting of the channel will occur and that "either of these effects has negative impacts to fish habitat." These statements are contradicted immediately on Page 61 of the above cited report where it is stated that public access should be provided, "Because the project would Improve sport fish populations below the dam."

Perhaps the most confusing, i.e. contradictory, statements are found in the Summary section of the document where it is stated that the reservoir minimum pool will: provide a brood site for the Colorado River cutthroat trout, however the Game and Fish report on Pages 62 to 65 suggests that such a brood stock population can only be supported by an expensive and significant stocking program. Furthermore, the Summary section states that the 120 (p. S-4) or 130 (p. S-1) foot deep reservoir will be drawn down 51 feet (p. S-1) or 105 feet (p. S-4) during the operational season. These discrepancies in figures are troubling enough, however, the potential for a successful recreational fishery with continued stocking is hard enough to imagine with such reservoir level fluctuations. The potential for this reservoir to act as a successful brood site for fish that are adapted to small streams seems absurd to say the least.

1. Although the abstract notes that channel scour would be an impact of dam operation, the abstract also states two sentences later that "Impacts to the Savery Creek channel would be minimized by the installation of grade control structures downstream from the dam." The discussion of the potential fishery downstream from the proposed dam in Appendix C. should be read in its full context. The first paragraph on page 59 begins "Construction of High Savery Dam would likely improve habitat conditions for trout over the entire length of the stream between High Savery Dam and the confluence of Savery Creek with the Little Snake River." On page 59, the report further states "Because habitat for trout is relatively limited in Savery Creek under existing conditions, fishery losses caused by inundation of the streams within the reservoir basin would be minor." Additionally, on page 59 the report notes that "Based on presently available project design and operation information, trout habitat unit losses would be more than compensated for at a late summer reservoir release of 10 cfs, if summer water temperature was 55 °F."

On page 60 the report does note that the channel below the dam is expected to cut or widen and either of these impacts will be detrimental to the trout fishery. However, on the same page the report also states that grade control structures would minimize or prevent this potential impact.

In summary, the releases of cooler water from the dam will improve this component of trout habitat, the more stable releases of water during the summer growing season will provide more trout habitat, the channel of Savery Creek will be maintained or improved by installation of bank protection, grade control structures, and improved grazing practices.

2. The reproducing population of Colorado River Cutthroat Trout above the proposed reservoir is insufficient to maintain the fishery stocks in the reservoir. In addition, to maintain genetic diversity, marking and stocking CRCT of known genetics in the reservoir will be needed to control the genetic integrity of different sub-populations.

The draw down will affect last season stocking although fishing on most of the reservoir should not suffer. There is no discrepancy in the reservoir capacities or the amount of draw down. If an 18,000 acre-foot High Savery reservoir is constructed, there will be no provision for a minimum pool and the reservoir will have 120 feet of active storage and will be drawn down 105 feet annually. The 22,433 acre foot alternative would have 130 feet of active storage which will be drawn down 51 feet annually. This alternative would provide a 5,724 acre foot conservation pool and almost 80 feet of water depth in the winter. Many reservoirs fluctuate more than the proposed High Savery Reservoir with a 5,724 acre foot conservation pool.
As far as downstream fisheries resources are concerned, I find it especially disturbing that the salinity loading in the Little Snake River is expected to increase by over 2,000 tons per year and that flows will be reduced by over 10,000 acre feet annually. The endangered fish species in both the that river and the Yampa River in Colorado must be considered if these disruptions to the aquatic conditions are anticipated. I would hope that the Wyoming Water Quality Division and the Region VIII office of the EPA provide additional comments regarding the increased level of salinity into this system. There is also the matter of the state’s membership in the Colorado River Basin Salinity Control Form. The addition of over 2,000 tons of salinity into the Little Snake River may be severely detrimental to the continued existence of the listed species as well as the cutthroat recovery program suggested as a potential benefit of this project.

Overall this project is very similar to the Greybull River Dam Project in Park County. That is, a very small group of agricultural producers would likely reap the direct benefits of the proposed project with only “potential” benefits to the fish and wildlife resources, and indirectly the remainder of the people, of our state. The only real guarantees we, the public, have is that the aquatic resources will be negatively impacted. I truly believe it is time we started putting a lot more thought into the wise use of our water resources, rather than simply building environmentally damaging and costly dams to supply late season, supplemental water supplies for irrigators.

Thank you for accepting these comments at this late date. Please keep me updated on the Project’s progress by adding me to the Interested Parties mailing list.

Sincerely,
David H. Haire
625 North Bent Street
Powell, WY 82435
Telephone/FAX (307) 754-7952
Dear Chief Thomas:

The following are our comments on the Draft Environmental Impact Statement (DEIS) on the U.S. Army Corps of Engineers' (ACOE's) proposal to issue a 404 permit for the planned Little Snake Supplemental Irrigation Water Supply project.

At the outset, we have some objections to the process used in studying developing the DEIS. Our group is dedicated to protecting biological diversity in this part of the world. The damming of Rocky Mountain rivers, and the diversion of surface water for desert irrigation, have had profound impacts on aquatic biodiversity. For example, it is fair to say that, as a result of widespread damming, rivers and streams are now the most fragmented ecosystems in the United States. Nevertheless, we were not invited to participate in the scoping process, and we were not sent a copy of the DEIS until the comment period was well underway. We note that the project area is in the vicinity of the Medicine Bow National Forest and land administered by the Bureau of Land Management; the ACOE could have learned about other potentially interested parties by asking for the MBNF and BLM mailing lists (our organization's name is on both). Apparently, this simple task was not done.

On October 4 of this year, we sent a letter to your office pointing out these omissions and asking for a 30-day extension of the comment period, beginning October 13th, to correct them. In response, your office agreed to extend the comment period, but only to October 30th. While we are glad to have some time to comment, this seems token. And it is less time than we explained was needed for us to prepare meaningful comments on such a large set of technical documents (the DEIS and appendices comprise hundreds of pages) that discuss such a worrisome proposal. We still do not know why we were excluded from the scoping process when we had previously expressed interest in such projects. We do not know why the ACOE felt a 30-day extension was unreasonable in light of our exclusion from the earlier process. And we wonder how many other concerned citizens and groups were not given a fair opportunity to participate in this public process. After seeing the

1. Notices of all scoping meetings and public hearings were published in Wyoming newspapers and the federal register. In addition, there have been several articles in Wyoming papers regarding this project. Other people in Laramie have been aware of the meetings and hearings. We have checked and your organization is on our mailing list.

2. No one was excluded from the process. We conducted an open and fair public information program throughout the EIS process. In response to the October 4 request, the comment period was extended to October 30.
investment made in the DEIS -- and the few alternatives it contains -- we feel it may be too late for us to meaningfully influence the NEPA study and your ultimate decision in this matter. Indeed, it is our experience working with other federal agencies that by the time a proposal reaches the DEIS stage, newly-suggested alternatives will not be seriously considered and the scope of the NEPA analysis will not change regardless of how detailed our comments may be on the DEIS. We are not sure how this problem with your NEPA process can be corrected now. It might be sufficient to conducted a "supplemental" scoping process and, if it results in any comments not previously considered, to prepare and circulate a supplemental DEIS.

As for the substance of the proposal, we appreciate that the ACOE has taken a hard stand on the earlier incarnations of the Little Snake Irrigation project that were based on proposals to construct the Savory-Pothook and Sandstone Dams. We feel the ACOE's refusal to approve permitting of those ill-conceived projects shows the agency is committed to honoring the spirit and letter of the Clean Water Act. It therefore came as a surprise to learn that the ACOE is now proposing to approve a 404 permit for yet another incarnation of this project, this time based on the damming of Savery Creek.

Although this latest design involves somewhat less storage capacity than the earlier plans, the impacts will be just as significant. Endangered fish will still be adversely affected; there will be less water flowing through the already over-taxed Colorado River ecosystem; and a free-flowing stream will still be obstructed. Moreover, the smaller capacity of the latest design will invariably be associated with larger relative draw-downs in late summer; this will leave the reservoir with even less biological value and will cause even greater sediment discharge when summer storms cause erosion of the extensive denuded banks extending up to the annual high-water line.

Furthermore, the impacts involved with this project can only be reliably estimated to "order of magnitude," yet the scope of the current plan is the same, within an order of magnitude, to the earlier plans that were rejected because they would cause unacceptable adverse impacts. Why does the ACOE now feel the current proposal poses acceptable impacts when very similar projects were deemed unacceptable? What specifically is the ACOE using as the criterion for gauging when impacts become "unacceptable" and undeserving of a 404 permit? Why does ACOE now believe that the various significant impacts associated with this project can be largely or entirely be mitigated when such impacts were found to be unmitigatable in the previous designs? Why does ACOE believe there is no less damaging alternative to the current proposal? For the public to understand the ACOE's decision on this project, questions such as these will need to be answered. The DEIS does not provide the answers and does not provide a basis for comparing this proposal against the previously rejected ones.

Because we believe this proposed project will still cause unacceptable and unmitigatable impacts, we are asking the ACOE to deny the requested 404 permit. Other reasons the permit should be denied are discussed in the following pages.
1. The Potential Impacts of the Project Are Significant, Unacceptable, and Unmitigatable, and the DEIS Fails to Fully Evaluate Them.

The Colorado River was once one of the mightiest rivers in north America, from its tributary headwaters in the Rockies to its delta in the Sea of Cortez. Today, the Colorado is sucked dry before it reaches the delta — the result of extensive damming and water diversions along its course. Incrementally, most of these projects probably seemed to pose little impact and to represent a reasonable trade-off between development and conservation. But cumulatively, they have had a profound impact on the aquatic ecosystem.

The Colorado River system -- which includes the Green, Snake, and even Savery Creek -- is now one of the most degraded freshwater river ecosystems in the nation. No other river harbors as many imperilled and declining populations of native fresh water fish; no other river system has suffered greater water losses from diversions and reservoir evaporation and seepage; and no other major river is dried up in-stream from human over consumption.

It is therefore hard to believe we are now confronted by yet another proposal to construct a major dam and diversions in the Colorado River system. The DEIS admits these actions would reduce flow in the Little Snake River by over 10,000 acre-feet (AF) per year. The cumulative impacts to the river from past projects of this nature are already so significant that the federal government is now considering ways to fix the problems by removing dams. There is no basis for concluding a further 10,000 AF/year loss -- enough to cover over 15 square miles of land with a foot of water -- poses an acceptable impact. This loss cannot be mitigated.

The project would also result in unacceptable changes to the water stored and later passed through the dam. This includes changes in seasonal flow rates and cooler downstream water temperatures -- both of which will adversely impact native fish species. The DEIS suggests the temperature changes can be mitigated by using a multi-level discharge scheme on the Upper Savery dam. While this may lessen the changes somewhat, some cooling of downstream waters will still occur. Several Colorado River fish species -- notably, the Bonytail Chub and Colorado Squawfish -- are already endangered because of changes in stream flow and increased water temperatures. These species already at the extremes of their tolerance limits for further changes to the river flow and temperature regimes. Even a slight additional increase in temperature and decrease in flow could lead to the eventual extinction of these species. Thus, we disagree with the DEIS's conclusion that flow patterns and water temperature changes can be mitigated to eliminate any further adverse impact to native fish species. Any adverse impact must be considered unacceptable to species such as these which are already living a very precarious existence.

Beyond the listed Colorado River fish, we also have serious concerns about the proposed project's impacts to unlisted species known to be in serious trouble. These include the Colorado River Cutthroat Trout, the Flannelmouth Sucker, the

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<th>Little Snake Supplemental Irrigation Water Supply Project</th>
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<td>7. Your opinion is noted. Cumulative impacts to the entire Colorado River watershed were determined to be outside the scope of this EIS. Analysis has shown that downstream depletions at Lily, Colorado were immeasurable. These depletions are proposed to be mitigated via payment of $109,140.12 to the FWS's Colorado River Recovery Agreement (Appendix D).</td>
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<td>8. Your opinion is noted.</td>
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<td>9. Your opinion is noted. Again, cumulative impacts to the entire Colorado River watershed were determined to be outside the scope of this EIS. The State of Wyoming and the irrigators are entitled to develop and use water within the limitation of the Colorado River Compact. No additional diversion dams are anticipated from this project.</td>
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<td>10. The endangered species of fish reside primarily in the Yampa, Green, and Colorado rivers. A few have been found in the lower Little Snake River a short distance above the confluence with the Yampa. Changes in water temperature resulting from storage releases will not affect the critical habitat of these species. The Biological Opinion (Appendix D) prepared by the U.S. Fish and Wildlife Service under the mandate of Section 7 of the federal Endangered Species Act, describes measures that will mitigate any impacts of the proposed project on endangered species.</td>
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<td>11. The project will benefit CRCT. Flannelmouth sucker, bluehead sucker, and roundtail chub are not candidates for endangered species listing.</td>
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CRCT would pose a risk to the few genetically pure CRCT populations west of the Continental Divide. Consequently, the reservoir will not be suitable for recovering pure CRCT populations. In fact, stocking Wyoming waters with such CRCT would pose a risk to the few remaining genetically pure CRCT populations.

The DEIS mentions possible impacts to these species, but does not realize that their populations are so precarious that additional significant impacts should be deemed unacceptable. The DEIS fails to adequately assess the impacts of fragmentation, loss of genetic interchange, and changes in water quality and quantity on these species. In addition, the DEIS fails to evaluate the effects to these species associated with making the waters more suitable for non-native competitors and predators. These impacts cannot be mitigated.

It is also impossible to mitigate the significant impacts associated with fragmentation of the aquatic river ecosystem caused by a dam. Rivers and streams - which many people view as the model of a continuous ecosystem - have become the most fragmented habitats in the western United States. Dams create an impenetrable barrier against migration of aquatic species and essential genetic dispersal to upstream populations. Over time, this will lead to less genetic diversity and more inbreeding in the upstream populations. The DEIS fails to recognize and evaluate these impacts.

Wildlife managers across the state, such as the Bluehead sucker, and the Roundtail Chub. For example in a recent survey of Wyoming native fish species west of the Continental Divide, Wheeler found:

"Among all sites sampled in the Little Snake River drainage in 1995 and 1996, only seven flannelmouth suckers were captured" and "immediate attention to this species in this area may be necessary."1

In a thinly veiled attempt to green-wash the proposal, the project proponents are suggesting that the planned reservoir would be used as a breeding pond for Colorado River Cutthroat Trout (CRCT), and that the CRCT produced in the reservoir could be used to restock other waters in the state where CRCT have been eliminated or are in trouble. We do not believe the reservoir would serve this purpose. It would be virtually impossible to eliminate all non-native trout upstream from the dam site without wiping out upstream CRCT and other troubled native species such as the Bluehead sucker. Even a barrier installed above the dam inflow to the reservoir -- and poisoning of the entire stream segment between the dam and barrier -- would not keep the reservoir free of non-natives which hybridize with the CRCT. For one thing non-native trout from upstream could pass back into the reservoir and mix with CRCT; for another, past experience shows reservoirs will be stocked illegally with non-native fish to improve recreational opportunities. Consequently, the reservoir -- if stocked with CRCT -- would eventually contain both CRCT and non-native trout: any CRCT produced in the reservoir would therefore be of questionable genetic integrity and would not be suitable for recovering pure CRCT populations. In fact, stocking Wyoming waters with such CRCT would pose a risk to the few remaining genetically pure CRCT populations.


12. Your opinion is noted. The FWS has not proposed their listing as either a threatened or endangered species.

13. We recognize that dams serve as migration barriers to fish and often prevent genetic exchange from occurring. However, in the case of Savery Creek where two species of fish have extirpated others have been severely impacted by non-native introductions, the barrier will do some good by preventing additional rainbow trout from entering the upper reaches of Savery Creek and breeding with cutthroat trout.

14. Your opinion is noted. The WGFD, not the project sponsor, suggested that the reservoir be enlarged to accommodate a brood stock pool for CRCT. As the WGFD is the state agency charged with management of this species, we have deferred to their science and professional judgement.

The reproducing population of Colorado River Cutthroat Trout above the proposed reservoir is insufficient to maintain the fishery stocks in the reservoir. In addition, to maintain genetic diversity, marking and stocking CRCT of known genetics in the reservoir will be needed to control the genetic integrity of different sub-populations. Rainbow trout are the only non-native fish capable of cross breeding with CRCT. There is little risk that the genetic integrity of CRCT will be compromised by this program. The WGFD has an outstanding record of restoring rare and endangered species (Grizzly bear, black footed ferret, Wyoming toad) and we are optimistic that the CRCT restoration efforts will be successful also.

Eradication of non-native species will unquestionably result in the death of non target animals. The impacts of this action will be carefully weighed against the potential benefits. Non-native control in the reservoir will be facilitated by the presence of fish traps on the tributary streams.

The CRCT used to stock other areas will not be raised by breeding in High Savery reservoir. The CRCT raised in the reservoir will be merely brood stock used for collection of their eggs and milt. The CRCT used to stock other areas will be raised in a hatchery under controlled conditions.

Little Snake Supplemental Irrigation Water Supply Project

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Furthermore, the size of the reservoir capacity is not significantly greater than the amount of water sought for supplemental irrigation. As a result, the reservoir depth and volume will suffer drastic changes over the year, making the reservoir unsuitable for CRCT and other troubled species. Although the DEIS considers a “minimum pool” alternative, it would still be small and of limited value for CRCT rearing. Indeed, even the Wyoming Game and Fish Department concluded that “The reservoir fishery could not be maintained by natural recruitment...” and would require continued stocking of “[a] significant number of fingerling [CRCT] simply to maintain the population for egg production and angling purposes.” G&F Report of May 4, 1998 on the Little Snake River Management Project, High Savery Reservoir Site, Fish and Wildlife Impacts Analysis and Proposed Mitigation, page 63. Thus, to keep the reservoir stocked with CRCT would require another hatchery of comparable size and would take away CRCT fry which could be used to stock other waters where CRCT would stand a better chance of surviving and avoiding hybridization. G&F also concluded a CRCT population in the stream below the dam would probably not be self-sustaining. In other words, the proposed reservoir— even if stocked with pure CRCT—is likely to have a significant net adverse impact on this species and cause a further setback in CRCT recovery.

In addition, it is unlikely that the project proponents would support stocking the reservoir with CRCT once this species is listed for protection under the Endangered Species Act. Listing would prohibit fishing for the CRCT and thus eliminate the reservoir’s recreational benefits claimed in the DEIS. DEIS, page 4-93. Furthermore, when the CRCT is listed (it is no longer a question of “if” but “when”), massive draw-downs of the reservoir would probably be prohibited to prevent takings of the species. As listing gets nearer (a petition is being drafted at this time), the proponents would become opponents of CRCT stocking in the reservoir.

While fish are the obvious species that would impacted by the project, we are also concerned about impacts to invertebrates and rare and sensitive plant species. The DEIS does not present an assessment of invertebrate diversity in the project area or how invertebrates could be impacted. There is a brief discussion on a couple of plant species: Ute Ladies’ Tresses Orchid and Weber’s Ipomopsis. But this is inadequate and ignores a host of plant species that may be in trouble and may occur in the project area. We have compiled a list of rare Wyoming plants from various sources, and we are providing a copy of the list for your consideration. We ask that the project area be evaluated for the existence of suitable habitat for each of these species; for those that may occur in the area, field surveys (preferably 2-3 consecutive years) should be performed to determine the extent of populations. Apparently, no field surveys for rare plants were performed (we can refer the ACOE to qualified botanists who can perform reliable plant surveys). In any case, impacts to rare plants probably will not be mitigatable because it will not be possible to recreate, in some remote “replacement wetland,” the precise conditions (e.g., soil and microclimate) which allowed rare plants to grow in the project area.

**15.** See response to #14. The size of the minimum pool that is needed for each project is calculated using a formula that considers several variables. These factors include: 1) the physical characteristics of the impoundment, 2) water quality of the inflow, 3) volume of winter inflows and, 4) the number of overwintering fish desired.

The WGFD calculated that a minimum pool of 5,724 AF was needed to accommodate a CRCT brood stock population of 14,640 adult fish. The requested pool is 25.5% of the normal operating pool of the proposed reservoir.

**16.** Provision of the minimum pool for CRCT will enable the WGFD to implement an aggressive program of reintroduction to prevent listing. If the species is listed, the need for a brood stock facility would be an even more urgent and a necessary priority for the State of Wyoming even if recreation had to be sacrificed. Should the species be listed the use of High Savery Reservoir as a brood fish rearing facility would likely be an integral part of the recovery plan.

**17.** We have surveyed for those species that are federally listed as threatened or endangered. Additional survey work to determine the presence of rare species listed on the Wyoming Natural Diversity Database is not required.
We also disagree with the DEIS’s repeated assertions the loss of wetlands, that would be covered by the dam and reservoir, can be mitigated by the creation of new “enhanced” wetlands. The loss of a natural wetland cannot be mitigated by an attempt to create artificial wetlands and flood-irrigated and cultivated fields.

The DEIS also fails to analyze the likely indirect effects of providing increased irrigation water. The water will not be used only to water existing fields late in the year, but some will undoubtedly be used to irrigate lands that are not currently converted to agricultural use. Indeed, the DEIS admits that “Since 1983, changes in commodity prices have made it feasible to pump water to permitted lands which, in 1983, could not be reached by gravity flow.” DEIS, page 1-7. Similarly, creation of a new water supply will make it feasible to convert and irrigate lands that are currently in a natural condition. When new areas are cultivated and irrigated, there will be a loss of wildlife habitat. It is also likely that new irrigation ditches will be created to use the additional water. These are indirect effects of the proposed project and any alternative that supplies more irrigation water. They were not evaluated in the DEIS.

2. A Genuine Need for Extra Storage Capacity and Additional Irrigation Water has Not been Demonstrated.

The DEIS is based on the premise that “a nominal need exists for 15,090 acre-feet of water for supplemental, late-season irrigation.” DEIS at 1-7. The alternatives presented in the DEIS were designed to address this purported need; and the ACOE’s proposal to issue a 404 permit to implement one of the alternatives is also based on the idea that this need is genuine.

As a threshold matter, a desire to use more water does not create either a “need” or a “right” to the water. While Wyoming agricultural interests may wish to have more water to irrigate more of the desert west of the Sierra Madre, this does not mean they “need” the additional water. Indeed, those seeking the additional supply of late-season irrigation have been making do with the current supply for years. They merely want more late-season water to grow another rotation of low-value crops; this is greed, not necessity.

Furthermore, the DEIS presents no factual or reliable evidence to support the claim that there is demand for 15,090 more acre-feet of irrigation water in the Snake River basin. Instead, this professed “need” is based on three dubious assumptions:

(1) 73% of the lands in the Wyoming side of the Snake River basin lands are irrigated (this figure was derived from 1983 aerial photographs);

(2) the exact same percentage of lands are irrigated in the Colorado portion of the basin (even though no actual photo-interpretation or surveys were done), implying there are 17,460 acres of irrigated land in the entire basin; and

18. If permitted, wetlands will be mitigated to the satisfaction of the Corps, the WGFD, EPA, and the FWS.

19. As stated in the EIS, the water will be used as a supplemental supply on currently irrigated lands. This can be enforced through permit conditions that require specific language in the contracts with the irrigators.

20. The Corps, and the cooperating agencies carefully reviewed the need and determined that it was justified. Currently, ranchers in the valley are forced to purchase hay or ship their cattle to other locations in the winter because hay production is limited.

21. See response to #20.

22. The NRCS office in Baggs (Norman Vigil, November 4, 1998, Personal Communication) indicated that cropping patterns and irrigated acreage has not changed significantly since 1983 and may have even increased slightly. Mr. Vigil indicated the 73% figure was probably conservative because it did not fully consider pasture that was being irrigated but not cut for hay.

23. The lands in Colorado are similar to those in Wyoming and have Wyoming water rights. Many are served by the same canals that provide water to Wyoming lands. The NRCS office in Baggs (Norman Vigil, November 4, 1998, Personal Communication) indicated that this is a reasonable assumption. Further, Mr. Vigil again reiterated that the 73% figure was probably conservative because it did not fully consider pasture that was being irrigated but not cut for hay.
(3) 0.864 acre-feet (AF) of water are needed per acre of irrigated land.

DEIS, page 1-7. There are several problems with these assumptions. First, it is inappropriate to use 15-year old photographs to estimate current acreage of irrigated land in Wyoming. Recent aerial photographs and satellite images are available at reasonable cost and should have been used for the estimate.

Second, it is inappropriate to use an estimate of "percent irrigated land in Wyoming" to determine what percentage of land is irrigated in the Colorado portion of the basin. The Colorado side is generally lower in elevation, more arid, and less suitable for irrigation. Furthermore, the State of Colorado has a different political climate, different agricultural incentives (i.e., subsidies), and different sociodemographics than Wyoming; these factors may have led to a lower percentage of irrigated land in the Colorado portion of the basin.

Third, no references or discussions are provided to justify the assumption that 0.864 AF of water are needed per acre of irrigated land. This estimate seems very high to us. The types of crops being grown, length of growing season, the slope, aspect, and elevation of the land, and the type of soil being irrigated all affect how much water is needed per acre. Classes of different irrigation rates (AF/acre) exist, and these rates should have been used. A geographic information system can be used to estimate the number of acres subject to each irrigation rate.

Fourth, there is no consideration of how conservation measures are (or could be) used to reduce the purported "need" below 0.864 AF/acre of irrigated land. The DEIS admits conservation measures could reduce some of the demand for more water. See, e.g., DEIS page 1-6. This needs to be factored into any estimate of how much water is desired.

Finally, there is no discussion on how existing supply of water was used to derive the estimate that an additional 15,090 AF are still "needed." If existing supply was considered, the DEIS does not explain how. The ACOE has an obligation to disclose the assumptions and methodologies, and to admit any uncertainties, used in such calculations. See, e.g., Sierra Club v. Costle, 657 F.2d 298, 334 (D.C. Cir. 1981).

Because the ACOE is obligated to deny a 404 permit if reasonable alternatives exist that would cause less environmental harm (see, e.g., 40 CFR 230.10(a)), it is crucial for the ACOE to know whether an alternative with less storage capacity - and hence less dredging and filling of the stream channel - exists. Moreover, the ACOE cannot simply accept the estimates of the State of Wyoming or the affected agricultural interests. Instead the agency has a responsibility to ensure any information used in the EIS is accurate and to "independently evaluate" any information submitted by an applicant. See, e.g., 40 CFR 1506.5(a). We do not believe these requirements were satisfied in drafting the current DEIS and developing the alternatives.

24. A cursory review of lands irrigated in the Savery Creek drainage was conducted using 1997 aerial photography was conducted and compared to the estimate made from the 1983 photos. No appreciable change in cropping patterns or irrigated acreage was observed. This was assumed to be the case for the Little Snake River valley also.

25. See response to #23.

26. Originally, studies completed by Black and Veatch (1994) reported that a supplemental water supply of 1 AF/acre was a reasonable water supply. The figure was revised downward after additional information was provided by the USGS.

27. Conservation cannot store water for late season use. This was clearly stated in chapters 1 and 2 of the DEIS. The second to the last paragraph of Section 1.2 begins: "The widespread use of conservation measures in the basin would not eliminate the need for late-season supplemental irrigation water." The paragraph concludes: "Because no additional water supplies have been developed, between six and eight weeks of late-season irrigation water need remains unsatisfied in years with normal and above normal runoff. In below normal years, and especially consecutive low runoff years, the irrigation season ends in June." Following a detailed discussion of the conservation alternative in Section 2.4.2., the last paragraph of the section lists three reasons why conservation is not a viable alternative but concedes in the final sentence: "However, to adequately respond to comments received during the public scoping process, the conservation alternative will be evaluated for its environmental impacts (Chapter 4)." Therefore, the only reason conservation was carried forward past Chapter 2 was because of public concern that it be fully evaluated as part of the process of full disclosure NOT because it passed the screening in Chapter 2.

28. See responses to comments 20, 22, and 23. There is an adequate discussion of the need for 15,090 acre-feet of supplemental late season irrigation water in Chapter 2 of the EIS.

29. We disagree, the EIS fully complies with all applicable laws, rules, and guidelines. An independent evaluation was completed by the Corps for all aspects of this EIS.
3. Costs Will Greatly Outweigh the Possible Benefits of Implementing the Project, and the DEIS’s Economic Analysis is Inadequate to Show This

Beyond the fact that a genuine need for the project has not been demonstrated, the DEIS also fails to show that the project’s costs, in the balance, be offset by its purported benefits.

The DEIS suggests that all of the dam/reservoir alternatives would yield a gain in agricultural economic benefits of $245,600 and recreation benefits on the order of $100,000 each year. DEIS page 4-95. Thus, the DEIS concludes the various alternatives would each yield about a half-million dollars a year in increased benefits. We do not believe these estimates are reliable.

Regarding recreation, the area is far from any population center and the DEIS admits there are already numerous reservoirs meeting recreational demand in the region. Thus, any increase in recreational use at the proposed reservoir would be accompanied by a decrease in recreational use at another location. This means a net increase in recreational benefits would not be realized by the project (supply of reservoir-based recreation opportunities greatly exceeds demand for reservoir-based recreational opportunities.) The decrease in recreational use at other sites must be factored in as a cost associated with the project, and this cost precisely cancels any recreational value the proposed reservoir may have. In addition, the DEIS ignored the cost associated with the need to repeatedly stock the reservoir.

The same is true of the DEIS’s claimed agricultural benefits for the alternatives. The DEIS figures are based on the assumption that the water to be diverted for local agricultural use is excess and would not be used anywhere downstream. In fact, all of the water would be used downstream, and it has much higher value to downstream users. This is because the water would be used for domestic drinking water and higher value crops (the proponents of the Little Snake project would use the water largely for producing low-value hay/alfalfa crops). For this reason, the proposed project would actually reduce net agricultural benefits. The economic analysis is flawed because it failed to consider the loss of downstream benefits that would be caused by the alternatives. The loss of existing benefits must be treated as a cost of the project. In the balance, the proposed project and alternatives represent a net agricultural cost, not an isolated benefit.

Furthermore, the simplistic economic analysis presented in the DEIS ignores the enormous existence value of a natural, free-flowing river. The DEIS recognizes that the alternatives would “permanently change” the natural landscape and eliminate the “opportunity for remote area recreational uses.” DEIS, page 4-111. However, no attempt is made to value these losses in the economic analysis, and the DEIS simply assumes these losses would result in no tangible costs. This is an unfounded and incorrect assumption. To estimate the loss of existence values associated with the proposal and alternatives, the ACOE can use contingent valuation or other methodologies. The courts have found the use of contingent valuation to be a
reasonable means for federal agencies to assess damage to natural resources and the values of currently non-priced natural resources (e.g., a free-flowing river). See, e.g., State of Ohio v. U.S. Department of the Interior, 880 F.2d 432, 474-480 (D.C. Cir. 1989). We ask that such an analysis be performed on this project so the actual project costs can be weighed against the actual project benefits. This requirement is also implicit in NEPA. See 42 USC 4332(2)(B). In the balance, we believe a thorough and reliable economic analysis will show the proposal and alternatives will not yield a net economic benefit.

A reliable economic analysis is also crucial for this proposal because the DEIS admits cost-effectiveness was an important consideration in deciding whether certain alternatives were viable (e.g., conservation alternative, see page 2-16 of the DEIS). A full cost-benefit analysis must be included in the EIS when cost-benefit is relevant to a choice between environmentally different alternatives. See 40 CFR 1502.23. The DEIS's simplified tabulation of incremental "agricultural" and "recreational" benefits does not satisfy the hard look requirement of NEPA.

The 404(b) regulations indicated that an alternative is only practicable "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics...." 40 CFR 230.10(a)(3). If all costs of the proposed project (in its various designs) were properly considered, none of the alternatives considered in the DEIS could be deemed "practicable." The ACOE should not permit a project which is more costly than beneficial, and further degrades the waters of the United States.

4. The DEIS Failed to Consider Reasonable Alternatives That Pose Less Environmental Impact.

To achieve the purposes of the Clean Water Act and the National Environmental Policy Act, it is essential that the NEPA document consider all reasonable and less damaging alternatives. This includes alternative ways of achieving the same objectives, alternative ways of reducing conflict, and alternative ways of mitigating impacts. See, e.g., 40 CFR 1508.25(b), 1501.2(c), and 1502.14.

The DEIS, however, only considers a few alternatives — and all are based on the construction of large dams and reservoirs. Missing from the DEIS is an analysis of the following alternatives:

- an alternative based entirely on conservation measures (the DEIS claims conservation alone could not meet the "need" for more water, but this is not demonstrated, and NEPA requires rigorous exploration of such an alternative to see whether or not this is true);
- alternatives based on a mix of water conservation measures and smaller dams;
- Twenty-seven alternatives were considered. In addition several combinations of alternatives were also evaluated and rejected on the basis of cost, technological feasibility, or environmental constraints. The rationale for selection of the alternatives that were determined to be "reasonable" and were carried forward into Chapters 3 and 4 is discussed in detail in Chapter 2 and Appendix A.

34. See responses to #30 and #31.
35. See responses to #30 and #31.
36. Twenty-seven alternatives were considered. In addition several combinations of alternatives were also evaluated and rejected on the basis of cost, technological feasibility, or environmental constraints. The rationale for selection of the alternatives that were determined to be "reasonable" and were carried forward into Chapters 3 and 4 is discussed in detail in Chapter 2 and Appendix A.
37. See response to #27. Water conservation alone will not satisfy the need for supplemental, late season irrigation water.
38. See responses to #27 and #36.
alternatives based entirely on meeting demand with ground water (the Sierra Madre Mountains provide abundant recharge and a large sustainable supply of ground water; in addition, coalbed dewatering in fields to the north will be providing large quantities of unused and presently unallocated water);

alternatives based on a mix of ground water and smaller surface storage;

alternatives based in whole or part on eliminating demand (e.g., through purchase of marginal land now in irrigation);

alternatives based on reducing transfer of water from the Little Snake River to the Hog Park Reservoir; and

an alternative based on a mix of all of the above measures, possibly together providing an additional 10,000+ AF of water and eliminating any purported need for a new reservoir.

All of these alternatives provide some benefits with less costs (e.g., environmental impact, loss of existence values, loss of downstream benefits, etc.). Thus, they should be rigorously explored and objectively considered.

For the foregoing reasons, we urge the U.S. Army Corps of Engineers to disapprove a 404 permit for the proposed Little Snake Supplemental Irrigation project. The project poses unacceptable impacts, is not needed, and will not yield a net benefit. Furthermore, less damaging alternatives exist.

Thank you for providing us with the opportunity (even though it was limited) to comment on the DEIS and proposal. Please address each of these comments in the subsequent NEPA document/s and the ultimate decision. In addition, we ask that you place us on your mailing list for this proposal so that we will be sent all future documents (i.e., supplemental scoping notice, revised/supplemental EIS, Final EIS, Record of Decision).

Sincerely,

Donald J. Duerr
P.O. Box 6032
Laramie, WY 82073

Leila Stanfield

Jeff Kessler
# TABLE 4

## WETLAND PLANTS of WYOMING — RIPARIAN

**NOTE:** Locations available on request from Wyoming Natural Diversity Database (WYNDD)

<table>
<thead>
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Riparian Plants, Biodiversity Associates, page 2
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<td>American germander</td>
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<td></td>
</tr>
<tr>
<td>Thelypodium sagittatum</td>
<td>Slender thalypody</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td>Torreyochloa palida var. fernaldii</td>
<td>Fernald alkali-grass</td>
<td>S1/G3?</td>
<td></td>
</tr>
<tr>
<td>Veronica scutellata</td>
<td>Marsh-speedwell</td>
<td>S1/G5</td>
<td></td>
</tr>
</tbody>
</table>
April 26, 1999

Certified, Return Receipt Requested No: _____

Mr. Rodney Schwartz
Army Corps of Engineers
Omaha District
215 North 17th Street
Omaha, NE 68102-4978

Re: Little Snake Supplemental Irrigation Water Supply; Comments of the Little Snake River Conservation District and Little Snake River Conservancy District

Dear Mr. Schwartz:

On behalf of the Little Snake River Conservation District (Conservation District) and the Little Snake River Conservancy District (Irrigators), and with the assistance of Frank Law Office, P.C., the Conservation District and the Irrigators hereby submit their comments regarding the Little Snake Supplemental Irrigation Water Supply project proposed by the Wyoming Water Development Commission. These comments are directed at the Draft Environmental Impact Statement (DEIS) dated October 1998 and the Draft Mitigation Plan (DMP) dated March 1999. The District and the Irrigators thank Mr. Rodney Schwartz of the Army Corps of Engineers (ACOE) for allowing these comments on the DEIS after the deadline and request that these comments be considered and incorporated into the DEIS and the DMP prior to adoption of the Final Environmental Impact Statement (FEIS) and Record of Decision (ROD).

Conservation District Responsibilities

The Little Snake River Conservation District is a political subdivision of the State of Wyoming authorized under Wyoming Statutes §§ 11-16-101, et seq. As a political subdivision of the State of Wyoming, it is a local government. Under its authorizing statutes, the District has jurisdiction over natural resources located within its boundaries with the mission of stabilizing ranching and farming operations, preserving natural resources, protecting the tax base, preserving wildlife, protecting public lands and protecting and promoting the health, safety and general welfare of the people of the state. Wyo. Stat. § 11-16-103. In accomplishing this mission, the District is generally given

1
responsibility to conserve natural resources within its boundaries.

"Conservation" is defined as "the development, improvement, maintenance, preservation, protection and use of natural resources..." Wyo. Stat. § 11-16-102(a)(v). "Natural resources" include "land, soil, water, vegetation, trees, wild rivers, wilderness, natural beauty, scenery and open space." Wyo. Stat. § 11-16-102(a)(x). Among its broad authorities over natural resources within its boundaries, the District may:

- Carry out preventive and control measures and works of improvement within the district, including engineering operations, range management, methods of cultivation, the growing of grass or other vegetation, changes in use of land or any measure which may be developed for the control of erosion and better use of soil, and works of improvement for flood prevention or the conservation, development, utilization and disposal of water on lands owned or controlled by this state or its agencies, with the cooperation of the agency administering and having jurisdiction thereof, or on other lands within the district with the consent of the owner or occupier of the land.


The Little Snake River Conservation District also has authority to:

- Cooperate, or enter into agreements with and furnish financial or other aid to, any agency, governmental or otherwise, were any owner or occupier of lands with in the district, in carrying on range management or erosion control and prevention operations and works of improvement for flood prevention or the conservation, development, utilization and disposal of water within the district, subject to such conditions as the supervisors deem necessary.


All agencies of the state, county or in any political subdivision of the state which have jurisdiction over her or are charged with the administration of any state, county or other publicly owned lands lying within the boundaries of a conservation district are required to cooperate with the conservation district, and provisions of conservation district ordinances have the force and effective law on those lands. Wyo. Stat. § 11-16-132. Thus, given its authorities and responsibilities for conservation, the District has a concrete interest in the environment within its boundaries, which includes the area under consideration in the DEIS.

The Water Conservancy District

The Little Snake River Conservancy District (previously referred to as "the irrigators" for clarity)
is organized pursuant to Wyoming Statute §§ 41-3-701, et seq. As a water conservancy district, the Little Snake River Conservancy District has the purposes of acting to directly and indirectly benefit the state of Wyoming (through increases in taxable property valuations) and the industries in the state, directly benefit lands to be irrigated, including stabilization and increase of return flows to streams, and to cooperate with the federal government under the federal reclamation laws or other federal laws construction and financing of irrigation works and for the operation and maintenance thereof. Wyo. Stat. §§ 41-3-701(a) and 41-3-742. Because the proposed project is designed to benefit the irrigated lands within the Conservancy District, it has an interest in ensuring that the project accomplishes the multi-faceted purposes set forth in its authorizing statute.

The National Environmental Policy Act And Implementing Regulations

The NEPA regulations promulgated by the Council on Environmental Quality (CEQ) instruct all federal agencies how to comply with the NEPA. 40 C.F.R. § 1500.1(a). Among those requirements are instructions to prepare an environmental impact statement (EIS) for proposed actions. The EIS must include the items set forth in 40 C.F.R. Part 1502. The Army Corps of Engineers (ACOE) must also comply with the requirements set forth in 33 C.F.R. Part 230. In general, the ACOE is required to set forth in the EIS the environmental consequences of the proposed action and the alternatives thereto. 40 C.F.R. § 1502.16. The discussion of environmental consequences must include, among other topics, direct effects and their significance; indirect effects and their significance; possible conflicts between the proposed action and the objectives of federal, regional, state, and local land-use plans, policies and controls for the area concerned; and the environmental effects of alternatives including the proposed action. 40 C.F.R. § 1502.16.

In preparing an EA, the federal agency must involve environmental agencies, applicants and the public. 40 C.F.R. § 1501.4(b). In developing any "environmental document," which includes EISs, the federal agency must also (1) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences, (2) identify environmental effects and values in adequate detail so they can be compared to economic and technical analyses, and (3) study, develop and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources as provided by section 102(2)(E) of NEPA. 40 C.F.R. § 1501.2(a), (b) and (c).

In its EIS, an agency is required to insure the professional integrity, including scientific integrity, of the discussions and analyses. 40 C.F.R. § 1502.24. The agency is required to identify any methodologies used and make explicit reference to the scientific and other bases relied upon for the conclusions in the EIS. Id.

Comments

The Conservancy District and the irrigators have several comments regarding the DEIS. Most of these comments pertain to certain analyses which the Conservancy District believes are not correct, or for which the Conservancy District may have higher quality information. To that end, the

Little Snake Supplemental Irrigation Water Supply Project

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3. Your comments regarding the scope of NEPA documents are noted. We believe that this EIS fully meets the legal requirements and spirit of NEPA.
Conservation District and the irrigators request the ACDE to reconsider those portions of the DEIS prior to releasing the final EIS.

Summary: Major Conclusions

The first general comment of the Conservation District and irrigators concerns the "Major Conclusions" portion of the Summary. The DEIS states as Major Conclusions that 12,000 acre-feet (AF) are needed. However, there is a need for 17,460 AF as stated on page S-2. The DEIS also states as a Major Conclusion that downstream flows would be depleted. However, the only downstream flows that would be depleted would be on the main stem of the Little Snake River at the points of diversion, not in Savery Creek.

The DEIS states as a Major Conclusion that salinity would be increased. However, the Conservation District believes that all lands which will receive supplemental irrigation water have had all soluble salts leached from the soil profile given the fact that these areas have been flood irrigated for decades, and are generally well-drained topsoils that overlay an alluvial aquifer.

Finally, although the DEIS states that all of the reservoir alternatives provide a site for flat water recreation, it should further state that "flat water recreation was identified as a local need in the recreation survey associated with this project." Therefore, the ACDE should amend the DEIS to reflect these changes to the Major Conclusions.

General Comments

The NEPA and the implementing regulations require the responsible federal agency to analyze all of the predicted environmental impacts in an EIS, including both the positive impacts and the negative impacts, even when the positive impacts outweigh the negative impacts. 40 C.F.R. § 1508.3. The Conservation District has reviewed the DEIS and its own data within its and believes that the DEIS, while generally accurate, at times overstates the negative impacts and fails to mention or give full credit to a number of the positive impacts associated with this project. The issues which the Conservation District contends the DEIS should address more fully appear below:

1. The DEIS focuses on impacts to fish and wildlife as far down as 70 miles from the dam regarding the potential negative impacts, but fails to outline the positive impacts on both fish and wildlife. The ACDE should revise the DEIS in the final version to account for the following:

   1. Neither the Razorback Sucker nor the Bonytail Chub exists in the Little Snake or Yampa Rivers. Therefore, the possibility that this project will have any effect on these species is remote and should be so stated.

   2. Potential positive effects could occur for both the Colorado River Squawfish and the Humpback Chub. At best the information presented is inconclusive regarding whether, on balance, there would be positive or negative effects to these species.

   4. The Wyoming Water Development Commission defined the project purpose and prepared reports justifying the need. The reports document the need for additional supplemental irrigation water. However, at the request of the Wyoming Water Development Commission, the project purpose was restricted to providing supplemental irrigation to lands currently being irrigated as that one acre foot per acre of supplemental water was sufficient to meet the needs of crops grown in the Little Snake River Valley.

Analysis has shown that downstream depletions at Lily, Colorado were immeasurable. These depletions are proposed to be mitigated via payment of $109,140.12 to the FWS’s Colorado River Recovery Agreement (Appendix D).

5. The modeling originally used to determine the effect of project operation on TDS levels in the Little Snake River was a simple, and extremely conservative, mass balance equation. The revised modeling shows that the maximum TDS concentrations at Lily, Colorado, would increase about 25 percent in October and 27 percent in November under average flow conditions. The total salt delivery to the Colorado River as a result of project operation is not anticipated to increase as a result of operation of the High Savery alternative; however, because the flow would be less, the average concentration of TDS would tend to be increased. Overall, changes in TDS concentrations are seasonal and temporary and do not represent a change that would adversely alter the quality of the existing stream habitat.

6. The “need” for additional flat water recreation was never conclusively determined. However, all of the alternatives were evaluated on their ability to provide recreation benefits. Therefore, we do not agree that it is necessary to revise the text to reflect the “need” for local flat water recreation.

7. Your comments regarding the scope of NEPA documents are noted. We believe the that this EIS fully meets the legal requirements and spirit of NEPA.

8. The Yampa Canyon is within the historic range of the Bonytail and Razorback Sucker. The Fish and Wildlife Service has determined that all water depletions in the Green River system may affect the survival of all four species of endangered fish.

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Little Snake Supplemental Irrigation Water Supply Project

Final Environmental Impact Statement

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3. The U.S. Fish & Wildlife Service (FWS) has indicated that Peregrine Falcon, Bald Eagles, Northern Goshawk, and Mountain Plovers may potentially benefit from the project. These types of positive impacts should be placed in the main discussion of effects in the DEIS instead of being mentioned only in the appendices.

4. Both Bluehead Suckers and Flannel Mouth Suckers (sensitive species) evolved with Colorado River Cibbread Trout (CRCT). The Wyoming Game & Fish Department (WGFD) has stated that 41 miles of Savery Creek below the dam will be enhanced for trout fisheries. Therefore, logic would indicate it should also result in improved habitat for Blueheads and Flannel Mouths.

5. While the EIS clearly points out potential negative impacts downstream some 70 miles, it does not point out the potential benefits of supplemental water to wildlife downstream.

   a. White-faced Ibis, Black Terns and Long-bill Curlews are all species of "special concern" that are found in the Little Snake River (LSR) basin. All three species inhabit wet meadows, marshes, and sloughs. Hundreds of acres of this type of habitat are the direct result of irrigation water in the LSR valley. The late season supplemental irrigation water which the proposed project will provide will result in the maintenance, improvement, and/or extending the time when water is available in these types of habitat. Seven of the nine species of special concern may directly benefit from the project (Bluehead Suckers, Round Tail Chubs, Flannel Mouth Suckers, CRCT, White-faced Ibis, Black tern, and Long-bill Curlew). The other two species either do not exist at the site (Weber's Iopomopole) or populations in Wyoming are very stable (Farraginous Hawk).

**Amendments Section D, Pp. 2-6**

The Conservation District and irrigators take some issue with the FWS's assumption that 1.5% of the average sediment load in the Yampa River would be reduced by High Savery. The FWS made this estimate by "Assuming the sediment contribution from the remaining 33.6% of the Little Snake River watershed is evenly distributed, the High Savery dam would trap 1.5% of the sediment load currently in the Yampa." Reduction of sediment in the Little Snake and Yampa by High Savery dam will not have an impact on endangered fish for the following reasons:

1. Sediment is the primary non-point source (NPS) pollutant in the Little Snake drainage. Eight streams or stream segments including Savery Creek and the Little Snake River were determined by the Wyoming Department of Environmental Quality (DEQ) to have sediment loads exceeding state water quality standards.

2. In 1996 and 1997 the LSRCD conducted the Savery Watershed Assessment under a
Clean Water Act § 319 project to evaluate water quality based on sub-basin hydrology. Savery Creek, Big Gulch, Loco Creek, Bird Gulch, and Little Savery all had turbidity levels that showed excessive sedimentation during all or part of the year. Ratings of stream bed substrate embeddedness indicated that Savery Creek, Big Gulch, Loco Creek, Bird Gulch, Dirtyman, Hart Creek, and Hatch Creek were rated as marginal to poor (greater than 50% embedded with sediment) using the WDEQ stream bioassessment method. Currently the LSRC&D, WDEQ, and EPA are in the process of implementing a CWA Section 319 watershed water quality improvement project in the Savery Creek watershed to reduce stream sedimentation.

3. It should be noted that the assessment indicated that the three tributaries of Savery Creek, the North Fork, East Fork, and Dirtyman Fork ranked in the top four sub-basins in the watershed for good water quality with little or low sediment and turbidity. Because of the location of these tributaries in relation to the High Savery, the project would actually catch very little sediment. Given this information, the data clearly shows little or no detectable reduction in sediment will occur in the main stem of the Little Snake or Yampa Rivers because the High Savery site will capture some of the cleanest water in the Savery Creek basin. This data along with the other collected for the watershed clearly demonstrates that the FWS's extrapolation based upon assumption of equal contribution of sediment to the system is does not yield the most accurate information available that NEPA requires.

4. The Savery Creek watershed is also a funded USDA EQIP Priority Area Project to address rangeland and riparian grazing issues to reduce stream sedimentation and sensitive wildlife species' habitat.

5. In 1998 the Natural Resources Conservation Service (NRCS) Regional Riparian Team conducted an assessment of the upper Little Snake River. This assessment results indicated accelerated and excessive bank erosion on the main stem of the Little Snake River. This assessment also indicates that the USFWS' assumption of equal sedimentation throughout the upper Little Snake River basin is not accurate and that the main stem of the Little Snake River is the major contributor of sediment, not Savery Creek above the proposed dam.

6. USGS records indicate that 60 percent of the sediment load in the Yampa comes from lands in the Little Snake drainage below Dixon. This includes the Muddy Creek and Sand Creek basin in addition to numerous other tributaries originating in the Red Desert, which is a low precipitation area with highly erodible soils. WDEQ and U.S. EPA data indicates that the Muddy Creek has accelerated and excessive sedimentation. Four of the eight streams listed as impaired on the Wyoming 1998 CWA § 303(d) list due to excessive sedimentation above natural background levels are in the one thousand square mile Muddy Creek drainage. Since 1993 the LSRC&D has been implementing a CWA Section 319 non-point source pollution project on 280,000 acres in the Muddy Creek.

16. We believe the EIS acknowledges this. A 1.5% reduction in sediment loading to the Yampa river is virtually undetectable.

17. Your comment is acknowledged.

18. Your comment is acknowledged. We do not dispute this finding. However, reduction in peak flows may reduce sediment transport. Further, even assuming the Fish and Wildlife Service selected a worst-case scenario, a 1.5% reduction in sediment loading to the Yampa river is virtually undetectable.

19. Please see the previous response.
7. In both the Muddy Creek and Sand Creek watersheds, oil and gas exploration now has rights-of-ways on approximately 12-18 percent of the total land area. Well pads and roads associated with these activities leads to substantial accelerated erosion and sedimentation. Development activities in the Muddy Creek watershed resulted in several times of magnitude of accelerated soil erosion over natural background rates. Stephen Wollmer M.S. thesis; San Francisco State University, 1995.

8. Any sediment removed by High Savary would rapidly be re-aquired by sediment starved (i.e., hungry water) below the dam and on the forty-one miles of Savary Creek above the confluence with the Little Snake River.

Summary - Sediment

Current sediment rates and stream turbidity in the Little Snake River are substantially higher than pre-European settlement due to past rangeland overgrazing, deterioration of riparian zones, increased surface disturbance, and shift in vegetative communities due to historic fire suppression. Sagebrush dominant rangelands have higher soil loss than herbaceous dominant rangelands with the same soil type. Fire suppression has resulted in much of the rangelands in the LSR basin to reach climax communities of mature big sagebrush. The historical evidence supports the conclusion that endangered fishes indigenous to the Yampa and the LSR evolved under levels of less turbidity and sediment/bed loads than occurs in the LSR today.

A mere 3.0 percent of the total watershed would be inundated by the High Savary Dam. This area currently and historically has some of the least turbid water in the entire LSR basin. Both the Savary Creek Watershed Assessment conducted by the LSROCD and the Upper Little Snake River Assessment conducted by the NRCS indicate that the majority of the sediment in the Savary Creek drainage and the LSR basin above Dixon originates from the lower elevation sub-basins and basin entering from the west in the Savary Creek drainage with a substantial input from river bank failure on the main stem of the Little Snake River. The Conservation District concludes that no determinable or significant impact to Colorado River endangered fish will occur because of reduced sediment associated with High Savary.

Water Conservation Alternative Pg. 3-14

Changing Crops: The section of the DEIS pertaining to alfalfa as a water conservation measure is not supported by data. Contrary to the assertion in the DEIS, conversion to alfalfa would not save water. Alfalfa has the highest rate of evapotranspiration of any forage crop produced in the intermountain west. Alfalfa requires more water per ton of alfalfa hay than grass hay given the same growing conditions. Alfalfa also incurs a much higher yield reduction than does grass when it becomes water stressed. Alfalfa has the potential to produce a greater yield of high quality hay when sufficient late season water is available to take advantage of its superior regrowth potential. The DEIS discussion on the cost of conversion from grass to alfalfa is correct. Add this cost to the
uncertainty of having sufficient late season irrigation water and this demonstrates why very little alfalfa is grown in the Little Snake River Valley.

Wildlife Mitigation for High Savery Pas. 4-67

The first issue concerns mitigation for lost elk AUM's. This has already been mitigated within the range of the Baggs herd unit and there is no reason to require mitigation of uplands that will be inundated by the project. The population objective for Baggs elk herd unit is 4,200 animals (WGFD). The current population, as of April 1999, is estimated at 7,000-8,000 animals, which is 190 percent of objective (Tim Wooley, WGFD). This herd has been over objective for the last eight years (WGFD records). Because the WGFD has been unable to maintain this elk herd at objective levels, the USFWS, BLM, and LSRCD have implemented numerous measures to mitigate the effects of these population levels. The following is a list of items taken to mitigate the impact of this elk herd.

1. 1990-91 the USFS retired > 400 livestock AUM's in the Sandstone allotments on the Medicine Bow National Forest.
2. 1994 BLM/LSRCD conducted prescribed burns on 1,200 acres of crucial elk winter range in Loco Creek.
3. 1994 BLM burned 2,500 acres of elk season long/winter range on Snowshoe Canyon.
5. 1996 BLM conducted a prescribed burn on 4,000 acres of elk seasonal/winter range in Grizzly Wildlife Habitat Management Area and Deep Gulch allotment.
6. 1996 BLM conducted a prescribed burn on 1,100 acres of elk spring, summer/fall range on the east fork of Savery Creek.
7. 1997 BLM/LSRCD conducted a 400-acre prescribed burn on elk crucial winter range in Loco Creek.
8. 1998 BLM conducted a prescribed burn on 700 acres in Wildcow Creek, elk winter/transitional range.
9. 1998 BLM conducted a prescribed burn on 4,500 acres of elk season long/crucial winter range.

In March 1998, WGFD personnel from the Little Snake River Valley and Cheyenne headquarters rejected a proposal to the Rocky Mountain Elk Foundation to improve elk habitat in the project area. The WGFD rejected the proposal on the basis that too many habitat treatments had already been done to favor elk.
In April 1999, WGFD personnel stated that one reason that the elk population is 190 percent of objective is because too many habitat treatments have been conducted that benefit elk.

The Conservation District's recommendation for mitigation of impacts is for WGFD to take extra efforts to reduce numbers back to the WGFD's desired objective level. This would result in 3,400 less elk competing for the same amount of forage.

**Mitigation 4.6.1.4 Pg. 4-52**

**Vegetation**

Permanent removal of livestock from mitigation acres is unnecessary and unwarranted. The Conservation District recommends development of a defined grazing plan with clear, objective goals, for successful enhancement and improvement to both herbaceous and woody plant communities. The Conservation District, BLM and area ranchers have already demonstrated numerous successful grazing plans to accomplish objectives for woody and herbaceous plant communities in the Savery Creek drainage on Loco Creek.

Any mitigation plans developed must include all appropriate parties for the land area affected. This includes the BLM, which has jurisdiction over the lands it administers in the project area. Also, the LSRCD has jurisdiction over the management of state lands in the project area. Furthermore, where private lands are involved, the private land owners must be involved.

The NEPA requires action agencies to ensure that their actions are coordinated with other efforts by identifying and analyzing conflicts between the proposed action and other activities. 40 CFR § 1502.14(c).

Currently the Savery Creek watershed is an approved USDA-NRCS Environmental Quality Incentive Program (EQIP) Watershed Project. In addition the LSRCD has been approved by the WDEQ and the U.S. EPA to implement a CWA Section 319 Watershed Project. The EQIP funding for the project totals $525,000, the CWA § 319 grant totals $171,052. These purpose of these grants is to address livestock grazing in the Savery Creek watershed. The Mitigation Plan for the High Savery project should be coordinated to account for past and current actions for mitigation and rehabilitation and incorporate future planned actions into the Plan in a comprehensive manner.

**Assesmaprent Coordination**

This section should include a section on guidelines of federal agencies in compliance with federal statutes in dealing with local land use plans. Specifically Carbon County has an approved land use plan adopted by the Carbon County Commissioners. Also, the LSRCD/NRCS have existing plans under the USDA Environmental Quality Incentive Program and the Clean Water Act Section 319 Watershed Program to address livestock grazing and water quality issues. 40 C.F.R. § 1506.2(b), 40 C.F.R. § 1506.12(b) and 40 C.F.R. § 1502.16(c).
The Carbon County Land Use Plan, to which the Conservation District and the Irrigators subscribe, contains a policy that there be no net loss of private lands in the County. Within the Little Snake River Conservation District, private lands comprise less than 20 percent of the land area. The Conservation District urges the ACOE to critically examine all mitigation measures which preserve the existing private land base by first focusing mitigation efforts on lands other than private lands. If private lands are necessary for mitigation, easements and management agreements which continue the lands in private ownership and economically productive use are the preferred course of action to protect the socioeconomic stability and the tax base of the area within the Conservation District.

Under NEPA, "Copies of comments by the state and local governments must accompany the EIS or EA throughout the review process." 42 U.S.C. § 4332(2)(c) and 40 C.F.R. § 1502.18. The Conservation District and the Irrigators request that their comments be reproduced in the EIS appendix.

The Little Snake River Conservation District and the Little Snake River Conservancy District appreciate the opportunity to comment and be involved in the Little Snake River Supplemental Irrigation Supply Project. The Districts continue to look forward to continuing involvement in this project and the opportunity to apply their expertise toward ensuring its success.

Sincerely,

John R. Cobb, Chairman
Little Snake River Conservation District

James L. Chart, Jr., Chairman
Little Snake River Conservancy District
CHAPTER 6
REFERENCES


Little Snake Supplemental Irrigation Water Supply Project Final Environmental Impact Statement


Little Snake Supplemental Irrigation Water Supply Project


Moore, Austin L., ed. 1962. Souls and Saddlebags, the Diaries and Correspondence of Frank L. Moore, Western Missionary, 1888-1896. Big Mountain Press, Denver.


