Chapter 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes existing physical, biological, natural, and cultural resources that could be affected and identifies any potential impacts or benefits to those resources if any one of the alternatives were implemented.

The No Action Alternative (Alternative 1) describes conditions in the future if bank stabilization were not implemented and provides the basis to compare the action alternatives (Alternatives 2, 3, 4, and 5).

The resources analyzed include land use, geology and soils, water resources, wetlands, vegetation, fish and wildlife, threatened and endangered species, cultural resources, Indian sacred sites, Indian trust assets, socio-economics, and environmental justice. This chapter also describes cumulative effects of the alternatives.

Section 3.13 – *Standard Practices* describes practices that would be followed in order to avoid or minimize potential effects that could occur if any of the action alternatives were implemented. Section 3.14 – *Mitigation* lists potential measures that may be taken to reduce specific effects.

3.1 Land Use

3.1.1 Affected Environment

Reservation lands encompass approximately 544,000 acres and are located in Bingham, Bannock, Caribou, and Power counties (USBR 2001). Approximately 385,000 acres of the Reservation remain as open grassland, while the rest is divided as woodlands, crops, and residential. The project area, including lands both upstream and downstream on either side of the Snake River, has been influenced by farming and livestock grazing for more than 100 years. Livestock ranching and agricultural crops are the largest and most important land uses within these counties.

The Fort Hall Bottoms (Bottoms) is a unique area of the Reservation, established as a communal area for the Tribes. It is not included in the Tribal Rangelands, and the Land Use Policy Commission oversees the Bottoms area. The Bottoms provides valuable forage for big game which includes deer, moose, antelope, elk, and buffalo.

Livestock

The Tribes Land Use Director oversees the Reservation Range Program, which manages the rangelands and monitors livestock grazing. This program was contracted by the Tribes from BIA in 2003. According to BIA data (1994), 65 livestock operators utilize the Reservation with an average herd size of 150 head (USBR 2001). This same data shows approximately 46,525 total animal unit months (AUM) of grazing within the Reservation. One AUM is equal to the feed needed for one cow and one unweaned calf for one month. Approximately 9,222 cow units graze on the Reservation range units. A problem for range units on the Reservation is lack of adequate stock water, with 60,000 acres having low water supply and a carrying capacity of 10 acres per AUM (USBR 2001).

Agriculture

The Tribe currently leases irrigated farmland and grazing land. Over 120,000 acres of Reservation land are farmed, primarily in potato and grain rotation, in addition to sugar beets, alfalfa, pasture, and barley (USBR 2001). No agricultural influences exist within the immediate area of the project site; however, there may be minimal agricultural influence from upstream landowners.

Recreation

Except for access to the American Falls Reservoir, there are no developed recreation areas or facilities on either Reclamation or Tribal lands near the proposed action area. During high water in the Reservoir increased boat traffic may occur on the Snake River in the area of the project. The Idaho Department of Fish and Game (IDFG) stocks portions of the Snake River for fishing and the Tribes utilize the Bottoms area for fishing and hunting.

3.1.2 Environmental Consequences

Alternative 1 – No Action

Under the No Action Alternative, measures to stabilize the banks in the vicinity of the Landmark would not be implemented. The Snake River would continue to seek its natural course through the Bottoms and erosion would continue on the main channel bank. Livestock, agriculture, and recreation activities would continue to be managed as is.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

Alternative 2 would provide the highest level of protection of the Landmark. Streambank stability would be improved. The stone toe option would provide little access for wildlife or livestock to reach the water. However, it would allow the smallest amount of ground disturbing impacts to the land within or near the historic Landmark boundaries.

Alternative 3 – Stone Spurs

Under Alternative 3, streambank stability would be improved. Alternative 3 would allow livestock or wildlife access to the river and contribute to bank erosion by trampling.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

This alternative would provide an intermediate amount of protection of the Landmark within the existing uses of livestock, agriculture, and recreation.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Alternative 5 would provide moderate protection of the Landmark while preserving natural and cultural resources on Reservation lands.

3.1.3 Cumulative Effects

The Tribes and Reclamation ensure a high level of resource protection on the land surrounding the Landmark. Taking no action to prevent further loss of the land due to erosion would cause the most damaging cumulative effects.

The preferred alternative along with continued livestock, agriculture, and recreation management would reduce cumulative effects.

The CCRP program, which disallows cattle grazing, will positively impact the project area. In addition, the Tribes have entered into the EQIP with the NRCS to cut and plant willows and dogwoods along the demonstration project. Reclamation will coordinate with the Tribes and NRCS as to the optimal time to begin this effort upon completion of the proposed project.

3.2 Geology and Soils

3.2.1 Affected Environment

Geology

The geology of the Landmark consists of volcanic rocks that are complexly inter-layered with older river channel and lake deposits associated with the Snake River. American Falls Lake was formed as a result of damming of the Snake River by the Cedar Butte basalt about 72,000 years ago at Eagle Rock, located downstream of the town of American Falls (Scott et al. 1982; Houser 1992). Scott et al. 1982 indicated American Falls Lake had at least partially drained as the last glacial advance neared its end about 14,000 to 15,000 years ago.

Glaciation of the adjacent mountain ranges led to the deposition of large gravel sheets along the margins of American Falls Lake and along the channel of the Snake River upstream from the lake (Pierce and Scott 1982).

Melting and subsequent retreat of glacial ice at the end of the Pleistocene filled the basin of Lake Bonneville (now the Great Salt Lake) in Utah. Between 14,000 and 15,000 years ago, the rising lake waters overtopped the north rim of the lake at Red Rock Pass and spilled down the Portneuf River drainage to the Snake River near Pocatello, Idaho (Scott et al. 1982; Houser 1992). The resulting Bonneville Flood flowed northeasterly across the remnant of American Falls Lake, extending up the valley to the northeast and east past the present town of Blackfoot before the flood receded and drained down the Snake River channel across southwestern Idaho. The flood deposited extensive sheets of gravel across the area southeast of the present-day American Falls Reservoir. The entire region is covered by varying depths of wind-blown deposits composed of fine sand and silt. These wind-blown sediments were deposited concurrent with and subsequent to Pleistocene glaciation. Wind-blown silt deposits are common on the highlands east of the modern Snake River floodplain in the study area.

Subsequent to the end of the last Pleistocene glaciation and recession of the Bonneville Flood, the Snake River has incised its modern floodplain into the older Pleistocene sediments. The present river channel and relatively narrow floodplain on the north are confined by a high terrace of relatively young basaltic bedrock. A terrace of similar height exists along the boundary of the floodplain in the Bottoms, but at a distance of about a mile from the river channel's left (south) bank. This terrace is composed chiefly of Pleistocene gravels capped by wind-blown silt. The Snake River floodplain is sited on top of tectonic downwarp of older volcanic rock that dips gently west to northwest toward and under the basaltic bedrock on the right or north side of the river (Houser 1992). This downwarp tends to force the channel position to remain along the north, resulting in a relatively narrow floodplain along the right side and a wide floodplain along the left side. The left-side channel banks typically consist of a layer of fine sand- and silt-sized sediments about 3 to 6 feet thick. These sediments overlie unconsolidated (loose) gravels.

The main channel's left bank of the Snake River is composed of loose deposits of sand and gravel that are highly susceptible to erosion. The left bank has experienced significant erosion in the project area and has retreated to the left for a lateral distance of several hundred feet since the 1990s. The loose nature of the alluvium and the lack of any significant riparian vegetation to help anchor the bank indicates that bank erosion would continue in this area.

Soils

The Bottoms have been mapped by the U.S. Department of Agriculture (USDA 1977) as Snake-River-Philbon Association soils consisting of silty loam and peat deposits on bottom lands. These soils are nearly level and thick. The soils have a low to very low permeability (poorly drained), which accounts for the very high water table. The Snake River soils have developed on low terraces and are formed in calcareous alluvium (containing calcium carbonate). These soils are a light brown to gray silty loam in the first foot, then a light-colored silty clay loam in the next 4 feet. The Philbon soils occur lower on the landscape than the Snake River soils, with a peat surface 22 inches thick and a silty-clay loam subsurface similar to that of the Snake River series.

Due to the loose, unconsolidated nature of the alluvium forming the Bottoms, these soils generally experience erosion along the main Snake River channel and some of the larger side channels. Channel migration due to excessive erosion of the left bank of the Snake River in the project area has resulted in the loss of several hundred lateral feet of soils directly adjacent to the channel. Some localized scouring of the soils may also occur during large flood events when flows overtop channel banks and move overland across the Bottoms.

3.2.2 Environmental Consequences

Geology

Environmental consequences of the proposed action alternatives involve disturbance and/or removal of the alluvial materials comprising the left bank of the main channel of the Snake River and active channel and bar deposits within the river itself. Each of the proposed bank stabilization alternatives involves excavation of the alluvium and partial replacement with large rock structures which are capable of resisting the erosive forces of the Snake River. The amount and extent of excavation varies widely dependent on the alternative selected, but options for excavations include curve shaping of the existing channel bank, construction of a bioengineered terrace, construction of tie backs for stone spurs, and construction for key-in trenches to prevent potential future river channel migrations. Regardless of the alternative selected, there would be short-term impacts to the local geology due to the required excavations.

Analysis of Alternatives

The following analysis of environmental consequences outlines the anticipated effects that the No Action Alternative and the four action alternatives would have on the geologic materials forming the Landmark and Tribal lands. The analysis focuses on the disturbance and/or removal of the materials forming the main channel's left bank and the adjacent materials comprising the Bottoms. The volume of excavation needed within the geologic materials for construction of the bank stabilization structures is evaluated for each of the action alternatives and is compared to the projected loss of land based on measured erosion rates for this site under the No Action Alternative. The results of the analysis are summarized in Table 3-1.

Sediment present within the active river channel and occurring as bar deposits adjacent to the channel are transient in nature and reside within the study reach for only a few years to tens of years. These deposits are frequently mobilized during large flood events and moved downstream by the Snake River to be ultimately deposited within the upper reaches of American Falls Reservoir. The time interval between flood events determines the resident time of the sediment within the reach. These channel and bar deposits have been excluded from the analysis due to their temporary nature and the difficulty in assessing potential impacts to transient materials. Disturbance and removal of the channel and bar deposits would be limited to excavation for the toes of rock structures and the placement of scour protection. The volume of disturbance for these features is very small in comparison to that projected for the river bank and adjacent lands under the No Action Alternative.

The interlayered gravel and sand materials composing the alluvium would be affected by any alternative requiring sloping or excavation of the channel bank to place erosion protection. The area of alluvium to be affected would depend largely on the preferred alternative selected to protect the main channel of the Snake River and the Landmark.

The downstream reach near the Landmark was analyzed separately from the upstream main channel reach due to depositional rather than erosional channel morphology, different bank characteristics, and the presence of a riparian zone along much of the river bank.

Alternative 1– No Action

Meandering river systems, such as that observed for the Snake River through the Bottoms, tend to be very active and dynamic systems characterized by downstream migration of meander belts, frequent channel changes, and recycling of the adjacent floodplain through lateral erosion of channel banks and associated floodplain deposits. The No Action Alternative would allow these natural processes to continue unchecked, thereby allowing continued erosion of the main channel's left bank. Over time, this erosion would lead to substantial loss of tribal lands within the Bottoms and destruction of the Landmark and its associated cultural resources and historic value.

Reclamation (USBR 2002) analyzed bank erosion rates in the study area using a series of historic aerial photographs taken on approximate 10-year intervals between 1936 and 2001. Prior to 1976, the Snake River was located on the right side of the floodplain although small side channels near the left bank were occasionally activated during large flood events. The Snake River began to access one of these side channels in 1976 and over time enlarged the channel through erosion of the left bank. As the left channel enlarged, it captured an increasing volume of the total Snake River flows which then accelerated erosion of the left bank. By 2001, the Snake River had eroded the left bank for a horizontal distance of nearly 350 feet from the 1976 location. The average rate of horizontal bank erosion over the 25 years between 1976 and 2001 was about 14 feet per year, although analysis showed an increasing rate of erosion over time as the left side channel captured progressively more flow from the Snake River. The highest measured rate of erosion was 21 feet per year occurring between 1996 and 2001. Two-dimensional hydraulic modeling completed by Reclamation in 2005 demonstrated that the main channel now conveys about 70 percent of the total flow in the Snake River. Monitoring of bank conditions in the study reach has shown little or no measurable erosion since 2001 (USBR 2006), due to extreme drought conditions in eastern Idaho which have limited runoff in the upper Snake River basin. A return to normal or above normal precipitation is expected to resume bank erosion at rates similar to that seen from 1996 to 2001.

Main Channel

The analysis for the No Action Alternative assumed normal to above normal flows of the Snake River with continued erosion of the main channel's left bank at the observed rate of 21 feet per year measured between 1996 and 2001. The main channel's left bank is composed of highly erodible unconsolidated sand and gravel overlain by 5 to 6 feet of fine-grained sand and silt. The median grain size of the bank materials is 0.16 mm (Mooney and Baird 2006). The main channel portion of the study reach lacks any riparian vegetation which could help stabilize the bank. Erosion of the left bank is expected to continue to the south into the Bottoms until the channel becomes too elongated to effectively transport sediment. Reclamation's analysis (USBR 2002) of channel migration patterns between 1936 and 2001 has shown that migration distances of 800 to 1000 horizontal feet are common in the reach of river between Tilden Bridge and American Falls Reservoir. The analysis of the No Action Alternative assumed future erosion of an additional 500 feet of the left bank and adjacent Fort Halls Bottoms beyond the 350 feet of erosion measured between 1976 and 2001. Using an average bank height of 10.5 feet (USBR 2006), future erosion of the left bank would result in the loss of about 428,000 cubic yards (yd^3) of material from the left bank and adjacent bottoms. This material would eventually be transported downstream into American Falls Reservoir. Based on the measured erosion rate of 21 feet per year, erosion of the left bank for the additional 500 feet would occur over about 24 years assuming normal to above normal flows in the Snake River. This erosion rate could accelerate above the 21 feet per year, if the main channel continues to capture additional flow from the Snake River. The estimated 500 feet of horizontal erosion should be considered a minimum value, based on comparison with actual erosion rates observed elsewhere along the study reach. Distances in excess of 1,000 feet are possible due to the highly erodible nature of the river bank materials.

The analysis for the main channel reach did not account for beneficial effects of the demonstration project constructed at the site in 2002. This project consists of a series of rock barbs, woody debris, and rootwads installed as a cooperative effort between the Tribes, BIA, the NRCS, and Reclamation. Although similar in concept to the spur field in Alternative 3, the demonstration project is much smaller in size and is limited in extent. These types of structures are vulnerable to channel changes and bank migration upstream of the treatment zone which can change the approach angle of the river current where it impacts the barbs, resulting in flanking of the structure. In the No Action Alternative, bank erosion upstream from the demonstration project would be expected to continue at observed rates, leading to flanking and loss of the barb structures, rootwads, and woody debris. The rate of erosion and subsequent flanking of the demonstration project are dependent on the precipitation and annual runoff and are, therefore, difficult to predict. Flanking of the project could occur over a matter of a few years, if above normal precipitation and high runoff occurred over consecutive years.

Downstream Reach

Prior to the migration of the Snake River into the left side channel beginning in 1976, the river wound north to the right edge of the floodplain and then looped back to the left via a large meander curve to flow directly against the left bank of the river at the site of the Landmark, causing a considerable amount of bank erosion. Once the main flow of the Snake River moved into what is now the main channel, the approach angle at the Landmark site changed to the inside of the meander curve which became a zone of deposition. A prominent point bar has now developed as a buffer between the Landmark and the Snake River. As long as the present channel morphology remains in-place, the immediate threat of erosion to the Landmark is low. The geologic materials comprising the bank in the downstream reach are similar to those observed in the main channel: sand and gravel overlain by fine-grained sand and silt. The primary difference in bank conditions is the presence of riprap armoring placed as bank protection prior to the channel migration in 1976. Although somewhat limited in extent, this riprap armor provides an effective defense against bank erosion. Finally, the river bank in the vicinity of the Landmark does exhibit some riparian habitat which should help retain bank position in the event of a future channel migration and a return to a more erosional environment. Although lacking a large forested area that would provide large woody debris as bank protection, there is potential to develop a floodplain forest if this riparian area were allowed to be undisturbed from natural processes and human effects, particularly grazing activities which can destroy young growth.

The primary threat to the downstream reach at the Landmark is from continued upstream bank erosion in the main channel reach. This would eventually lead to flanking of the riprap armor and erosion of the point bar. Once the point bar and riprap were flanked, the highly erodible nature of the bank materials would likely lead to a rapid erosion rate similar to the main channel reach. For the purpose of this assessment, a horizontal erosion distance of approximately 250 horizontal feet was selected to reflect the more favorable conditions at the downstream reach. Factoring in an average bank height of 16.8 feet for the downstream reach (USBR 2006), horizontal bank erosion for a distance of about 250 feet would result in the erosion and loss of about 249,000 yd^3 of geologic materials and adjacent land from the Bottoms. If the erosional rate of the bank material after flanking of the riprap armor is similar to that seen upstream at the main channel reach (i.e., 21 feet per year), the Snake River would take about 19 years to erode the estimated horizontal distance of 250 feet, assuming consistent normal to above normal flows in the river over that time period.

The foregoing analysis estimates the total effect on geologic materials present at both the main channel and the downstream reach at a combined volume of about 677,000 yd^3 for the No Action Alternative. For comparative purposes, this volume placed on a regulation football field, including end zones, would reach a height of slightly more than 315 feet. Under the No Action Alternative, complete erosion of the Landmark would eventually occur over the long term, resulting in loss of the associated cultural resources and historic materials in addition to the geologic materials comprising the bank and adjacent lands.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

The construction of a stone toe and revetment in Alternative 2 would stabilize the left bank of the Snake River and control further erosion of the Bottoms. This alternative involves construction of a stone toe and revetment over the existing streambank and construction of an upstream 200-foot key-in feature using sheet piling to prevent flanking by future channel migrations. These construction activities would result in disturbance, excavation, and removal of the geologic materials of the main channel. In some instances, excavated material may be used in the construction of the structural features of the alternative. The consequences of these activities are analyzed separately for the main channel and the downstream reach due to significant differences in considerations and design concepts.

Main Channel

The stone toe and revetment would be constructed by placing riprap directly into the Snake River to provide armor protection while minimizing disturbance of the existing bank. The stone toe and revetment would be constructed to a suitable thickness and slope to minimize future operations and maintenance of the structure. A key-in feature consisting of a sheet pile wall would extend about 200 feet into the bank upstream of the stone toe to prevent possible flanking by future channel migrations. A short trench about 30 feet long, 10 feet deep (i.e., the average river bank height in this reach), and about 35 feet wide at the top would be excavated at the junction of the sheet pile wall and the revetment. This trench would be backfilled with rocks as a counter measure to prevent erosion from occurring at the junction of the revetment and sheet piling, and potentially causing a failure of the structure. The cumulative volume of geologic materials excavated for the stone toe/revetment alternative at the main channel is about 250 yd^3 (see Table 3-1).

Downstream Reach

The stone toe concept in the downstream reach is similar to the main channel in that the river bank is only disturbed where the upstream and downstream ends of the stone toe tie into the bank. The intent of this concept is to minimize bank disturbance as much as possible in the immediate vicinity of the Landmark and to use the existing point bar adjacent to the site. The stone toe would protect the young riparian vegetation on the point bar, thereby eliminating the need for a bioengineered terrace in the downstream reach. The existing riprap armor would be left in-place as a secondary defense for the stone toe. The bulk of the excavation for the stone toe would involve the alluvium present in the point bar rather than the undisturbed bank materials. The outside end of the downstream reach stone toe would include a sheet-pile key-in feature similar to the key-in proposed for the main channel (above). This feature would be similarly comprised of a steel sheet pile driven into the ground and angled away from the water, for 30 feet on the downstream end. A short excavation of approximately 20-30 feet into the bank is required to secure the key-in to the stone toe.

The total volume of excavation of geologic materials for both the main channel and the downstream reach is about 500 yd^3 for Alternative 2. This volume represents less than ½ percent of the total estimated volume of bank material that would be eroded by the Snake River as described under the No Action Alternative.

Alternative 3 – Stone Spurs

Alternative 3 would provide bank stabilization at the Landmark by constructing stone spurs rather than stone toes. The stone spurs would have a higher cost due to the greater volume of rock required. The stone spurs would have greater susceptibility to upstream flanking resulting from channel migrations, and would require periodic maintenance to replace eroded rock. The stone spurs at the main channel and downstream reach have slightly different configurations and are discussed separately in the following analysis.

Main Channel

Approximately 15 stone spurs, 60 feet in length would be constructed at spaced intervals (about 150-feet apart) along roughly 2,200 feet of the bank of the main channel, upstream of the Landmark. Installation would occur on the current river bed with a 20-foot-long tieback into the existing bank to secure each spur. A 425-foot-long key-in trench would be required to provide protection against flanking of the spur field due to upstream channel migrations. This alternative does not provide for a bioengineered terrace as properly spaced spur fields should initiate sediment deposition on the downstream side of each spur. With time, the sediment deposition would form bar deposits that would be colonized by local vegetation to form a riparian zone. The estimated volume of excavated geologic materials for the spur field is 5,500 yd^3, including the key-in trench (see Table 3-1).

Downstream Reach

The spur field for the downstream reach would take advantage of the point bar recently deposited adjacent to the river bank and would limit the tie back excavation into the river bank to about 5 feet to not disturb lands within the Landmark boundary. The bulk of the excavation for the spurs would occur in the point bar sediments and incorporate the existing riprap armor. The spur field would be composed of 5, 100-foot-long spurs spaced on approximate 320-foot intervals. A 100-foot revetment would also be constructed to protect against upstream flanking at the transition between the main channel and the downstream reach spur fields. The spur field would be protected by the revetment in case there is an increase in the amount of flow in the historic channel. The construction of the revetment would involve placement of rock directly into the channel and would not require any additional excavation. The design of the spur field would also provide protection for the existing point bar and the young riparian vegetation on the bar, eliminating the need for a bioengineered terrace at this site. The estimated volume of excavated bank materials for construction of a spur field at the downstream reach is about 150 yd^3.

The total volume of excavation of geologic materials for both the main channel and the downstream reach is about 5,700 yd^3 for Alternative 3. This volume represents about 1 percent of the total estimated volume of bank material that would be eroded by the Snake River under the No Action Alternative.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Alternative 4, a combination of Alternatives 2 and 3, would maximize protection of the main channel through construction of a stone toe while minimizing disturbance at the Landmark by constructing a spur field in the downstream reach. For this alternative, a stone toe would be constructed in the main channel, similar to Alternative 2. The stone toe would be extended to the first stone spur on the downstream reach to protect the bank in case there is an increase in flow in the historic channel. A primary component of Alternative 4 is construction of a bioengineered terrace to improve the bank's ability to resist erosion and also provide needed riparian habitat. The height of the bank would be lowered by about 3 feet to provide better access to the water table for planted vegetation and the terrace would require excavation for a horizontal distance of about 24 feet into the left bank. Construction of the bioengineered terrace would extend along the entire 2,200 feet of the stone toe and involves the largest volume of excavation of any of the four action alternatives under consideration. The estimated volume of bank materials to be disturbed by this element would be about 22,000 yd^3, including the key-in trench. The downstream reach would be protected by a spur field, as described above for Alternative 3. Construction of a spur field and 30-foot revetment at this location would involve the disturbance of about 150 yd^3 of bank materials.

The total volume of excavation of geologic materials for both the main channel and the downstream reach would be about 22,150 yd^3 for Alternative 4. This volume represents less than 5 percent of the total estimated volume of bank material that would be eroded by the Snake River under the No Action Alternative.

Alternative 5 –Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Alternative 5 was developed to minimize disturbance of the main channel bank through construction of a spur field while maximizing protection at the Landmark by constructing a stone toe in the downstream reach. Under this alternative, a spur field would be constructed in the main channel, as described for Alternative 3. The estimated volume of bank materials to be disturbed is about 3,300 yd^3, including the 100-foot key-in trench. A 10 to 30-foot-long key-in trench would be constructed downstream of the stone toe to prevent flanking of the structure by the Snake River. A short excavation about 10 to 30 feet long would be needed to tie the downstream end of the stone toe into the left bank. The estimated volume of excavation for the key-in trench is about 100 to 250 yd^3 (Table 3-1).

The total volume of excavation of geologic materials for both the main channel and the downstream reach is about 3,550 yd^3 for Alternative 5. This volume represents about ½ of a percent of the total estimated volume of bank material that would be eroded by the Snake River under the No Action Alternative.

Construction-related Environmental Considerations for All Alternatives

Construction-related considerations for geologic materials involve moving heavy equipment onto the site, excavating the materials of engineered structures, and hauling the excavated materials to other features of the project or to disposal sites, if necessary. Alluvium present in the channel at the toe of the structures or in the point bar next to the Landmark in the downstream reach would likely have high moisture contents and would require drying before used in engineered fills. The geologic materials present in the left bank and adjacent lands that lie at depth near or at the local water table would also have high moisture contents and would require special handling. Drying would require spreading these materials in a stock pile area and allowing them to drain and dry out. Initial setup of the stockpile area would need to account for control of the drainage water from the wet excavated materials. Alternately, the wet materials could be hauled to a disposal area.

Vehicular access to the site and the individual excavations is expected to have some impact on the local geologic materials. Access would include temporary haul roads, access ramps and loops to individual features of the project, parking areas, stockpile sites, contractor use areas, and fueling and maintenance stations for heavy equipment. Effects from equipment traffic would be confined to relatively shallow depths within the geologic materials. These effects would have greater influence on the soils that have developed within, and that are imprinted on, the parent geologic materials comprising the Bottoms.

Summary of Alternatives

The environmental effects on the local geologic materials have been analyzed based on the estimated amount of disturbance and/or removal of the materials under the No Action Alternative and the four proposed action alternatives. Disturbance is measured on the basis of volume in cubic yards which includes the estimated surface area disturbance (see Table 3-1).

Of the four proposed action alternatives, Alternative 2 involves the lowest volumes of excavation of geologic materials and provides the greatest amount of protection against future bank erosion of the options under consideration. Alternative 3 requires a considerably larger amount of excavation, but results in a lower level of site protection and assumes a greater risk of long-term flanking of the structure by future upstream channel migrations. Alternatives 4 and 5 provide for a mixing of structural elements to provide flexibility for management options and represent intermediate solutions between the stone toe and the spur fields. Alternative 4 requires the largest volume of ground disturbance of the four alternatives.

The No Action Alternative has the highest estimated environmental consequences due to the highly-erodible nature of the geologic materials comprising the main channel's left bank and adjacent Bottoms. Although the demonstration project and the riprap armor near the Landmark provide some measure of short-term protection, these structures would be ultimately flanked and destroyed by bank erosion over the long-term leading to destruction of the Landmark. The volume of bank material lost to erosion is substantially greater than the estimated disturbance for any of the action alternatives which range from about 0.5 to less than 5 percent of the volume of the naturally-eroded material that would be lost under the No Action Alternative.

3.2.3 Environmental Consequences

Soils

Environmental consequences of the proposed bank stabilization alternatives on the local soils present at the site involve two distinct categories: (1) disturbance and/or removal of the soils during excavations for engineered structures, and (2) disturbance of soils adjacent to excavations due to vehicular traffic and heavy equipment. Soils have developed within the geologic materials over long periods of time and extend to depths of about 3 to 5 feet in the Bottoms (USBR 2002). Because the soils have developed within and are imprinted on the geologic materials, the discussion on environmental consequences for geology (Section 3.2.2) incorporated consequences for soils in the estimates for material disturbed or removed from excavations or lost to erosion by natural processes.

Anticipated effects to the soils could include, but are not limited to, compaction under vehicle traffic loads with associated loss of internal soil structure and loss of infiltration capability, winnowing and rutting due to equipment traffic, and loss of soil material in the form of dust as the soil breaks down under traffic pressures. Some disruption of soils should be expected during driving of the sheet pile wall for the upstream key-in feature in Alternative 2. Each of the proposed bank stabilization action alternatives involves excavation of the soils and their parent geologic material and replacement, at least in part, with large rock structures which are capable of resisting the erosive forces of the Snake River. The amount of excavation and the extent of associated equipment traffic vary by alternative. Excavations include curve shaping of the existing channel bank, construction of a bioengineered terrace, construction of tie backs for stone spurs, and construction for key-in trenches. Regardless of the alternative selected, there would be short-term, localized impacts to the soils due to the required construction activity.

Analysis of Alternatives

The following analysis of environmental consequences discusses the anticipated effects that all alternatives would have on the soils forming the Bottoms which surround the Landmark. This analysis evaluates potential surface area disturbance of the soils and consists of three related components: (1) localized disturbance areas adjacent to excavations for engineered structures, (2) potential disturbance areas along haul roads and access ramps to the construction site, and (3) potential disturbance at staging areas, stockpile sites, equipment maintenance sites, and parking areas. The environmental consequences of the action alternatives are compared with the estimated loss of soils in the Bottoms, if natural erosion processes are allowed to continue at present rates under the No Action Alternative. The results of the analysis are summarized in Table 3-1.

The amount of excavation and soils disturbance would vary by action alternative but the layout of haul roads and staging areas would likely be similar regardless of the alternative implemented due to the geometry of the site. For this analysis, a length of 10,000 feet was assumed for the haul roads and access ramps with an average width of 24 feet to accommodate two-way traffic. The surface area impacted by the haul roads totals about 240,000 square feet using these dimensions. It is estimated (USBR 2006) that an area of about 5.75 acres (i.e., 250,470 square feet) would be needed for contractor's use area, stock piles, and staging areas. The total combined disturbance area for both haul roads and staging areas is slightly less than 490,470 square feet. This surface area represents an upper end limit for expected disturbance.

Alternative 1– No Action

In the No Action Alternative, the Snake River would be allowed to seek its natural course through the Bottoms and loss of soils would continue through erosion of the main channel bank. As discussed previously, channel migrations of 800 to 1,000 feet have been observed at several locations throughout the bottoms (USBR 2002) and a future migration of 500 to 1,000 feet could reasonably be expected at the main channel area. Once the existing demonstration project is flanked by upstream erosion and channel migration, the rate of bank erosion is expected to occur at about 21 feet per year, which is the rate that erosion was measured prior to construction of the demonstration project. At this rate, the Snake River would be projected to erode a horizontal distance of 500 feet in about 24 years. The surface area of soils lost to bank erosion in the main channel is estimated at about 1,100,000 square feet over the 2,200-foot length of the main channel bank that would be protected by the proposed stabilization project.

The downstream reach at the Landmark is protected by riprap armor placed along the existing left bank and is buffered from the Snake River by a point bar which has developed at the site in response to the river's migration into the present main channel since 1976 (USBR 2002). The riprap and the point bar provide short-term protection for the Landmark, but continued erosion upstream of the Landmark in the main channel area would progress to the point that the riprap and point bar would eventually be flanked. Due to the similarity of the highly erodible bank materials in the main channel and downstream reaches, erosion would likely then proceed at the observed rate of 21 feet per year once the riprap and bar have been flanked. The main channel currently contains about 70 percent of the total flow in the Snake River (USBR 2006) and if the channel captures more of the flow in the future, the measured rate of erosion would likely increase. Because it is difficult to estimate when upstream erosion would flank the riprap section and point bar, a horizontal erosion distance of 250 feet (i.e., half that estimated for the main channel area) was assumed for this analysis. A loss of about 400,000 square feet of soils would be expected to occur over the proposed treatment length of 1,600 feet for the downstream reach.

The No Action Alternative would ultimately lead to erosion and loss of the Landmark over the long term. The estimated disturbance of soils as a consequence of the No Action Alternative would total about 1,500,000 square feet for both the main channel area and the downstream reach at the Landmark. This area would equate to a loss of slightly less than 35 acres in the main channel and adjacent Bottoms.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

Alternative 2 would treat about 2,200 feet of the main channel with construction of a stone toe and upper bank revetment. A short excavation about 30 feet long would be required to protect the junction of the revetment and the upstream sheet pile wall serving as a key-in feature. A similar excavation would be required at the downstream end of the toe to prevent erosion and flanking of the stone toe and revetment. Factoring in a disturbed area about 24 feet wide around the perimeter of the excavations and along the length of the sheet pile wall, the estimated consequences in the main channel would be about 8,300 square feet. The length of stone toe for the downstream reach is about 1,600 feet, but most of this construction would occur in the existing point bar and a short 30-foot-long excavation to anchor the downstream end of the toe would impact the existing left bank. Using an assumed 24-foot disturbance area around the key-in features, the estimated amount of soil disturbance in the downstream reach is about 3,500 square feet.

The total combined estimated disturbance for Alternative 2 in both the main channel and the downstream reach is about 11,800 square feet around the perimeter of the excavations, as shown in Table 3-1. Additional soil disturbance from haul roads and staging areas, discussed above, would increase this total to 502,270 square feet for the stone toe alternative. This surface area equates to about 11.5 acres of disturbance and is about 33 percent of the estimated loss of soil under the No Action Alternative.

Alternative 3 – Stone Spurs

A spur field consisting of 15 stone spurs keyed 20 feet into the left bank would be constructed along the main channel. The revetment in the transition zone would provide protection in case there is an increase in the amount of flow in the historic channel. There is no excavation associated with the revetment. A key-in trench would provide some protection against upstream channel migration. The disturbance around the perimeter of these excavations is estimated at about 49,200 square feet using a traffic area 24 feet wide. The downstream reach would be protected with 5 spurs keyed 5 feet into the bank to minimize disturbance of the

Landmark. Most of this excavation would occur in the point bar deposit and minimal impact would occur to the in-place bank materials and soils. The surface area disturbance in the downstream reach is estimated at 8,000 square feet.

Construction of spur fields in the main channel and in the downstream reach results in an estimated 57,200 square feet of disturbance in soils adjacent to the excavations (see Table 3-1). The total disturbance estimated for this option is about 547,700 square feet when factoring effects from haul roads and staging areas, as discussed above. The estimated disturbance from the spur fields is slightly more than 12 acres and is about 36 percent of the estimate for soil lost to bank erosion under the No Action Alternative.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Alternative 4 combines stone toe construction in the main channel for greater bank protection with spur field construction in the downstream reach to minimize disturbance in the Landmark area. The stone toe is extended as a revetment to the first stone spur on the downstream reach to protect the bank in case there is an increase in flow in the historic channel. There is no excavation associated with the revetment. The estimated soil disturbance resulting from stone toe and bioengineered terrace construction in the main channel is approximately 86,000 square feet. Construction of 5 stone spurs in the downstream reach results in disturbance of about 8,000 square feet of soil.

The total soil disturbance adjacent to excavations under Alternative 4 is estimated at about 94,000 square feet. This total increases to 584,500 square feet when effects from haul roads and staging areas are factored in. This represents about 13.4 acres and is about 40 percent of the estimated soil loss to bank erosion under the No Action Alternative.

Alternative 5 –Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Structural elements constructed in Alternative 5 minimize disturbance of the main channel area through a spur field while providing greater protection of the Landmark with a stone toe. The estimated soil disturbance from a spur field in the main channel is 34,000 square feet adjacent to the tie-back and key-in excavations. Construction of a stone toe involves excavation of a 10 to 30-foot-long key-in trench at the downstream end of the toe and disturbs an estimated 1,900 square feet of soil in a 24-foot wide traffic area around the excavations.

Alternative 5 results in a total estimated soil disturbance of 35,900 square feet around the perimeter of the excavations. Additional disturbance from haul roads and staging areas brings the total estimated soil disturbance for this alternative to 526,370 square feet or slightly more than 12 acres. This surface area is about 36 percent of the estimated amount of soils that would be lost to bank erosion by the Snake River under the No Action Alternative.

Construction-related Environmental Considerations for All Alternatives

Environmental consequences for soils from the proposed action alternatives result from heavy equipment operation, vehicular traffic, stock pile areas, and staging areas similar to effects described for Geology.

Summary of Alternatives

The environmental effects on the local soil have been analyzed based on the estimated amount of disturbance of soil under the No Action Alternative and the four proposed action alternatives. Disturbance has been estimated on the basis of area in square feet and summarized for each alternative in Table 3-1 and also includes the estimated volume of disturbance for local geologic materials described in the previous section.

Of the four proposed action alternatives, Alternative 2 involves the lowest area of disturbance of soil and provides the greatest amount of protection against future bank erosion of the alternatives under consideration. Alternative 4 has the largest area of disturbance when compared to the other options. Alternative 3 requires an intermediate amount of excavation, but results in a lower level of site protection and assumes a greater risk of long-term flanking of the structure by future upstream channel migration. Alternative 5 includes a similar amount of soil disturbance as Alternative 3.

The No Action Alternative has the highest estimated environmental consequences due to the highly-erodible nature of the geologic materials comprising the main channel left bank and adjacent Bottoms. Although the demonstration project and the riprap armor near the Landmark provide some measure of short-term protection, these structures would ultimately be flanked and destroyed by bank erosion over the long-term leading to destruction of the Landmark. The area of soil lost to erosion is considerably greater than the estimated disturbance for any of the action alternatives which range from about 36 to 40 percent of the area lost to natural bank erosion.

Table 3-1. Volume of geologic & soils materials disturbed during construction of alternatives

	Volume of Material Disturbed (cubic yards)	Disturbance Area Adjacent to Excavations (square feet)[1]	Net Expected Effect on Geology/Soils
Alternative 1 – No Action, continuation of current situation, no project			
Main Channel	428,000[2]	1,100,000	Continued bank erosion leads to loss of tribal lands and Landmark
Downstream Reach	249,000[2]	400,000	
Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment			
Main Channel	250[3]	8,300	Effects limited to area of construction of an upstream 200-foot key-in structure for sheet piling.
Downstream Reach	250[3]	3,500 (502,270)[4]	Effects limited to areas where toe keys into bank and at 30-foot revetment. This alternative involves the lowest area of disturbance of soil and provides the greatest amount of protection against future bank erosion.
Alternative 3 – Stone Spurs			
Main Channel	5,500[3]	49,200	Effects limited to areas where spurs key into bank and at 425-foot key-in trench; alternative has some risk for upstream flanking and future bank erosion.
Downstream Reach	150[3]	8,000 (547,700)[4]	Effects limited to areas where spurs key into bank and at 30-foot revetment. This alternative requires an intermediate amount of excavation and results in a lower level of site protection.
Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)			
Main Channel	22,000[3]	86,000	Curve shaping and bioengineered terrace affect approx. 75 to 100-foot-wide zone along 2,200-foot-long treatment area plus 425-foot key-in trench; alternative has the largest area of disturbance.
Downstream Reach	150[3]	8,000 (584,500)[4]	Effects limited to areas where spurs key into bank and at 30- foot revetment
Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)			
Main Channel	3,300[3]	34,000	Effects limited to areas where spurs key into bank and at 100- foot key-in trench; alternative has some risk for upstream flanking and future bank erosion.
Downstream Reach	250[3]	1,900 (526,370)[4]	Effects limited to areas where toe keys into bank and at 30-foot revetment. Similar amount of soil disturbance as Alternative 3.

[1] Calculation assumes at 24-ft wide disturbance zone around the perimeter of the excavations.
[2] Volume shown is material lost from left channel bank due to lateral erosion by Snake River.
[3] Volume shown is estimated excavation needed for required structure (i.e., stone toe or rock spur).
[4] Area shown is estimated total including effects from haul roads and staging areas.

3.2.4 Cumulative Effects

Large fluvial systems such as the Snake River in the Bottoms are complex, dynamic systems in a continual state of change. Downstream migration of meander bends results in a frequent recycling of the floodplain materials and a constant cycle of bank erosion and sediment deposition. Analysis of channel migration patterns (USBR 2002) has shown that the Snake River has migrated across nearly the entire width of the floodplain at several locations since 1936. Alterations at one site in the system can result in the changes upstream and downstream directions, although these changes are typically localized in nature.

River channel alterations have occurred in the Bottoms in the form of bank armoring through the disposal of waste rock along the channel bank and through the placement of riprap. Several of the alterations have occurred upstream of the proposed project site. Hydraulic modeling and geomorphic analysis of these alterations (USBR 2002; Mooney 2007) have shown that the effects are very localized and are limited to within one to two meander bends of the individual site. These alterations are located too far upstream to have cumulative effects with the project under consideration in this proposed action. The proposed action is not expected to have cumulative impacts with the upstream alterations.

3.3 Water Quality

3.3.1 Affected Environment

A significant amount of water quality and other related data for the Snake River between Ferry Butte and American Falls Reservoir were used in this analysis. Most of the water quality data were collected at Tilden Bridge near Ferry Butte, which is approximately 12 river miles upriver from the Landmark site. These data are used to describe the affected environment at the Landmark site because they represent the nearest available water quality data that are robust enough for a thorough analysis. No water quality data were readily available from the vicinity of the Landmark site.

The data were collected through long-term monitoring programs by a variety of agencies, including the USGS, Reclamation, and Idaho Department of Environmental Quality (IDEQ). Table 3-2 shows the collecting agency, the type of data used in the analysis, and the relative period of record (POR) for each data set.

Table 3-2. Summary of water quality and other related data for the Snake River between Ferry Butte and American Falls Reservoir.

Collecting Agency	Type of Data[1]	Period of Record
U.S. Geological Survey	Chemical	1980-89, 1993-95,
Idaho Department of Environmental Quality	Chemical, Physical	2000-2005
U.S. Bureau of Reclamation	Chemical	2001-2004

[1] Chemical data include parameters such as sediment, nutrient, and dissolved oxygen concentration. Physical data include parameters such as water temperature and channel grade.

The IDEQ lists the Snake River from Ferry Butte to American Falls Reservoir as water quality limited under Section 303(d) of the Clean Water Act (CWA) due to excess sediment. The designated beneficial uses in the Snake River from Ferry Butte to American Falls Reservoir include cold water aquatic life, salmonid spawning, primary and secondary contact recreation, and domestic water supply.

In July 2004, IDEQ completed the draft *American Falls Subbasin Total Maximum Daily Load Plan (TMDL): Subbasin Assessment and Loading Analysis* (IDEQ 2004). The subbasin assessment found that water column sediment levels in normal and low flow years are not impairing the designated beneficial uses in the Snake River between Ferry Butte and American Falls Reservoir. However, IDEQ also concluded that the effect of water column sediment and bedload sediment in high flow years were unknown. Due to this uncertainty, IDEQ did not remove sediment from the Section 303(d) list and assumed that sediment is impairing beneficial uses in the segment. IDEQ cited agriculture, livestock grazing, eroding banks, and in-stream channel erosion as possible sources of sediment. As a result of not de-listing sediment, IDEQ established a TMDL for sediment within the reach. The load allocation for suspended sediment as measured at the USGS gage at Ferry Butte (13069500) is 72,024 tons/year. This load allocation is based on an average concentration of not to exceed 60 milligrams per liter (mg/L) suspended sediment over a 14-day period.

In addition to establishing the sediment TMDL for the Snake River between Ferry Butte and American Falls Reservoir, IDEQ established nutrient allocations for total phosphorus and total nitrogen. Although the segment is not Section 303(d) listed for nutrients, and IDEQ found no evidence of nutrient induced impairment to beneficial uses, IDEQ set the TMDLs because the Snake River is the primary water source for American Falls Reservoir, which is water quality limited by excess nutrients. The TMDL load allocations, which apply at Ferry Butte are 167 tons/year total phosphorus and 1918 tons/year total nitrogen. These load allocations represent no increase above current loads. The total phosphorus load allocation is based on maintaining an average water column concentration of 0.035 mg/L.

The Snake River in the vicinity of the Landmark widens in several areas as it flows around numerous islands and side channels. The meander belt for the Snake River below Ferry Butte is 2,000-3,000 feet wide (Sampson et al. 2001). The river gradient throughout this stretch is 0.1 percent (IDEQ 2004).

Suspended Sediment

Suspended sediment (sediment floating in the water column) can have detrimental effects on aquatic life communities. Many fish species can tolerate, and may actually benefit, from elevated suspended sediment levels for short periods of time, such as during natural spring runoff. However, longer durations of exposure can interfere with feeding behavior, damage gills, reduce growth rates, and in extreme cases eventually lead to death. Likewise, aquatic macroinvertebrate communities can withstand short durations of elevated suspended sediment, but longer durations may negatively alter their distribution, abundance, and community composition.

As part of the National Water Quality Assessment Program (NAWQA), USGS collected suspended sediment concentration (SSC) data from the Snake River near Ferry Butte in the years 1993-1995 (Clark 1997). While these years alone do not necessarily provide a good representation of current sediment conditions, they do provide an estimation of past conditions for three consecutive low to moderate flow years and provide for the recognition that sediment concentrations and their associated loads fluctuate based on varying annual mean flows. Table 3-3 shows the summary statistics for SSC in the Snake River near Ferry Butte during the 1993-1995 period of record.

Table 3-3. Summary statistics for 1993-1995 SSC in the Snake River near Ferry Butte

		Concentration of Indicated Percentile (mg/L)					
Period of Record	No. of Samples	10	25	50	75	90	Maximum Concentration
1993-1995	13	--	16	49	174	--	427

Figure 3-1 illustrates how the mean annual flow in the Snake River at the USGS Tilden Bridge gage (near Ferry Butte) can fluctuate from year to year. Figure 3-1 also shows the mean of the mean annual flows for the 1980 to 2002 period of record, which is 4,959 cubic feet per second (cfs). To further analyze the affected environment in terms of sediment and other water quality data, this flow serves as the basis for estimating representative high, medium, and low flow years. Based on the data presented Figure 3-1, 2002 is chosen as a low flow year (8.6 percentile rank), 1995 is chosen as an average flow year (58.3 percentile rank), and 1996 is chosen as a high flow year (82.6 percentile rank). The water quality data for these representative years are further evaluated to analyze how flow affects sediment concentrations and other water quality parameters in the Snake River near the Landmark.

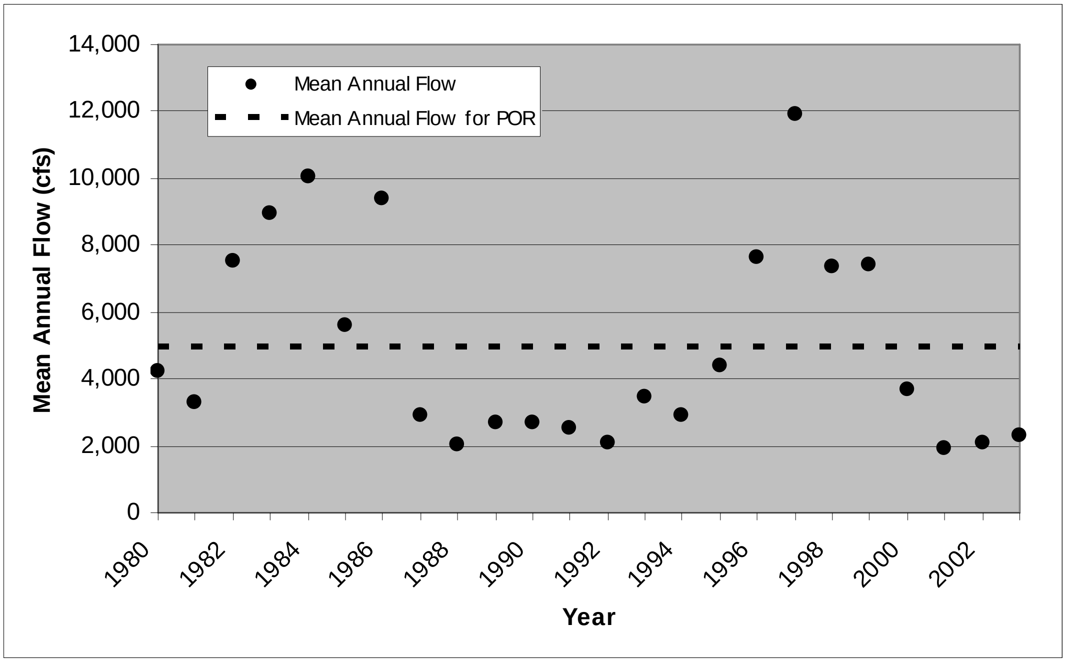


Figure 3-1. Mean annual flow in the Snake River at Tilden Bridge as compared to the mean of the mean annual flows

Table 3-4 shows the mean annual SSC and loads in the Snake River near Ferry Butte for the years 1995, 1996, and 2002. Note that the mean annual concentration and load adjusts correspondingly with mean annual flow. Additionally, while the frequency of the data do not allow for a direct comparison to the 60 mg/L 14-day average target established by IDEQ, the mean annual concentrations suggest that levels are below the target.

Table 3-4. Mean annual SSC concentration and load in the Snake River near Ferry Butte for the years 1995, 1996, and 2002

Year	Mean Annual SSC (mg/L)	Mean Annual SSC Load (tons/day)
1995 (Average Flow Year)	27	321
1996 (High Flow Year)	38	783
2000 (Low Flow Year)	17	96

Turbidity

While not an ideal measure of water column sediment (due to other suspended material that may exist in the water column), the Environmental Protection Agency (EPA) has indicated that turbidity is a suitable endpoint for determining the effects of sediment on beneficial use support status (EPA 1999).

The data are not sufficient enough to determine the flow-related turbidity levels in 1995, 1996, and 2002. However, the American Falls Subbasin Assessment and TMDL (IDEQ 2004) presents descriptive statistics for turbidity data collected by IDEQ and USGS in the Snake River near Ferry Butte, as shown in Table 3-5. The data were collected from 2000 to 2003, which are all low flow years. As such, it is difficult to determine whether turbidity levels near Ferry Butte fluctuate with flow.

Table 3-5. Descriptive statistics for turbidity data (n=39) collected in the Snake River near Ferry Butte from April 2000 to July 2003

Descriptive Statistic	Turbidity (NTU)
Mean	5
Standard Deviation	4
Maximum	22
Minimum	0.3
Median	4.3

Bedload

Excessive bedload sediment (particles that saltate along the river bottom without becoming suspended) can be detrimental to fish and other aquatic species which serve as a primary food source for fish. Increased sedimentation can decrease the availability and quality of spawning gravels that are critical to the reproductive cycle. Sedimentation can also lead to a macroinvertebrate community that is adapted to burrowing, thereby making the macroinvertebrates less available as a prey base to fish.

IDEQ presented USGS bedload data in the American Falls Subbasin Assessment and TMDL (IDEQ 2004). The data showed that most of the sediment load in the Snake River is passing in the suspended state, suggesting that bedload does not appear to be impairing water quality. Limited data sets collection in 2000 and 2002 (low flow years) showed that most particles were less than 4.0 mm but greater than 0.25 mm in diameter, although the bedload size is based in part on flow velocity. Thus, these observation do not qualify as a definitive bedload analysis.

Nutrients

As part of the same NAWQA study in which the sediment data were collected, USGS collected nutrient data from the Snake River near Ferry Butte in the years 1980-1989 and 1993-1995 (Clark 1994, 1997). Again, while these years alone, particularly the early 1980s data do not necessarily provide a good representation of current nutrient conditions, they do provide an estimation of past conditions and are able to capture the relative concentration and load fluctuations that occur with varying annual mean flows (note the large range of mean annual flows that occur in Figure 3-1).

Table 3-6 shows the summary statistics for nutrient concentrations in the Snake River near Ferry Butte during the 1980-1989 and 1993-1995 periods of record.

Table 3-6. Summary statistics for 1980-1989 and 1993-1995 nutrient concentrations in the Snake River near Ferry Butte

			Concentration of Indicated Percentile (mg/L)					
Parameter	Period of Record	No. of Samples	10	25	50	75	90	Max. Conc.
Total Phosphorus	1993-1995	35	<.01	<.01	.02	.03	.04	.11
Total Phosphorus	1980-1983	13	--	.035	.050	.055	--	--
Total Nitrogen	1980-1983	48	.270	.425	.745	1.08	1.73	--
Dissolved Orthophosphate	1993-1995	35	<.01	<.01	<.01	.01	.02	.03

Table 3-7 shows the mean annual nutrient concentrations and loads in the Snake River near Ferry Butte for the representative average, high and low flow years of 1995, 1996, and 2002, respectively. Note that in the case of nutrients, the mean annual concentration and load does not adjust correspondingly with mean annual flow.

Table 3-7. Mean annual nutrient concentrations and loads in the Snake River near Ferry Butte for the years 1995, 1996, and 2002

Year	Mean Annual TP (mg/L)	Mean Annual TP Load (kg/day)	Mean Annual Dissolved Orthophosphate (mg/L)	Mean Annual Dissolved Orthophosphate Load (kg/day)
1995 (Average Flow Year)	.023	249	.011	119
1996 (High Flow Year)	.033	618	.012	225
2000 (Low Flow Year)	.037	189	.008	41

Field Parameters

Beginning in 2003, IDEQ has collected near-monthly water temperature, pH, dissolved oxygen, and specific conductance data from the Snake River near Ferry Butte. These data are collected in-situ using multiprobes, with the measurements being taken along with laboratory samples for sediment and nutrient analysis. IDEQ's sampling protocol calls for a measurement to be taken from the left bank, the middle of the river, and the right bank. However, the data presented in this analysis are the mean of the three measurements for the given sampling day.

Table 3-8 shows the summary statistics for pH, dissolved oxygen, and specific conductance in the Snake River near Ferry Butte from January 2003 to June 2005. Figure 3-2 shows the dissolved oxygen and water temperature data for the same period of record. Note the inverse correlation between dissolved oxygen and water temperature. As expected, when water temperatures increase in the hot summer months the dissolved oxygen concentrations decrease. The phenomenon is likely due to the nighttime consumption of oxygen (respiration) by aquatic plants that grow during the summer.

Table 3-8. Summary statistics for pH, dissolved oxygen, and specific conductance in the Snake River near Ferry Butte from January 2003 to June 2005

		Percentile					
Parameter	Period of Record	10	25	50	75	90	Max. Conc.
pH	2003-2005	8.16	8.32	8.45	8.55	8.67	8.78
Dissolved Oxygen (mg/L)	2003-2005	7.65	9.14	10.78	12.24	13.62	15.43
Specific Conductance (µs/cm2)	2003-2005	303	316	333	352	366	469

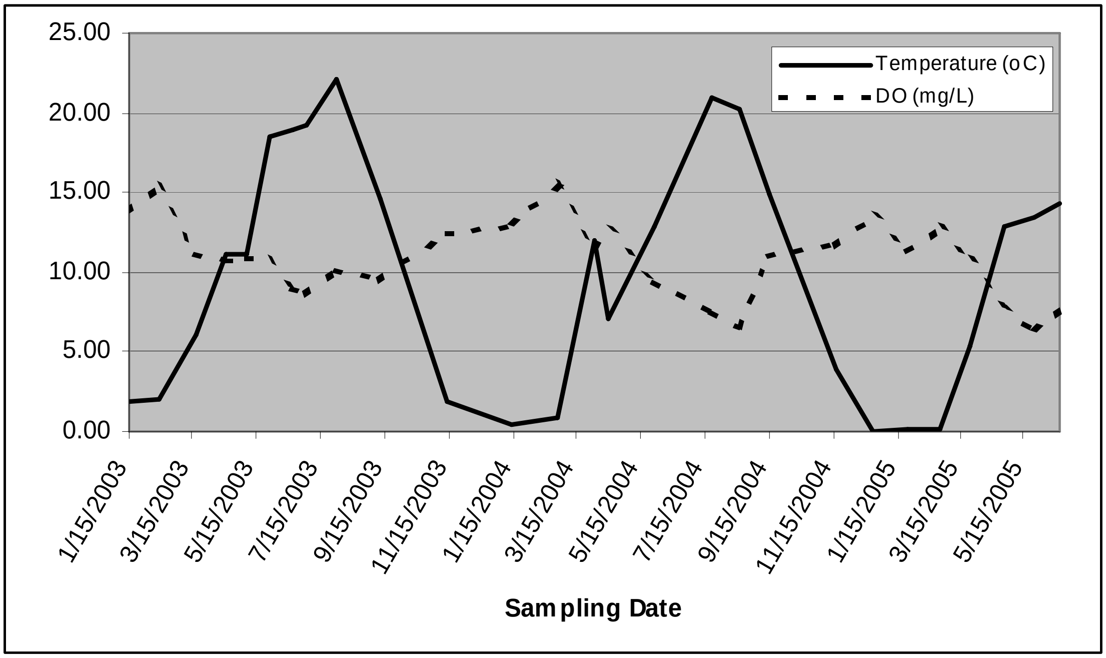


Figure 3-2. Dissolved oxygen concentrations and water temperatures in the Snake River near Ferry Butte

Sediment Transport / Nutrient Cycling

Material that is eroded from the river bank contains attached nutrients, which contributes to the nutrient cycle in the river. While the exact amount and availability of nutrients bound within the bank sediments is unknown, there likely some amount of bound nutrients. When the sediments are eroded into the river, some of the associated nutrients would become unattached and available for primary production. In terms of nutrient cycling, the Snake River is a conservative system, meaning that it imports more nutrients that it exports and has a rapid rate of recycling nutrients to downstream sources. Once the banks are stabilized the localized nutrient cycle would change.

3.3.2 Environmental Consequences

The primary water quality concern associated with Alternatives 2, 3, 4, and 5 is a short-term increase in turbidity due to construction-related sediment discharge to the Snake River. The increase would primarily occur during river construction activities that disturb existing sediment or introduce new sediment at or below the ordinary water line. Sediment may also enter the river via storm water from the construction site during precipitation events, but comparatively speaking this amount is expected to be minimal and may not occur if precipitation is not encountered during construction. Other water quality concerns associated with the action alternatives include short-term increases in nutrient levels and construction related pollutants such as oil and grease. However, the effects of these pollutants on water quality is expected to be minimal, if even detectable.

Analysis of Alternatives

The following discussion outlines the effects each alternative would have on water quality in the Snake River. Due to the anticipated brevity and relative mildness of any sediment discharge to the river, sediment transport modeling has not been performed. In order to provide a semi-quantitative comparison between alternatives in terms of *potential* sediment discharge and the resulting turbidity, the total volume of rock material used to construct each aspect of each alternative is used as a surrogate. Consideration is also given to the volume of rock that would actually be placed near or below the ordinary water line, since this volume of rock is more likely to cause turbidity than rock placed away from the water line.

Alternative 1 –No Action

Under a No Action Alternative, no additional rock material would be added to the banks and the current rate of bank erosion and resulting in-river sediment load is expected to continue or increase slightly as banks become more unstable. The bank material is highly erodible, with a median particle size of 0.16 mm in diameter. With migration rates of up to 600 feet over a 30-year period detected slightly upstream of the project area (USBR 2006), and a meander belt of 2,000-3,000 feet wide (Sampson et al. 2001), the river has the potential to migrate across and inundate the entire Landmark boundary.

Current trends and fluctuations in localized bedload and river bed particle size distribution are expected to continue as well. Although slight changes may occur over brief timelines, they would be in response to natural events and would not persist over extended periods. Due to the controlled nature of the river flow mass sediment wasting is not expected under normal conditions. However, given the already erosive nature of the river banks, flood events could increase the risk of mass wasting.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

Under the Preferred Alternative, a total of 3,800 feet of bank line would be treated (2,200-feet along the main channel and 1,600-feet in the downstream reach). Construction associated with this alternative would occur in phases. The first phase of clearing a staging area and stockpiling riprap material is not expected to have an affect on water quality, particularly from a sediment standpoint.

The next two phases of construction consist of developing paths for construction equipment and placing and grading the riprap material. The development of construction paths on the terrace above the river bank is not expected to affect water quality. However, the development of paths directly adjacent and perpendicular to the river for purposes of placing and grading riprap would likely disturb the sediment enough to cause brief periods of turbidity.

The placing and grading of soil or additional rock to bring the existing vertical undercut bank to an angled slope of 1.5 to 1.0, and the placing of riprap material is expected to result in the largest amount of sediment discharged with this alternative. A total of 8,184 yd^3 of rock would be placed in the main channel. The initial placement of this rock is expected to cause large, but brief increases in turbidity as the river bottom sediments are disturbed. However, these periods of increased turbidity are expected to be short-term in duration and are not expected to chronically affect water quality. As additional rock is placed on top of the previously placed rock there may be additional brief increases in turbidity due to shifting. The placing and grading of nearly all riprap on the downstream reach is expected to occur above the water line on an existing point bar; therefore, no substantial increase in turbidity is anticipated. The total volume of rock that would be placed in the downstream reach is 8,952 yds^3.

The outside ends of the main channel and downstream reach stone toes would include key-in features. These features would be comprised of a steel sheet pile driven into the ground and angled away from the water for 200 feet on the upstream ends and 30 feet on the downstream ends. Approximately 20-30 feet of excavation into the bank is required to secure the key-in to the stone toes. Since this excavation would occur near the waters edge on the main channel, it is expected to result in large, but brief periods of turbidity. Less turbidity is expected on the downstream reach, since only the lower end of the stone toe would be in contact with the water. While a small amount of turbidity may occur when the sheet pile is driven into the ground (due to vibration), it is not expected to be substantial since the key-in features would be angled away from the waters edge.

If appropriately-sized riprap material is not used during construction, the possibility of erosion on and within the stone toe exists. Design scenarios to determine the appropriate size of rock determined that a D_{50}[1] of 1.0 feet on the main channel and a D_{50} of 1.1 feet on the downstream historic channel is appropriate to prevent interstitial erosion (USBR 2006).

Following construction of the stone toe bank protection, the river would likely shift the thalweg toward the protected bank (USBR 2006). This shift would result in temporary scouring of the river channel as the thalweg migrates. However, the scour associated with the creation of a new thalweg is in essence a natural process, would stabilize over time, and is not expected to result in a substantial increase in water column or bedload sediment. Once the thalweg has migrated to the toe of the protected bank, there may be temporary scouring at the toe of the riprap. Additional material would be placed at the toe to account for this anticipated scour.

[1] D_{50} = the median rock diameter

Alternative 3 – Stone Spurs

A total of 20 stone spurs would be constructed within the project area. Fifteen spurs would be placed on the 2,200-foot main channel and 5 spurs would be placed on the 1,600-foot downstream reach. The point bar in the transition zone would be protected by the revetment in case there is an increase in the amount of flow in the historic channel.

Similar to Alternative 2, the development of construction paths on the terrace above the river bank is not expected to affect water quality. However, the development of paths directly adjacent and perpendicular to the river for purposes of constructing the stone spurs may disturb the sediment enough to cause brief periods of turbidity. Less vegetation would be removed from the entire project area with the rock spur alternative since this alternative does not provide for bioengineering. However, some vegetation would be removed from the shoreline and the potential for erosion remains, particularly during storm events. Again, all appropriate construction best management practices (BMPs) would be used to minimize runoff during this period.

Assuming a rock core is used, a total volume of 10,500 yd^3 of rock material would be used to construct the spurs in the downstream reach (USBR 2006). However, the placement of these spurs is not expected to result in an increase in turbidity since the spurs would be wholly constructed out of the river on an existing point bar. The base of the downstream spurs would be trenched to the elevation of the water table, but there would be no surface water hydrologic connection to the Snake River. The exception is the last downstream spur, which may be constructed in a backwater area if river flows are high enough. However, no substantial increase in turbidity is expected in the flowing portion of the river. These spurs would be in place if the flow of the river returns to the pre-1976 path, in which case the river would likely erode through the point bar to the spurs and cause a temporary, but natural increase in water column and bedload sediment.

A total volume of 26,700 yd^3 of rock material would be used to construct the spurs and the bank revetment in the main channel (USBR 2006). The placing and shaping of the spurs is expected to result in the largest amount of sediment discharged with this alternative, since the toe end of the spurs is expected to be near and below the ordinary water line. The initial placement of rock on the bank line and river bottom would result in a large amount of sediment causing brief periods of turbidity. For each spur, material would be placed in the river beginning at the bank and would be slowly extended into the river until the desired spur length is reached. The periods of sediment discharge resulting in turbidity increases are expected to be short-term in duration, with the bulk of the disturbance occurring during initial placement of material on the river bottom. As additional rock is placed on top of the previously placed rock, there may be additional brief increases in turbidity due to shifting. The initial placement of rock to construct the revetment is also expected to result in brief periods of turbidity, but the turbidity would quickly subside as the revetment is completed.

The spurs in the main channel can be constructed with a soil core or a rock core, depending on limitations from the regulatory agencies. If a soil core is used, the amount of sediment lost to the river before the soil can be covered with rock is expected to be between 10-20 percent of the total volume of soil (Mooney 2005). If a rock core is used, the amount of sediment causing turbidity would likely be limited to that disturbed during placement and the small amount that may be attached to the rock itself. As the spurs are built up, the amount of disturbed sediment discharged to the river would decrease. The total amount of sediment discharged to the river is not expected to chronically affect water quality, even if a soil core is used. Spurs in the downstream reach may be constructed of existing point bar material overlain with rock.

Following construction of the spur fields, the thalweg would likely move toward the tips of the spurs and create large pools (USBR 2006). This shift in the thalweg would result in temporary scouring at tips of the spurs. However, the scouring would subside over time as the thalweg stabilizes and is not expected to result in a substantial increase in sediment load. In addition to a shift in the thalweg, the river may also exhibit sediment deposition between the spurs (USBR 2006).

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

This alternative combines the stone toe design with the spur field design. The stone toe is extended to the first stone spur on the downstream reach to protect the bank in case there is an increase in the amount of flow in the historic channel A total of 2,200 feet of bank in the main channel would be shaped for the construction of a bioengineered, vegetated terrace with stone toe protection, and a total of 5 stone spurs would protect the 1,600-foot downstream reach.

While this is a combined alternative, the development of a staging area and construction paths is essentially the same as described in the previous alternatives. The development of paths on the terrace above the river bank is not expected to affect water quality. However, similar to the other alternatives, the development of paths directly adjacent and perpendicular to the river for purposes of constructing the stone toe on the main channel may disturb the sediment enough to cause brief periods of turbidity. No disturbance from construction paths for placement of the stone spurs is expected since the spurs would be entirely above the water line on the point bar in the downstream reach.

The construction of the stone toe, vegetated terrace, and bank revetment on the main channel is expected to use a total of 6,900 yd^3 of rock material. The initial placement of the stone toe and revetment material is expected to result in a large amount of turbidity, since the placement would occur below the ordinary water line. However, these periods of increased turbidity are expected to be short-term in duration and are not expected to chronically affect water quality. As additional rock is placed on top of the previously placed rock, there may be slight increases in turbidity due to shifting, but the period is expected to be brief. The removal of vegetation in the project area during this phase could potentially result in erosion, particularly during storm events, and contribute to additional sediment in the river downstream of the project area.

While a total of 10,500 yd^3 of rock material (assuming a rock core) would be used to construct the spurs in the downstream reach (USBR 2006), the placement of these spurs is not expected to result in an increase in turbidity. The spurs would be wholly constructed out of the river on an existing point bar, and even though the base of the spurs would be trenched to the elevation of the water table, there would be no surface water hydrologic connection to the Snake River.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

This alternative combines the stone spur design from Alternative 3 with the stone toe design from Alternative 2. A total of 2,200 feet of bank in the main channel would be protected by 15 stone spurs while 1,600 feet of bank in the downstream reach would be protected by stone toe. The section of bank between the main channel and the downstream reach would be protected by a revetment.

As with Alternatives 2, 3 and 4, the development of construction paths on the terrace above the river bank is not expected to affect water quality. However, the development of paths directly adjacent and perpendicular to the river for purposes of construction may disturb the sediment enough to cause brief periods of turbidity. Less vegetation would be removed from the entire project area with the rock spur alternative since this alternative does not provide for curve shaping or bioengineering.

A total volume of 26,700 yd^3 of rock material would be used to construct the spurs and bank revetment in the main channel (USBR 2006). The placing and shaping of the spurs is expected to result in the largest amount of sediment discharged with this alternative, since the toe end of the spurs is expected to be near and below the ordinary water line. The initial placement of rock on the bank line and river bottom would result in a large amount of sediment causing brief periods of turbidity. For each spur, material would be placed in the river beginning at the bank and would be slowly extended into the river until the desired spur length is reached. The periods of sediment discharge resulting in turbidity increases are expected to be short-term in duration, with the bulk of the disturbance occurring during initial placement of material on the river bottom. As additional rock is placed on top of the previously placed rock, there may be additional brief increases in turbidity due to shifting. The initial placement of rock to construct the revetment is also expected to result in brief periods of turbidity, but the turbidity would quickly subside as the revetment is completed

The spurs in the main channel can be constructed with a soil core or a rock core, depending on limitations from the regulatory agencies. If a soil core is used, the amount of sediment lost to the river before the soil can be covered with rock is expected to be between 10 -20 percent of the total volume of soil (Mooney 2005). If a rock core is used, the amount of sediment causing turbidity would likely be limited to that disturbed during placement and the small amount that may be attached to the rock itself. As the spurs are built up, the amount of disturbed sediment discharged to the river would decrease. The total amount of sediment discharged to the river is not expected to chronically affect water quality, even if a soil core is used.

Following construction of the spur fields, the thalweg would likely move toward the tips of the spurs and create large pools (USBR 2006). This shift in the thalweg would result in temporary scouring at the tips of the spurs. However, the scouring would subside over time as the thalweg stabilizes and is not expected to result in a substantial increase in sediment load. In addition to a shift in the thalweg, the river may also exhibit sediment deposition between the spurs (USBR 2006). This phenomenon occurs more often in rivers with elevated levels of suspended material, a phenomenon which this segment of the Snake River does not demonstrate (IDEQ 2004).

The placing and grading of the 9,000 yds^3 of stone toe on the downstream reach is expected to occur above the water line on an existing point bar unless flows are high enough to reach the bar. In this case, the downstream most bar may be constructed in a backwater area. However, no substantial increase in turbidity is anticipated.

Summary of Alternatives

The total volume of rock material used to construct each aspect of each action alternative, in combination with a consideration of the volume of rock that would actually be placed near or below the ordinary water line, is used as a surrogate to the potential for increased turbidity in the Snake River. Table 3–9 shows the volume of rock material associated with the construction of each aspect of each action alternative. For this analysis, it is assumed that the total volume of rock placed in or near the water would have an affect on turbidity. However, in actuality not all of the rock placed near the water line would come into contact with water and cause an increase in turbidity. This assumption is made so that a relative comparison between alternatives can be evaluated.

The information provided in Table 3–9 suggests that when compared to Alternatives 2 and 4, Alternative 3 is expected to result in the largest amount of turbidity in the river. This expectation is based on the total volume of rock material that would be used to construct the 15 stone spurs in the main channel. Assuming similar construction practices for each, Alternatives 2 and 4 are expected to result in similar amounts of turbidity in the river.

Compared to the long-term benefits of stabilizing the main channel and downstream reach banks, the drawbacks of creating acute levels of construction-related turbidity are minimal. From a water quality standpoint, none of the four action alternatives would create chronic detrimental effects.

Table 3-9. Volume of rock material used to construct alternatives

	Volume of Rock Material (yd^3)	Volume of Rock Placed In/Near Water (yds^3)**	Net Expected Effect on Water Quality
Alternative 1 – No Action	0	0	No change
Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment			
Main Channel	8,184	8,184	Brief periods of high turbidity
Downstream Reach	8,952	0	No change
Alternative 3 – Stone Spurs			
Main Channel	26,700	26,700	Brief periods of high turbidity, greater than Alternatives 2 & 4
Downstream Reach	10,500	0	No change
Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)			
Main Channel	6,900	6,900	Brief periods of high turbidity
Downstream Reach	10,500	0	No change
Alternative 5 –Stone Spurs (Main Channel); Stone Toe (Downstream Reach)			
Main Channel	26,700	26,700	Brief periods of high turbidity, greater than Alternatives 2 & 4; similar to Alternative 3
Downstream Reach	9,000	0	No change
** The entire volume of rock would not result in turbidity			

3.4 Wetlands

3.4.1 Affected Environment

The Bottoms located on the west side of the Reservation are part of one of the largest wetlands in Idaho and provide resting, foraging, and nesting cover for migratory birds; high quality habitat for various fish and wildlife species; flood water storage; increased groundwater recharge; and sediment removal (Sampson et al. 2001). Additionally, these areas provide fish and wildlife habitat, erosion control, forage, late season streamflow enhancement, aquifer recharge, and water quality improvement.

The wetlands located along the Snake River generally belong to the Palustrine Class of wetlands as described by the Cowardin Wetland Classification System (Cowardin et al. 1979). Tree/shrub wetland or riparian habitat constitutes a very small portion of Idaho's landscape (approximately 0.7 percent according to Boccard 1980). Wetland and riparian habitats have been subject to extensive modification, particularly along the Snake River.

National Wetland Inventory (NWI) maps show a small scrub/shrub, freshwater emergent wetland oxbow is located just to the north of the Landmark and is hydrologically connected to the Snake River via subsurface flow and seepage. It is also inundated during high-flow events.

3.4.2 Environmental Consequences

Alternative 1 – No Action

Assuming past erosion, averaging 21 feet per year, continues into the future, the composition and location of existing wetlands would change. Some wetlands may be lost with the continued erosion of the banks and some may be gained as flows move inland.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

The stone toe revetment structure would be modified by one of the three oxbow options in the area of the entrance to the oxbow, so that waterflow could continue to seep into the wetland area. Impacts caused by construction would be temporary. Tribal management of the wetlands would not change.

Alternative 3 – Stone Spurs

The stone spur structures would be spaced to avoid the oxbow entrance; however, one of the three oxbow options would be applied in the area of the entrance to the oxbow so that waterflow could continue to seep into the wetland area. Since construction of a road is necessary across the entrance of the oxbow the area would be temporarily disturbed. Tribal management of the wetlands would not change.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach).

The stone toe structure would be modified by one of the three oxbow options in the area of the entrance to the oxbow, so that waterflow could continue to seep into the wetland area similar to Alternative 2. Impacts caused by construction would be temporary. Tribal management of the wetlands would not change.

Alternative 5 –Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

The stone spur structures could be spaced to avoid the oxbow, yet still allow waterflow to continue to seep into the wetland area similar to Alternative 3. Impacts caused by construction would be temporary. Tribal management of the wetlands would not change.

3.4.3 Construction-related Environmental Considerations for All Alternatives

Options for Maintaining Oxbow Wetlands

To retain current habitat in the oxbow area requires maintaining connectivity with the main channel to allow a defined amount of water to flow through the oxbow. This involves creating a hydraulic break in the bank engineering where the oxbow connects to the channel. There are three options proposed to create the hydraulic break.

Figure 3-3. Aerial view of the oxbow

Option 1 – Solid Riprap Weir Entrance

Construct a riprap weir entrance to the oxbow channel in which a rock sill restricts the amount of flow but increases risk for future damage to surrounding bank protection at the entrance to the oxbow.

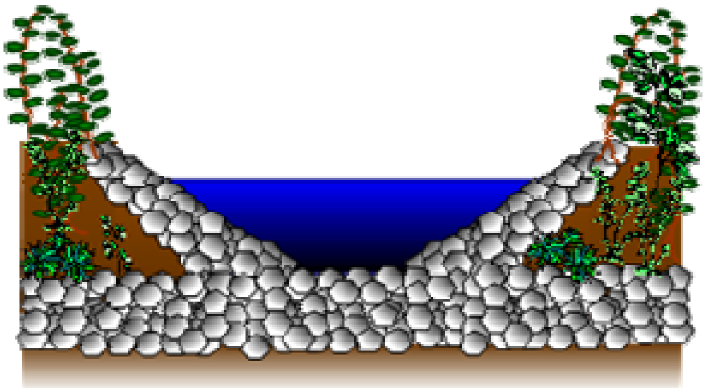


Figure 3-4. Conceptual front view of weir entrance through bank protection

Option 2 – Porous Riprap Wall

A porous riprap wall would provide a continuous line of bank protection while still allowing water to flow through the interstitial spaces and saturate the area behind the rock material. This design would reduce the risks of surrounding bank damage and wetland inundation at high water flows, but includes a high degree of uncertainty in the quantity of water able to pass through due to potential obstruction.

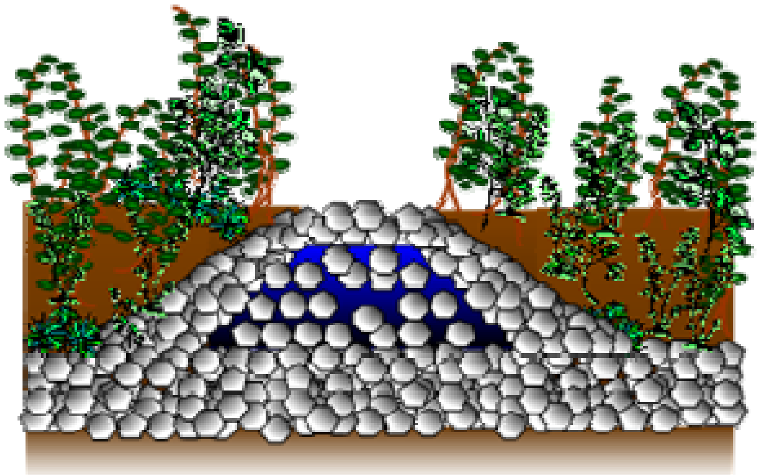


Figure 3-5. Conceptual front view of a porous riprap wall

Option 3 – Culverts

A structure consisting of one or more culverts installed at the entrance of the oxbow provides controlled hydraulic connectivity without breaking the line of bank protection. This design may require increased maintenance due to a higher degree of obstruction and the potential for plugging with debris.

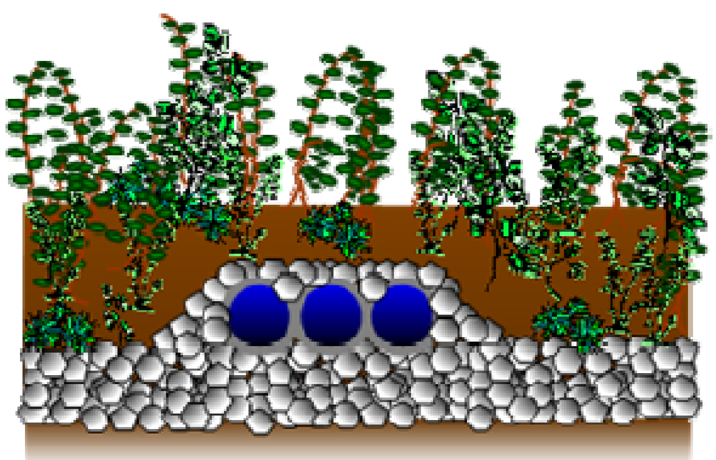


Figure 3-6. Conceptual front view of a culvert entrance

3.4.4 Cumulative Effects

The Army Corps of Engineers (Corp) and the Idaho Department of Lands (IDL) through the CWA regulate the loss of wetland habitat through permitting programs that track the loss and creation of wetlands. The small area affected by the Preferred Alternative would not significantly alter wetland values. The Corp through the CWA 404 permitting process would determine how Reclamation would mitigate for the loss or change in character of the wetlands.

The spur alternative would induce sediment deposition that could ultimately create a vegetated shoreline or a potential new wetland and riparian habitat that are currently lacking in the main channel area. Presently, this area is a grassland serving as pasture.

3.5 Vegetation

3.5.1 Affected Environment

The Reservation contains approximately 385,000 acres of habitat classified as sagebrush-grassland habitat (USBR 2001). Maintaining the native vegetation is an important part of Tribal spirituality and traditional healing as many plants are used for remedies for different ailments (USBR 2001). However, much of the native sagebrush-grassland area has been disturbed and altered for rangeland and agricultural purposes, while the remaining portions are woodlands.

The Reservation is located in the ecoregion classified as Dry Domain, Intermountain Sagebrush Province, Sagebrush-Wheatgrass Section (USBR 2001) Low Elevation (Sagebrush Zone). In eastern Idaho narrow-leaf cottonwood is present. Diverse communities of riparian shrubs including red-osier dogwood, water birch, American silverberry, smooth sumac, and common snowberry, are present in both the understory of cottonwood stands and as community dominants. Stands of common cattail, softstem bulrush, creeping spikerush, and bladder sedge are present in backwater sloughs and abandoned channels. Historically, the broad floodplain of the Snake River above American Falls Reservoir was several miles wide. The floodplain is now confined by levees placed up to 0.5 mi (0.8 km) away from the main channel. Cottonwood forests are well developed on islands and channel banks within the levees. Examples of this type are Bottoms and the Snake River below Heise (Ritter 2000).

In the 15,000 acres of woodlands and forests on the Reservation, four vegetative groups can be identified: 1) cottonwood/willow, 2) juniper, 3) quaking aspen, and 4) conifers (USBR 2001). The Bottoms and McTucker Island represent remnant floodplain forest, with large cottonwoods and tree-form brittle willows and a diverse understory with willows, alders and annual and perennial herbaceous vegetation. The dynamic nature of the cottonwood floodplain forest is the subject of considerable research. The regeneration of this association is dependent upon periodic, large-scale disturbance through flooding. Absence of such flooding over the Bottoms adjacent to the Snake River may be adversely affecting regeneration, as few young cottonwoods are present in much of the area.

3.5.2 Environmental Consequences

Alternative 1 – No Action

Under the No Action Alternative, existing vegetation along the entire length of the proposed site would be influenced by the continued migration of meander belts and lateral erosion of banks. In this section of the main channel, vegetation is dominated by grasses because the bank height is too high above the normal water surface elevation to permit establishment of riparian vegetation. Potential flooding could increase erosion and loss of some vegetation.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

A total of 3,800 feet of the main channel bank would be disturbed and some temporary loss of vegetation could occur during construction of structures. The stone toe would benefit and protect upslope plants from disturbance caused by further erosion. Potential impacts could occur due to temporary access roads for monitoring and periodic maintenance. Stabilizing the bank would have an overall positive effect by preserving and increasing the riparian vegetation along the river.

Vegetation disturbance in the downstream reach would be limited to relatively new growth on the point bar as the stone toe would tie in with existing riprap along the crest of the bank, limiting disturbance to upslope vegetation.

Alternative 3 – Stone Spurs

Alternative 3 would disturb only the sections of the main channel bank where spurs and access to the spurs are built. Established vegetation along the bank in these areas would be removed, including the area for the transition zone revetment. Vegetation and slopes between the spurs would remain undisturbed from construction and, over time, sediment accumulation between the spurs would provide a base for vegetation growth.

In the downstream reach, spurs would be placed on the existing point bar. Spurs would be anchored into the existing riprap as much as possible so bank vegetation would have minimal to no disturbance.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Alternative 4 would result in the similar disturbance as Alternatives 2 and 3 where temporary removal of existing vegetation would occur in specific locations, including the transition zone area for revetment. This alternative would require extensive bioengineering revegetation for the main channel. Any temporary loss of vegetation would have to be mitigated by planting or hydroseeding the terrace in order for vegetation to hold it in place and reduce further erosion. Potential impacts could also occur due to temporary access roads for monitoring and periodic maintenance.

Under this alternative, the downstream reach would remain similar to Alternative 3 and the stone spurs would have minimal to no impacts to vegetation as spurs would be anchored to the existing riprap and point bar.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Alternative 5 would result in similar disturbances as Alternative 3 where removal of existing vegetation would occur in specific locations. This alternative would create solid bank stabilization for the main channel as shown for Alternative 3. Potential impacts could occur due to temporary access roads for monitoring and periodic maintenance.

The downstream reach would have minimal to no impacts to vegetation as the stone toe would be placed against the existing riprap and/or constructed on the existing point bar which has limited, immature vegetation.

3.5.3 Cumulative Effects

The Tribes and Reclamation ensure a high level of resource protection on the land surrounding the Landmark. Taking no action to prevent further loss of the land due to erosion would cause the most damaging cumulative effects to vegetative loss. The Preferred Alternative would reduce cumulative effects by involving the Tribes and Reclamation in discussions on site-specific stabilization efforts and providing natural and effective solutions that protect the vegetation resources surrounding the project area and the Landmark.

3.6 Fish and Wildlife

3.6.1 Affected Environment

Fish

The Snake River is a low gradient, large river complex with adjoining tributaries and springs that occur throughout the drainage and within the Reservation. The Snake River resident fish species includes rainbow trout, cutthroat, brown trout, mountain whitefish, mottled sculpin, Utah sucker, Utah chub, Common Carp, redside shiner, longnose and speckled dace, smallmouth and largemouth bass, bluegill, and yellow perch. Some of the Reservation and surrounding streams have been stocked to create sport fishing opportunities. Other transient, non-resident species which may be encountered are an occasional black crappie.

No data exists describing the local aquatic invertebrate (except *Valvata utahensis*, See Section 3.7) or aquatic macrophyte community structure. Riffles, runs, pools, side channels, backwaters, aquatic vegetation, overhanging vegetation, cut banks, large woody debris, and substrate ranging from boulder to fines (dominated by fines to coarse gravel) provide a variety of habitat types available for species utilization.

Wildlife

There are 263 bird, 45 mammal, 17 reptile, and 6 amphibian species known to occur in the project area (USFWS 1992). This wide variety of species is a result of the unique diversity found in a relatively small area. Large reservoir, spring, large river, riparian woodland, sagebrush steppe, farmland, riparian meadow, wetland, grassland, and shrub habitat are all found within a 4-mile radius of the project site.

This portion of southern Idaho has continental significance, providing resting and forage for migratory bird species in the Pacific Flyway. Thirty-one species of waterfowl use the Bottoms area (USFWS 1992). In addition, many thousands of shorebirds utilize the downstream mudflats (upper end of American Falls Reservoir) during migration. Although there are approximately 28 species of shore birds that frequent the mud flats, 4 species can generally be found on the exposed gravel flats within the project area. These species include the killdeer, the western sandpiper, Baird's sandpiper, and the occasional American avocet. Some other avian species found in the project area at different times of the year include: herons, ducks, turkey vultures, hawks, eagles, doves, hummingbirds, crows, pelicans, and numerous other species.

The project area is part of a relatively large and ecologically rich and diverse area that is composed of much of the original multi-layered riparian forest and meandering channel floodplain of the original river. It is also part of a larger area nationally recognized for its avian significance. The wide variety local species attracts many bird watchers. It provides a significant buffer and security zone for many passerine and raptor species. Many passerine and raptor species rest, nest and forage in the project area, including the bald eagle, which is discussed in Section 3.7.

In addition to a diverse avian presence, the area is also home to a variety of small and large mammal species. The river and riparian habitat support such mammals as the mink, muskrat, longtail weasel, and beaver. The adjacent multi-layered cottonwood forest is home to the fox, squirrel, cottontail rabbit, red fox, coyote, raccoon, bobcat, badger, beaver, porcupine, skunk, white-tailed deer, mule deer, elk, Pronghorn, moose, and the occasional mountain lion. In addition, many small mammals exist including the masked shrew, meadow vole, longtail vole, western jumping mouse, deer mouse, western harvest mouse, cottontails, ground squirrels, and the brown bat.

3.6.2 Environmental Consequences

Alternative 1 – No Action

Under the No Action Alternative, the absence of preventative maintenance and bank stabilization would likely result in continued erosion of the river bank. Minimal levels of sedimentation may affect aquatic species and semi-aquatic species, but upland species habitat or distribution would not be affected.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

A standard engineering structure such as the stone toe and upper bank revetment would immediately control erosion and reduce sediment and turbidity. During construction, a total of 3,800 feet of main channel and downstream reach bank would be temporarily disturbed and have temporary effects on aquatic and semi-aquatic species distribution and habitat, in terms of sediment and turbidity. Upland species would have minimal benefit as improvements created by terraced slopes and bioengineering would not occur and the lack of a gradual slope or transition zone to the water line would decrease water access for upland species. Minimal temporary impacts could occur on or along access roads, but no large vegetation (trees) would be removed.

During construction, the stone toe in the downstream reach would have little to no impacts to fish as the activities should be well inside the point bar, away from the water line. Some temporary loss to terrestrial and semi-aquatic species habitat would occur, but over time should be reestablished.

Alternative 3 – Stone Spurs

Although not as immediate or stable for erosion control as Alternative 2, this alternative would have slightly less bank disturbance; the bank would be disturbed enough to dislodge sediment into the river. This moderate disturbance during construction would have temporary effects on aquatic and semi-aquatic species distribution and habitat in terms of sediment and turbidity. During construction, human disturbance and the use of heavy construction equipment could cause temporary disturbances to upland wildlife. During and following construction this action would be more beneficial than Alternative 2 to the terrestrial, riparian zone and semi-aquatic species as some of the banks would remain intact along the waters edge (transition zone). Minimal temporary impacts could occur on or along access roads, but no large vegetation (trees) would be removed.

The work on the downstream reach of the project area would have minimal to no impacts to fish or wildlife and the spurs may actually benefit species by providing habitat for terrestrial species and semi-aquatic species, or aquatic species, should the river return to its historic channel. Additionally, spurs would allow access to the river for upland wildlife.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Alternative 4 would result in the similar disturbance as Alternatives 2 and 3 where temporary removal of existing vegetation would occur in specific locations, including the transition zone area for revetment. However, unlike Alternative 2, long-term benefits of curve shaping and bioengineering would benefit all species with increased vegetation, shade, and other micro-habitats. Minimal temporary impacts could occur on or along access roads, but no large vegetation (trees) would be removed.

Under this alternative, the downstream reach would remain similar to Alternative 3 and the stone spurs would have minimal to no impacts to vegetation as spurs would be anchored to the existing riprap and point bar and would provide habitat for terrestrial and semi-aquatic species, or aquatic species, should the river return to its historic channel.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Alternative 5 would result in similar disturbances as Alternative 3 where removal of existing vegetation would occur in specific locations. The difference between Alternative 3 and Alternative 5 is that Alternative 5 would have reduced key-in lengths reducing upland ground disturbance. Minimal temporary impacts could occur on or along access roads, but no large vegetation (trees) would be removed.

The downstream reach would have minimal temporary impacts to vegetation on the sandbar which would be used as an access route. The stone toe would be placed against the existing riprap so minimal dislodging of existing bank material would occur. Impacts to habitat for fish and wildlife in this reach would be minimal and temporary.

3.6.3 Cumulative Effects

Alternative 1 – No Action

Riparian zones provide a complex habitat structure for a high degree of biologically diverse species. Under Alternative 1, cumulative effects of the absence of preventative maintenance and bank stabilization would likely result in continued erosion of the bank. Increased erosion could worsen, as would downstream water quality from increased suspended solids. Increased sediment could have some negative biological impacts. Minimal sedimentation may affect aquatic and semi-aquatic species; upland species would not be affected. No new vegetation would be planted and shade habitat and riverine habitat would be dependent upon natural recolonization and present waterflow conditions respectively.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

The Preferred Alternative's long-term effects and use of primarily standard engineering structures (stone toe), would prevent vegetation growth and reduce habitat for terrestrial, aquatic and semi-aquatic species such as song birds, salamanders and frogs, and shrews. Stone toe structures create monotypic habitats which decrease the degree of biologically diverse species. A decrease in undercut banks and overhanging and other vegetation would occur, which would normally provide habitat for aquatic and semi-aquatic species. Alternative 2 may also increase or shift the stream velocity in this reach, which may shift the course of the river downstream to the opposite bank. Cumulative effects of this shift could result in the loss of established willows and young cottonwoods, but should have minimal long-term effects on fish and wildlife species and may create new habitat. Semi-aquatic and upland species would not benefit from any new habitat as no new vegetation would be planted.

The Preferred Alternative would reduce cumulative effects by reducing erosion and improving water quality, thereby improving conditions for fish and wildlife. Stabilizing the bank would be completed in concert with other efforts to preserve and protect local fish and wildlife species. Other land uses affecting terrestrial and aquatic habitats in the area would be unaffected by the Preferred Alternative.

Alternative 3 – Stone Spurs

Alternative 3's long-term effects would benefit fish and wildlife species as the spur structures would control erosion, reduce sediment and turbidity in the river, and provide access to the water line. Over time the spurs would slow the river's velocity and create some backwater pools, runs and riffles, and other secure habitat dynamics for all age classes of fish and other semi-aquatic species. Upland species may benefit through improvements by recruitment of vegetation on the sediment bars expected to develop downstream of the individual spurs. These sediment bars would also retain some habitat for continued semi-aquatic and upland species use/access to the water line. Although this alternative does not use bioengineering practices, it would be more beneficial to fish and wildlife species than Alternative 2.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Alternative 4 would provide the best immediate erosion control option, but would require extensive digging (curve shaping) and bioengineering revegetation for the main channel improving long-term habitat, especially for upland or semi-aquatic species. Minimal habitat would be created for fish, but the potential for overhanging vegetation to establish may provide some shade, depending on the distance (height of the revetment) from the water surface. This alternative, although the most costly, would combine the standard engineering practices with bioengineering providing the most stable, long-term option, in addition to providing the best long-term habitat for fish and wildlife species.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

The long-term effects of Alternative 5 would be similar to Alternative 3 and would benefit fish and wildlife species as the spur structures would control erosion, reduce sediment and turbidity in the river. Over time the spurs would slow the river's velocity and create some backwater pools, runs and riffles, and other secure habitat dynamics for all age classes of fish and other semi-aquatic species. Upland species may benefit through improvements by recruitment of vegetation on the sediment bars expected to develop downstream of the individual spurs. These sediment bars would also retain some habitat for continued semi-aquatic and upland species use/access to the water line. Although this alternative does not use bioengineering practices, it would be more beneficial to fish and wildlife species than Alternative 2, have less ground disturbance than Alternative 3, and would be less beneficial to fish and wildlife than Alternative 4.

3.7 Threatened and Endangered Species

3.7.1 Affected Environment

For this section, Reclamation used information from the *2004 Biological Assessment for Bureau of Reclamation Operations and Maintenance in the Snake River Basin above Brownlee Reservoir* (USBR 2004c). In this 2004 Biological Assessment, the U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries provided a list of proposed threatened and endangered species that could be present in the upper Snake River basin. As part of the upper Snake River basin, the Bottoms could contain the following listed species:

- gray wolf (threatened or as experimental/nonessential populations)
- bald eagle (threatened)
- Utah valvata snail (endangered)
- Ute ladies'-tresses (threatened)

Gray Wolf

The gray wolf (*Canis lupus*) currently listed as threatened, was historically present throughout much of the region. This animal was extirpated from the western states about 1930. An experimental population of gray wolves was introduced into Yellowstone National Park and into central Idaho in 1995 and 1996.

Bald Eagle

The USFWS lists the bald eagle (*Haliaeetus leucocephalus*) as threatened in the lower 48 states. The historic distribution of bald eagles included most of the North American continent

(USFWS 1986). Bans on DDT and other organochloride pesticides, habitat protection, and growing public awareness helped bald eagle populations steadily increase. This increase led the USFWS to reclassify the bald eagle in 1995 from endangered to threatened, in all lower 48 states (60 FR 35999). A Pacific Bald Eagle Recovery Plan (PBERP) was approved in 1986 (USFWS 1986). The Snake River basin is within the PBERP and includes California, Idaho, Montana, Nevada, Oregon, Washington, and Wyoming. In July 1999, USFWS published a proposed rule to remove the bald eagle from the list of endangered and threatened wildlife in the lower 48 states; however, there has been no further formal action to delist the species (64 FR 36453). The bald eagle population in the Pacific Recovery Region is currently five times larger than when the recovery team developed the Pacific Recovery Plan (64 FR 36453).

Bald eagles require suitable trees for nesting and perching. In the Bottoms, nests are typically found in large cottonwoods. Nests and roosts are located along the Snake River and are generally located within 1 mile of other large bodies of water (lakes, reservoirs, large rivers, and coastal estuaries). Bald eagles breed from January through mid-August and winter from approximately November through March near ice-free water concentrated food sources such as fish runs or concentrations of waterfowl. Bald eagles are opportunistic foragers and consume a range of foods, including a variety of fish, waterfowl, jackrabbits, and mammalian carrion depending on prey availability (USFWS 1994).

The Snake River above Milner Dam supports a large breeding population of bald eagles and a significant population of wintering bald eagles. Immediately above American Falls Reservoir, the mature cottonwood forests provide an abundance of day and night roosting opportunities adjacent to foraging areas on the Snake River. This portion of the river provides substantial fish and waterfowl populations as a source of food. The area is currently being monitored under a Reclamation contract with the Fort Hall Business Council of the Shoshone-Bannock Tribes.

Utah Valvata

Utah valvata (*Valvata utahensis*) were historically documented as one of the most abundant species of mollusks in the Snake River and Box Canyon Creek during surveys conducted in the 1960s and 1980s (Bowler and Frest 1992). The Utah valvata currently has a discontinuous distribution ranging from Hagerman upstream to the lower Henrys Fork. Little is known about the abundance, distribution, and habitat of populations in this reach.

Utah valvata occur in low velocity habitats of free-flowing rivers, spring habitats, or reservoirs (USFWS 1995a; Weigel 2002, 2003). They are typically associated with fine sediments, pebble-size substrates, or gravels mixed with fines (Lysne 2003). Preferred temperatures range between 30 °C, and 7 °C (Lysne 2003). The snails appear to tolerate dewatering if conditions are damp, but mortality increases in drier environments (Lysne 2003).

Various factors have adversely affected the free-flowing, cold-water environments where listed Utah valvata snail species have existed for many years (USFWS 2004). Human activities that have adversely modified habitat and have contributed to deteriorated water quality include: hydroelectric development, operations, and maintenance; water withdrawal and diversions; point and non-point source water pollution; inadequate regulatory mechanisms; and adverse effects associated with non-native species.

Very low densities of Utah valvata have been detected in the Snake River downstream from the Henrys Fork confluence (USFWS 2003). Some aspects of river impoundment appear to be favorable to Utah valvata and they are known to exist in American Falls Reservoir (Weigel 2002, 2003). A 2005 diving survey conducted by Reclamation and the Tribes at the Fort Hall proposed project location resulted in no findings of the Utah valvata snail (Newman 2005).

Ute Ladies'-tresses

Ute ladies'-tresses (*Spiranthes diluvialis*), a perennial orchid, was federally listed as threatened in 1992 (57 FR 2048). Ute ladies'-tresses was first discovered in Idaho by Mabel Jones in 1996 along the South Fork of the Snake River (Moseley 1997a). The species is now known from Bonneville, Fremont, Jefferson, and Madison counties along the Snake River and from wetland sites along the Henry's Fork River (Mancuso 2004, Moseley 1998a, 1998b, 1999, Murphy 2001). Idaho populations occur in the Idaho Falls, Palisades, and Lower Henrys watersheds within the Columbia Plateau and Utah-Wyoming Rocky Mountains ecoregions.

The number of vegetation and hydrology types occupied by Ute ladies'-tresses has expanded to include seasonally flooded river terraces, subirrigated or spring-fed abandoned stream channels and valleys, and lakeshores. In addition, several populations have been discovered along irrigation canals, berms, levees, irrigated meadows, excavated gravel pits, roadside barrow pits, reservoirs, and other human-modified wetlands. The elevation range of the species varies from 720-1830 feet (220-558 meters) in Washington to 7000 feet (2134 meters) in northern Utah.

Populations of streamside Ute ladies'-tresses typically occur on shallow sandy loam, silty-loam, or clayey-silt alluvial soils overlying more permeable cobbles, gravels, and sediments. Surrounding vegetation is dominated by perennial graminoids and forbs, particularly *Agrostis stolonifera*, *Elymus repens*, *Juncus balticus,* and *Equisetum laevigatum.* Wet meadow habitats may become encroached by riparian shrub or woodland vegetation dominated by *Salix exigua*, *Populus angustifolia,* or *Betula occidentalis*. Groundwater-irrigated wet meadows occur in depressions, valley bottoms, and swampy lowlands characterized by a high water table and silty to loamy calcic soils with surface accumulations of crumbly, limey, marl (Heidel 1998, 2001). These wetlands mostly occur well outside of active river and stream channels and are not directly impacted by seasonal or periodic flooding events. Vegetation associated with marl-rich wet meadows is dominated by *Eleocharis pauciflora*, *Carex simulata, Muhlenbergia richardsonis, Juncus balticus,* and *Triglochin maritima* and often occurs within somewhat drier *Sporobolus airoides-Distichlis stricta-Sarcobatus vermiculatus* vegetation (Heidel 1998, 2001, Jones 2002).

Although Ute ladies'-tresses have been found in the South Fork of the Teton Canyon, a Snake River tributary upstream of the Reservation, very few surveys have been conducted along the Snake River downstream of the South Fork; population status is unknown throughout this area. No confirmed findings have occurred or been reported within the Reservation to this date.

Life History and Requirements

Ute ladies'-tresses are a perennial, terrestrial orchid with the stem arising from tuberously thickened roots. Its narrow leaves are about 11 inches long at the base and become reduced in size toward the apex (Jordan 1999). The small white or ivory flowers cluster into a spike arrangement at the top of the stem. Individual flowers are long and faintly fragrant (with a vanilla-like scent). The lip petal is oval to lance-shaped, narrowed at the middle, and has wavy margins. Sepals are separate or fused only at the base (not fused into a hood-like structure) and are often spreading at their tips. Fruits are cylindrical capsules with numerous seeds (Sheviak 1984, Sheviak and Brown 2002, USFWS 1992).

Ute ladies'-tresses are primarily located in moist meadows associated with perennial stream terraces, floodplains, and oxbows at elevations between 4300-6850 feet (1310-2090 meters) (Coyner 1990, Jennings 1989, USFWS 1992). Most locations are in openings where vegetation cover is not overly dense or heavily grazed (USFWS 1992). Most populations occur within or near agricultural or urban settings and those that are not in these locations are persistent only where moist conditions prevail and in locations not greatly altered by human activity (Jennings 1989, USFWS 1992).

The orchid is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams (USFWS 1995b). The elevational range of known Ute ladies'-tresses is 4300 to 7000 feet. The plant seems to require permanent sub-irrigation (Coyner 1989), indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season. It grows primarily in areas where the vegetation is relatively open and not overly dense or overgrown (Coyner 1989, 1990; Jennings 1989, 1990), although a few populations in eastern Utah and Colorado are found in riparian woodlands. Plants usually occur in small scattered groups and occupy relatively small areas within the riparian system (Stone 1993). These preferred habitat features seem to imply that the plant is most likely to occur in riparian habitats created and maintained by stream activity within their floodplains (USFWS 1995b).

Environmental Baseline

Section 7 ESA consultation guidelines for the Ute ladies'-tresses require that all riparian and wetland communities below 7,000 feet be surveyed. In 1997, a Large-Scale Rural Water

Delivery System project was implemented on the Reservation. During this time, intense surveys were conducted to determine potential habitat for the Ute ladies'-tresses. The results of the survey indicated that the known distribution is restricted to the Snake River floodplain and no Ute ladies'-tresses populations were identified in the Reservation at that time.

Approximately 92 percent of the population of Ute ladies'-tresses occurrences in Idaho are between 8 and 49 miles below Palisades Dam (Murphy 2004). The Idaho Conservation Data Center has surveyed and monitored Ute ladies'-tresses on public lands along the Snake River, and they have published annual status/monitoring reports from 1997 through 2003 (Moseley 1997b, 1998a, 1998b, 2000; Murphy 2000, 2001, 2002, 2003, 2004a).

There are currently 20 occurrences that are monitored annually on public lands. Two occurrences on private land have not been visited since 1997 (Murphy 2004). There is also one known occurrence on State lands in the Chester Wetlands on the Henrys Fork (Murphy 2002) and one know occurrence on private land along the Texas Slough within the historical floodplain of the Snake River that are not monitored (Murphy 2004).

All known Ute ladies'-tresses occurrences within Idaho either are or were at one time associated with the Snake River floodplain and early to mid-seral riparian habitats. With the exception of the two occurrences mentioned above, Ute ladies'-tresses occurrences in Idaho still depend on fluvial processes or other disturbances to set back woody vegetation succession and create new flood-borne soil deposits that would later be suitable for colonization (USFWS 2005). Along the river, Ute ladies'-tresses is associated with relict flood channels that were abandoned between 25 and 150 years ago (USFWS 2005). These orthofluvial deposits, characterized by riparian vegetation, maintain a shifting habitat mosaic that is the basis for biological diversity within riparian areas. The flows required for creating new orthofluvial (straight) deposits are significantly higher than the flows required for parafluvial (in-stream) deposits that are needed for the aquatic community.

3.7.2 Environmental Consequences

Gray Wolf

Alternative 1 – No Action

There is no known record of a gray wolf sighting or designated critical habitat along the Snake River, Reservation, or in the area of the lands surrounding the Landmark and the No Action Alternative would have no effect on gray wolves.

Alternatives 2, 3, 4 and 5

No known wolf populations presently occur on the Reservation. Wolves do occur in northern and central Idaho and could use the Reservation as a corridor but their expected stay would be limited. Due to the high density and activity of human populations and the low population of ungulate populations on the Reservation, wolves are not expected to occur near the project area. The proposed actions would not impact the gray wolf.

Bald Eagle

Alternative 1 – No Action

There is one bald eagle nest is located approximately ½ mile away from the project area on the east bank and upstream from the demonstration project. The area provides suitable habitat for nesting, roosting and migrating. Under the No Action Alternative, continued channel alterations and increased sediments may diminish water quality, which may affect fish prey populations. These activities are not likely to alter or limit fish populations or bald eagle prey base to a significant degree. Habitat that would provide potential roosting, nesting, perching and feeding habitat would not be affected by the proposed action. This alternative would have no effect on bald eagles.

Alternatives 2, 3, 4 and 5

There is one bald eagle nest is located approximately ½ mile away from the project area on the east bank and upstream from the demonstration project. The habitat is suitable in this area and is currently occupied, in addition to occasional migrants. The Snake River near the location of the project area would continue to support an abundance of waterfowl and fish. The nesting eagles within this area benefit from the abundant forage base. Any of the four alternatives although contributing to increased sedimentation and possibly temporarily reducing the prey base, is not significant and it is unlikely they would adversely affect the food base for bald eagles in this reach. Though the flow velocity and direction may be altered and shifted into established cottonwood stands which currently provide roosting habitat, they should not significantly reduce the availability of nesting or roosting trees in the Bottoms area. Additionally, the construction timeline would be outside of the nesting season for the bald eagles. Therefore, the proposed action would not impact bald eagles.

Utah Valvata

Alternative 1 – No Action

Though the area is suitable habitat, there are no Utah valvata snails currently in the area of the proposed action (Appendix C). Under the No Action Alternative, continued channel alterations and increased sediments may diminish water quality, which may affect snail populations. These activities are not likely to alter or limit the populations to a significant degree. This alternative would have no effect on the Utah valvata snail.

Alternatives 2, 3, 4 and 5

No Utah valvata snails currently exist in the proposed project area. The habitat, though suitable in this area, is currently unoccupied. Any of the four alternatives may contribute to sedimentation and reduced water quality, but it is not significant and they are not likely to adversely affect snails in this reach. The proposed actions would not impact the Utah valvata snail.

Ute Ladies'-tresses

Alternative 1 – No Action

Under the No Action Alternative, bank erosion would continue causing loss of soil and vegetative material. The proposed project area does not contain the elements for suitable habitat for Ute ladies'-tresses; therefore, there would be no effect on the plant.

Some of the eroded material may be deposited downstream and may assist in the establishment of these species' since they prefer slightly disturbed areas. These activities are not likely to alter or limit the populations to any measurable degree. This alternative would have no effect on the Ute ladies'-tresses.

Alternatives 2, 3, 4 and 5

The area was scheduled for a presence/absence survey during the late summer early fall season of 2006. The survey was not completed for a variety of reasons; therefore, it is unknown if Ute ladies'-tresses exist in the project area. During an initial site visit of the proposed project area, two locations were identified as potential habitat. Under all action alternatives, a survey would be completed prior to construction. The presence/absence survey would be a pedestrian survey in the vicinity of the Landmark and conducted by an experienced biologist. The survey would be conducted during August through early October prior to construction, when the characteristic flowers are identifiable.

The areas of potential habitat are at the entrance and exit to the oxbow. The entrance to the oxbow would be disturbed by the construction of a temporary access road. If the plant is found in this location, the site of the access road would be located to avoid the plant. If this is not possible, disturbance would be minimized by using a bridge-like structure, such as a railroad car to cross the oxbow. If the plant is not found, the temporary access road would be built using rock and gravel crossing. Under all options, flow would be maintained to the oxbow.

The exit of the oxbow is located at an area of deposition. Therefore, the oxbow exit is located back from the river, with the water meandering through a gravel bar. At this site, the temporary road crossing is not located in potential habitat and should not affect the habitat or any plants found during the survey.

The entrance to the oxbow would include one of three options for a hydraulic break in the bank engineering. All three options include riprap being placed in the oxbow entrance to secure the bank engineering on the main channel and to protect the oxbow from erosion. If the plant is found in the oxbow, a determination would be made if the riprap can be placed to avoid the plant. If the plant cannot be avoided, the plants would be relocated or may be disturbed by the placement of riprap.

3.7.3 Conclusion

The closest known population of Ute Ladies'-tresses in the vicinity of the proposed project area is in the Chester wetlands, Henrys Fork basin (ID-023) and is used as a surrogate for determining the effects to the species. The Chester wetlands population covers four sites of 1 – 10 acres containing approximately 482 plants, with an estimated plant density of approximately 12.5 to 120.5 plants per acre. Based on the Chester wetlands site, the proposed action could affect up to 5 plants. Based on the total estimated population in Idaho of 7,807 plants (Table 3-10), the proposed action could affect 3-4 plants. Therefore, Reclamation concludes that the proposed action "*may affect, not likely to adversely affect*" the Ute ladies'-tresses.

Table 3-10. Ute Ladies'-tresses *(Spiranthes diluvialis)* population totals by state through 2004

State	Total # Populations circa 2004	# of Extant Populations circa 2004	Estimated # of Plants circa 2004	Area (Acres) circa 2004
Colorado	10	8	24,166	173-200
Idaho	4	4	7,807	74-83
Montana	11	11	1,588	40
Nebraska	1	1	2,300	140
Nevada**	1	0	0	1
Utah	28	23	47,859	234-308
Washington	2	1	384	1
Wyoming	4	4	1,212	11
TOTAL	61	52	85,316	674-784

* Population estimates are derived from the sum of the maximum number of plants recorded at each extant population in the state based on data from 1980-2004. Since not all plants in a population are observable each year, these figures are probably conservative.
** The Nevada population was rediscovered in July 2005 and contains a minimum of 75 plants in 0.8 acres of habitat.

3.7.4 Cumulative Effects

The alternatives would have minimal significant cumulative effects on federally-listed species in the area. Tribes and Reclamation could provide natural and effective solutions that protect the Threatened and Endangered Species resources surrounding the project area and the Landmark.

3.8 Cultural Resources

3.8.1 Affected Environment

Historic Context and Significance of the Fort

Fort Hall was constructed during the summer of 1834 by Nathaniel Wyeth of the Columbia River Fishing and Trading Company. Wyeth established the post on the Snake River near the mouth of the Portneuf River to engage in trade and trapping with the Indians. The original fort consisted of a wooden stockade with two bastions on opposite corners and a house on the interior of the fort (Thompson 2004).

Wyeth sold Fort Hall to the Hudson's Bay Company who continued to operate the fort as a fur trading post and supply trade with free trappers and Company brigades in the Snake River valley and other locations throughout the region. However, the high cost of transportation, competition with American trappers and traders, a continued decline in the numbers of beaver, along with a reduction in the market value for beaver pelts, were a serious drain on the revenues at Fort Hall. Nonetheless, a profitable mercantile trade existed with the increasing numbers of American immigrants passing through Fort Hall en route to the Oregon country beginning in 1839. Fort Hall was considered as one of the more important "way stations" on the Oregon Trail (Thompson 2004).

After the Hudson's Bay Company abandoned Fort Hall, the site was occupied by seasonal traders capitalizing on the immigrant traffic and U.S. Army and volunteer troops were dispatched to protect the immigrant travelers. The Fort was essentially abandoned by the early 1860s and much of the structure was salvaged for building materials. The Snake River flooded in 1862 and 1864 leaving the site in ruins. The same floods apparently cut a new channel for the Snake River bringing it closer to the fort site than it was during the fur trade era (Thompson 2004).

Several segments of the Oregon and California Trail are known to have crossed the Bottoms area. Although there are small segments of these trails that are still visible, many sections now form part of the current road system and are no longer visible. Changes in the river channel and agricultural uses of the area have also affected trail visibility (Thompson 2004).

The Secretary of the Interior designated the historic fort as a National Historic Landmark in 1961. Reclamation and BIA (as trustee for the Tribes) have joint ownership and responsibility under the National Historic Preservation Act (NHPA) for protecting this Landmark. Under the NHPA, (Sec. 110(a)(2)(B)), Federal agencies are required to manage and maintain significant properties in a way that gives special consideration to preserving such properties having national significance. The 36 CFR 800 regulations require Federal agencies to take actions to minimize damage occurring to a nationally significant site. Failure of an agency to protect a site is an adverse effect under the regulations.

The Threat to the Fort

The primary threat to the Landmark is from active bank erosion immediately upriver from the fort and moving downstream toward the fort. The BIA and Tribes have been mapping lateral recession upriver from the fort since 1992, and have recorded over 250 feet of loss of bank due to erosion. Presently, bank movement is cutting into a former meander scar that forms the slough along the eastern boundary of the fort. If a significant high flow event occurs, the Landmark as well as the cultural resources in the immediate vicinity would suffer considerable damage. The NPS, in providing its annual Section 8 report to Congress on the state of our Nation's historic Landmarks, has assigned the Landmark a Priority 1 ranking as an endangered Landmark, in which the loss of the site to erosion is imminent (NPS 1991).

Past Efforts to Protect the Fort Hall National Historic Landmark

Concern over the damaging effects of bank erosion on the Landmark has existed since the mid 1970s, at which time the BIA placed riprap on the north bank of the Landmark (Hernandez 2004). In 1984, the Tribes passed a resolution authorizing the BIA to:

- Investigate hydraulic and load characteristics of the Snake River near the Landmark
- Coordinate an effort with NPS, Corps, Reclamation, USGS, and Idaho SHPO to analyze the type and degree of erosion occurring at the site
- Develop a method of bank stabilization

The result of the effort was a 1986 Reclamation/BIA interagency agreement which provided riprap on the riverbank and fencing to restrict livestock access (USBR and BIA 1986).

There has been ongoing concern over the river cutting off a meander just upstream of the historic fort, flowing through an actively enlarging neck channel, and breaking out onto a vast area of tribal farm land and the Landmark (NPS 1984). From the mid 1980s and into the 1990s, much debate ensued over the cause of the erosion that was posing a threat to the historic Landmark, and over responsibilities for fixing the problem. Flows from American Falls Reservoir, higher releases from Palisades Reservoir, the 1976 Teton Dam flood, ice jams on the Snake River caused by American Falls Reservoir, were several of the possible causes being cited.

In 1993, the Corps prepared a streambank protection plan for the Landmark under its Section 14 Emergency Streambank Protection Congressional authority (Corps 1993; Curtis 1997). The program, which would have involved cost sharing with the Tribes, eventually failed to materialize. Nevertheless, the Landmark coalition of Federal and State agencies, along with the Tribes, resolved to develop a plan of action to deal with the ongoing bank erosion threats to the historic fort.

As a result of an interagency coalition meeting in December 1999 involving the Advisory Council on Historic Preservation (ACHP), it was decided that a short-term fix was needed to deal with immediate threats to the Landmark and a longer-term program needed to be developed to manage river action and provide future bank stabilization. In March 2000, the interagency coalition agreed to implement a demonstration project in order to relieve streamflow pressure from the critical outside bank of the northeast channel. This action lessened the possibility for impacts to the eastern side of the fort. The demonstration project was accomplished in 2001 and 2002 through a Reclamation/BIA agreement (BIA 2003) with project designs by NRCS.

As a result of a Congressional appropriation for fiscal year 2001, Reclamation was authorized to complete a study of erosion at Fort Hall. Reclamation entered into a cooperative agreement with the Tribes to participate in the study. As a result of the efforts of the Tribes, BIA, NRCS, and Reclamation, the *"Snake River at Fort Hall, Idaho Bank Erosion Study"* was completed and presented to the Tribes in February 2002. The report offered a series of long-term protective bank stabilization alternatives, including bendway weirs, conventional riprap armoring, rock sills, and engineered log jams. Subsequent development of conceptual designs by Reclamation (USBR 2006) has expanded protection methods to include stone toe protection, bioengineering, stone spurs, and curve shaping. This document presents the analysis of these alternatives.

Previous Cultural Resource Investigations

Several cultural resource projects of note have been carried out in the vicinity of the boundaries of the Landmark.

1988	NPS contracted for a photo interpretive survey near the Landmark, revealing various historic road segments and pattern zones which could be indicative of past cultural use (Ebert and Camilli 1989).
1993	Through cooperative efforts of Reclamation, BIA, NPS, Shoshone-Bannock Tribes, and Idaho SHPO, archaeological test excavations were conducted at the Landmark. The testing supported the conclusion that the present Landmark boundaries encompass the Wyeth-Hudson's Bay Company Fort Hall site, and that based on the rich array of artifacts, the site remains intact and possesses significant research potential (Thomas 1994).
2001	NPS mapped and field-measured the fort and associated features, geo-referencing all features to the Idaho state plane coordinate system (NPS 2001).
2004	Reclamation contracted with the Tribes to conduct a Class III cultural resources survey in the area of the Landmark (Thompson 2004). The survey combined pedestrian transects and visual inspection of 800 acres. Two historic properties were recorded,

	neither considered to meet the criteria for eligibility to the National Register of Historic Places (NRHP). A potential historic grave site near the northwest corner of the Landmark boundary, may be that of one of the Native Hawaiians employed during construction of the original Wyeth fort.
2004	Reclamation conducted a GPR study of the suspected burial site (noted above), including a number of profiles conducted across the suspect burial site. The GPR data indicate that the site should be regarded as a potential gravesite characterized by disturbed sediments and/or buried material (Carpenter 2004).
2006	Reclamation contracted for a GPR and magnetometry survey in areas adjacent to and upstream of the Landmark that would be impacted by impending bank stabilization. No anomalies were found over the entire survey area that would indicate burials or subsurface archaeological deposits.

Cultural Resource Site Potential

It is recognized that the formal Landmark boundaries are artificial constructs and do not delineate an area fully representative of the range of activities that were occurring in the vicinity of the fort, outside the Landmark boundaries. Historical accounts mention agricultural fields, graves, fur trader encampments, corrals, and Shoshone-Bannock winter lodges in the area of the fort. Shoshone and Bannock members are known to have camped in the vicinity of Fort Hall and it is also thought that the Tribes utilized other areas of the Bottoms for winter encampments. Particularly, during the height of immigration along the Oregon Trail, Fort Hall was the site of repair, refitting, and trading of thousands of wagons, oxen, and horses. Food and supplies were sold to tens of thousands of immigrants who passed by. Some immigrants camped at Fort Hall for weeks while such activities took place, and many support personnel lived there as well. Few of these intense activities, which undoubtedly left considerable material evidence, would have taken place within the walls of the Fort (Ebert and Camilli 1989; Thompson 2004). It is in this context that the planned stabilization of banks must take into account the potential for finding prehistoric and historic archaeological subsurface deposits not only within the Landmark boundaries, but outside the boundaries as well.

Traditional Cultural Properties (TCPs)

Tribal members are reluctant to provide specific information about locations where traditional artistic, economic, or other cultural practices were conducted, and to publish such information would be disrespectful. Nevertheless, the cultural and traditional importance of the Bottoms area to the Tribes cannot be overstated. Various areas of the Bottoms hold traditional values for various members of the Tribes, mainly from the standpoint of biological and natural resource collection and utilization (for food, medicine, and other purposes), and long-term occupation and use of certain locations in the Bottoms. Although prehistoric archaeological sites were not encountered during the 2004 survey or the 2006 geophysical survey, it is widely acknowledged that the Bottoms area has been used for traditional practices for generations and is still held in high regard by the Tribes (Yupe 1999; Hevewah 1996). On the basis of documented past and present use of the Bottoms area by the Tribes, lands in the vicinity of and encompassing the historic Landmark would appear to meet the criteria for a TCP.

Cultural Resource Site Identification

The 2004 cultural resource survey examined only the surface of the present project area, not subsurface deposits that might contain cultural resources. To insure that every possible effort is made to identify cultural sites that might be impacted by the proposed bank stabilization, Reclamation committed to the following additional activities:

Prior to bank stabilization activities and pending Tribal approval, Reclamation would conduct soil augering in areas where surface disturbance is expected, to identify the presence or absence of cultural deposits and to evaluate such deposits. The purpose of the augering would be to identify artifacts and other cultural materials which, because of small size, were unable to be identified during recent GPR and magnetometry investigations. These smaller materials could represent important archaeological and cultural sites which would need to be flagged for protection prior to construction. Augering would be scheduled in advance of project implementation, so that project modifications could occur in order to protect important sites or locations.

All construction activities would be monitored by a professional archaeologist. In the event that subsurface archaeological deposits are discovered, construction activities would cease in the immediate area of the find while an archaeologist evaluates the significance of the find. If properties eligible for the NRHP cannot be avoided by project operations, Reclamation would follow 36 CFR 800 procedures in consulting with the Idaho SHPO, the Tribes, ACHP, and interested parties, to arrive at a plan for mitigating adverse effects to the property.

3.8.2 Environmental Consequences

Alternative 1 – No Action

Under the No Action Alternative, measures to stabilize the banks in the vicinity of the Landmark would not be implemented. Therefore, there would be no immediate effect on the Landmark or adjacent historic properties. Reclamation would continue to consult with the SHPO for Federal undertakings if the No Action Alternative is chosen, and would work with the Tribes, SHPO, and NPS to mitigate any adverse effects from those undertakings. However, if prompt action is not taken to stabilize the active bank erosion occurring upriver from the historic Landmark, there is an increased potential that “no action” would result in the Landmark being lost or suffering extensive damage from a future high flow event.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

Main Channel

Implementation of the Preferred Alternative along the main channel upstream of the Landmark is potentially less damaging to subsurface cultural resource deposits than any of the other action alternatives. The stone toe revetment would be constructed by placing riprap directly into the Snake River to provide armor protection while minimizing disturbance of the existing bank. The stone toe barrier would be constructed to a suitable thickness and slope to minimize future operations and maintenance of the structure. A key-in feature consisting of a sheet pile wall would extend about 200 feet into the bank upstream of the stone toe to prevent possible flanking by future channel migrations. A short trench about 30 feet long, 10 feet deep (i.e., the average river bank height in this reach), and about 35 feet wide at the top would be excavated at the junction of the sheet pile wall and the revetment. This trench would be backfilled with rocks as a counter measure to prevent erosion from occurring at the junction of the revetment and piling and potentially causing a failure of the structure.

Primary access to construction areas for any of the action alternatives would be by means of an existing two-track road splintering off the Monument Road that runs by the historic Landmark, and roughly paralleling the river bank. Movement on the primary access would be in one direction along the main channel, becoming two-way as it approached the oxbow inlet channel and continuing to a point where it would terminate at the oxbow outlet. At that point a vehicle turnaround would be created. At the turn-around, access to the gravel bar at the Landmark would be afforded by constructing a temporary crossing at the oxbow outlet and creating a new construction path along the gravel bar.

Areas associated with portions of road segments thought to have connected the historic fort area with the multiple remnants of the Oregon Train east of the Fort would remain intact under this alternative. These possible segments are reported by Ebert in his 1988 photo-interpretive analysis as “R-4" and “R-5.” These segments have not been confirmed on the ground in recent cultural resource and GPR surveys, although they were observed in historic photographs. The edge of the sparse remains of a homestead identified by Thompson in his 2004 survey (Site FH-2), determined ineligible for the National Register, would be avoided under Alternative 2.

The results of Thompson’s 2004 survey as well as the 2006 GPR and magnetometry survey point to minimal subsurface archaeological deposits along the main channel. If deposits are present, the reduced surface disturbance from Alternative 2 construction methods render those deposits less likely to be impacted relative to other action alternatives. Indirect visual effects from stone toe construction along the main channel would also be less intrusive than from spur field construction along the same stretch, as the rocks would be placed close to the bank as opposed to stone spurs which would angle out from the bank and could be seen for a greater distance. Because the Preferred Alternative does not include bioengineering, the historic landscape upstream of the Landmark on the bank would remain visually intact.

Downstream Reach

The intent of stone toe in this area is to limit bank disturbance as much as possible in the immediate vicinity of the Landmark. The stone toe would protect the young riparian vegetation which has recently become established on the point bar, thus eliminating the need for a bioengineered terrace. The existing riprap would be left in-place as a secondary defense for the stone toe.

Construction-related surface alteration would occur within the official Landmark boundaries and for a short distance along the bank downstream of the Landmark boundary. Within the official Landmark boundaries, all riprap placement and vehicle and equipment movement would be confined to the gravel depositional point bar that has formed in recent years as a result of a shift in predominant flow from the historic channel to the current main channel. The gravel bar is devoid of archaeological deposits or other cultural resources. There would be no excavation into the banks at the Landmark to anchor riprap, with excavation for the stone toe utilizing alluvium present in the point bar. The outside end of the downstream reach stone toes would include a sheet-pile key-in feature similar to the key-in proposed for the main channel (above). This feature would be similarly comprised of a steel sheet pile driven into the ground and angled away from the water, for 30 feet on the downstream end. A short excavation of approximately 20-30 feet into the bank is required to secure the key-in to the stone toe. The downstream reach key-in feature would be located in previously undisturbed deposits outside the Landmark boundaries.

The intact portion of the Landmark would be unaffected by the stone toe stabilization activities that would occur on the gravel bar, thus the physical integrity of the Landmark and any subsurface cultural deposits within the Landmark boundaries would remain unaltered. For that reason, there would be no direct adverse effect upon the Landmark from physical alterations. Placement of sheet piles for a key-in downstream of the Landmark could affect subsurface cultural deposits outside the Landmark boundary that would not have been located in previous archaeological surveys, but that might become exposed during earth moving activities.

Vehicles and equipment would access the gravel bar from an existing two-track road running across the northern extent of the oxbow, crossing the oxbow outlet to the gravel bar, continuing along the gravel bar as a new construction path. At the Landmark, heavy equipment and construction vehicles would operate on the recent gravel bar, avoiding the undisturbed deposits above the bank.

The addition of stone toe would not have adverse visual effects on the Landmark because the new riprap would complement previous riprap armoring placed by the Boy Scouts in the 1970s and Reclamation and BIA in the 1980s. The new riprap is of natural stone and would blend in with the existing riprap, which over the years has taken on a natural appearance. Because the riprap would be placed on north bank of the Landmark, it would not be visible from the Landmark above the banks.

Alternative 3 – Stone Spurs

Main Channel

Approximately 15 stone spur fields 60 feet in length would be installed at spaced intervals along approximately 2,200 feet of the bank of the main channel, upstream of the Landmark. The point bar in the transition zone (where the historic channel joins the main channel) would be protected by a revetment in case there is an increase in the amount of flow in the historic channel. There is no excavation associated with the revetment. Installation would occur on the current river bed with a 20-foot-long tieback for each spur into the existing bank to secure the spurs. An excavated trench approximately 10 feet wide at the bottom and 40 feet wide at the top would accommodate each spur at the tieback. Fifteen access ramps splitting from the primary two-track road paralleling the bank, would be constructed for heavy equipment movement to and from the bank. Earthfill curve-shaping and bioengineering would not occur with stone spurs along the main channel. A 425-foot by 35-foot key-in trench would be excavated at the upstream terminus of the stone spurs.

The areas associated with possible historic road segments (Ebert's R-4 and R-5) and homestead remains within the area of potential effect under Alternative 3**.** However, because of flexibility regarding stone spur placement, possible road segments could be avoided (if identified on the ground) and no previously recorded sites would be impacted. Stone spurs at spaced intervals pose less of a direct threat to subsurface cultural resources than does stone toe protection with earthfill curve shaping and bioengineering (Alternative 4), where soil disturbance would be continuous and complete up to 24 feet from the bank. Nevertheless, the surface disturbance on the main channel from stone spur fields (mainly from the trenches to accommodate each spur) could expose undiscovered intact cultural deposits.

Downstream Reach

Undisturbed portions of the Landmark within its boundary would remain intact, and would not be subject to direct physical impacts from stone spur installation or from construction activities associated with the spur installation. Construction of 5 stone spurs, 100 feet in length (and associated vehicle and equipment movement) would occur on the recently formed gravel point bar adjacent to the river. Spurs in this reach will have a minimal tie back extending 5 feet into the bank. Where a spur would be installed within the Landmark boundaries, the existing riprap would be removed to allow for this minimal tie-back distance; however, existing natural ground would remain undisturbed. Although the action would occur partially inside the Landmark boundaries, the effect would not be adverse and the integrity of the Landmark would remain intact. Alternative 3 would also require a downstream above-ground 30-foot revetment to protect against upstream flanking, which would minimize impacts to any subsurface cultural deposits.

The "*no adverse effect*" determination at the Landmark assumes that the spurs would be tied back into the existing riprap without disturbing the existing bank deposits. Heavy equipment and vehicles would operate on the gravel bar only and not on undisturbed land above the bank. In the event that a tieback must be excavated into undisturbed portions of the Landmark or that equipment and vehicles cannot be confined exclusively to the gravel bar, consultation under Section 106 would be required.

Five stone spurs extending into the river would be more visually intrusive to the Landmark than placement of stone toe. In addition, the arrangement of spurs along the river evoke an artificial and more human-influenced quality potentially detracting from the feeling and association of the original fort environment.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Main Channel

Access ramp construction, bank-shaping/sloping and terracing, stone toe placement, and bioengineering would disturb an entire 2,200-foot-long by 24-foot-wide surface area to a depth of 3 feet along the existing bank. Because of the magnitude of disturbance of intact soils in from the bank, Alternative 4 has greater potential to expose subsurface cultural deposits than any of the action alternatives. The areas associated with the two possible road segments that may have connected the historic fort area with multiple remnants of the Oregon Trail east of the Fort would be obliterated under Alternative 4 (although these segments have yet to be observed on the ground in recent years). A 425-foot by 35-foot key-in trench would be excavated at the northern (upstream) portion of the stone toe construction in order to prevent flanking by future channel migrations.

Downstream Reach

As with Alternative 3, undisturbed portions of the Landmark within its boundary would remain intact, and would not be subject to direct physical impacts from stone spur installation or from construction activities associated with the spur installation. Construction of 5 stone spurs, 100 feet in length (and associated vehicle and equipment movement) would occur on the recently formed gravel point bar adjacent to the river. Spurs in this reach would have a minimal tie back extending 5 feet into the bank. Where a spur would be installed within the Landmark boundaries, the existing riprap would be removed to allow for this minimal tie-back distance; however, existing natural ground would remain undisturbed. Although the action would occur partially inside the Landmark boundaries, the effect would not be adverse and the integrity of the Landmark would remain intact. In the event that a tieback must be excavated into undisturbed portions of the Landmark or that equipment and vehicles cannot be confined exclusively to the gravel bar, consultation under Section 106 would be required. Construction of a 30-foot-long downstream above ground revetment would minimize disturbance of any subsurface cultural deposits. In terms of potential indirect effects from Alternative 4, stone toe is less visually intrusive than the stone spurs.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Main Channel

Refer to Alternative 3 for a discussion about stone spur construction and its potential effects on cultural resources along the main channel. Use of stone spurs on the main channel (Alternatives 3 and 5) would potentially be less of an impact to intact subsurface archaeological deposits than the use of stone toe with earthfill curve shaping and bioengineering (Alternative 4). Reduced impacts would be due to a smaller area of surface disturbance resulting from no planned curve shaping or bioengineering. Except for the length of the northern 100-foot key-in trench, Alternative 5 would be similar to Alternative 3 in terms of location and amount of surface disturbance from spurs, trenches, and construction paths paralleling each spur.

Downstream Reach

The integrity of the Landmark would be retained with no physical adverse effects occurring if heavy equipment and construction vehicles are confined to the point bar. Any visual effects that might occur to the Landmark would be minimal, as the riprap would complement the existing riprap already in place, and would be less conspicuous than if stone spurs were erected at the Landmark. Downstream of the Landmark, construction of a 10 to 30-foot-long key-in trench has the potential to affect undisturbed subsurface archaeological deposits in those areas.

Table 3-11. Potential impacts to cultural resources by alternative

Alternative	Potential Impacts to Cultural Resources
Alternative 1 – No Action Main Channel Downstream Reach	Measures to protect banks would not be implemented; no immediate effect on the Landmark; however, there is increased potential that “no action” would result in the Landmark being lost or suffering extensive damage from continued erosion.
Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment Main Channel	Utilizes system to place riprap from above the bank and eliminates bioengineering and curve shaping. Northern 200-foot key-in of sheet pile reduces impacts from key-in excavation, lessening the threat to cultural resources. Minimal visual impacts relative to stone spurs.

Alternative	Potential Impacts to Cultural Resources
Downstream Reach	Intact portions of Landmark avoided; effects in Landmark boundaries limited to areas where toe keys into bank & recent gravel point bar.[1] Downstream of Landmark, placement of sheet piles for key-in eliminates need to excavate key-in trench, reducing potential impacts to archaeological deposits (although some excavation into the bank will be necessary). Minimal visual impacts relative to stone spurs.
Alternative 3 – Stone Spurs	
Main Channel	No curve shaping or bioengineering limits surface disturbance to tie-back trenches for 15 spurs & access ramps, thus potential impacts to subsurface cultural resources less than for stone toe with bioengineering and curve shaping (Alternative 4). Northern 425-foot excavated key-in trench poses threat to subsurface cultural resource deposits. Possible visual effects from unnatural spur appearance.
Downstream Reach	Intact portions of Landmark avoided; effects in Landmark boundaries limited to areas where the 5 stone spurs would tie into existing riprap on the recent gravel bar.[2] Possible visual effects from unnatural spur configuration.
Alternative 4 – Stone Toe (Main Channel); Stone Spurs (Downstream Reach)	
Main Channel	Bioengineering & curve shaping entirely disturb a 2,200 foot by 24 foot area along the bank, posing a threat to any subsurface cultural deposits. A northern excavated 425-foot key-in trench poses a threat to any subsurface cultural resource deposits.
Downstream Reach	(Same as Alternative 3, Downstream Reach)[2]
Alternative 5 –Stone Spurs (Main Channel); Stone Toe (Downstream Reach)	
Main Channel	(Same as Alternative 3, Main Channel, except a 100 feet by 30 feet northern key-in trench is proposed, reducing potential impacts to subsurface cultural deposits compared to other action alternatives)
Downstream Reach	Intact portions of the Landmark avoided; effects in Landmark boundaries limited to areas where toe keys into the bank and recent gravel bar. Downstream of the Landmark, excavated key-in trench could expose subsurface archaeological deposits.

[1] If vehicles or equipment must operate on undisturbed portions of the Landmark, consultation under Section 106 would be required.

[2] In the event that a tieback must be excavated into undisturbed portions of the Landmark or that equipment or construction vehicles cannot be confined exclusively to the gravel bar, consultation under Section 106 would be required.

Construction-related Environmental Considerations for All Cultural Resource Alternatives

Soil augering would be completed for the Preferred Alternative pending Tribal approval, in areas where undisturbed soils would be impacted by construction. No augering would occur within the Landmark boundaries. The auger is a hand-held device that is used to bore an approximate 6-inch diameter hole into the soil, in order to remove a small core that the archaeologist could examine to identify any archaeological materials. Auger holes would be spaced approximately 30 feet apart. All holes would be backfilled and compacted. Surface disturbance impacts from the auger holes would be minor and limited to the holes themselves. All auger holes would be backfilled and compacted.

The advantage of augering is that the sample size is limited and ground disturbance is confined to the diameter of the auger hole. Augering would also allow those archaeological sites of Tribal concern to be avoided. If augering is not implemented and significant archaeological sites are encountered during construction, potential damage could occur to those sites, and construction delays from Section 106 consultation could be expected.

Staging Areas

Potential staging areas for all alternatives would be located at three locations, depicted on Figure 3-7. These locations were included in the 2004 Thompson archaeological survey and were found to be devoid of cultural resources.

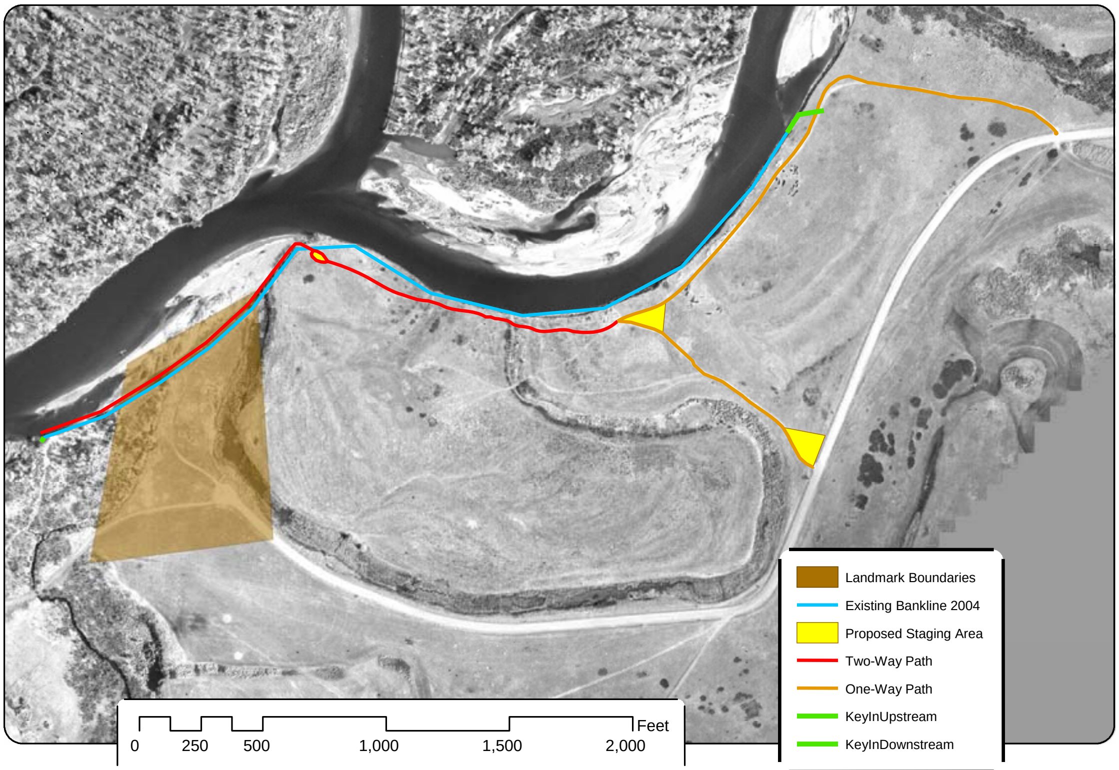


Figure 3-7. Potential staging areas and access routes for the Fort Hall Landmark Bank Stabilization Project

3.9 Indian Sacred Sites

3.9.1 Affected Environment

Federal responsibility for Indian sacred sites is defined in Executive Order (EO) 13007. Indian sacred sites are defined as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian Tribe, or an Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion..." Under EO 13007, Federal land managing agencies must accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and avoid adversely affecting the physical integrity of such sacred sites.

Tribal members are reluctant to provide specific information about locations of sacred sites, and to publish such information would be disrespectful. The cultural and traditional importance of the Bottoms area to the Tribes cannot be overstated. As previously discussed under TCPs, the cultural resource assessment process does not adequately address places that might be of religious or sacred importance to Indian people. Those places would include physical locations that are recounted in tribal oral history, grave sites, vistas of natural or physical features, places of community ceremonial events (such as the sundance or ghost dance), and places where tribal people gather natural resources for these sacred ceremonies (Yupe 2000).

3.9.2 Environmental Consequences

Alternative 1 – No Action

Under the No Action Alternative, efforts to eliminate streambank damage in the vicinity of the Landmark would not occur. Therefore, there would be no immediate effect upon sacred or religious properties. Reclamation would continue to ensure that its actions do not adversely affect Indian sacred or religious sites, if such sites are present, to the extent practicable, and that access to and ceremonial use of Indian sacred sites is accommodated. However, if prompt action is not taken to stabilize the active bank erosion occurring upriver from the Landmark, there is an increased potential that “no action” would result in the Landmark being lost or suffering extensive damage from future erosion.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

The use of sheet pile construction for the main channel key-in (rather than excavated trenches) considerably reduces the likelihood that human skeletal remains or other sacred sites or materials would be exposed. In addition, stone toe without curve shaping and bioengineering essentially leaves the area above the banks free of physical and visual disturbances, therefore, the character, feeling, and association of any sacred sites would be retained. Stone toe lining the bank of the main channel could be considered a visual intrusion, therefore, the “sacredness” and importance of the general area as a religious or sacred area could be diminished.

Because disturbance from stone toe placement to the downstream reach at the Landmark would occur only on the recently-formed gravel bar, burials or other sacred places within the Landmark boundaries would not be affected. Use of sheet pile construction (rather than excavated trenches) would cause minimal soil disturbance due to ground vibration on the downstream reach; however, it lessens the possibility that human skeletal remains or other sacred sites or materials would become exposed under this alternative.

Alternative 3 – Stone Spurs

Along the main channel, construction of 15 stone spurs (along with associated trenches and construction paths) and excavation of a 425-foot-long key-in trench, could increase the potential for encountering human skeletal remains and other sacred materials. The point bar in the transition zone would be protected by the revetment in case there is an increase in the amount of flow in the historic channel. There is no excavation associated with the revetment. Natural vistas regarded as sacred by the Tribes could be compromised by stone spurs, which would impart a “manmade” aspect to an otherwise very natural and pristine river environment. If sacred sites are located within the area of potential effect, their integrity would be compromised by physical as well as visual intrusions, thus altering the character, feeling, and associative qualities of the site.

Undisturbed portions of the Landmark within its boundary would remain intact, and would not be subject to direct physical impacts from stone spur installation or from construction activities associated with the spur installation. Construction of 5 stone spurs, 100 feet in length (and associated vehicle and equipment movement) would occur on the recently formed gravel point bar adjacent to the river. Spurs in this reach would have a minimal tie back extending 5 feet into the bank. Where a spur would be installed within the Landmark boundaries, the existing riprap would be removed to allow for this minimal tie-back distance; however, existing natural ground would remain undisturbed. Although the action would occur partially inside the Landmark boundaries, the effect would not be adverse and the integrity of the Landmark would remain intact. Downstream of the Landmark, a 30-foot revetment constructed on the surface, designed to prevent upstream flanking, would minimize impacts to possible burials or other archaeological deposits.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Access ramp construction, bank-shaping/sloping and terracing, stone toe placement, and bioengineering would completely disturb a 2,200-foot-long by 24-foot-wide surface area to a depth of 3 feet along the existing bank. Because of the magnitude of complete and total surface disturbance associated with Alternative 4 along the main channel, there would be a greater likelihood of unearthing subsurface sacred or religious features than for any of the other alternatives. In addition, vistas regarded as sacred by the Tribes could be compromised as areas along the main channel took on a different appearance, resulting in changes in character, feeling, and association.

As with Alternative 3, undisturbed portions of the Landmark within its boundary would remain intact, and would not be subject to direct physical impacts from stone spur installation or from construction activities associated with the spur installation. Construction of 5 stone spurs, 100 feet in length would occur on the recently formed gravel point bar adjacent to the river. Spurs in this reach would have a minimal tie back extending 5 feet into the bank. Where a spur would be installed within the Landmark boundaries, the existing riprap would be removed to allow for this minimal tie-back distance; however, existing natural ground would remain undisturbed. Although the action would occur partially inside the Landmark boundaries, the effect would not be adverse and the integrity of the Landmark would remain intact. In the event that a tieback must be excavated into undisturbed portions of the

Landmark or that equipment and vehicles cannot be confined exclusively to the gravel bar, consultation under Section 106 would be required. Construction of a 30-foot-long downstream above ground revetment would minimize disturbance of any subsurface cultural deposits. Natural vistas regarded as sacred by the Tribes could be compromised by stone spurs at the Landmark, which would impart more of a "manmade" aspect to a natural environment than would use of stone toe. A downstream revetment constructed on the surface, designed to prevent upstream flanking, would minimize impacts to possible burials or other archaeological deposits.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Except for Alternative 2, Alternative 5 is potentially the least impacting alternative for sacred sites on the main channel. However, along the main channel, activities associated with construction of stone spurs for Alternative 5 (and Alternative 3) could cause physical impacts to sacred properties. Erecting 15 stone spur fields with associated tieback trenching, construction paths, and excavation of a 100-foot key-in trench, would have the potential to disturb sacred sites if present. Alternative 5 could also degrade natural vistas and river landscapes that might be considered by the Tribes as sacred, thus compromising the integrity of those features. Changes in the character, feeling, and association of sacred sites could diminish the sacredness and religious qualities of the site. This visual degradation of vistas and landscapes would be more pronounced with stone spurs than stone toe construction.

Stone toe construction within Landmark boundaries would be limited to the recently-formed gravel bar, thus sacred sites that might exist within those boundaries would not be affected. Potential visual effects to the Landmark from stone toe (Alternatives 2 and 5) would be considerably less than from stone spurs (Alternatives 3 and 4). An excavated 10 to 30-foot-long key-in trench could have the potential to expose human graves and other sacred properties in intact soil deposits downstream of the Landmark boundaries. If such sites are encountered, all operations would cease and an onsite professional archaeologist would be consulted.

3.10 Indian Trust Assets (ITAs)

3.10.1 Affected Environment

ITAs are legal interests in property held in trust by the United States for Indian Tribes or individuals. The Secretary, acting as the trustee, holds many assets in trust for Indian Tribes or Indian individuals. Examples of ITAs are lands, minerals, and hunting fishing, and water rights. While most ITAs are on-Reservation, trust assets may also be off-Reservation. The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian Tribes or Indian individuals by treaties, statutes, and executive orders. These are sometimes further interpreted through court decisions and regulations.

Reservation Lands

The Fort Hall Reservation was designated as the Tribal homelands by the United States President Andrew Johnson who set apart lands for the Reservation currently inhabited by the Shoshone and Bannock Indian Tribes with an Executive Order issued June 14, 1867. The Second Treaty of Fort Bridger relating to the Fort Hall Reservation was signed July 3, 1868.

Effects to resources associated with the Reservation lands are discussed in the previous and following sections.

Water Rights

The 1990 Fort Hall Indian Water Rights Agreement was signed on July 10, 1990 in settlement of litigation involving claims made by the United States on behalf of the Tribes to water rights in the upper Snake River basin and its tributaries. There are no formal water diversions in either the vicinity of the erosion or the stabilization sites. Rights reserved with the Fort Hall Indian Water Rights Act of 1990 are not impacted by any of the alternatives.

A discussion of water quality effects that are associated with a Tribal reserved water right, can be found under Section 3.3 – *Water Quality*.

Mineral Rights

There are no known minerals of commercial value in the vicinity of the erosion near the Landmark on the Reservation. Likewise there are no known minerals of commercial value in the vicinity of the proposed stabilization access sites.

A discussion of effects to geology and soils, a natural resource associated with a mineral right, can be found under Section 3.2 – *Geology and Soils*.

Hunting and Fishing Rights

The Tribal members have the right to hunt or fish on their homeland and are regulated according to Fort Hall Reservation Ordinances.

A discussion of effects to fish and wildlife, natural resources associated with the rights to hunt and fish, can be found under Sections 3.6 – *Fish and Wildlife* and 3.7 – *Threatened and Endangered Species*.

3.10.2 Environmental Consequences

Alternative 1 – No Action

Under the No Action Alternative, the Reservation lands near the Landmark would continue to erode from the forces of the Snake River since no stabilization actions would occur. Erosion would ultimately threaten the Landmark site which encumbers Tribal lands and Reclamation lands. Impacts to all other resources associated with the Reservation land are identified in the previous sections under the No Action Alternative.

There are no formal water diversions in the vicinity of the erosion. The No Action Alternative would not impact the water rights reserved in the Fort Hall Indian Water Rights Act of 1990.

There are no known minerals of commercial value in the vicinity of the erosion near the Landmark on Reservation lands. There would be no impacts to mineral rights.

Under the No Action Alternative, the Tribal members have the right to hunt or fish and are regulated according to Fort Hall Reservation Ordinances. Hunting and fishing rights would not be impacted by the No Action Alternative.

Alternative 2 (Preferred Alternative) – Stone Toe and Upper Bank Revetment

Stabilization sites and construction access would occur on Reservation lands near the Landmark. For safety purposes, access to the stabilization site would be restricted during construction. Natural resources associated with the lands could be affected. For a summarized understanding of the effects of ITAs refer to Table 3-12.

There are no formal water diversions in the vicinity of the proposed locations for bank stabilization along the Snake River. Alternative 2 would not impact the water rights reserved in the Fort Hall Indian Water Rights Act of 1990.

There are no known minerals of commercial value in the vicinity proposed stabilization sites. Mineral rights would not be impacted by Alternative 2. A discussion of effects to geology and soils, a resource that may be associated with mineral rights, can be found in Section 3.2 – *Geology and Soils*.

The Tribal members would continue to have the right to hunt or fish; the rights would be regulated according to Fort Hall Reservation Ordinances. There would be no impacts to hunting and fishing rights; however, for safety purposes, access for hunting and fishing would be restricted during construction.

Alternative 3 – Stone Spurs

Both the stabilization sites near the Landmark and construction access would occur on Reservation lands. The natural resources associated with the lands could be affected. For a discussion of the effects to the natural resources associated with the Reservation lands read the entire document. For a summarized understanding of the effects to ITAs refer to Table 3-12.

As with Alternative 2, there would be no impacts to water rights, mineral rights, and hunting and fishing rights. For safety purposes, access to the construction area would be restricted during construction.

Alternative 4 – Stone Toe with Earthfill Curve Shaping and Bioengineering (Main Channel); Stone Spurs (Downstream Reach)

Both the stabilization sites near the Landmark and construction access would occur on Reservation lands. The natural resources associated with the lands could be affected. For a discussion of the effects to the natural resources associated with the Reservation lands read the entire document. For a summarized understanding of the effects to ITAs refer to Table 3-12.

As with Alternative 2, there would be no impacts to water rights, mineral rights and hunting and fishing rights. For safety purposes, access to the construction area would be restricted during construction.

Alternative 5 – Stone Spurs (Main Channel); Stone Toe (Downstream Reach)

Both the stabilization sites near the Landmark and construction access would occur on Reservation lands. The natural resources associated with the lands could be affected. For a discussion of the effects to the natural resources associated with the Reservation lands read the entire document. For a summarized understanding of the effects to ITAs refer to Table 3-12.

As with Alternative 2 there would be no impacts to water rights, mineral rights, and hunting and fishing rights. For safety purposes, access to the construction area would be restricted during construction.

3.10.3 Cumulative Effects

The proposed action will stabilize Tribal Lands thereby protecting a valuable Tribal resource. The resources associated with the land will have some temporary impacts as described in Table 3-12. Tribes will be able to exercise their right to hunt or fish.

Table 3-12. Indian Trust Assets (legal interests)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Reservation Lands & associated resources	Erosion occurs on some Tribal lands with some effects to associated resources.	Construction sites would stabilize some Tribal lands with some temporary effects to associated resources. For safety purposes, access would be restricted during construction.	Construction sites would stabilize some Tribal lands with some temporary effects to associated resources. For safety purposes, access would be restricted during construction.	Construction sites would stabilize some Tribal lands with some temporary effects to associated resources. For safety purposes, access would be restricted during construction.	Construction sites would stabilize some Tribal lands with some temporary effects to associated resources. For safety purposes, access would be restricted during construction.
Right to Hunt or Right to Fish	Tribal members may exercise their right to hunt and fish.	The right to hunt and fish continues. For safety purposes, access would be restricted during construction	The right to hunt and fish continues. For safety purposes, access would be restricted during construction	The right to hunt and fish continues. For safety purposes, access would be restricted during construction	The right to hunt and fish continues. For safety purposes, access would be restricted during construction
Right to Water	No impacts to federally-reserved water rights.	No impacts to federally-reserved water rights.	No impacts to federally-reserved water rights.	No impacts to federally-reserved water rights.	No impacts to federally-reserved water rights.
Right to Minerals	No known minerals at this site.	No known minerals at this site.	No known minerals at this site.	No known minerals at this site.	No known minerals at this site.

3.11 Socio-economics

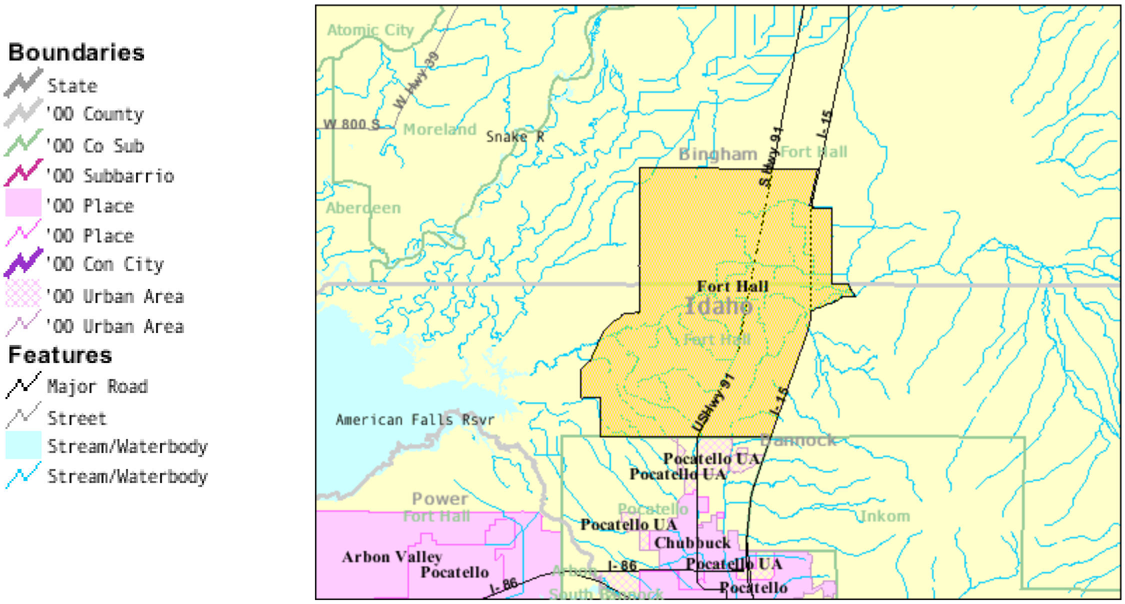
3.11.1 Affected Environment

The Presidential EO 12898 (1994) mandates Federal agencies to identify and address any impact the action would have on environmental justice with regard to human health as well as social and economic issues. The Fort Hall area has a diverse geographical terrain that provides opportunity for agricultural production and recreation (USBR 2001). This section describes and analyzes the general features of the population, including the minority population, and employment that could be affected by the proposed action.

Population

The Census Bureau does not have specific information for the Fort Hall Indian Reservation; therefore, the following information is for surrounding areas. According to 2000 Census estimates, approximately 3,193 Indian and non-Indian residents live within the Census Designated Place (CDP) area surrounding the Fort Hall Reservation. In 2000, the American Indian portion of this population lists 2,072 residents. A majority of this population reside in

Bannock and Bingham counties. Bannock and Bingham counties are the largest with populations of 75,565 and 42,926, respectively.



20 miles across

Figure 3-8. Fort Hall Census Designated Place (CDP), Idaho (www.census.gov)

Income and Employment

Median household income (MHI) and per capita income are two measures of income that are often used. The MHI and per capita income for the CDP are $31,961 and $11,309 respectively (income in 1999) (Census 2000). The CDP's unemployment and poverty levels are moderate compared to levels in the state of Idaho. Unemployment within the CDP including non-Indians, was 11.2 percent compared to the 3.8 percent for the State in 2000. The percentage of individual residents below the poverty level was 23.6 percent on the CDP compared to 11.8 percent for Idaho. The three counties contain a larger percentage of people considered below the poverty level than the national average of 12.4 percent below the poverty level (Census 2003).

The distribution of employment by industry on the CDP is unlike the State or the four counties. The service sector including education, health and social services is the largest employment category in the CDP area, accounting for 15 percent of the total employment. Manufacturing, construction, arts, and recreational services are also important. The government is the largest noncommercial employer on the Reservation with a 30 percent of the area employed, while private and salary workers make up about 60 percent of the CDP area employment (Census 2003).

Environmental Justice

Environmental justice analysis examines disproportionately high or adverse impacts to minority and low-income populations resulting from the implementation of the proposed action. These populations are:

- minority populations: persons of Hispanic or Latino, African-American, American-Indian and Alaska Native, Asian, Pacific Islander origins.
- low-income populations: persons living below the poverty level, based on a weighted-average total-annual income of $8,501 for a single person.

Information contained in the 2003 Census of Population was used to identify these populations. The 2003 Census set apart people of Hispanic or Latino heritage from the White category; however, prior to 2003 these people were counted as nonminorities. For this analysis they would be counted as a minority status. The percentages of racial populations, and persons and children below poverty within the three counties and the state are shown in Table 3-13. Approximately 38.3 percent of the total United States population belongs to minority groups, including the Hispanic and Latino populations. None of the three counties contain a higher minority population than the national average. From the 2000 Census data for the Reservation and Off Reservation Trust Land 64.6 percent of the population is included in the American Indian or Alaska Native category, followed by 33.2 percent in the White racial category.

Table 3-13. Percentage of racial population and poverty within the main counties in the Fort Hall Indian Reservation

U. S. Census Bureau 2003 Statistics	Bannock	Bingham	Power	Idaho State
Total Population, 2003 estimate	75,630	42,926	7,373	1,366,332
Population, percent change (2000 to 2003)	0.1%	2.9%	-2.2%	5.6%
White	93.1	84	84.9	92.8
Hispanic or Latino	4.7	13.3	21.7	7.9
American Indian or Alaska Native	0.9	0.4	0.2	0.6
Asian	3.6	7.3	3.7	2.1
Black or African American	1.5	0.9	0.5	1.3
Native Hawaiian or Pacific Islander		0.1	0.1	0.2
Other Races	2.7	9.1	12.0	5.0
Persons below poverty	13.5	12.6	13.8	11.8
Children below poverty	16.8	16.6	18.9	14.9

3.11.2 Environmental Consequences

The No Action Alternative or any of the action alternatives would not cause disproportionately adverse social, economic, or human health impacts to local minority or low-income populations. Since the bank stabilization project is located within the Reservation boundaries, the Shoshone-Bannock Tribal membership would have an opportunity to work through the Tribal Employment Rights Ordinance (TERO). A TERO program monitors and enforces employment and contracting rights of Indians and ensures their rights are protected and exerted. The TERO office negotiates job slots in contracts, which must be filled by qualified Indians before any non-Indians can be hired. The Tribes would have an opportunity to work with Reclamation collecting biological information and would assist with cultural resource activities.

3.12 Cumulative Impacts

During preliminary meetings with the Tribes and agencies, cumulative impacts, particularly relating to river hydrology and geomorphology, were discussed.

As discussed previously in Section 3.3 – *Water Quality,* large fluvial systems such as the Snake River in the project area, are complex, dynamic systems in a continual state of change. Sediment flux, bedload and suspended load, driven by the system's turbulence, velocity and magnitude, are continually reshaping the channel. Alterations in one portion of the system are going to inevitably result in changes upstream and downstream from that point, although changes upstream are typically localized in nature with respect to the alteration.

River channel alterations have occurred in the Bottoms in the form of bank armoring, typically via the disposal of waste rock along the channel bank and through the placement of riprap. Several of these alterations have occurred upstream of the proposed project site. However, the proposed action is not expected to have cumulative impacts with the upstream alterations. Hydraulic modeling and geomorphic analysis of these alterations (USBR 2002; Mooney 2007) have shown that they have very localized effects that are limited to within one to two meander bends of the individual alteration site. These alterations are located too far upstream to have cumulative effects with the project under consideration in this proposed action.

3.13 Standard Practices

The following standard practices would be followed to avoid or minimize potential effects that could occur if any of the action alternatives were implemented.

- Following structure placement, restore vegetation to produce a suitable vegetative cover, provide protection to soils and the adjacent stream, and provide wildlife habitat.

- Contingent on Tribal approval, temporarily fence off the area until the vegetation has been established.
- As much as possible, perform bank stabilization and construction during dry periods and when flow is low in the channel.
- Contingent on Tribal approval, restrict the use of the access road to dry periods and only to those performing the construction and oversight.
- Use BMPs to minimize environmental consequences caused by stabilizing activities and construction.
- Take standard and reasonable precautions to reduce erosion and limit sediment runoff from the construction site.
- At standard engineering sites, stockpile or deposit excavated materials away from streambanks, wetlands, or other watercourse perimeters where they could be washed away by storm events.
- Implement final erosion control and site restoration measures, such as restoring original contours, and blocking unnecessary construction access roads, and reseeding areas of construction, including culvert installation sites to prevent future erosion.
- Obtain and follow all conditions of the appropriate Corps permits.
- Obtain and follow all conditions of the appropriate storm water permit through the Environmental Protection Agency and the BMPs identified in a storm water pollution prevention plan.
- During construction, take appropriate measures to prevent the entrance of accidental spillage of contaminants or other objectionable pollutants into the surface water.
- Remove heavy equipment and machinery from the river area prior to refueling, repair and/or maintenance. Heavy equipment use in the river channel would be kept to a minimum, and within the areas specified in applicable Federal permits.
- Avoid wetlands during the construction process where possible.
- Follow the appropriate requirements and obtain all permits required for construction in or near a wetlands area to comply with the CWA.
- Maintain waterflows during construction of oxbow exit crossings.
- Arrange clearing operations and standard engineering structures to preserve and protect all trees, shrubs and current vegetation to the maximum practicable extent.
- Implement site specific erosion control to avoid degradation of downstream fish habitat caused by release of sediment or increased turbidity
- Coordinate with USFWS and the Tribes to preserve and protect species and ensure potential impacts are either avoided or minimized.

- During the 3 years following project completion, Reclamation recommends joint monitoring and evaluation of the project's performance. This would be accomplished semi-annually, first in the spring and second after irrigation season ends. In the years following this initial 3-year period, monitoring will take place annually. Contingent upon Tribal approval, if problems are identified, necessary repairs would be completed to prevent potential failure of the project.

In addition to the above standard practices, the following would apply:

Cultural Resources

- To the maximum extent possible, avoid affecting known cultural resource sites or areas.
- Locate rock sources and or borrow sites and stockpile at an existing gravel pit at the end of Sheepskin Road. This location on the Reservation has been used for stockpiling materials in the past and would avoid further impacts to the project location near the Landmark.
- Use the services of a professional archaeologist, approved by the Heritage Tribal Office (HeTO) staff, to monitor all construction or any other soil-disturbing activity.
- If cultural deposits are encountered during construction, cease operations in the immediate area of the discovery, and resume operations only after authorized by Reclamation to proceed.
- Resolve the adverse effects by consulting with the Idaho SHPO, Tribes, NPS, and BIA, in accordance with 36 CFR Part 800.6, 7, and 10.
- For unavoidable adverse impacts, develop a memorandum of agreement (MOA) pursuant to 36 CFR Part 800.6, stipulating how mitigation would be accomplished.
- Implement the Native American Graves Protection and Repatriation Acti (NAGPRA) if Native American human skeletal remains or other cultural items that fall under the purview of that statute are located during construction.
- Provide awareness training to construction staff on the cultural significance of the Landmark and Bottoms emphasizing the need to preserve its cultural integrity.

Indian Sacred Sites

- Use a professional archaeologist to monitor all construction to ensure maximum protection of identified sacred sites.
- In accordance with EO13007, avoid, whenever possible, adversely affecting actual or suspected human burials or other sites that could harbor sacred qualities.
- If Indian sacred sites are encountered during construction, cease operations in the immediate area of the discovery, and resume operations there only after authorization from Reclamation to proceed.

- If it is not possible to avoid adverse effects to sacred sites discovered during project implementation, consult with the Idaho SHPO, Tribes, NPS, and the BIA, to arrive at a plan of action to lessen the adverse effects. Follow 36 CFR Part 800 procedures for sacred sites that might also qualify as "historic properties" and thus fall under those procedures. All consultation must be completed before construction may resume in the area of the discovery.
- Implement NAGPRA if Native American skeletal remains or other NAGPRA cultural items are located during construction.
- Curate recovered archaeological collections at the Archaeological Survey of Idaho – Eastern Repository, Idaho State University (except for NAGPRA items). When NAGPRA cultural items are recovered, follow 43 CFR Part 10 procedures for Tribal consultations and custody.

Indian Trust Assets

- Follow Reclamation Standard Practices to protect Tribal lands and the resources associated with these lands.

3.14 Mitigation Measures

In addition to the standard practices, the following mitigation measures may be selected:

Geology / Soils

- Replace some of the haul roads and access ramps with one-way traffic loops to decrease effects to soils from roads.
- Protect areas of high traffic volume by placement of temporary road fill particularly if construction occurs during winter months; fill could be removed upon project completion.
- Reduce amount of staging area by using off-site areas if possible.
- Construct temporary work pads and parking areas to help prevent short-term damage of local soils but with increased costs.

Wetlands

- Implement one of the three options identified in Section 3.4.3 for creating a hydraulic break in the bank engineering where the oxbow connects to the main channel (applicable to all action alternatives).

Vegetation

- Use only live cuttings and suitable local native vegetative species for bioengineering techniques that would provide quality habitat and forage for wildlife.

Fish and Wildlife

- Revegetate streambanks and other disturbed areas with native species that would provide habitat and forage for fish and wildlife.

Cultural Resources

- Use the services of a professional archaeologist to conduct on-the-ground monitoring of all construction to ensure maximum protection of identified archaeological sites.
- Provide awareness training to construction staff on the cultural significance of the Landmark and Bottoms area emphasizing the need to preserve its cultural integrity.
- If necessary, widening of existing access to the gravel bar at the Landmark would be by placement and buildup of gravel on the surface (which would be dispersed or removed upon project completion).
- All short-term construction and maintenance, including use of construction equipment and vehicle activity, must be limited to designated staging areas that have cultural clearances from HeTO.
- Any archaeological materials recovered during the course of this project are property of the Shoshone-Bannock Tribes, and must be returned to the in situ location, or reburied as close to the original location as possible.

Indian Trust Assets

- Comply with identified Tribal Regulation and where appropriate, obtain permits to protect Tribal lands and resources associated with these lands.