

Chapter 5: Environmental Consequences

This chapter describes the environmental consequences of the project alternatives. The discussions that follow focus on those resources that could be affected by the project alternatives, that need to be reviewed because of NRCS policy, or that were identified as subjects of concern during the scoping process. The resources discussed in this chapter are the following:

- Land-use plans, policies, and controls (begins on page 5-2)
- Social and economic conditions
 - Community resources (begins on page 5-10)
 - Quality of life (begins on page 5-13)
 - Environmental justice (begins on page 5-18; also discussed in Appendix C4, Demographics and Environmental Justice)
 - Economics (begins on page 5-20)
 - Recreation (begins on page 5-23)
 - Scenic beauty and landscape resources (begins on page 5-30)
 - Energy (begins on page 5-37)
- Natural resources
 - Agriculture (begins on page 5-42)
 - Biological resources (begins on page 5-46)
 - Special-status species (begins on page 5-55; also discussed in Appendix C5, Special-Status Species)
 - Cultural and tribal resources (begins on page 5-58)
 - Topography, soils, and geology (begins on page 5-62)
 - Water resources (begins on page 5-67)
- Construction impacts (begins on page 5-97)

Each resource section in this chapter includes a description of the laws, policies, and direction that apply to the resource, an analysis of and conclusion about the expected effects of each alternative on the resource, and a summary of impacts and mitigation for each resource.

Finally, this chapter includes the following environmental consequence summaries for each alternative:

- Cumulative effects (begins on page 5-124)
- Hazard potential (begins on page 5-137)
- Consistency with approved regional plans for water resource management (begins on page 5-151)
- Relationship between short-term uses and long-term productivity (begins on page 5-157)
- Irreversible and irretrievable commitments of resources (begins on page 5-158)
- Mitigation measures and adverse environmental impacts that cannot be avoided (begins on page 5-162)

5.1 Land-Use Plans, Policies, and Controls

This section describes the expected impacts on land use from the project alternatives. Land-use impacts are presented quantitatively according to the amount of different types of existing or planned land uses that would be directly or indirectly affected by the alternatives. The geographical area used for the land-use effects analysis includes properties within about 100 feet of the LN and LHPS Canals. Potential construction impacts are discussed in Section 5.4.1, Land Use.

5.1.1 Laws, Policies, and Direction

Section 610.54 of the NRCS National Environmental Compliance Handbook states that the discussion of the environmental impacts of a proposed action should consider possible conflicts between the alternatives and the land-use plans and controls in the area. The NRCS EIS template guidelines also state that the EIS should describe the relationship of each alternative to local and regional comprehensive plans and land-use plans, policies, and controls.

5.1.2 No-Action Alternative

5.1.2.1 Land-Use Effects

Under the No-Action Alternative, the delivery of irrigation water in the LN Canal would not be restored, and structures along the historically unstable area of the Logan Bluff along Canyon Road would not be purchased. This alternative would not directly convert any land to canal easement, so no changes to existing land uses adjacent to the canal would occur. In some areas, the existing canal would continue to be used for conveying stormwater. Residential land use would continue along Canyon Road next to the LN Canal.

5.1.2.2 Relationship to Plans, Policies, and Controls

Because the land uses would not change, the No-Action Alternative would not cause conflicts with the existing land-use plans of each community surrounding the LN Canal.

Under the No-Action Alternative, irrigation water would not be carried by the LN Canal, but the canal would still carry stormwater. The amount of water in the canal at any given time would vary, but the canal would not carry as much water as it did when it was in service. Without irrigation water, the canal would still generally provide visual interest and relief from development, and it would still be a community “billboard.” However, the section that was damaged by the 2009 landslide would not be repaired and would not fit into the City’s desired conditions for canals in the area.

Because the No-Action Alternative would not change the LHPS Canal, this alternative would not conflict with management direction of the general plan of the City of North Logan (City of North Logan 2002) or with the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003).

5.1.3 Purple Alternative

5.1.3.1 Land-Use Effects

The Purple Alternative would directly affect the LHPS Canal easement; land under Lundstrom Park, city streets, and undeveloped areas; and the LN Canal easement. Temporary easements needed for construction are discussed in Section 5.4.1, Land Use.

Permanent easements on undeveloped land might be needed where the underground pipeline sections are located between the LHPS Canal at Lundstrom Park and the LN Canal at about 1500 North. These areas include about 2.6 acres total. This total does not include permanent easements on about 4,000 linear feet of local roads.

The only undeveloped area that would require a permanent easement is along an existing property line at 1500 North between about 1000 East and 1200 East. The two properties on either side of the proposed easement are currently used for agriculture. If the area over the pipeline could not be farmed after construction because of pipeline access points (such as manholes or access roads), the conversion of this area to a canal easement would take about 0.3 acre out of agricultural production. This amount is not a significant percentage of agricultural land in the study area.

Because the LHPS Canal easement is located on the edges of residential properties, some additional permanent easements would likely be required on about 10 properties between

How would the Purple Alternative affect land use?

The Purple Alternative would require permanent easements from about 2.6 acres of land for the pipeline between the LHPS Canal and LN Canal, in about 4,000 linear feet of local roads, and on about 10 properties along the LHPS Canal. This alternative would convert 14 properties from residential use to use-restricted undeveloped land.

Cedar Heights Drive and 1200 North. The final design of the alternative would need to be completed to determine if and where permanent easements would be needed and the exact area needed for various properties. Because the landowners would be fairly compensated for the loss, this impact would not be significant.

The City of Logan owns six properties along the Logan Bluff in the area where NRCS would acquire structures on 14 other properties (between about 750 East and 1100 East). These city-owned properties cannot be developed with residential or commercial uses in the future. The additional 14 properties affected through acquisition of structures would be similarly converted from residential use to undeveloped land with covenants preventing any kind of future development. NRCS would pay fair market value for the structures.

The existing LN Canal between the LN Canal POD and about 400 North would continue to be used for conveying stormwater. This continued use would not affect nearby land uses.

5.1.3.2 Relationship to Plans, Policies, and Controls

This alternative would not conflict with planned future land uses of properties along or near the Purple Alternative alignment in Logan and North Logan. Acquiring structures from 14 properties along Canyon Road and converting the residential use to nonresidential use would not conflict with the City of Logan's overall land-use management direction. Past actions by the city to acquire properties along the Logan Bluff indicate that the City would support further property acquisitions and changes to nonresidential use.

The Purple Alternative would change the way the LN and LHPS Canals look in Logan. Some residents of the city and city officials might feel that placing the LN Canal water in a pipe (but leaving the LN Canal open for conveying stormwater) and enclosing the LHPS Canal in a box culvert might not be compatible with the City's direction to enhance the beauty of the city or to provide habitat for fish and wildlife. Enclosing both canals as proposed should not affect local recreation opportunities, since residents and visitors would still be able to use existing parks and trails near the canals. Enclosing the canals should also not affect wildlife migration corridors and associated ecological connectivity, since wildlife would still be able to use the canal corridors for travel. Section 5.3.2.3, Purple Alternative, describes how the Purple Alternative could affect wildlife habitat.

Constructing the Purple Alternative would require removing mature trees and other vegetation along the LHPS Canal within the Logan city limits. Removing this vegetation would affect the "billboard" character of the canal highlighted in the City of Logan's general plan. Section 5.2.6.3, Purple and Orange Alternatives, and Section 5.3.2.3, Purple Alternative, describe the effects of vegetation removal associated with the Purple Alternative.

The Purple Alternative would not affect the LHPS Canal in North Logan, so it would not conflict with that city's direction to provide a trail along the LHPS Canal. As described in Section 4.3.4.3, Other Recreation Resources, Cache County plans to support developing linear parks (greenways) along canals in the county, including the LHPS Canal. Any linear

park along the LHPS Canal in Logan would connect into a canal trail established along the canal in North Logan.

The Purple Alternative would affect land administered by USFS in Logan Canyon. The Logan, Hyde Park and Smithfield Canal Company already has a special-use permit for operation of the LHPS Canal on land administered by USFS. However, the canal company's existing permit needs to be updated, so the alternative would require a new use permit. Construction activity would be conducted under a separate temporary-use permit. During the use-permitting process, USFS would determine if the proposed construction activity would comply with the agency's goal to balance the proposed use with the greater long-term public interest. The USFS authorization would address a change to an existing use, so it would not conflict with that agency's goal to minimize the addition of special-use-encumbered areas. The Purple Alternative would have a public benefit of providing a secondary water supply downstream, so USFS would not be likely to encourage the canal use of Federal land to be phased out.

5.1.3.3 Cumulative and Long-Term Effects

The Purple Alternative would convert about 0.3 acre of undeveloped land that is currently used for agriculture to canal easement. Converting undeveloped land to residential and commercial/industrial uses is historic and ongoing. The land in the easement would need to remain accessible for pipeline maintenance, so it would probably remain undeveloped for the entire 50-year lifespan of the proposed action. Since the converted land would remain vacant, the conversion associated with the Purple Alternative is not expected to cause or contribute to a cumulative conversion of undeveloped land to developed uses.

The Purple Alternative would convert 14 residential properties to deed-restricted public property. This conversion is not expected to change the long-term development patterns in Logan. Loss of land for residential uses is not a concern in the region. The region currently supports enough residentially zoned land for residential development to continue into the future. The loss of 14 parcels for residential development would not create a cumulative effect from a shortage of residential land.

The proposed action is not expected to induce future land-use changes, since the amount of water available and the locations to which the water would be delivered would not change.

Some land-use changes over the next 50 years would probably conflict with the City of Logan's general plan (City of Logan 2007). The City will consider development changes as it updates its general plan and might modify policies based on changed land-use conditions. Other activity in the region is likely to affect how the canals and the Logan River contribute to community livability. These changes would occur with or without the Purple Alternative. Even though the Purple Alternative might be in conflict with some of the City of Logan's management direction, this alternative would not substantially contribute to an overall degradation of community livability that is in conflict with the City's general plan.

5.1.4 Orange Alternative

5.1.4.1 Land-Use Effects

The Orange Alternative would directly affect the LHPS Canal easement, land under undeveloped areas and/or city streets, and the LN Canal easement. Temporary easements needed for construction are discussed in Section 5.4.1, Land Use.

Permanent easements would be needed for the 2900 North option where the underground pipeline section is located between the LHPS Canal and the LN Canal. The permanent easements required would be 3.6 acres of private residential land, most of which is currently used for agriculture.

In addition to the easements required in residential areas for the Purple Alternative, the Orange Alternative could require additional permanent easements on residential properties along the LHPS Canal between about Cedar Heights Drive and 1500 North, especially where residential properties abut both sides of the existing canal easement. Easements could be required on about 17 additional properties for the Orange Alternative. The final design of the alternative would need to be completed to determine if and where permanent easements would be needed. Because the landowners would be fairly compensated for the loss, this impact would not be significant.

The undeveloped area along 2900 North that would require a permanent easement is along existing property lines. If the area over the pipeline could not be farmed after construction because of pipeline access points (such as manholes and access roads), the conversion of this area to a canal easement would permanently affect about 3 acres of agricultural land. This amount is not a significant percentage of agricultural land in the study area. Because this easement would be located along property lines and because the landowners would be fairly compensated for the loss, this impact would not be significant.

The 3100 North option would require an easement of about 3,100 feet in existing local roads.

The effects of acquiring and demolishing structures from 14 properties along the Logan Bluff would be the same as those of the Purple Alternative. The 14 properties affected through acquisition of structures would be converted from residential use to undeveloped land with covenants preventing any kind of future development. NRCS would pay fair market value for the structures.

As described for the Purple Alternative, the existing LN Canal between the LN Canal POD and about 400 North would continue to be used for conveying stormwater. This continued use would not affect nearby land uses.

How would the Orange Alternative affect land use?

The Orange Alternative would require permanent easements from about 3.6 acres of land for the pipeline between the LHPS Canal and LN Canal under the 2900 North option, in about 3,100 linear feet of local roads under the 3100 North option, and on about 27 properties along the LHPS Canal. This alternative would also convert 14 properties from residential use to use-restricted undeveloped land.

5.1.4.2 Relationship to Plans, Policies, and Controls

This alternative would not conflict with planned future land uses of properties along or near the Orange Alternative alignment in Logan and North Logan. Acquiring structures from 14 properties and converting the residential use to nonresidential use would not conflict with the City of Logan's overall land-use management direction. Past actions by the City to acquire properties along the Logan Bluff indicate that the City would support further property acquisitions and changes to nonresidential use.

The Orange Alternative would change the way the LHPS Canal looks in Logan and North Logan. The Orange Alternative's relationship to the City of Logan's general plan direction is the same as that for the Purple Alternative.

The Orange Alternative differs from the Purple Alternative in that it would affect land in North Logan. The LHPS Canal easement could still be used for an upper canal pathway as described in the North Logan general plan.

The impacts of the Orange Alternative on National Forest System land would be the same as those of the Purple Alternative.

5.1.4.3 Cumulative and Long-Term Effects

The Orange Alternative would convert 3.6 acres of undeveloped land that is currently used for agriculture to canal easement. Converting undeveloped land to residential and commercial/industrial uses is historic and ongoing. The land in the easement would need to remain accessible for pipeline maintenance, so it would probably remain undeveloped for the entire 50-year lifespan of the proposed action. Since the converted land would remain vacant, the conversion associated with the Orange Alternative is not expected to cause or contribute to a cumulative conversion of undeveloped land to developed uses.

The Orange Alternative would convert 14 residential properties to deed-restricted public property. This conversion is not expected to change the long-term development patterns in Logan. Loss of land for residential uses is not a concern in the region. The region currently supports enough residentially zoned land for residential development to continue into the future. The loss of 14 parcels for residential development would not create a cumulative effect from a shortage of residential land.

The proposed action is not expected to induce future land-use changes, since the amount of water available and the locations to which the water would be delivered would not change.

Some land-use changes over the next 50 years would probably conflict with the Cities' general plans. The Cities will consider development changes as they update their general plans and might modify policies based on changed land-use conditions. Other activity in the region is likely to affect how the canals and the Logan River contribute to community livability. These changes would occur with or without the Orange Alternative. Even though the Orange Alternative might be in conflict with some of the City of Logan's management

direction, this alternative would not substantially contribute to an overall degradation of community livability that is in conflict with the City's general plan.

5.1.5 Blue Alternative

5.1.5.1 Land-Use Effects

The Blue Alternative would directly affect the LN Canal easement and residential land along the canal between about 750 East and 1100 East. Temporary easements needed for construction are discussed in Section 5.4.1, Land Use.

This alternative would not require any permanent easements but would require the acquisition of structures on 14 properties along the Logan Bluff. As described for the Purple and Orange Alternatives, the 14 properties affected through acquisition of structures would be converted from residential use to undeveloped land with covenants preventing any kind of future development. NRCS would pay fair market value for the structures.

How would the Blue Alternative affect land use?

The Blue Alternative would convert 14 properties from residential use to use-restricted undeveloped land.

5.1.5.2 Relationship to Plans, Policies, and Controls

The Blue Alternative would not conflict with existing or planned land uses in Logan. Acquiring structures from 14 properties and converting the residential use to nonresidential use would not conflict with the City of Logan's overall land-use management direction. Past actions by the City to acquire properties along the Logan Bluff indicate that the City would support further property acquisitions and changes to nonresidential use.

This alternative would change the way the LN Canal looks between the LN Canal POD and 400 North. Some residents of the city and city officials might feel that placing the LN Canal water in a pipe and changing the look of land along the canal is incompatible with the City's direction to enhance the beauty of the city. Enclosing the LN Canal as proposed should not affect local recreation opportunities, since residents and visitors would still be able to use existing parks and formal trails near the canal. Enclosing the canal should also not affect wildlife migration corridors and associated ecological connectivity, since wildlife would still be able to access the Logan River and use the canal corridor for travel. Section 5.3.2.4, Orange Alternative, describes how the Orange Alternative could affect wildlife habitat.

Constructing the Orange Alternative would require the removing trees and vegetation along the LN Canal. Removing this vegetation would affect the "billboard" character of the canal. Section 5.2.6.3, Purple and Orange Alternatives, and Section 5.3.2.4, Orange Alternative, discuss vegetation removal associated with the Blue Alternative.

The Blue Alternative would not affect the LHPS Canal in North Logan and would not affect land administered by USFS, so it would not conflict with the City of North Logan's general plan or the *Revised Forest Plan for the Wasatch-Cache National Forest*.

5.1.5.3 Cumulative and Long-Term Effects

The Blue Alternative would convert 14 residential properties to deed-restricted public property. This conversion is not expected to change the long-term development patterns in Logan. Loss of land for residential uses is not a concern in the region. The region currently supports enough residentially zoned land for residential development to continue into the future. The loss of 14 parcels for residential development would not create a cumulative effect from a shortage of residential land. The proposed action is not expected to induce future land-use changes, since the amount of water available and the locations to which the water would be delivered would not change.

5.1.6 Summary of Impacts and Mitigation

The No-Action Alternative would not affect existing land uses in the study area.

The Purple Alternative would permanently convert 2.6 acres of undeveloped land to canal easement, and the Orange Alternative would permanently convert 3.6 acres of undeveloped land along 2900 North to canal easement. These areas would remain undeveloped, so the conversion would not affect long-term land use of the affected parcels or other nearby parcels. All of the action alternatives would require temporary construction easements.

All of the action alternatives would convert 14 residential parcels to undeveloped, publicly owned land along Canyon Road. The loss of these 14 residential parcels would not affect local or regional land use. The Purple Alternative could require up to 10 permanent easements on residential properties. The Orange Alternative could require up to 27 easements. The exact locations and areas of these easements would be determined in the final design stage of the project.

No mitigation is proposed for easements because landowners would be fairly compensated for the permanent use of their properties.

5.2 Social and Economic Resources

This section describes the environmental consequences of each alternative on social and economic resources. Section 5.4.2, Social and Economic Environment, describes the expected construction impacts of each alternative on social and economic resources. The impact analysis area for each resource is the alternative alignment and those parts of Logan and North Logan that are immediately adjacent to the alignments.

5.2.1 Community Resources

This section describes how the project alternatives would affect community resources including public and facilities, schools and universities, and other public amenities in the study area. Recreation resources are discussed in Section 5.2.5, Recreation. Construction impacts to community resources are discussed in Section 5.4.2.1, Community Resources, Quality of Life, Landscape Resources, and Scenic Beauty.

5.2.1.1 Laws, Policies, and Direction

The EWPP regulation and guidelines and other NRCS guidelines do not provide any policies specific to community resources. The NRCS guidance states that NRCS should administer its programs in a way that considers environmental quality equal to economic, social, and other factors in decision-making (General Manual, Title 190, Part 410.3[b][III]). This section evaluates how each alternative would affect community resources as they relate to the social environment.

5.2.1.2 No-Action Alternative

Because this alternative would not result in any physical changes to the LN Canal (the canal would continue to not carry irrigation water), it is not expected to affect use of any land currently committed to community facilities or affect access to community resources. The No-Action Alternative would not involve repairing the 2009 landslide area or purchasing structures along the historically unstable area of the Logan Bluff along Canyon Road. The No-Action Alternative would not affect access to community resources such as emergency facilities, municipal services, or public gathering places.

5.2.1.3 Purple Alternative

The Purple Alternative would not require the use of or affect access to land associated with any emergency service facilities, schools, or other public amenities such as post offices, museums, or churches. The Purple Alternative would not require the relocation of any businesses but would require relocating people living in 14 structures along Canyon Road and modifying one publicly maintained bridge crossing of the LHPS Canal at Cedar Heights Drive. No relocations are anticipated along the LHPS Canal.

Table 3-1, Proposed Structure Acquisitions along the North Side of Canyon Road in Logan, and Figure 3-5, Parcels From Which Structures Would Be Acquired, show the location of the 14 privately owned properties between about 750 East and 1100 East along the north side of Canyon Road that would be affected by the structure acquisition.

Cumulative and Long-Term Effects. The Purple Alternative would require acquiring residential structures along Canyon Road and relocating people living in them. Because there is currently ample housing available in the region, this impact is not expected to contribute to a cumulative demand for housing and associated community resources such as new roads, emergency services, or other public amenities. The Purple Alternative is not expected to have any other long-term effects on community resources, so it would not contribute to any cumulative impacts on community resources in the region.

How would the Purple Alternative affect community resources?

The Purple Alternative would require modifying one road crossing of the LHPS Canal. This alternative would also require the acquisition of 14 residential structures, which would require relocating the people living in those structures.

5.2.1.4 Orange Alternative

As with the Purple Alternative, the Orange Alternative would not require the use of or affect access to land associated with any emergency service facilities, schools, or other community facilities. The Orange Alternative would not require the relocation of any businesses but would require relocating people living in 14 structures along Canyon Road and modifying four publicly maintained bridge crossings of the LHPS Canal at Cedar Heights Drive, 1770 East, 1900 East, and Cottonwood Lane. Table 3-1, Proposed Structure Acquisitions along the North Side of Canyon Road in Logan, and Figure 3-5, Parcels From Which Structures Would Be Acquired, show the location of the 14 privately owned properties between about 750 East and 1100 East along the north side of Canyon Road that would be affected by the structure acquisition. No relocations along the LHPS Canal are anticipated.

How would the Orange Alternative affect community resources?

The Orange Alternative would require modifying four road crossings of the LHPS Canal. This alternative would require the acquisition of 14 residential structures, which would require relocating the people living in those structures.

Cumulative and Long-Term Effects. The Orange Alternative would require acquiring residential structures and relocating people living in them. Because there is currently ample housing available in the region, this impact is not expected to contribute to a cumulative demand for housing and associated community resources such as new roads, emergency services, or other public amenities. The Orange Alternative is not expected to have any other long-term effects on community resources, so it would not contribute to any cumulative effects on community resources in the region.

5.2.1.5 Blue Alternative

The Blue Alternative would not require the use of or affect access to land associated with any emergency service facilities, schools, or other community facilities. The Blue Alternative would not require the relocation of any businesses but would require relocating people living in 14 structures along Canyon Road. Table 3-1, Proposed Structure Acquisitions along the North Side of Canyon Road in Logan, and Figure 3-5, Parcels From Which Structures Would Be Acquired, show the location of the 14 privately owned properties between about 750 East and 1100 East along the north side of Canyon Road that would be affected by the structure acquisition.

How would the Blue Alternative affect community resources?

This alternative would require the acquisition of 14 residential structures, which would require relocating the people living in those structures.

Cumulative and Long-Term Effects. The Blue Alternative would require acquiring residential structures and relocating people living in them. Because there is currently ample housing available in the region, this impact is not expected to contribute to a cumulative demand for housing and associated community resources such as new roads, emergency services, or other public amenities. The Blue Alternative is not expected to have any other long-term effects on community resources, so it would not contribute to any cumulative impacts on community resources in the region.

5.2.1.6 Summary of Impacts and Mitigation

The No-Action Alternative would not affect any community resources. None of the action alternatives would affect access to community facilities or affect any community facility buildings or properties. All of the action alternatives include the acquisition of structures from 14 properties, which would affect the community along Canyon Road. Because NRCS and the SLO would fairly compensate affected residents and because the affected properties are isolated in a small area, this impact would not significantly affect the community of Logan. No mitigation is proposed.

5.2.2 Quality of Life

This section describes how the project alternatives would affect the quality of life and public safety in the study area. The overall hazard potential of each alternative is discussed in Section 5.6, Hazard Potential of Each Alternative. Construction impacts on quality of life are discussed in Section 5.4.2.1, Community Resources, Quality of Life, Landscape Resources, and Scenic Beauty.

Some residents in the study area value the appearance and presence of the canal system, believe that it is an important part of the area's cultural history, and consider it a community amenity. People who live along the canal feel that the canal contributes to their quality of life and enjoyment of their properties. These residents and landowners feel that any changes to the canal's appearance or function would reduce their quality of life.

Public safety contributes to quality of life. While many residents value the canals as an amenity, others feel that the existing open canal system poses a hazard to public safety.

5.2.2.1 Laws, Policies, and Direction

The EWPP regulations and guidelines and other NRCS guidelines do not provide any policies specific to quality of life. The NRCS guidance states that NRCS should administer its programs in a way that considers environmental quality equal to economic, social, and other factors in decision-making (General Manual, Title 190, Part 410.3[b][III]).

5.2.2.2 No-Action Alternative

Under the No-Action Alternative, the LN Canal would not carry irrigation water but would carry stormwater. The LHPS Canal would continue to function as it has historically, carrying irrigation water and stormwater. This alternative would not result in any changes to the canal system, so it would not affect the quality of life of people who feel that the LHPS Canal is an amenity to the community and positively affects their enjoyment of their properties. However, people living along the LN Canal might feel that having less water in the canal during the irrigation season affects the enjoyment of their properties.

Under this alternative, both canals would remain open, and the section of the LN Canal downstream of the Laub Diversion would be abandoned in place. The open canals would continue to pose a safety risk due to open water.

North Logan is dominated by low-density residential development, and many residents enjoy the rural feel of the community. Owners of agricultural properties in North Logan who have historically relied on the LN Canal for delivery of irrigation water would have to modify use of their land (such as change to dry farming, or stop farming altogether and sell or develop their land for other purposes) if water delivery is not restored. Since the No-Action Alternative would not restore water delivery capability to the LN Canal, people who have historically relied on the canal might feel that this alternative would reduce their quality of life. This

alternative would not involve purchasing structures along a historically unstable section of the Logan Bluff along Canyon Road, so risks to life and property would continue to be a concern of people living along this area of the bluff. Continued exposure to these risks could affect the quality of life for these residents.

5.2.2.3 Purple Alternative

Under the Purple Alternative, about 2.4 miles of the LHPS Canal would be enclosed in a box culvert, and use of about 1 mile of the LN Canal would change with water delivery using a pressure pipe instead of an open canal. Of the 2.4 miles of the LHPS Canal that would be enclosed, about 0.8 mile is in an area where the canal contributes to people's perception of quality of life (between the golf course and Lundstrom Park).

Residents and landowners who associate a positive quality of life with the existing canal system might feel that these changes reduce their quality of life. However, this alternative would allow ongoing agricultural production to continue, so it would benefit residents who feel that agricultural land uses contribute to a positive quality of life.

This alternative would eliminate safety hazards associated with an open LHPS Canal between the LHPS Canal POD and Lundstrom Park. However, the LHPS Canal would remain open downstream of Lundstrom Park. This downstream section is accessible in many places, and some residents might feel that it continues to pose a safety hazard, especially to small children who might live or play near the canal.

Under this alternative, the LN Canal would remain open but would carry less flow. Some residents might feel that this open canal would continue to pose a safety hazard. The LN Canal would carry all of the irrigation water placed into it downstream of about 1500 North, so this section would continue to pose a safety hazard due to open water as it has historically.

The Purple Alternative includes purchasing and demolishing structures from 14 properties and relocating the people living in them but does not otherwise address the landslide area along the LN Canal at about 970 East. This part of the LN Canal would be abandoned in place, and any future stabilization of the area would need to be planned and implemented through a separate process. Removing the structures would reduce the risk of loss of life or property damage associated with future slope failure along this part of the Logan Bluff, but it would adversely affect the quality of life of those residents who are relocated. The remainder of the people living along this section of the canal would be safer than they would be if the canal were still carrying water, but the area would continue to pose a safety risk, since this area of the Logan Bluff would remain unstable.

How would the Purple Alternative affect quality of life?

This alternative would enclose about 1 mile of the LN Canal and about 2.4 miles of the LHPS Canal. This alternative would allow ongoing agricultural production to continue and would remove structures at greatest risk from future instability along the Logan Bluff.

If the slope were to fail in the future, the resulting incident could still damage other occupied structures in the area (such as those on the south side of Canyon Road), but the extent and type of damage would depend on the severity of the incident. So, while the Purple Alternative would address some of safety hazards associated with conveying water along the Logan Bluff, it would not fully address its historic instability or guarantee the complete safety of the people living in the area. This could affect the quality of life of people who continue to live near the historically unstable area.

5.2.2.4 Orange Alternative

The impacts on quality of life from the Orange Alternative would be similar to those from the Purple Alternative except that, under the Orange Alternative, between 4.9 and 5.2 miles of the LHPS Canal would be enclosed in a box culvert. Additionally, water delivery for 3.1 to 3.4 miles of the LN Canal would change from using an open canal to using a pressure pipe. Of the 4.9 to 5.2 miles of the LHPS Canal that would be enclosed, between 3.3 and 3.6 miles are in an area where the canal contributes to people’s perception of quality of life.

As described for the Purple Alternative, residents and landowners might feel that these changes reduce their quality of life, but residents who feel that agricultural land uses contribute to a positive quality of life would probably recognize a benefit.

The Orange Alternative would also eliminate safety hazards associated with an open LHPS Canal, but for a longer distance than with the Purple Alternative. Under the Orange Alternative, the benefit would extend to either 2900 North or 3100 North. The canal would remain open downstream of 2900 North or 3100 North and would continue to pose safety risks associated with an open canal. The section of the LN Canal for which the use would change would also be longer, since the pressure pipe would be installed upstream of either 2900 North or 3100 North. The LN Canal would remain open downstream of either 2900 North or 3100 North and would continue to pose a safety hazard as it has historically.

Finally, as described for the Purple Alternative, acquiring structures from 14 properties along the north side of Canyon Road would address some of the future risk to life and property along an unstable part of the Logan Bluff but would affect the quality of life of relocated residents. Some safety risk would remain for people living near the historically unstable area, which could affect the quality of life of people who continue to live near the historically unstable area.

How would the Orange Alternative affect quality of life?

This alternative would enclose between 4.9 and 5.2 miles of the LHPS Canal and between about 3.1 and 3.4 miles of the LN Canal. This alternative would allow ongoing agricultural production to continue and would remove structures at greatest risk from future instability along the Logan Bluff.

5.2.2.5 Blue Alternative

Under the Blue Alternative, the LHPS Canal would not be enclosed, so the quality of life impacts described for the Purple and Orange Alternatives would not occur. The LHPS Canal would remain open and would continue to pose a safety hazard due to open water as it has historically.

The Blue Alternative would convert about 1.7 miles of the LN Canal to piped flow, which would eliminate the safety hazards associated with an open canal through this reach. The canal would remain open downstream of about 400 North and would continue to pose a safety hazard due to open water as it has historically.

Some area residents who live along or near the LN Canal in this reach might feel that enclosing the canal would change the feel of the area and reduce their quality of life. However, as described for the Purple and Orange Alternatives, this alternative would restore irrigation water delivery, and residents who feel that agricultural land uses contribute to a positive quality of life would probably recognize a benefit.

Because this alternative would traverse a historically unstable area and would address instability only along the LN Canal alignment (and not along the entire Logan Bluff), people living below and adjacent to the canal would still be at risk from landslides (Section 3.2.4, Blue Alternative: Reconstruct LN Canal, and Section 5.6, Hazard Potential of Each Alternative, describe the instability of the area). As described in Section 1.1.2.1, Emergency Watershed Protection Program, EWPP funds cannot be used to address hazards that existed before the disaster that is the focus of the EWPP assistance. Since the Logan Bluff area is historically unstable regardless of the presence of the LN Canal, NRCS cannot include stabilization of the entire bluff area as part of the Blue Alternative.

Like the Purple and Orange Alternatives, the Blue Alternative includes purchasing and demolishing structures from 14 properties and relocating the people living in them. This action would reduce the risks to life and property associated with future slope failure along this part of the Logan Bluff, but it would adversely affect the quality of life of those residents who are relocated and who place a value on the open canal near their properties. However, because of the historic instability of this area along the Logan Bluff, the risk of future landslides would remain.

If the slope were to fail in the future, the resulting incident could still damage other occupied structures in the area (such as those on the south side of Canyon Road), but the extent and type of damage would depend on the severity of the incident. So, while the Blue Alternative would address some of safety hazards associated with the Logan Bluff, it would not fully address its historic instability or guarantee the complete safety of the people living in the

How would the Blue Alternative affect quality of life?

This alternative would not enclose the LHPS Canal but would enclose about 1.7 miles of the LN Canal. This alternative would allow ongoing agricultural production to continue, would address some of the instability along the LN Canal alignment, and would remove structures at greatest risk from future instability along the Logan Bluff.

area. Knowing that irrigation water is being conveyed through this historically unstable area might adversely affect the quality of life of some people living near the new pipeline.

5.2.2.6 Cumulative and Long-Term Effects

Urbanization within the region has occurred from early Euro-American settlement through the present and will likely continue. Changes to the canal system under any of the action alternatives would contribute to the ongoing urbanization of the Logan and North Logan areas. This urbanization, which includes effects such as traffic, noise, and development of previously undeveloped areas, could affect people's perception of quality of life. These changes in quality of life due to urbanization would take place even without the proposed action. People living along the canals might feel that the proposed action adversely affects their quality of life, but these individual effects are not expected to significantly contribute to regional, ongoing changes that are affecting quality of life in the study area. The change in the canal system is not expected to cause long-term effects or adverse cumulative effects on quality of life.

All three of the action alternatives would address some of the risk associated with people living along a part of the Logan Bluff that is unstable, could fail in the future, and could cause loss of life or property damage. The City of Logan has already purchased five properties in the same area because of the existing risk. The removal of structures from another 14 properties would contribute to the safety of the area but would not improve or worsen any safety conditions that are considerable on a regional cumulative basis.

5.2.2.7 Summary of Impacts and Mitigation

The No-Action Alternative would not restore water delivery to most of the LN Canal, so the canal would no longer serve as an open-water feature that some residents feel is a community asset. The No-Action Alternative would not change the LHPS Canal, so landowners along that canal would not experience a change in the open-water feature and associated quality of life benefits and safety risk. Under the No-Action Alternative, the historically unstable area of the Logan Bluff along Canyon Road would continue to pose risks to residents living in the area; this continued risk could affect the quality of life of these residents. The No-Action Alternative would not acquire any properties or address the 2009 landslide site, but it would not reintroduce irrigation water to the unstable slope. However, people living in the area might still feel that their quality of life is reduced because of the continued risk.

The Purple and Orange Alternatives would re-establish some use of the LN Canal, but, since the irrigation water would be in a pipe upstream of the discharge points, these alternatives would reduce the amount of open water in the LN Canal. This could adversely affect the quality of life of people living along the LN Canal who feel that an open canal contributes positively to their quality of life. Even with a small amount of water in the LN Canal, it could still pose a drowning hazard. The Purple and Orange Alternatives would enclose reaches of the LHPS Canal that some local residents and landowners feel provide a quality of life benefit

as an open canal, but enclosing the canal could also reduce the drowning hazard along some areas of the canal.

All of the action alternatives would acquire structures from 14 properties along the Logan Bluff. Affected residents might feel that being relocated adversely affects their quality of life. The Purple and Orange Alternatives would not reintroduce irrigation water delivery through the historically unstable area but would not otherwise address the remaining instability. People who continue to live along the Logan Bluff on Canyon Road would be safer than they would be if the canal were still carrying water, but the area would continue to pose a safety risk since this area of the Logan Bluff would remain unstable.

The Blue Alternative would repair the 2009 landslide site and reintroduce water delivery through the historically unstable area; while the repair would address some of the hazard, the slope above the canal would still be subject to failure in the future. Under all of the action alternatives, the continued risk of slope failure (landslide only for Purple and Orange Alternatives or landslide and possible flooding for the Blue Alternative) could adversely affect the quality of life of people who continue to live along this segment of Canyon Road.

Because quality of life effects are subjective and the proposed action is not expected to significantly improve or reduce the quality of life of residents living in the study area, no mitigation is proposed.

5.2.3 Environmental Justice

This section summarizes the expected long-term impacts of the project alternatives on environmental justice populations in the study area. Short-term construction impacts are discussed in Section 5.4.2.2, Environmental Justice.

The project team used the demographic and income information presented in Appendix C4, Demographics and Environmental Justice, to identify potential environmental justice populations (either low-income or minority populations) in the study area. For the purpose of this EIS, *environmental justice populations* are census blocks or block groups having a proportion of people living in poverty or a proportion of minorities that is at least 10 percentage points higher than the county average.

As described in Appendix C4, eight block groups had poverty levels that were at least 10 percentage points higher than the county average of 13.5%, while 22 blocks had a percentage of minority persons that was at least 10 percentage points higher than the county average of 20.3%.

All low-income and most minority populations are concentrated west of 1200 East and south of 1400 North in Logan. In addition, some minority populations are west of 800 East and

What are census tracts, blocks, and block groups?

Census data are reported for larger geographic areas called *census tracts* and smaller areas within the census tracts called *blocks*. A *block group* is a cluster of census blocks having the same first digit of their four-digit identifying numbers within a census tract.

south of 1800 North, east of 1600 East and south of 1900 North, west of 1600 East and south of 1500 North, and east of 1200 East and north of US 89. Much of the area where low-income and minority populations are located is student housing for USU.

As explained in Appendix C4, some of the population in the study area has limited English proficiency. Spanish is the most spoken language among people who speak a language other than English. In order to comply with Executive Order 12898, Federal Actions To Address Environmental Justice in Minority and Low-Income Populations, and USDA DR 5600-2, Environmental Justice, reasonable measures should be taken during public involvement to ensure that this part of the population has meaningful access to meetings and information regarding this proposed action.

5.2.3.1 Laws, Policies, and Direction

Executive Order 12898 and DR 5600-2 require impacts to low-income, minority, and tribal populations as a result of a project to be evaluated. If these populations are near or within the study area, they have to be provided the opportunity to comment before decisions are rendered on, allowed to share in the benefits of, not excluded from, and not affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment. Therefore, Executive Order 12898 and DR 5600-2 were considered during the analysis of impacts to environmental justice populations in the study area as a result of each alternative.

5.2.3.2 No-Action Alternative

Under the No-Action Alternative, no low-income or minority populations would be affected by not re-establishing irrigation water delivery using the LN Canal. Therefore, there would be no disproportionately high and adverse environmental or human health impacts to low-income and minority populations in the study area as a result of the No-Action Alternative. In addition, no measures would be taken in regard to populations with limited English proficiency.

5.2.3.3 Action Alternatives

Operation of the modified LHPS and/or LN Canals would not result in disproportionately adverse effects to the quality of life, environment, or mobility of low-income or minority populations. All people would experience the same effects described in this chapter regardless of race, ethnicity, or income. Construction impacts to environmental justice populations are discussed in Section 5.4.2.2, Environmental Justice.

How would the Action Alternatives affect environmental justice populations?

The Action Alternatives would not cause disproportionately adverse effects to environmental justice populations.

5.2.3.4 Cumulative and Long-Term Effects

Because none of the action alternatives would have a disproportionate effect on low-income or minority populations in the study area, the proposed action would not cause a long-term or cumulative effect on environmental justice populations.

5.2.3.5 Summary of Impacts and Mitigation

Because operation of the action alternatives would not affect environmental justice populations differently than they would affect all non-environmental justice populations, none of the alternatives would have disproportionately high adverse impacts on any environmental justice populations. No mitigation is proposed.

5.2.4 Economics

This section examines the economic impacts of either restoring the LN Canal so that shareholders have access to water according to their water rights or not restoring the canal under the No-Action Alternative. Construction impacts to economics are discussed in Section 5.4.2.3, Economics.

5.2.4.1 Laws, Policies, and Direction

The NRCS Environmental Compliance Handbook requires that a social and economic analysis is conducted to identify areas of potential conflict in the human environment.

5.2.4.2 No-Action Alternative

As noted in Section 4.3.3.1, Employment, Cache County is an agricultural-based community. The irrigation canals in the county and the study area provide an important resource needed to sustain the agricultural component of the local economy. Since the 2009 landslide that damaged the LN Canal, some LN Canal shareholders have had very limited access to irrigation water provided through a temporary system (for a description of the temporary system used in 2009 and 2010, see Section 2.1.2.2, Operation of the LN and LHPS Canals). Without irrigation water, shareholders have lost and would continue to lose the economic benefit that is normally received from the use of LN Canal irrigation water.

Under the No-Action Alternative, the LN Canal would not be restored, and shareholders would not be able to capitalize on their shares. Without irrigation water, shareholders would lose crop production value. NRCS has conducted an analysis that examined the economic benefit of the LN Canal's irrigation water (Appendix C3, NRCS Economic Analysis Calculations). This analysis is based on the percent of land in Cache County that is currently used for various types of crops, the market value of crops, and the production value associated with irrigated cropland (Utah Department of Agriculture and Food, no date; USU Extension 2005; USDA NRCS 2010c;).

According to the NRCS analysis, LN Canal shareholders using the section of the LN Canal from its POD to about 3100 North own 4,748 acres of land that are irrigated for agricultural use. Based on this area and the market prices for crops in 2009, NRCS estimated that the LN Canal provides an annual benefit of about \$995,000 in terms of crop production for irrigated farming versus dryland farming for the LN Canal shareholders. Over the 50-year planning period for the Logan Northern Canal Reconstruction project, this overall benefit in agricultural revenue would be about \$20,934,000¹ and would be considered a “lost” benefit under the No-Action Alternative. Besides this direct loss of agricultural revenue, other indirect effects could occur, such as losses of revenue for area businesses that are associated with agricultural production, such as farm implement and seed and fertilizer dealers.

Other impacts under the No-Action Alternative that would have associated costs include the loss of water for municipal irrigation and culinary uses. Loss of irrigation water for such facilities as parks and golf courses would require the municipalities in the study area to find other sources of water. Culinary water could replace irrigation water from the canal but at additional costs to the municipalities and other users.

In addition to the loss of revenue from crop production, without the LN Canal irrigation water, shareholders and the community would lose other benefits associated with their shares. These benefits include such things as the ability to water landscaping or to support industrial uses. The value of water rights and shares varies throughout Cache Valley and can be difficult to quantify. Most likely, under the No-Action Alternative, the value of water rights and shares associated with the LN Canal would not be totally lost from the community.

An economic benefit to the No-Action Alternative would be the use of the LN Canal for conveying stormwater. This could save the Cities of Logan and North Logan the expense of constructing a new municipal stormwater system or expanding the existing system.

5.2.4.3 Purple Alternative

The Purple Alternative would restore the LN Canal and allow shareholders to continue to receive the benefits associated with crop production and water rights. Therefore, no loss of revenue due to losses in crop production would be expected as a result of this alternative.

The Purple Alternative would provide an opportunity for shareholders between 400 North and 1500 North to convert to sprinkler irrigation without needing power to operate pumps. However, since few of these shareholders use pumps to take water from the canal, the energy cost benefit would be minor.

How would the Purple Alternative affect economics?

The Purple Alternative would not adversely affect the local economy. Providing the ability for shareholders using flood irrigation to convert to sprinkler irrigation could cause minor economic benefits.

¹ This benefit was calculated using a discount rate of 4.125%.

5.2.4.4 Orange Alternative

The Orange Alternative would also restore the LN Canal and allow shareholders to continue to receive the benefits associated with crop production and water rights. This alternative would place the LN Canal irrigation water in a pressure pipe along the existing LN Canal between 400 North and either 2900 North or 3100 North, which would eliminate the need for shareholders to operate pumps. As described in Section 5.2.7, Energy, these pumps currently require 1,000 horsepower for 8 hours each day during the 6-month irrigation season. By eliminating this pumping, shareholders would save about 1,073,826 kWh each year, which would result in a savings of about \$48,644 per year. Detailed cost information about the cost to operate pumps along the LN Canal is included in Appendix C2, Alternatives Development Cost Estimates.

How would the Orange Alternative affect economics?

The Orange Alternative would not adversely affect the local economy. Providing the ability for shareholders using flood irrigation to convert to sprinkler irrigation could cause substantial economic benefits.

5.2.4.5 Blue Alternative

The Blue Alternative would restore water delivery to the LN Canal and allow shareholders to continue to receive the benefit associated with crop production and water rights. Therefore, no economic impact due to crop production losses is expected.

How would the Blue Alternative affect economics?

The Blue Alternative would not cause adverse or beneficial effects to the local economy.

5.2.4.6 Cumulative and Long-Term Effects

Because none of the action alternatives would cause an adverse impact on the local economy, no cumulative adverse or long-term economic effects would result from the construction of any of the action alternatives. However, since all of the action alternatives would support long-term agricultural production, they would contribute to the long-term economic health of the Cache Valley economy.

5.2.4.7 Summary of Impacts and Mitigation

The No-Action Alternative would cause adverse effects to the local economy because of loss of revenue from agricultural production. This alternative would, however, enable the Cities of Logan and North Logan to use the LN Canal for conveying stormwater, which could save or reduce expenses associated with constructing a new system or expanding the existing system.

The Orange Alternative would result in an economic benefit because many LN Canal shareholders between 400 North and either 2900 North or 3100 North would be able to convert to pressurized systems. By converting to pressurized systems, shareholders would not need an outside energy source to operate pumps for sprinkler systems. Because most of the

shareholders between 400 North and 1500 North use flood irrigation, the same type of conversion benefit for the Purple Alternative would be minor compared to that of the Orange Alternative.

5.2.5 Recreation

This section describes impacts to recreation in the study area. Recreation resources include parks and open spaces, trails, private facilities such as the Logan Golf & Country Club, the Uinta-Wasatch-Cache National Forest, and recreation activities such as floating and wading in the canals and hiking and biking along the canals. Potential construction impacts to recreation are discussed in Section 5.4.2.4, Recreation.

5.2.5.1 Laws, Policies, and Direction

The NRCS Environmental Compliance Handbook does not provide direction for evaluating how a proposed action might affect recreation activities or facilities. However, because recreation is an important part of the social environment and NRCS must evaluate the socioeconomic impacts of the proposed action, Section 5.2.5 reviews how each alternative might affect recreation in the region.

USFS is a cooperating agency for this EIS. Recreation is an important function of National Forest System land such as that in Logan Canyon.

5.2.5.2 No-Action Alternative

The No-Action Alternative would not affect recreation use of National Forest System land in Logan Canyon, city parks and trails, or private recreation facilities. The No-Action Alternative would not repair the 2009 landslide area. People have historically used the canal maintenance roads as trails, even though such use has not been authorized by the Logan & Northern Irrigation Company or the City of Logan.

Under the No-Action Alternative, people would probably continue to use sections of the trail along the Logan Bluff that are intact but would avoid the landslide area since it would remain impassable. However, the City of Logan has identified a potential future public trail that would connect to an existing city-maintained trail and that would follow the LN Canal alignment through the Logan Bluff. If the City were to authorize and construct the trail, its construction and maintenance would need to address the stability of the section that travels through the 2009 landslide area.

How would the Purple Alternative affect recreation?

The Purple Alternative would directly affect National Forest land in Logan Canyon, unauthorized use of the LHPS Canal between the POD and Lundstrom Park, and the golf course property. It would also cross over the Bonneville Shoreline Trail in Logan. The Purple Alternative would not cause long-term effects to recreation use of these resources.

5.2.5.3 Purple Alternative

The Purple Alternative runs through National Forest System land in Logan Canyon, the golf course, Ray Hugie Park, and Lundstrom Park and crosses over the Bonneville Shoreline Trail. The Purple Alternative would also cross proposed trail alignments that begin at the Bonneville Shoreline Trail and connect to Lundstrom Park and that run along 1500 North between about 1600 East and 1200 East (Figure 5-1).

Impacts Associated with Constructing the Box Culvert between the LHPS Canal POD and Lundstrom Park

Constructing the box culvert between the LHPS Canal POD and Lundstrom Park would permanently change National Forest System land and land in the golf course in Logan. This alternative would also permanently affect unauthorized recreation use of the LHPS Canal easement. USFS would require a use permit for the activity on National Forest System land and would assign permit conditions and appropriate mitigation as part of the permit. Most of the section of the LHPS Canal that is on National Forest System land is on a steep rock slope that is not normally used for recreation, so permit conditions would probably address activity that could affect people traveling in the canyon to access recreation sites or people using the Riverside Trail.

USFS, UDOT, and the Logan, Hyde Park and Smithfield Canal Company recently installed a fence along part of the LHPS Canal near where the canal crosses under US 89 to discourage unauthorized use of the canal between the LHPS Canal POD and the canyon mouth.

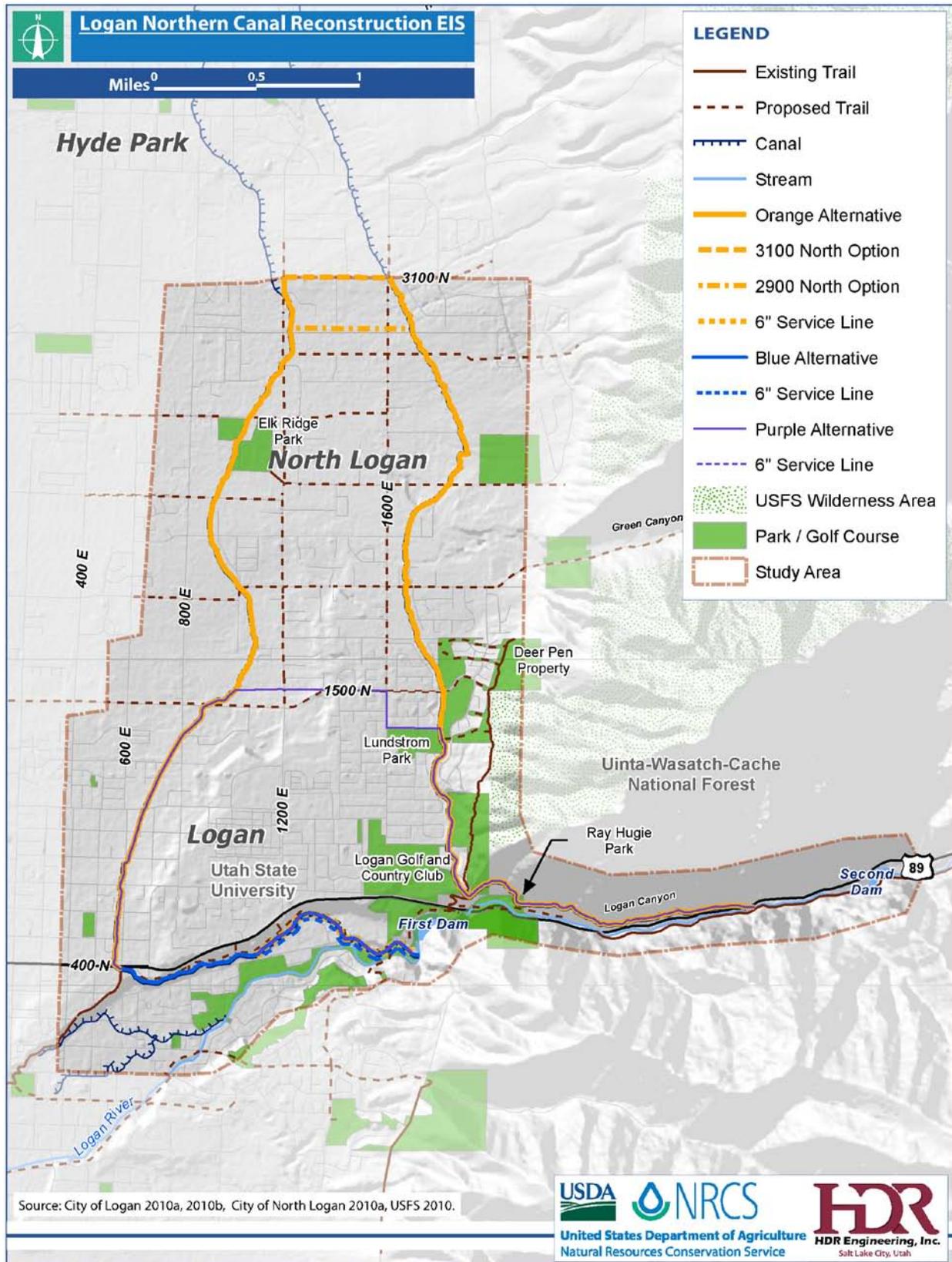
Enclosing the canal in a box culvert would prevent rather than discourage this unauthorized use and would be consistent with how USFS manages land along the canal in the canyon. Even though this type of recreation use of the canal is unauthorized, it would be permanently lost with enclosure of the canal.

After leaving the canyon, the canal passes through the golf course. This is a privately operated facility on land owned by the State of Utah (USU) and leased to the golf course operator. The golf course currently uses the canal as a water feature and amenity. According to the golf course operator, enclosing the canal would adversely affect operation of the golf course by requiring parts of the golf course to be reconstructed.

Constructing the box culvert would affect a reach of the canal that passes into Lundstrom Park. The box culvert would not affect park use, but park visitors might feel that the loss of the open water negatively affects their recreation experience.

The Purple Alternative would not affect the ability to construct the planned trail along 1500 North between about 1600 East and 1200 East. The trail could still be constructed next to the existing roadway.

Figure 5-1. Alternative Alignments and Recreation Resources



Currently, the canal easement is not available for legal recreation use. However, residents of the area have historically used this reach of the LHPS Canal and areas downstream for activities such as walking and bicycling along the canal and wading and tubing in the canal. Enclosing the canal would prevent unauthorized uses such as tubing and wading but would probably not affect using the canal easement for walking and bicycling. Cache County does not have formal plans to create a linear park along the canal but has stated that it intends to consider options for developing a recreation corridor along the canal and thereby establish a way for people to legally use the canal easement. Putting this reach of the LHPS Canal in a culvert would not prevent establishing a trail along the easement in the future.

Impacts Associated with the Water-Control Structure and Underground Pipeline at Lundstrom Park

The Purple Alternative includes constructing a water-control structure at and installing a pipeline through Lundstrom Park. The water-control structure would be entirely within the canal and would not affect any land in Lundstrom Park. The pipeline, which would connect into a headgate at the water-control structure, would be installed underground and would not affect long-term use of the park.

Impacts Associated with the Water-Control Structure at the LN Canal and Service Pipeline between 400 North and 1500 North

The water-control structure would be entirely in the canal easement but would not permanently affect existing unauthorized recreation use in the area. The service pipeline, which would be placed underground, would not prevent establishing a trail along the LN Canal in the future.

Impacts Associated with the Service Pipeline between the LN Canal POD and the Laub Diversion

The reach of the LN Canal between Canyon Road and 600 East has also been historically used for unauthorized recreation activity such as hiking and bicycling along the canal. The City of Logan has identified the canal easement as a future trail but to date has not established a legal easement along the canal for this future use.

The 2009 landslide curtailed but has not prevented unauthorized use of the LN Canal easement between the LN Canal POD and 600 East. Scoping comments on the subject indicate that many residents would like the ability to use the existing informal trail along the entire section. This alternative does not include any work at the 2009 landslide site and would not restore the connectivity of this trail. If the City of Logan wants to establish a trail in the future, it would need to repair the trail so that it could be safely used.

Cumulative and Long-Term Effects

The Purple Alternative would change some formal, legal recreation resources but would not affect the long-term use of these resources or others in the study area. Changes to the LHPS Canal and LN Canal would affect unauthorized recreation use, but this change is not expected to contribute to or cause cumulative effects related to the loss of a recreation feature or prevent establishing a trail system along the canal easements in the future. People living in the area could still use existing legal trails and parks and could probably continue to access the canal easement.

5.2.5.4 Orange Alternative

The Orange Alternative runs through National Forest System land in Logan Canyon; the golf course, Ray Hugie Park, and Lundstrom Park in Logan; and Elk Ridge Park in North Logan.

Along the LHPS Canal, this alternative crosses over the Bonneville Shoreline Trail in Logan. The Orange Alternative also crosses proposed trail alignments that begin at the Bonneville Shoreline Trail and connect to Lundstrom Park and proposed alignments along 1500 North, 1900 North, 2300 North, 2700 North, 1600 East, and 3100 North in North Logan. Along the LN Canal, the Orange Alternative crosses over proposed trail alignments along 1550 North, 1900 North, 2200 North, 2500 North, about 1150 East, 2750 North, and 1200 East in North Logan.

How would the Orange Alternative affect recreation?

The Orange Alternative would directly affect National Forest land in Logan Canyon, unauthorized use of the LHPS Canal between the POD and either 2900 North or 3100 North, and the golf course property. It would also cross over the Bonneville Shoreline Trail in Logan. The Orange Alternative would not cause long-term effects to recreational use of these resources.

Impacts Associated with Constructing the Box Culvert between the LHPS Canal POD and either 2900 North or 3100 North

The box culvert between the LHPS Canal POD and Lundstrom Park would cause the same permanent impacts to National Forest System land and the golf course as the Purple Alternative. Under the Orange Alternative, the box culvert would continue north to either 2900 North or 3100 North. Constructing a box culvert along the reach between Lundstrom Park and 2900 North/3100 North would not permanently affect any additional developed recreation resources. Like the Purple Alternative, the Orange Alternative would permanently affect unauthorized recreation use of the LHPS Canal easement.

The reach of the box culvert between Lundstrom Park and 2900 North/3100 North would cross over several trail alignments proposed by the City of North Logan. Installing the culvert would not affect the City's ability to construct these trails in the future.

The City of North Logan currently identifies the LHPS Canal as having a trail. As discussed in Section 5.2.5.3, Purple Alternative, using the canal easement is currently unauthorized, but Cache County has stated that it would consider options to establish a legal trail (linear park) along the canal in the future. Constructing the box culvert would not prevent Cache County from establishing this future trail.

Impacts Associated with Water-Control Structures at the LHPS Canal and LN Canal and an Underground Pipeline at either 2900 North or 3100 North

The water-control structure at either 2900 North or 3100 North on the LHPS Canal would not permanently affect the use of pocket parks at about 2950 North and 3100 North.

If the 3100 North option is selected, constructing the pipeline between the LHPS Canal and the LN Canal would follow proposed trail alignments along 3100 North and along a short section of 1200 East. Because the pipeline would be placed underground, the City of North Logan could still establish trails along these roads.

Impacts Associated with the Service Pipeline along the LN Canal between 400 North and either 2900 North or 3100 North

This reach of the LN Canal passes through Elk Ridge Park in North Logan. However, because the pipeline would be placed underground in the canal maintenance road, people using the park might not know that the pipeline is there. The Orange Alternative would not permanently affect Elk Ridge Park.

As described for the Purple Alternative, the LN Canal easement is used for unauthorized recreation activities such as walking and bicycling along the canal maintenance road. Because the pipeline would be in the maintenance road, it would not affect this type of use.

The pipeline would cross several trail alignments proposed by the City of North Logan. Constructing the pipeline would not affect the City's ability to establish these trails or trails along the LHPS and LN Canals in the future.

Impacts Associated with the Service Pipeline between the LN Canal POD and the Laub Diversion

The impacts associated with the service pipeline between the LN Canal POD and the Laub Diversion would be the same as those described for the Purple Alternative.

Cumulative and Long-Term Effects

The Orange Alternative would change some formal, legal recreation resources but would not affect the long-term use of these resources or others in the study area. Changes to the LHPS Canal and LN Canal would affect unauthorized recreation use, but this change is not expected to contribute to or cause cumulative effects related to the loss of a recreation feature or prevent establishing a trail system along the canal easements in the future. People living in

the area could still use existing legal trails and parks and could probably continue to access the canal easement.

5.2.5.5 Blue Alternative

The Blue Alternative would not pass through any existing designated recreation areas. This alternative would directly affect a section of the LN Canal maintenance road that has historically been used for unauthorized recreation use.

The reach of the LN Canal between Canyon Road and 600 East has historically been used for unauthorized recreation use such as hiking and bicycling along the canal and as a way to access the USU campus from the “Island” area. The City of Logan has identified the LN Canal maintenance road as a future trail but to date has not established a legal easement along the canal for this use. Constructing the Blue Alternative would repair the damaged segment of the existing canal maintenance road since it would repair the 2009 landslide site but would not construct a new designated recreation trail along the entire length of the canal.

If the City of Logan wants to establish a recreation trail in the future, it would need to coordinate with Cache County, UDOT, and the Logan & Northern Irrigation Company to design and construct the trail so that its use would be compatible with operation of the canal. The reconstructed reach of the canal could probably still be used for unauthorized recreation such as walking and bicycling.

Because this alternative would not affect the LHPS Canal, it would not affect the ongoing unauthorized recreation use of the LHPS Canal maintenance road.

Cumulative and Long-Term Effects

The Blue Alternative would not affect the long-term use of any formal, legal recreation resources in the study area. Changes to the LN Canal could affect unauthorized recreation use along the canal, but this change is not expected to contribute to or cause cumulative effects related to the loss of recreation features in the study area. People living in the area could still use existing legal trails and parks.

5.2.5.6 Summary of Impacts and Mitigation

The No-Action Alternative would not affect any recreation resources.

The Purple and Orange Alternatives would directly affect National Forest System land, unauthorized use of the LHPS Canal between the POD and the golf course, and the golf course and would cross over one existing trail in Logan (the Bonneville Shoreline Trail) and several proposed trail alignments in North Logan. Because the long-term effects would not

How would the Blue Alternative affect recreation?

The Blue Alternative would not affect any formal recreation resources and probably would not affect existing unauthorized use of the LN Canal easement between the LN Canal POD and 400 North for recreation.

change the way these recreation resources are used or accessed, these impacts are not significant. These alternatives would not preclude Cache County or the Cities from establishing legal trails along the LN and LHPS Canals in the future. They would also not affect long-term unauthorized access to or use of the canal easements until the legal trails are established.

The Blue Alternative would not affect any formal recreation resources and probably would not affect unauthorized use of the LN Canal easement between the LN Canal POD and 400 North for recreation.

5.2.6 Scenic Beauty and Landscape Resources

This section describes the expected impacts of the project alternatives on landscape resources in the study area, which includes Logan Canyon and part of Cache Valley. Most of Logan Canyon in the study area is managed by USFS as a part of the Uinta-Wasatch-Cache National Forest. Cache Valley in the study area is characterized by urban, suburban, and rural residential development associated with the cities of Logan and North Logan. Potential construction impacts to scenic beauty and landscape resources are discussed in Section 5.4.2.1, Community Resources, Quality of Life, Landscape Resources, and Scenic Beauty.

5.2.6.1 Laws, Policies, and Direction

The NRCS NEPA guidelines state that contributions to scenic beauty are a normal product of NRCS's work (Title 190, Part 410.24). The guidelines state that

NRCS will:

- (i) Provide technical assistance with full consideration of alternative management and development systems that preserve scenic beauty or improve the landscape.
- (ii) Emphasize the application of conservation practices having scenic beauty or landscape resource values.

The NRCS National Compliance Handbook reiterates the importance of emphasizing resource conservation practices that contribute to the attractiveness of the landscape while increasing agricultural efficiency and productivity (Title 190, Part 610.96).

The *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) contains a number of guidelines related to scenery management and to the management prescription categories that apply to National Forest System land in the study area. The Logan Ranger District has identified the following guidelines that should be considered for the proposed action:

- **Guideline 59.** Manage Forest landscapes according to Landscape Character Themes, and Scenic Integrity Objectives as mapped.
- **Guideline 60.** Resource-management activities should not be permitted to reduce Scenic Integrity below Objectives stated for Management Prescription Categories.

- **Guideline 61.** For management activities viewable from Concern Level 1 (defined site-specifically) scenic byways (viewshed corridors 0 to 4 miles) and use areas, travelways, and scenic backways (viewshed corridors less than 0.5 mile), apply the Landscape Character Theme in which the management activity occurs and apply a Scenic Integrity Objective of *high*.
- **Guideline 62.** For management activities viewable from Concern Level 2 (defined site-specifically) use areas and travelways (viewshed corridors less than 0.5 mile), apply the Landscape Character Theme in which the management activity occurs and apply a Scenic Integrity Objective of at least *moderate*. *Because there are no Concern Level 2 areas in the study area, this item does not apply.*
- **Guideline 63.** Duration of visual impacts to allow for herbaceous and woody plants are established will be determined during project planning by the following criteria:
 - Capability of the landscape to recover.
 - The relationship of management activity to the seen area of sensitive-use areas and travelways.
- **Guideline 64.** Establishment of herbaceous vegetation may extend to 3 years after project completion for foreground and middle ground in Concern Levels 1 and 2 use areas and travelways. Consider immediate initiation of reseeded in these areas where natural recovery is questionable.

Additionally, the *Revised Forest Plan* identifies Management Prescription Category direction for National Forest System land as follows:

- **Management Prescription Category 2.5, Scenic Byways:** Manage scenic byways to protect and maintain their outstanding scenic quality. Scenic byway corridor management plans may be developed for designated byways to further define desired conditions and tailor management direction.
 - **(G2.5-1)** Timber harvest, vegetation/fuel treatments, prescribed fire, and wildland fire use are allowed when these activities are necessary to maintain or enhance the scenic setting for the long term.
 - **(G2.5-2)** Grazing is allowed and managed for compatibility with other elements of scenic byway corridor management plans. *Because the proposed action does not include grazing, this item does not apply.*
 - **(G2.5-3)** Road building, new recreation development, and new trail construction are allowed for purposes of enhancing use and enjoyment of the scenic byway corridor while maintaining or enhancing the scenic setting. *Because the proposed action does not include any road building, new recreation development, or new trail construction, this item does not apply.*

- **Management Prescription Category 4.5, Developed Recreation Areas:** These areas include developed facilities such as campgrounds, trailheads, boat docks, and resorts under special-use permit as well as adjacent areas associated with these sites. High levels of visitor interaction can be expected where sights and sounds of others are noticeable and there are moderate to high opportunities for social interaction. Access to these areas is primarily by motorized roads with some trails. Visitors can expect higher levels of regulation. Signs and visitor information are noticeable throughout the area. Site development tends toward the Roaded Natural to Rural end of the recreation opportunity spectrum (ROS). Facilities vary from rustic using native materials to facilities designed primarily for visitor comfort or convenience and built using synthetic materials. Visitor impacts can be noticeable. Impacts to natural resources are dealt with through various management techniques and regulations. Management visibility is high with managers focusing on public safety, service, education, user ethics, and enforcement. Americans with Disabilities Act (ADA)-level development is encouraged. Because of the large capital investments in these areas, site protection is paramount. *Because the proposed action does not include establishing new developed recreation areas, this item does not apply.*

Consistency with these guidelines as they pertain to construction activity is addressed in Section 5.4.2.1, Community Resources, Quality of Life, Landscape Resources, and Scenic Beauty.

5.2.6.2 No-Action Alternative

The No-Action Alternative would not change the existing scenic characteristics of the study area or affect the landscape. However, the scenic beauty of the area around the LN Canal downstream of the Laub Diversion would be reduced because the canal would be abandoned and would not carry irrigation water. Although features such as the landforms and major vegetation types along the canal would not be affected by this alternative, the aesthetic value of the canal would be diminished for local residents and recreational users because water would no longer flow in the canal.

The 2009 landslide area would not be repaired and would remain visible to residents and people traveling through the area. Many residents feel that the landslide site adversely affects the landscape and scenic quality of the adjacent area along Canyon Road.

Because the No-Action Alternative would not restore irrigation water delivery, the uses of land that had been irrigated using canal water could change. Areas that were historically used for agricultural production, a use that contributes to the scenic character of Cache Valley, might be developed into other, less scenic uses such as residential development.

5.2.6.3 Purple and Orange Alternatives

The direct impacts to landscape resources from the Purple and Orange Alternatives would be similar; only the extent of the impacts would be different. These alternatives would directly affect the vegetation and flowing water elements of scenic beauty for residents and recreational users by enclosing sections of both the LHPS and LN Canals into either box culverts or pipes and by removing vegetation and trees along the canal banks. While these changes would not increase scenic beauty or landscape resource values, they would not significantly change the way the areas look from a distance. The changes would be most noticeable to people living along the canals.

Converting the segment of the LN Canal between 400 North and 1500 North for the Purple Alternative and between 400 North and 2900 North/3100 North for the Orange Alternative to a pipe in the existing maintenance road would not affect the existing canal structure. This reach of the canal would remain open and would still be used for conveying stormwater. Keeping this reach open might allow the area to retain some aesthetic value for residents.

The Purple and Orange Alternatives would require work on National Forest System land in Logan Canyon. As described in Section 4.3.5.1, Logan Canyon (National Forest System Land), USFS considers the Landscape Character Theme of that part of the study area to be *Developed Natural Appearing* and the Scenic Integrity Objective to be *high*. The Management Prescription Categories for this area are 2.5, *Forest Service Scenic Byways*, and 4.5, *Developed Recreation Areas*. USFS has designated this corridor as *Concern Level 1 (Scenic Byways)* with a viewshed corridor of 1 to 4 miles (USFS 2003). Enclosing the LHPS Canal through the canyon would affect scenic beauty for only a short distance of the canal where it can be seen just downstream of the LHPS Canal POD. The box culvert would be placed within the current canal, which is above the road, so the change would not be apparent to the casual observer on US 89 or on the Riverside Trail that follows the Logan River on the south side of the canyon.

According to the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003), mechanical treatments such as canal easement maintenance in *Developed Natural Appearing* areas with a high Scenic Integrity Objective should mimic natural-appearing lines, forms, and edges found in the landscape. Because the LHPS Canal would be on a rocky hillside above the road, would follow the hillside contour, and would be visible at only few points to people using US 89, regular maintenance of the easement is not expected to affect the scenic integrity of this part of the canyon and would be consistent with the landscape character. Routine maintenance would have temporary effects that would be most visible during and immediately after the maintenance activity. However, since most of the easement area that

How would the Purple and Orange Alternatives affect scenic beauty and landscape resources?

The Purple and Orange Alternatives would modify the LHPS Canal, a change that would be noticeable to people living along the affected canal reach. Removing the structures from 14 properties would affect the appearance of the affected area.

would be maintained would not be visible from the scenic byway and most of the vegetation that would be affected is herbaceous and would quickly recover, this type of temporary effect is not expected to significantly affect the scenic quality of the area. Routine maintenance would not affect the scenic quality of the byway.

The box culvert placed in the LHPS Canal would be placed below grade along most of the alignment. Because of this, distant views of the canal would not be affected. However, people viewing the canal from points along the canal would see something different from what they are used to. People using the golf course and people living along the canal would experience the most substantial effects. The golf course operator and some landowners have incorporated the canal into their landscaping and feel that it enhances scenic quality. Comments received during scoping indicate that many people feel that converting the LHPS Canal to a box culvert and covering it would reduce the scenic quality of land along the canals.

Both the Purple and Orange Alternatives include purchasing structures on 14 properties along the LN Canal between about 750 East and 1100 East. NRCS and the SLO would demolish the structures and revegetate the affected area to prevent soil erosion. The affected area would not be landscaped, and the 2009 landslide site, which is located in the same area, would not be repaired. People who would be relocated and who feel attached to the visual quality of their properties and the canal could experience a substantial negative effect. However, relocating these residents would be necessary to ensure their safety. Removing these structures would affect the landscape of the area and possibly the scenic quality for people living on the south side of Canyon Road. These residents might feel that the change is positive or negative. The change in the landscape would be substantial for people living directly across Canyon Road from the area between about 750 East and 1100 East.

The biggest difference between the two alternatives is the extent of the impacts, with the Orange Alternative enclosing a greater distance of the LHPS Canal in a box culvert (4.9 miles for the 2900 North option or 5.2 miles for the 3100 North option) and enclosing a greater distance of pressure pipe along the LN Canal (about 3.4 miles). Both alternatives would affect residents of Logan, but only the Orange Alternative would also affect residents of North Logan and unincorporated Cache County. The changes to the LHPS Canal would affect the scenic beauty of not only the flowing waterways but also the vegetation that would likely be removed during construction. For further discussion of the impacts to local residents, see Section 5.2.2, Quality of Life.

Cache County has indicated that it intends to consider options for developing a greenway with a trail along the canal system in the future. The County does not have formal plans for this linear park but has stated that it would use the canals to provide water for low-flow irrigation to sustain landscaping. This greenway would return much of the lost aesthetic value of the current canal.

Cumulative and Long-Term Effects. The Purple and Orange Alternatives would change the way the LHPS Canal looks to people crossing over the canal, living along the canal, or engaging in recreation near the canal (such as at the golf course or Lundstrom Park). Recent

residential development in the area has gradually changed the landscape, including land along the canals. The modifications to the LHPS Canal proposed as part of the Purple and Orange Alternatives would add to the ongoing regional change. The landscape would continue to change even without the proposed action, but changes to the canal system would be unlikely without the proposed action. Because regional landscape changes would likely continue without the proposed action and because of the minor and subjective nature of the proposed action's effect on scenic beauty and the landscape, the proposed action is not expected to cause or contribute to an adverse cumulative effect. Some people who live along or spend time near the LHPS Canal might feel that the change would reduce the long-term scenic quality of the canal.

5.2.6.4 Blue Alternative

The Blue Alternative would change the way the LN Canal looks between the LN Canal POD just below First Dam and about 400 North. The Blue Alternative would not affect the LHPS Canal or the LN Canal downstream of 400 North.

The visual features of both flowing water and vegetation would be affected by this alternative, since the existing open-water canal structure and the surrounding vegetation would be removed and replaced with a buried pipe and stormwater channel. Constructing the soil buttress would also substantially change the way the slope below the LN Canal easement would look in Zone 2, which is between about 750 East and 1100 East (Section 3.2.4, Blue Alternative: Reconstruct LN Canal).

This alternative would affect the visual quality for residents of the area near this segment of the canal or for people passing through the area.

The Blue Alternative also includes purchasing structures on 14 properties that are between the existing LN Canal and Canyon Road in Zone 2. People who would be relocated and who feel attached to the visual quality of their properties and the canal could experience a substantial negative effect. However, relocating these residents would be necessary to ensure their safety. Removing these structures would affect the landscape of the area and possibly the scenic quality for people living on the south side of Canyon Road. These residents might feel that the change is positive or negative. The change in the landscape would be substantial for people living directly across Canyon Road from the area between about 750 East and 1100 East.

The biggest visual benefit associated with the Blue Alternative is that it would repair the 2009 landslide site, which has not been modified since the 2009 landslide. After construction, disturbed areas would be reseeded to establish a ground cover. This would improve the postconstruction appearance of some of the area, but the scenic beauty of the area along the

How would the Blue Alternative affect scenic beauty and landscape resources?

The Blue Alternative would modify the LN Canal between the POD and 400 North, a change that would be noticeable to people living along this reach. Removing the structures from 14 properties and constructing a buttress wall would significantly affect the appearance of this area.

canal might not return to pre-landslide conditions with mature vegetation unless the City of Logan or Cache County develops a formal trail along the canal and establishes and maintains a more scenic corridor.

Cumulative and Long-Term Effects. The Blue Alternative would change the historic scenic quality and landscape of the area along the LN Canal. This area has not changed much in recent years, and people living in the area might feel that the project-related changes would reduce the long-term scenic quality of the immediate area. The changes are not expected to have regional effects to the landscape or scenic quality of Cache Valley. Other areas of the valley would continue to change as development continues and as rural areas are converted to suburban and urban uses. Changes to the Logan Bluff would alter the appearance of the area between about 750 East and 1100 East, but this change would not affect the overall scenic beauty of the region. However, because the expected effects would be minor and subjective, the proposed action is not expected to cause an adverse cumulative effect. Some people who live along or spend time near the LHPS Canal might feel that the change would reduce the scenic quality of the canal in the long term.

5.2.6.5 Summary of Impacts and Mitigation

The No-Action Alternative would not substantially affect the scenic beauty of the study area or change the landscape. Under this alternative, the LN Canal would not be used for delivering irrigation water, so some residents might feel that the scenic quality of the area along the canal is reduced because water would not flow during the irrigation season.

The Purple and Orange Alternatives would permanently change the LHPS Canal, and the Blue Alternative would permanently change the LN Canal. These changes would be most noticeable to people living along the affected reaches of the canals and to people who regularly pass over the canal. Cache County plans to consider options to develop linear parks along the canals in the future but currently has no definite plans or funding for any improvements. Because of the expected changes and uncertainty of future improvements, these potential impacts might be considered significant by the landowners who live along the canals but are not regionally significant.

All of the action alternatives include removing structures from 14 properties along Canyon Road in Logan between about 750 East and 1100 East. Because the structures would be demolished and the area would not be landscaped, people directly affected by the removal (residents of acquired structures and people living very near the area) would be significantly affected by the way the area looks. Cache County could work with the City of Logan to restore the landscape, but neither party has expressed an intent to install landscaping or otherwise restore the site.

These impacts are unavoidable. No mitigation is proposed.

5.2.7 Energy

This section discusses the expected effects of the project alternatives on power requirements and power generation. Construction impacts on energy are discussed in Section 5.4.2.5, Energy.

5.2.7.1 Laws, Policies, and Direction

Section 610.54 of the NRCS National Environmental Compliance Handbook states that an EIS should review the energy requirements and conservation potential of the proposed alternatives.

5.2.7.2 No-Action Alternative

Power Requirements of Pumping Canal Water. Under the No-Action Alternative, water delivery would not be restored to the existing LN Canal. Before the 2009 landslide, some shareholders had changed the way they delivered irrigation water to their properties and were using pumps to operate sprinkler systems instead of gravity flow-based flood irrigation systems. Under the No-Action Alternative, shareholders who had converted to sprinkler irrigation systems would not be using pumps, so the energy that these shareholders historically used to pump water would not be required.

Under this scenario, some shareholders might switch to using culinary water for irrigation, which could require the construction of new facilities to deliver the water on private properties. Existing providers of culinary water would provide this new service, although many of the affected shareholders already have culinary water connections. If new facilities were required to serve new customers, constructing such facilities would result in short-term energy use during the building phase and would result in long-term energy requirements at large water treatment, water storage, and water delivery facilities.

The operation of new facilities would contribute to the cumulative increase in power generation already associated with regional growth. Because many of the affected shareholders already have culinary water connections, only some shareholders might need to connect to culinary systems. Shareholders who are currently using groundwater might or might not need to establish a new culinary water connection.

These scenarios are speculative, and the irrigation companies do not currently plan to access other water sources to serve their shareholders.

Power Generation by Logan City Light and Power. The No-Action Alternative would not affect the amount of water available for hydroelectric power generation by Logan City Light and Power.

5.2.7.3 Purple Alternative

Power Requirements of Pumping Canal Water. The Purple Alternative would re-establish the permanent delivery of water to LN Canal shareholders. Shareholders who take water between the LN Canal POD and the Laub Diversion would receive water from a separate, gravity-flow pipeline. If these users have converted to sprinkler irrigation systems, they would continue to use pumps to extract water. Installing the new gravity-flow line would not affect energy use along this reach of the canal or result in any indirect energy effects in the area.

Shareholders using sprinkler irrigation systems on the LN Canal downstream of about 1500 North would continue to pump water, so the Purple Alternative would not change the amount of energy used along that part of the canal. Most of the LN Canal shareholders upstream of 1500 North use flood irrigation systems. Converting the reach of the LN Canal between 400 North and 1500

North would provide an opportunity for shareholders to change to sprinkler irrigation systems, since the new pipeline would be under pressure. However, because these shareholders do not currently use large amounts of energy to extract water, the change to sprinkler irrigation would not substantially affect energy use in this reach.

LHPS Canal shareholders currently take water from the LHPS Canal using gravity systems and pump systems. The box culvert would be designed to accommodate either type of system. Because the box culvert would not be under pressure, LHPS Canal shareholders currently using gravity flow-based flood irrigation who would like to change to sprinkler systems would still need to use pumps to deliver water to their properties. Installing the box culvert would not change the way shareholders currently extract water or change the way shareholders wishing to convert from flood to sprinkler irrigation would extract water.

This alternative would not affect energy use associated with how shareholders take water from either the LN Canal or the LHPS Canal.

Power Generation by Logan City Light and Power. Under the Purple Alternative, the LN Canal shares previously diverted just below First Dam would instead be diverted upstream just below Second Dam at the LHPS Canal POD. As described in Section 4.3.6, Energy, Logan City Light and Power currently takes water for use at Hydro 2 at Second Dam, upstream of the LHPS Canal POD. In the past, Logan City Light and Power diverted the water and returned it to the river at First Dam, upstream of the point where the LN Canal shares were diverted.

This alternative would require a change in the Logan & Northern Irrigation Company's water rights to move up to 60 cfs from the LN Canal POD to the LHPS Canal POD. This change

How would the Purple Alternative affect energy?

The Purple Alternative could have minor energy conservation benefits if shareholders choose to use the pressurized line along the LN Canal between 400 North and 1500 North to deliver water to their properties in place of pumping. The Purple Alternative could affect power generation at the Logan City Light and Power Hydro 2 facility if the City and the Logan & Northern Irrigation Company do not reach an agreement regarding flows for each party's use.

could affect Logan City Light and Power's hydropower generation because it would have to bypass water from Second Dam. The amount of water that would need to flow past Second Dam would depend on conditions in the Logan River and would range from zero to 60 cfs. This amount of water (60 cfs) can generate about 1,000 kW at Hydro 2, which is about 1% of the City of Logan's peak summer demand.

Logan City Light and Power and the Logan & Northern Irrigation Company are currently negotiating an agreement to address the potential loss in power generation capability if the water historically diverted into the LN Canal is permanently diverted at the LHPS Canal POD and is unavailable for diversion by the City or changes the City's diversion scheduling. Water rights regulations would ensure that both water rights holders—Logan City Light and Power and the Logan & Northern Irrigation Company—receive the water associated with their water rights or agree to compensation or operating changes that would avoid or minimize adversely impairing a water right. The parties are identifying how and when to regulate flows and potentially offset costs.

The final agreement would describe the acceptable conditions for both parties. Once this agreement is finalized, the Purple Alternative would not affect power generation. However, because an agreement is not in place, the Purple Alternative could reduce power generation by up to 1,000 kW if the water historically available to the City is diverted at the LHPS Canal POD.

Cumulative and Long-Term Effects. The Purple Alternative would not result in any energy savings, so it would not contribute to ongoing energy conservation over the 50-year life span of the proposed action. Because the Logan, Hyde Park and Smithfield Canal Company, which operates the LHPS Canal, is not expected to establish new diversions from its canal system in the study area during the next 50 years, pumping operations associated with the reach of the canal between the POD and Lundstrom Park are not expected to increase in the long term.

If it is finalized, the agreement between Logan City Light and Power and the Logan & Northern Irrigation Company would ensure that the permanent change in the POD would not result in significant long-term or cumulative effects related to lost power generation. If the agreement between Logan City Light and Power and the Logan & Northern Irrigation Company is not finalized and Logan City Light and Power is unable to generate its historic levels of electricity, other regional power suppliers could probably produce enough energy to make up the difference. Regardless, if the agreement is not finalized, the loss of power-generation capability over a 6-month period associated with 60 cfs is not expected to cause or contribute to cumulative power shortages in the region.

5.2.7.4 Orange Alternative

Power Requirements of Pumping Canal Water. The Orange Alternative would re-establish the permanent delivery of water to LN Canal shareholders. As with the Purple Alternative, shareholders who take water between the LN Canal POD and the Laub Diversion would receive water from a separate, gravity-flow pipeline. If these users have converted to sprinkler irrigation systems, they would continue to use pumps to extract water. Installing the new gravity-flow line would not affect energy use along this reach of the canal or result in any indirect energy effects in the area.

As with the Purple Alternative, the new pressure pipe between 400 North and 1500 North would provide an opportunity for LN Canal shareholders along this reach to change to sprinkler irrigation systems. However, because these users do not currently use much energy to extract water, the change to sprinkler irrigation would not affect energy use in this reach.

The Orange Alternative differs from the Purple Alternative for shareholders along the LN Canal downstream of 1500 North. The Orange Alternative would allow LN Canal shareholders between 1500 North and either 2900 North or 3100 North who take their water using pumps to take their water from a pressurized system and eliminate energy use associated with pump operation. Canal company representatives estimate that shareholders along this reach of the LN Canal use about 1,000 horsepower (hp) for 8 hours per day during the 6-month irrigation season (HDR Engineering, Inc. 2010). Converting to a pressure-based sprinkler system would result in an energy savings as follows:

Where 1,000 hp equals 746 kW, 8 hours of pumping per day requires 5,968 kWh
(746 kW × 8 hours)

Not using the 5,968 kWh would result in energy savings of about 179,040 kWh per month for the 6-month period, or 1,074,240 kWh total for the entire irrigation season

In Utah, the average home uses about 792 kWh per month (U.S. Energy Information Administration 2010). The energy saved over the 6-month irrigation season could be used to provide power to about 226 homes per month for the 6-month period, or about 113 homes per month for a calendar year (assuming that a 6-month savings of 1,074,240 kWh is spread over 12 months instead of 6 months). This energy savings is a significant benefit of the Orange Alternative.

LHPS Canal shareholders currently take water from the LHPS Canal using gravity systems and pump systems. The box culvert would be designed to accommodate either type of

How would the Orange Alternative affect energy?

The Orange Alternative could have substantial energy savings because shareholders could use the pressurized line along the LN Canal between 1500 North and 2900 North/3100 North to deliver water to their properties instead of using pumps. The Orange Alternative could affect power generation at the Logan City Light and Power Hydro 2 facility if the City and the Logan & Northern Irrigation Company do not reach an agreement regarding flows for each party's use.

system. Because the box culvert would not be under pressure, LHPS Canal shareholders who are currently using gravity flow–based flood irrigation and who would like to change to sprinkler systems would still need to use pumps to deliver water to their properties. Installing the box culvert would not change the way shareholders currently extract water or change the way shareholders who want to convert from flood to sprinkler irrigation would extract water.

Power Generation by Logan City Light and Power. The power-generation effects of the Orange Alternative would be the same as those of the Purple Alternative.

Cumulative and Long-Term Effects. The Orange Alternative would result in energy savings during the 6-month irrigation season. This savings would contribute to ongoing regional energy conservation efforts and provide a long-term benefit.

Because the Logan & Northern Irrigation Company is not expected to establish new diversions from its canal system in the study area during the next 50 years, pumping operations associated with the reach of the LN Canal between 1500 North and either 2900 North or 3100 North are not expected to increase in the long term.

The cumulative and long-term effects on power generation would be the same as those from the Purple Alternative.

5.2.7.5 Blue Alternative

Power Requirements of Pumping Canal Water. The Blue Alternative would re-establish the permanent delivery of water to LN Canal shareholders. Shareholders along most of the section of the LN Canal that would be converted to piped flow would receive water from a separate, gravity-flow pipeline. The way that shareholders would take water from the LN Canal along the short reach between the LN Canal POD and 400 North would not change.

Because the LN Canal downstream of the point where the new pipeline would discharge to the existing LN Canal (about 400 North) would not change, energy use by downstream users would not change. The Blue Alternative would not affect power requirements for shareholders.

Power Generation by Logan City Light and Power. Similar to the No-Action Alternative, the Blue Alternative would not affect the amount of water available for hydroelectric power generation by Logan City Light and Power.

Cumulative and Long-Term Effects. Because the Blue Alternative would not affect energy use or conserve energy, it would not affect long-term energy use or conservation or contribute to regional cumulative effects related to energy use or conservation.

How would the Blue Alternative affect energy?

The Blue Alternative would not affect energy use or power generation at the Hydro 2 facility.

5.2.7.6 Summary of Impacts and Mitigation

The No-Action and Purple Alternatives would have minor energy-conservation benefits, but the No-Action Alternative could also require new energy sources in order to convert users to culinary water service. The Orange Alternative would result in energy savings because LN Canal shareholders between 400 North and either 2900 North or 3100 North would no longer need to pump water from the canal. The Blue Alternative would not affect energy use or conserve energy.

The No-Action and Blue Alternatives would not affect the ability of Logan City Light and Power to generate power at its Hydro 2 plant on the Logan River. The Purple and Orange Alternatives could affect hydropower generation, but an agreement between the City and the Logan & Northern Irrigation Company would ensure that adverse effects are minimized or that the City is compensated for the loss of hydropower generation.

No mitigation is proposed.

5.3 Natural Resources

This section describes the environmental consequences that each alternative would have on natural resources. Section 5.4.3, Natural Resource Environment, summarizes the construction impacts associated with each alternative. The impact analysis area for each resource is the alternative alignment and the parts of Logan and North Logan that are immediately adjacent to the alignments.

5.3.1 Agriculture

This section describes the consequences of constructing and operating the project alternatives on agricultural production and farmland. The primary concerns related to agriculture are interruptions to or changes in production, conversion of farmland to nonagricultural use, and the availability of water shares for agricultural use. Construction impacts to agriculture are discussed in Section 5.4.3.1, Agriculture.

5.3.1.1 Laws, Policies, and Direction

Section 610.54 of the NRCS National Environmental Compliance Handbook states that the EIS should review the environmental effects of the proposed action and alternatives on agricultural production and farmland. Section 610.94 states that NRCS shall use the criteria provided in the Farmland Protection Policy Act (FPPA) to identify and take into account the adverse effects of Federal actions.

Farmland Protection Policy Act (FPPA)

The purpose of the FPPA of 1981 is to minimize the extent to which Federal programs contribute to the irreversible conversion of farmland to nonagricultural uses and to ensure that Federal programs are administered in a manner that is compatible with State and local government and private farmland protection programs and policies. The FPPA directs Federal agencies to consider the effects of Federal programs or activities on farmland. The agencies are to consider alternative actions, as appropriate, that could lessen such adverse effects and ensure that such Federal programs, to the extent practicable, are compatible with State, local, and private farmland protection programs and policies.

NRCS is the Federal agency responsible for overseeing compliance with the FPPA. NRCS has stopped determining whether land that is already committed to development within city limits qualifies as prime farmland, unique farmland, or farmland of statewide or local importance. NRCS’s position is that, when funds have already been committed for utilities, water lines, and road replacement and widening, the land is committed to development and can be exempt from such a determination.

What is the Farmland Protection Policy Act (FPPA)?

The *Farmland Protection Policy Act* is intended to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. None of the alternatives would affect land regulated under the FPPA.

Agriculture Protection Areas (APAs)

Utah law does not specifically protect agricultural land from development, but one of the purposes of Utah’s zoning law is to support the state’s agriculture. Zoning is accomplished by a commission for each county that adopts a plan for zoning all land within the county. Utah law also allows the formation of APAs, which are geographic areas where agricultural activities are given special protections.

APAs are protected from State and local laws that would restrict farm practices, unless the regulations are required for public safety or are required by Federal law. The government of the county in which the APA is located cannot change the zoning designation of the land within the area unless all landowners give written approval for the change. According to Cache County, there are no APAs in the study area.

What are Agriculture Protection Areas (APAs)?

Agriculture Protection Areas are geographic areas where agricultural activities are given special protections.

Cache County Agricultural Advisory Board

The mission of the Cache County Agricultural Advisory Board is to facilitate the development of programs that can be implemented by the Cache County Council and Planning Commission to strengthen the agricultural economy and minimize the conversion of

farmland to urban uses (Cache County Agricultural Advisory Board 2002). The Advisory Board does not have any regulatory authority, but its policies are considered by the County Council and Planning Commission during their decision-making processes.

5.3.1.2 No-Action Alternative

Under the No-Action Alternative, water delivery would not be restored to the existing LN Canal, which means that shareholders who historically used water delivered through the canal for agriculture would no longer have access to this water. In addition, the temporary water-delivery systems used in the 2009 and 2010 irrigation seasons (described in Section 2.1.2.2, Operation of the LN and LHPS Canals) would not be used under the No-Action Alternative. Consequently, irrigation water that historically has been diverted into the canal system and conveyed from the LN Canal POD would not be available during the irrigation season. (The canal would remain, but it would not be used for conveying irrigation water.)

Water shareholders who historically diverted water for irrigation purposes would need to irrigate from other sources, farm nonirrigated crops, or stop farming altogether. Under this alternative, some shareholders might switch to using culinary water for irrigation, especially since many of the affected shareholders already have culinary water connections. This would be a likely choice for urban water users in the study area, who account for the largest amount of water use in the study area.

However, using culinary water for irrigation is not a likely choice for small independent or large farming operations because of the logistics associated with establishing a new system and because using culinary water would be very expensive. Without irrigation water available from other sources or the option to farm nonirrigated crops, land in the study area would likely be converted over time from agricultural uses to urban and nonagricultural uses.

These scenarios, as described above, are speculative, and the Logan & Northern Irrigation Company does not currently plan to access other water sources to serve its shareholders.

5.3.1.3 Purple Alternative

The Purple Alternative would directly affect land that is currently farmed near the proposed pipeline route between the LHPS Canal and the LN Canal at about 1500 North. This alternative would cause the permanent loss of about 0.3 acre of irrigated farmland. The proposed pipeline corridor would travel along a property line that separates two farmed areas, one of which is actively farmed for alfalfa and one of which is used by USU for educational purposes. The pipeline would not bisect any existing farms.

Some shareholders living along the reaches of the LHPS and LN Canals that would be affected by this alternative use their shares to water vegetable gardens. The Purple Alternative would enable these shareholders to continue this use of their water.

How would the Purple Alternative affect agriculture?

The Purple Alternative would cause the loss of about 0.3 acre of irrigated farmland.

The Purple Alternative would re-establish the permanent delivery of LN Canal water to shareholders, so all shares of the LN and LHPS Canals used for agricultural production would again be available for irrigation use.

Cumulative and Long-Term Effects. NRCS recognizes that the cumulative conversion of agricultural land to nonagricultural uses is an issue of national concern. Because the loss of farmland under the Purple Alternative would not be significant and most of the affected areas could still be farmed after construction, this change is not expected to contribute to the cumulative, regional loss of agricultural land. The temporary impacts are not expected to cause any long-term agricultural production impacts, since the affected land could continue to be used for agricultural production.

5.3.1.4 Orange Alternative

The Orange Alternative would directly affect land that is currently farmed near the proposed pipeline routes between the LHPS Canal and the LN Canal at either 2900 North or 3100 North. This alternative would permanently affect 3.0 acres of irrigated farmland and 0.1 acre of nonirrigated farmland. Because the pipeline along 2900 North would follow existing property lines, it would not bisect any active farming operations.

How would the Orange Alternative affect agriculture?

The 2900 North option would cause the loss of about 3.0 acres of irrigated farmland and about 0.1 acre of nonirrigated farmland. The 3100 North option would not cause the loss of any farmland.

Like the Purple Alternative, the Orange Alternative would restore the delivery of irrigation water to shareholders of the LN and LHPS Canals. The Orange Alternative also would not affect the ability of shareholders living along the reaches of the LHPS and LN Canals to water vegetable gardens.

Cumulative and Long-Term Effects. The cumulative and long-term effects of the Orange Alternative would be the same as those of the Purple Alternative.

5.3.1.5 Blue Alternative

The area along the Blue Alternative does not support any farmland or agricultural uses. Because of this, the alternative would not permanently affect farmland.

How would the Blue Alternative affect agriculture?

The Blue Alternative would not affect any farmland.

Some shareholders living along the reach of the LN Canal that would be affected by this alternative use their shares to water vegetable gardens. The Blue Alternative would not affect these water supplies.

Like the Purple and Orange Alternatives, the Blue Alternative would restore the delivery of irrigation water to shareholders of the LN and LHPS Canals.

Cumulative and Long-Term Effects. Because the Blue Alternative would not affect agricultural production or farmland, it would not cause or contribute to any cumulative or long-term adverse impacts to agriculture.

5.3.1.6 Summary of Impacts and Mitigation

The Purple and Orange Alternatives would have minor temporary and small permanent impacts to farmland but would not have any significant, long-term effects. The Blue Alternative would not affect agriculture. No mitigation is proposed.

5.3.2 Biological Resources

This section describes the expected long-term or permanent impacts of the project alternatives on biological resources. Construction impacts to biological resources are discussed in Section 5.4.3.2, Biological Resources. Threatened, endangered, and special-status species are discussed in Section 5.3.3, Special-Status Species.

5.3.2.1 Laws, Policies, and Direction

Table 5-1 lists the regulatory authorities for biological resources and regulated activities that are relevant to this proposed action.

Table 5-1. Regulatory Authorities for Biological Resources

Regulatory Authority	Implementing Agency(ies)	Regulated Activities or Resources
Fish and Wildlife Coordination Act (16 USC 661–667e)	USFWS, Utah Division of Wildlife Resources	Construction or activities that would affect surface waters
Bald and Golden Eagle Protection Act (16 USC 668a–d)	USFWS	Those that affect either bald or golden eagles in any way
Migratory Bird Treaty Act (16 USC 703–712)	USFWS	Those that affect migratory birds and their nesting
Utah Noxious Weed Act (Sections 4-2-2 and 4-17-3)	Utah Department of Agriculture and Food	Activities that could spread noxious weeds

NRCS is currently coordinating with USFWS and the Utah Division of Wildlife Resources under the Fish and Wildlife Coordination Act.

The *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) contains a number of policies, standards, and guidelines related to biological resources. The Logan Ranger District has identified the following policies and guidelines as being applicable to the proposed action. Consistency with some of the guidelines is addressed in Section 5.4.3.2, Biological Resources.

Policies

- **Policy 3a.** Maintain or restore the viability of populations of species at risk, Watch List Plants, and rare communities.
- **Policy 3f.** Maintain or restore species composition such that the species that occupy any given site are predominantly native species in the kind and amount that were historically distributed across the landscapes.
- **Policy 3i.** Maintain the viability of species at risk (including endangered, threatened, and sensitive species and unique communities).
- **Policy 3n.** Maintain or restore aquatic and riparian habitats through recognition and management of RHCAs for metapopulations of cutthroat trout, recognizing the relative degree to which these fish depend on National Forest System land and the conditions of these habitats outside the forest.
- **Policy 3q.** In revegetation projects, establish a variety of native species (avoid monocultures).
- **Policy 3s.** Greatly reduce known infestations of noxious weeds and rigorously prevent their introduction and/or spread.

What is viability?

Viability is the ability of biodiversity values or species in an area to persist for many generations or over long periods of time.

What are metapopulations?

Metapopulations are spatially separated subpopulations of wildlife that are separated by geography and linked by dispersal.

Guidelines

- **Guideline 6.** In RHCAs when projects are implemented, retain natural and beneficial volumes of large woody debris.
- **Guideline 8.** In stream channels, naturally occurring debris shall not be removed unless it is a threat to life, property, or important resource values or is otherwise covered by legal agreement.
- **Guideline 12.** Locate new actions (such as incident bases, fire-suppression camps, staging areas, livestock-handling facilities, recreation facilities, roads, and improvements including trails) outside of RHCAs. If the only suitable location for such actions is within RHCAs, sites will be located to minimize resource impacts.
- **Guideline 13.** Any long-term crossing of stream channels containing fish habitat will provide for desirable aquatic passage. *Because no long-term stream crossings are proposed as part of any of the alternatives, this item does not apply.*

- **Guideline 22.** Use native plant species, preferably from genetically local sources (harvesting seed from a project area's native species prior to project implementation), in revegetation efforts to the extent practicable. If no native seed of suitable origin is available, then certified weed-free, non-persistent non-natives may be used.
- **Guideline 25.** Integrated weed management should be used to maintain or restore habitats for threatened, endangered, proposed, and sensitive plants and other native species of concern where they are threatened by noxious weeds or non-native plants. When treating noxious weeds, comply with policy in Intermountain Region's Forest Service Manual 2080, *Supplement #R4 2000-2001-1*.
- **Guideline 29.** Avoid disruptive management activities in elk calving areas, elk spring-use areas, and bighorn sheep lambing areas from May 1 through June 30. *Since no elk calving, elk spring-use, or bighorn sheep lambing areas overlap with any of the alternatives' footprints, this item does not apply.*
- **Guideline 30.** Avoid disruptive management activities (not public recreation activities) on deer, elk, mountain goat, and bighorn sheep winter range from November 15 through April 30. *Since no mountain goat or bighorn sheep winter range has been designated in the study area, this item does not apply for those species.*
- **Guideline 44.** When constructing and reconstructing roads, trails, and facilities, minimize potential effects on habitat of plant species at risk and key big-game winter and spring ranges.
- **Guideline 45.** Access routes for heavy equipment should be selected to limit disturbance to riparian vegetation and to limit the number of stream crossings.

5.3.2.2 No-Action Alternative

Under the No-Action Alternative, existing seepage from the LHPS Canal would continue to provide water for vegetation on the banks of the canal. The vegetation along most of the LHPS Canal would also likely be unaffected unless it is disturbed by land owners or the irrigation company. Vegetation along the banks of the entire LN Canal could be affected under the No-Action Alternative because that canal would no longer flow with irrigation water, only with stormwater. Because the Logan Bluff would remain susceptible to future landslides, vegetation wildlife habitat along the bluff area might be at risk of damage as a result of landslides. The 2009 landslide area would not be repaired, so vegetation wildlife habitat in the landslide area would remain compromised.

Under this alternative, the Logan & Northern Irrigation Company would abandon the LN Canal downstream of the Laub Diversion and would cease maintenance of the canal and easement. This could allow the spread of noxious weeds from the unmaintained area into adjacent areas.

5.3.2.3 Purple Alternative

Effects on General Habitat, Vegetation, and Wildlife

Wildlife Habitat. Under the Purple Alternative, impacts to wildlife habitat would occur primarily at the LHPS Canal POD below Second Dam in Logan Canyon.

The effects of enclosing the canal on general wildlife habitat are not considered to be significant for two reasons. First, these canals are artificial structures built about 100 years ago for the purpose of agricultural irrigation in an area that previously had the wildlife habitats of arid, upland grasslands and shrublands in the benches and foothills. Since the canals were constructed, wildlife such as ducks, mule deer, and raccoons have taken advantage of the summertime flowing water and the immediately surrounding vegetation provided by the canals.

However, until the canals were built, these species' needs for water and habitat were satisfied by the existing canyons, rivers, and valley wetlands (which still satisfy these needs because the rivers, streams, and wetlands that existed before settlement still exist and provide adequate function to wildlife today). Currently, the open canal system is a barrier to wildlife movement during the irrigation season. Enclosing the LHPS Canal in a box culvert would remove this barrier.

Second, the Purple Alternative would enclose the most urbanized part of the LHPS Canal, which provides a limited strip of habitat for the most urban-adapted of the area's wildlife species. Urban-adapted species such as mule deer, mallards, raccoons, magpies, and starlings would continue to use the remaining urban habitats (such as parks and residential landscaping) that would likely be maintained in the future regardless of the continued existence of the open canal. Because the LN Canal would be kept open and used only for stormwater, some water from seeps and springs would likely be available for wildlife use as it is now.

Riparian Vegetation. The new LHPS Canal POD structure on the Logan River would directly affect riparian vegetation in a Category 1 RHCA. In addition, some woody debris might need to be removed to accommodate the new structure, and regular maintenance of the POD structure would require removing woody debris that blocks or might block the POD intake. Regular maintenance is required to ensure that blockages do not cause flooding, which could damage US 89 or the recreation trail on the left side (looking downstream) of the river. NRCS expects that most woody debris removed would not be large, so this regular maintenance of the POD structure would not significantly affect the overall amount of large woody debris in the river.

How would the Purple Alternative affect biological resources?

The Purple Alternative would cause the permanent loss of riparian vegetation at the LHPS Canal POD, potential entrapment of fish at the LHPS Canal POD, permanent loss of vegetation along the LHPS Canal between the golf course and Lundstrom Park, and loss of use of the open canal by locally common wildlife during the irrigation season between the POD and Lundstrom Park.

The new POD structure would be in the same location as the existing POD structure in the Logan River RHCA. The new structure must be placed on the river in the RHCA, so an alternative location outside the RHCA is not feasible. By placing the new structure in the same location as the existing structure, impacts would be limited to previously disturbed areas and would not require removing large areas of riparian vegetation.

Removing riparian vegetation and replacing the POD structure would not affect the overall integrity of the Logan River riparian zone because the affected area would not be very large. Overall, riparian vegetation communities along the Logan River would not be adversely affected by this alternative.

General Vegetation. Cache County has said that it would like to consider options to eventually develop greenways, or linear parks, along canals in the region with a footpath and some landscaping. In order to accommodate future greenways along the LHPS Canal and LN Canal and to facilitate the eventual re-establishment of vegetation along parts of these canals, the box culvert and pipelines would include components that would accommodate the installation of low-flow irrigation systems to serve land in the canal easements. Property owners along the canals might also choose to plant vegetation, but the County and irrigation companies would not be responsible for maintaining such vegetation.

General Wildlife. Enclosing the LHPS Canal between its POD and Lundstrom Park would prevent locally common wildlife from using the canal. For example, waterfowl that currently rest and feed in the canal between the canyon mouth and Lundstrom Park could not use the canal for this purpose. While this would be a direct effect, it would not adversely affect local or regional populations of waterfowl or other common wildlife species (such as raccoons or mule deer) that might use the canal. Enclosing the LHPS Canal also would not affect winter use of the canal by mule deer or elk (in Logan Canyon), since the canal is not used to deliver irrigation water between November 1 and March 31. Because the construction area on USFS-administered land (in Logan Canyon) would be limited to the existing canal structure, the Purple Alternative would not affect general wildlife habitat, including mule deer and elk winter range.

Fish. The modified POD structure below Second Dam would include a low-maintenance, self-cleaning screen to prevent debris from entering the LHPS Canal box culvert. This screen would be specially designed both to prevent any fish from entering the canal and to reduce the potential for fish becoming trapped or injured by the screen. The POD would probably be constructed using a flat plate fish screen (similar to the screen recently installed on the East Fork of the Bear River) or similar device. Aquatic species, including fish, would not experience long-term effects from the LHPS Canal POD structure.

As part of the proposed action, the canal operator would monitor flows below the POD in August and in October (when the POD is no longer used to divert irrigation water) to ensure that the fishery habitat would not be adversely affected by the diversion at the LHPS Canal POD. Details regarding flow monitoring and appropriate pool levels below the POD would be included in the special-use permit conditions issued by USFS, but NRCS and USFS expect

the conditions to specify annual monitoring requirements. As currently proposed, an appropriate in-stream flow rate would be determined after construction by monitoring how different flows affect fish habitat. For the purpose of this EIS, NRCS and USFS are estimating that a minimum in-stream flow of 5 cfs below the POD structure is adequate to maintain fish habitat. The Purple Alternative is not expected to adversely affect the fishery of this reach of the Logan River.

Migratory Birds (Including Bald and Golden Eagles). The Purple Alternative would not permanently affect populations of migratory birds or any bald or golden eagles. Section 5.4.3.2, Biological Resources, describes the effects of construction on birds protected by the Migratory Bird Treaty Act and bald or golden eagles.

Effects on Noxious Weeds and Invasive Species

The current canal supports some noxious and invasive species such as goatsrue, Johnsongrass, Canada thistle, salt-cedar, and reed canarygrass along its narrow banks. Once the box culvert and pipes are installed, the canal operators would perform yearly weed control along the canal alignments. The operators might use chemical treatments or mechanical treatments (such as mowing) depending on the location being treated. For example, if the canal alignment is in an area that can be easily accessed by a large riding mower, then the operator could easily drive the length of the area to be treated in a day. However, if access is difficult because of terrain or because of access restrictions, the operators might use smaller mechanical devices such as push mowers or might hand-spray weed-infested areas. The operators would maintain native or desirable vegetation along the alignments as long as the vegetation does not restrict access or interfere with maintenance.

If herbicide treatments are necessary for weed control on National Forest System land, such treatment should comply with USFS Intermountain Region's Forest Service Manual 2080, *Supplement #R4 2000-2001-1*, and should not occur during the flowering period of any known threatened, endangered, or sensitive plant population in the application area. Yearly vegetation maintenance would contribute to the maintenance of desirable species and reduce the potential for noxious weeds to become established along the canal alignments.

Replacing the existing earthen-bank canal with a box culvert, or placing a pipe within the easement of the canal, would allow an opportunity to control these weeds during construction by either removing or spraying them. Controlling the weeds during construction and during routine maintenance after construction would reduce the spread of noxious weeds.

Cumulative and Long-Term Effects

Because the permanent effects on biological impacts are minor or could be minimized or mitigated (Section 5.3.2.6, Summary of Impacts and Mitigation), the Purple Alternative would not have cumulative or long-term effects on biological resources.

5.3.2.4 Orange Alternative

Effects on General Habitat, Vegetation, and Wildlife

Under the Orange Alternative, the impacts to wildlife habitat and vegetation would be similar to those from the Purple Alternative. The Orange Alternative would affect the use of the open LHPS Canal by locally common wildlife.

The Orange Alternative differs from the Purple Alternative in that it would enclose a greater distance of the LHPS Canal in a box culvert (a total of 4.9 miles to 2900 North or 5.2 miles to 3100 North) and would enclose a greater distance of pressure pipe along the LN Canal (a total of 3.1 miles to 2900 North or 3.4 miles to 3100 North). Also, the pipeline connecting the two canals would be in a different location than that for the Purple Alternative.

Unlike with the Purple Alternative, much of the additional length of the LHPS Canal that would be enclosed is located in open, agricultural land. However, this would not have significant effects on wildlife because there are other water sources in these areas, such as ditches, livestock watering tanks, ponds, and native water sources in the canyons and valley wetlands. Additionally, some of this agricultural land is livestock pastures and orchards, which provide a similar type of wildlife habitat and forage area as what is currently available along the open canals.

How would the Orange Alternative affect biological resources?

The Orange Alternative would cause the permanent loss of riparian vegetation at the LHPS Canal POD, potential entrapment of fish at the LHPS Canal POD, permanent loss of vegetation along the LHPS Canal between the golf course and 2900 North/3100 North, and loss of use of the open canal by locally common wildlife during the irrigation season between the POD and 2900 North/3100 North.

Effects on Noxious Weeds and Invasive Species

As with the Purple Alternative, installing the box culvert and pipelines would allow an opportunity during the construction period and during routine maintenance after construction to control weedy species currently growing along the canals.

Cumulative and Long-Term Effects

Because the permanent effects on biological impacts are minor or could be minimized through avoidance or mitigation (Section 5.3.2.6, Summary of Impacts and Mitigation), the Orange Alternative would not have cumulative or long-term effects on biological resources.

5.3.2.5 Blue Alternative

Effects on General Habitat, Vegetation, and Wildlife

Wildlife Habitat. The reach of the LN Canal from the POD below First Dam to 400 North would be enclosed, so water would not be available for wildlife use. Animals would still be able to move through the area and access the Logan River nearby.

Riparian Vegetation. Reconstructing the LN Canal POD would directly affect riparian vegetation around the diversion structure on the Logan River. These effects to riparian vegetation would not affect the overall integrity of the Logan River riparian zone because the affected area would not be very large. Overall, riparian vegetation communities along the Logan River would not be adversely affected by the Blue Alternative. Section 5.4.3.2, Biological Resources, describes the construction impacts.

General Vegetation. Currently, the vegetation along the section of the LN Canal that would be converted to a pipe consists of a mix of common mesic trees, shrubs, and weedy herbaceous species. This vegetation would be affected by construction activities. Section 5.4.3.2, Biological Resources, describes the construction impacts.

To facilitate Cache County’s desire to provide future greenways along the canals in the study area, this alternative would include components that would allow the installation of low-flow irrigation systems to serve land in the canal easement. Because the gravity pipe would need to remain whole between the POD and 400 North in order to maintain adequate pressure to move the water up a steep slope just east of 600 East, water for a trailside irrigation system would probably come from the 6-inch line installed between the POD and the Laub Diversion. Property owners along the canals might also choose to plant vegetation, but the County and irrigation company would not be responsible for maintaining such vegetation.

General Wildlife. Enclosing the LN Canal between its POD and 400 North would prevent locally common wildlife from using the canal. However, wildlife could still access numerous other water sources (such as Logan River and the hillside seeps) and could still move through the area. The amount of vegetation that would be disturbed represents a minor amount of urban wildlife habitat. The Blue Alternative would not adversely affect the local wildlife.

Fish. As with the Purple and Orange Alternatives at the LHPS Canal POD, modifications to the LN Canal POD structure below First Dam on the Logan River would include a screen to

How would the Blue Alternative affect biological resources?

The Blue Alternative would cause the permanent loss of riparian vegetation at the LN Canal POD, potential entrapment of fish at the LN Canal POD, permanent loss of vegetation along the LN Canal between the POD and 400 North, and loss of use of the open canal by locally common wildlife during the irrigation season between the POD and 400 North.

What are mesic species?

Mesic species are those that require a moderate amount of water, as compared to *hydric* (high-water) or *xeric* (low-water) species.

prevent debris from entering the LN Canal pipe. This screen would also be designed to prevent any fish from entering the canal or from becoming trapped by the POD structure. The POD would probably be constructed using a flat plate fish screen (similar to the screen recently installed on the East Fork of the Bear River) or similar device. Aquatic species, including fish, would not experience long-term effects from the LN Canal POD structure.

Migratory Birds (Including Bald and Golden Eagles). The Blue Alternative would not permanently affect populations of migratory birds. Section 5.4.3.2, Biological Resources, describes the effects of construction on birds protected by the Migratory Bird Treaty Act and bald or golden eagles.

Effects on Noxious Weeds and Invasive Species

The reach of the LN Canal from the POD below First Dam to 400 North supports some noxious and invasive species such as Canada thistle, salt-cedar, and reed canarygrass. Replacing the existing canal with a pipeline would allow an opportunity to control these weeds during construction by removing or spraying them. Routine maintenance after construction should prevent the establishment of new noxious weed populations or the spread of existing weedy species from the area.

Cumulative and Long-Term Effects

The Blue Alternative would not have cumulative or long-term effects because any temporary construction effects would be short term and would not contribute to an ongoing cumulative loss of wildlife habitat, the ongoing spread of noxious weeds in the region, or effects to sensitive species. Because the slope above the canal receives runoff from the USU campus, SR 89, and the seeps along the slope, it is unlikely that the vegetation outside the construction corridor would change dramatically due to transferring the flow from the canal into a pipe. Any long-term changes in the vegetation along the canal outside the work area would be due to actions not connected with this proposed action (such as actions by private land owners or Cache County).

5.3.2.6 Summary of Impacts and Mitigation

All of the action alternatives would permanently affect biological resources (construction impacts are discussed in Section 5.4.3.2, Biological Resources). The expected permanent effects are as follows:

- Permanent loss of riparian vegetation at the LHPS Canal POD (Purple and Orange Alternatives) and LN Canal POD (Blue Alternative)
- Potential entrapment of fish at the LHPS Canal POD (Purple and Orange Alternatives) and at the LN Canal POD (Blue Alternative)
- Permanent loss of vegetation along the LHPS Canal (Purple and Orange Alternatives) and along the LN Canal (Blue Alternative)
- Loss of use of the open canal by locally common wildlife (all action alternatives)

None of these expected effects would be significant. The following measures would help avoid and/or reduce impacts to biological resources:

- After construction, Cache County or its contractor would use native riparian plants wherever possible as part of routine restoration of the work areas around the LHPS Canal POD (Purple and Orange Alternatives) or LN Canal POD (Blue Alternative).
- Any modifications to the LHPS Canal POD structure (Purple and Orange Alternatives) or LN Canal POD structure (Blue Alternative) would include a device to prevent fish from entering the canals and/or from becoming trapped at the POD structure. USFS would review and must approve the design of the proposed fish-exclusion structure for the Purple and Orange Alternatives. The Utah Division of Wildlife Resources and/or USFWS would review and provide comments on the proposed fish-exclusion structure for the Blue Alternative.
- To accommodate Cache County's desire to consider options for greenways along canals in the study area in the future, modifications to the LHPS and LN Canals would include components that would allow the installation of low-flow irrigation systems to serve land in the canal easements (all action alternatives).

5.3.3 Special-Status Species

This section describes the expected long-term or permanent impacts of the project alternatives on special-status species. Construction impacts on special-status species are discussed in Section 5.4.3.3, Special-Status Species.

5.3.3.1 Laws, Policies, and Direction

The Federal ESA (16 USC 1536, 1538, and 1539) provides protection for species that are in danger of becoming extinct. Species can be identified as threatened or endangered or as candidates for listing as either threatened or endangered. USFWS oversees implementation of the ESA.

The *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) contains a number of guidelines related to special-status species. The Logan Ranger District has identified the following guidelines as being applicable to the proposed action. Consistency with the guidelines as they pertain to construction is addressed in Section 5.4.3.3, Special-Status Species.

- **Guideline 15.** In goshawk habitat, design all management activities to maintain, restore, or protect desired goshawk and goshawk prey habitats including foraging, nesting, and movement. *Because there is no goshawk habitat along the project alternative alignments in Logan Canyon, this item does not apply.*
- **Guideline 21.** For projects that may affect Forest Service sensitive species, develop conservation measures and strategies to maintain, improve, and/or minimize impacts

to species and their habitats. Short-term deviations may be allowed as long as the action maintains or improves the habitat in the long term.

- **Guideline 23.** Avoid actions on the Forest that reduce the viability of any population of plant species classified as threatened, endangered, sensitive, or recommended sensitive. Use management actions to protect habitats of plant species at risk from adverse modification or destruction. For species that naturally occur in sites with some disturbance, maintain the appropriate level of disturbance.
- **Guideline 24.** Management activities that negatively affect pollinators (such as insecticide application, herbicide application, and prescribed burns) should not be conducted during the flowering period of any known threatened, endangered, or sensitive plant populations in the application area. An exception to this guideline is the application of *Bacillus thuringiensis*.
- **Guideline 25.** Integrated weed management should be used to maintain or restore habitats for threatened, endangered, proposed, or sensitive plants and other native species of concern where they are threatened by noxious weeds or non-native plants. When treating noxious weeds, comply with policy in Intermountain Region's Forest Service Manual 2080, *Supplement #R4 2000-2001-1*.
- **Guideline 44.** When constructing and reconstructing roads, trails, and facilities, minimize potential effects on habitat of plant species at risk and key big-game winter and spring ranges.

5.3.3.2 No-Action Alternative

Under the No-Action Alternative, the canal system would not be physically changed, so there would be no long-term or permanent changes to land that might support any ESA-listed species, State or USFS special-status species, or habitats for any special-status species.

The No-Action Alternative would result in the LN Canal not carrying irrigation water as it has historically. Because no special-status species use the canal system, abandoning the canal for irrigation water delivery would not affect any of these species.

5.3.3.3 Purple Alternative

The Purple Alternative would not affect any species listed under the ESA. None of the listed species have been observed near the Purple Alternative alignment, and no habitat for listed species is present along the alignment. Local populations of Maguire's primrose (*Primula maguirei*) are near the LHPS Canal POD. However, because these populations are on the opposite side of the river from the POD and are in a location that would not be affected during construction, the Purple Alternative would not affect this threatened species.

There is only one sensitive plant species, Logan buckwheat (*Eriogonum loganum*), that could be directly affected by construction activities (Section 5.4.3.3, Special-Status Species,

describes construction effects). Because this plant is adapted to the arid canyon slopes of northern Utah, it does not depend on any existing, unrepaired canal leaks, and therefore it would not be directly or indirectly affected if those leaks are stopped by installing the box culvert.

No other sensitive species would be directly affected by this alternative because the artificial canal does not provide the required habitat for these sensitive species. In Logan Canyon, where habitat exists for some of the sensitive species listed for the area, the Logan River provides the water source for these and other species and would continue to do so if the LHPS Canal were enclosed in a box culvert under the Purple Alternative.

5.3.3.4 Orange Alternative

Like the Purple Alternative, the Orange Alternative would not affect local populations of Maguire's primrose or result in permanent effects to Logan buckwheat. The Orange Alternative would not permanently affect any other sensitive species.

5.3.3.5 Blue Alternative

There is one historic record (more than 25 years ago) for the sensitive Logan buckwheat on the slope above the LN Canal below US 89. The current habitat in this location (dense woods with numerous small seeps) does not match the species' normal habitat (sagebrush-bunchgrass communities on rock outcrops). In addition, this species was not observed near the canal through this section. For these reasons, and because the record is more than 25 years old, it is likely that Logan buckwheat is no longer present at this location. Therefore, this species would not be affected by the Blue Alternative.

5.3.3.6 Summary of Impacts and Mitigation

None of the action alternatives would affect any special-status species. Construction impacts are discussed in Section 5.4.3.3, Special-Status Species.

No mitigation is proposed.

5.3.4 Cultural and Tribal Resources

This section describes the expected long-term or permanent impacts of the project alternatives on cultural resources. Construction impacts on cultural resources are discussed in Section 5.4.3.4, Cultural and Tribal Resources.

5.3.4.1 Laws, Policies, and Direction

Cultural resources, as the term is used by NRCS, are considered equivalent to *historic properties* as defined by the NHPA (16 USC 470 and subsequent sections) and the regulations for compliance with Section 106 of the NHPA (36 CFR 800). Cultural resources include any prehistoric or historic district, site, building, structure, or object listed on or eligible for listing on the NRHP. They also include all records, artifacts, and physical remains associated with NRHP-eligible historic properties. The term also includes properties of traditional cultural and religious importance to a Native American tribe or Native Hawaiian organization that also meet the NRHP criteria. These properties might consist of the traces of the past activities and accomplishments of people.

NEPA requires that all Federal agencies, including NRCS, “preserve important historic, cultural, and natural aspects of our natural heritage, and maintain, wherever possible, an environment which supports diversity[.]”

The NHPA, along with the Advisory Council on Historic Preservation’s regulations for compliance with Section 106 of the NHPA (36 CFR 800) and NRCS General Manual 420, Part 401, require NRCS to consider the effects of its proposed actions on NRHP-eligible cultural resources/historic properties in consultation with specific parties. NRCS is required to consult with the SHPO, Tribal Historic Preservation Officers (THPO), and Federally recognized tribes that want to consult on agency projects, as well as other interested parties such as the SLO, other State agencies, and Certified Local Governments.

In accordance with 36 CFR 800.6, NRCS would resolve adverse effects to historic properties by developing a treatment plan listing the measures that would be used to minimize and mitigate expected effects. The treatment plan would be developed through consultation between NRCS and other consulting parties including USFS, USACE, and the SLO. NRCS would act as the lead agency for purposes of the Section 106 consultation. NRCS would invite the Advisory Council for Historic Preservation to participate in the consultation process. Once the treatment plan and measures to minimize and mitigate adverse impacts are agreed on by the consulting parties, a Memorandum of Agreement (MOA) would be executed and implemented pursuant to Section 106. The proposed action could proceed as planned once the conditions of the MOA have been satisfactorily executed.

The NRCS Environmental Compliance Handbook identifies the following policies regarding the treatment of cultural resources:

- NRCS will protect cultural resources in their original location to the fullest extent practicable by avoiding impacts to resources.
- NRCS will consider cultural resources that might be significant under authorities in addition to or apart from Section 106 of the NHPA (for example, the American Indian Religious Freedom Act). When a proposed action might affect such resources (for example, contemporary cultural properties, traditional cultural values, landscape, or features having religious importance), NRCS will consult with concerned parties to determine what practices or treatments, if any, are acceptable to the concerned parties and will document the outcome of such consultation according to the statutes and authorities under which they are considered. If agreement among consulting parties regarding acceptable treatment of identified cultural resources cannot be reached, NRCS will complete documentation of compliance and determine if continued assistance is warranted. If NRCS does determine that such assistance is appropriate, it will seek consultation with the Advisory Council on Historic Preservation and, upon receipt of their recommendations and completion of additional compliance requirements, make a final decision on how to proceed.

What is NRCS’s policy with regard to cultural resources?

NRCS will protect cultural resources in their original location to the fullest extent practicable by avoiding impacts to resources.

The *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) contains one standard and one guideline related to cultural resources (called *heritage resources* in the *Revised Forest Plan*). The standard is as follows:

Standard 32. Review undertakings that may affect cultural resources to identify potential impacts. Compliance with Sections 106 and 110 of the NHPA shall be completed before the responsible agency official signs the project decision document.

The guideline is as follows:

Guideline 88. Design any mitigation measures necessary to resolve adverse affects to sites in such a way that they provide the maximum public benefit that the sites (or the information derived from them) can offer.

Because the proposed action would need to comply with Section 106 of the NHPA and because USFS is participating in the Section 106 consultation as a cooperating agency, NRCS assumes that the consultation process and outcome would comply with the standard and guideline.

5.3.4.2 No-Action Alternative

The No-Action Alternative would not directly affect any resources that are listed on the NRHP or are eligible for listing on the NRHP or any sites of importance to Native Americans. The LHPS Canal and the LHPS Canal POD below Second Dam, both of which are probably eligible for listing on the NRHP, would continue to be used for delivering irrigation water and would not be affected by the No-Action Alternative.

The LN Canal and the LN Canal POD, which also might be eligible for listing, would continue to be used to deliver about 2 cfs of irrigation water between the LN Canal POD and the Laub Diversion. The remaining reaches of the LN Canal downstream of the Laub Diversion would be abandoned for irrigation purposes. This change in the historic use could affect the canal's historic context.

The No-Action Alternative would not involve acquiring structures from parcels along the Logan Bluff, so if any of those structures are eligible for listing, they would not be affected by this alternative.

5.3.4.3 Purple Alternative

Table 5-2 summarizes the expected effects of the Purple Alternative on cultural resources that might be eligible for listing on the NRHP. The Purple Alternative would have adverse effects on the LHPS Canal POD structure and canal and the LN Canal.

Table 5-2. Cultural Resource Impacts from the Purple Alternative

Resource	Effect
LHPS Canal POD structure	Modify structure to accommodate increased flow.
LHPS Canal	Convert 2.4 miles of open canal to box culvert.
LN Canal	Place a 6-inch-diameter pipeline and support structures in about 1 mile of canal; place 1 mile of pipeline in the maintenance road adjacent to the canal between 400 North and 1500 North.

The Purple Alternative would require removing structures from 14 properties along the north side of Canyon Road between about 750 East and 1100 East. NRCS has not evaluated these structures for NRHP eligibility. Potential impacts to structures that might be eligible for listing on the NRHP would need to be included in subsequent consultation with the Utah SHPO.

5.3.4.4 Orange Alternative

Table 5-3 summarizes the expected effects of the Orange Alternative on resources that might be eligible for listing on the NRHP. The Orange Alternative would have adverse effects on the LHPS Canal POD structure and canal and the LN Canal.

Table 5-3. Cultural Resource Impacts from the Orange Alternative

Resource	Effect
LHPS Canal POD structure	Modify structure to accommodate increased flow.
LHPS Canal	Convert between 4.9 and 5.2 miles of open canal to box culvert.
LN Canal	Place a 6-inch-diameter pipeline and support structures in about 1 mile of canal; place between 3.1 and 3.4 miles of pipeline in the maintenance road adjacent to the canal between 400 North and either 2900 North or 3100 North.

Like the Purple Alternative, the Orange Alternative would require removing structures from 14 properties along the north side of Canyon Road between about 750 East and 1100 East. NRCS has not evaluated these structures for NRHP eligibility. Potential impacts to structures that might be eligible for listing on the NRHP would need to be included in subsequent consultation with the Utah SHPO.

5.3.4.5 Blue Alternative

Table 5-4 summarizes the expected effects of the Blue Alternative on resources that might be eligible for listing on the NRHP. The Blue Alternative would have adverse effects on the LN Canal and POD structure.

Table 5-4. Cultural Resource Impacts from the Blue Alternative

Resource	Effect
LN Canal POD structure	Modify the POD structure to accommodate the new pipelines.
LN Canal	Convert 1.7 miles of canal to piped flow between POD and 400 North.

The Blue Alternative would also require removing structures from 14 properties along the north side of Canyon Road between about 750 East and 1100 East. NRCS has not evaluated these structures for NRHP eligibility. Potential impacts to structures that might be eligible for listing on the NRHP would need to be included in subsequent consultation with the Utah SHPO.

5.3.4.6 Cumulative and Long-Term Effects

All three action alternatives would cause potentially adverse effects to cultural resources that might be eligible for listing on the NRHP. These resources are all parts of the existing canal infrastructure and could require some type of modification. Implementing any of the action alternatives would cause permanent, long-term effects to the resources.

Because the eligibility of structures on the 14 properties from which structures would be purchased and demolished is unknown, their removal could result in adverse effects to NRHP-eligible resources.

All of the action alternatives would require modifying existing and potentially eligible structures. Formal consultation under Section 106 of the NHPA is in process and will likely result in the development of a MOA regarding how the resource impacts would be avoided, minimized, or mitigated. Parties to the MOA would probably include the Utah SHPO, NRCS, USFS, USACE, and the SLO. Complying with the Section 106 requirements and making only the limited modifications proposed under any of the alternatives are expected to mitigate the potential for significant cumulative effects to cultural resources.

5.3.4.7 Summary of Impacts and Mitigation

Based on an initial review of the proposed action and project alternatives, it is likely that all three of the action alternatives would result in adverse effects to known or suspected historic properties in the APE. Completing the Section 106 consultation process as described in Section 5.3.4.1, Laws, Policies, and Direction, would minimize and mitigate potential effects to these properties. No additional mitigation is proposed.

5.3.5 Topography, Soils, and Geology

This section describes the expected impacts of the project alternatives to topography, soils, and geology. Geologic hazards are discussed in Section 5.6, Hazard Potential of Each Alternative. Construction impacts to topography, soils, and geology are discussed in Section 5.4.3.5, Topography, Surface Soils, and Geology.

5.3.5.1 Laws, Policies, and Direction

The NRCS Environmental Compliance handbook does not contain any specific policies that address topography, soils, or geology.

Construction-related impacts to soils are partially regulated through Section 402 of the CWA (NPDES), which primarily addresses protection of water quality. Section 402 requires that, if a proposed action would disturb 1 or more acres of ground, the project proponent must file a notice of intent to comply with the State's general permit for stormwater discharges from construction sites and prepare a SWPPP. A SWPPP typically includes measures that protect soil from erosion during and immediately after construction.

The Cache County and City of Logan building codes identify the need for specific investigations and design considerations related to projects crossing fault zones. These codes would be considered during the design process.

The *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) contains three guidelines related to protecting soils. The Logan Ranger District has identified the following guidelines as being applicable to the proposed action. Consistency with the guidelines as they relate to construction impacts is addressed in Section 5.4.3.5, Topography, Surface Soils, and Geology.

- **Guideline 4.** At the end of an activity, allow no more than 15% of an activity area to have detrimental soil displacement, puddling, or compaction and/or to be severely burned.
- **Guideline 9.** Avoid soil-disturbing activities (those that remove surface organic matter exposing mineral soil) on steep, erosive, and unstable slopes, and in riparian areas, wetlands, floodplains, wet meadows, and alpine areas.
- **Guideline 11.** Use best management practices (BMPs) and soil and water conservation practices during project-level assessment and implementation to ensure maintenance of soil productivity and minimization of sediment discharge into streams, lakes, and wetlands to protect designated beneficial uses.

5.3.5.2 Topography

No-Action Alternative

The No-Action Alternative would not affect the topography of any part of the study area. The topography along the LN Canal alignment and the 2009 landslide site would remain in its current condition.

Purple and Orange Alternatives

The LHPS Canal alignment crosses the steep hillside in Logan Canyon. Because this section of box culvert would be built in the existing canal and would not require large cuts and fills, it would not permanently affect the topography of the canyon reach. Construction would need to take place adjacent to steep slopes but is not expected to directly affect those slopes. No more than 15% of areas adjacent to the existing canal alignment would have detrimental soil displacement. The remaining reaches of the LHPS Canal and the affected reaches of the LN Canal travel through areas without steep slopes. Because of this, installing the box culvert would not require large cuts and fills and would not affect the topography of adjacent areas.

How would the Purple and Orange Alternatives affect topography?

The Purple and Orange Alternatives would not affect topography.

Both alternatives include a new pipeline from the LHPS Canal to the LN Canal. In both cases, the pipeline would be constructed through areas without steep slopes. Because these areas are gently sloped, construction would not require large cuts and fills or cause permanent changes to the local topography.

These alternatives would not affect the topography of the Logan Bluff, and the 2009 landslide area would remain in its current condition. Construction of the 6-inch-diameter service line in the LN Canal between the LN Canal POD and the Laub Diversion would not modify the topography, since this reach of the LN Canal passes through an area without steep slopes.

The construction impacts of the Purple and Orange Alternatives are discussed in Section 5.4.3.5, Topography, Surface Soils, and Geology.

Cumulative and Long-Term Effects. Because the Purple and Orange Alternatives would not change the topography of land in or near the work area, these alternatives would not create or contribute to cumulative, ongoing regional changes in topography, and these alternatives would not require long-term maintenance that would affect topography.

Blue Alternative

The Blue Alternative would permanently affect topography along the LN Canal by building structures on a steep hillside. This alternative would not affect any land administered by USFS.

For the Blue Alternative, the existing 2009 landslide area at about 970 East would be reshaped and graded to allow construction of the irrigation pipeline, soil buttress, and drainage ditch systems in the existing LN Canal alignment. This reshaping and grading of the landslide area would change the topography of portions of the bluff below the pipeline. The design would permanently affect the topography, but this impact would be positive in that it would restore the topography of an area that is currently damaged.

The Blue Alternative also includes construction of about 0.5 mile of soil buttress along the existing LN Canal alignment on the parcels from which the structures would be acquired. This buttress would increase the stability of the new conveyance structure and drainage ditch. The buttress design could incorporate, to the extent possible, topographic features such as benches and terraces that would integrate the buttress into the existing topographic features of the hillside. The design would consider the existing topography and the proposed topographic features so that the slope would blend into the natural environment yet provide the stabilization and slope protection required to make the system operate safely. The topography would permanently change, but this change would restore the topography of the damaged area in a way that would make it similar in appearance and contiguous to adjacent areas.

The construction impacts of the Blue Alternative are discussed in Section 5.4.3.5, Topography, Surface Soils, and Geology.

How would the Blue Alternative affect topography?

The Blue Alternative would affect the topography of the Logan Bluff.

Cumulative and Long-Term Effects. The area that would be topographically changed as part of the Blue Alternative is limited to a small area along the Logan Bluff. The affected part of the bluff has been slightly modified from construction and maintenance of US 89 and the USU parking lots between the LN Canal alignment and US 89. However, natural changes due to landslides have historically had a greater effect on the bluff. The proposed modifications associated with the Blue Alternative might improve the stability and therefore maintenance of topography in the area but would not guarantee that the rate of ongoing, natural changes would be affected. The proposed changes would not cause or contribute to other ongoing, regional changes in topography.

Summary of Impacts and Mitigation

The No-Action, Purple, and Orange Alternatives would not affect the overall topography of the study area. The 2009 landslide area would remain in its current condition.

The Blue Alternative would affect the topography of the Logan Bluff, but the design of the project elements (specifically the soil buttress and regrading the 2009 landslide area) would attempt to blend the affected areas into the existing topography.

No mitigation is proposed.

5.3.5.3 Surface Soils

No-Action Alternative

Because the No-Action Alternative would not disturb any ground, it would not affect surface soils in the study area. The existing LN Canal at the 2009 landslide site would not be altered. Stormwater runoff that passes through the landslide site would continue to cause erosion and loss of surface soils in the landslide area.

Action Alternatives

None of the action alternatives would permanently affect surface soils. The Purple and Orange Alternatives would require importing soil to cover the box culvert in Logan Canyon. The Blue Alternative would require using imported soils for reshaping the 2009 landslide site, constructing the soil buttress, and covering native surface soils. This alternative would not affect soils on land administered by USFS.

How would the Action Alternatives affect surface soils?

The Action Alternatives would not permanently affect surface soils.

The construction impacts of the action alternatives are described in Section 5.4.3.5, Topography, Surface Soils, and Geology.

Cumulative and Long-Term Effects. The action alternatives would not cause any long-term adverse impacts to soils. Reconstructing the 2009 landslide area and constructing the soil buttress for the Blue Alternative would not cause any long-term adverse impacts to soils.

Summary of Impacts and Mitigation

The action alternatives would not permanently affect surface soils. No mitigation is proposed.

5.3.5.4 Geology: Geologic Conditions, Faults, and Subsurface Soils

This section describes how the alternatives could affect geologic resources including geologic conditions, faults, and subsurface soils. Section 5.6, Hazard Potential of Each Alternative, describes how geologic hazards (rock fall, earthquakes, and ground shaking) could affect the alternatives.

No-Action Alternative

The No-Action Alternative would not affect geologic conditions, faults, or subsurface soils.

Action Alternatives

The Purple, Orange, and Blue Alternatives would not permanently affect geologic conditions or subsurface soils in the study area.

The action alternatives would disturb ground along the LHPS Canal and/or the LN Canal alignments. The Purple and Orange Alternatives would construct a new pipeline between the canals at 1500 North, 2900 North, or 3100 North at a depth of 3 to 5 feet below the ground surface. All ground disturbances, including those necessary to construct the new sections of pipeline, would not affect geologic units or subsurface soils because excavation would not disturb geologic units or subsurface soils.

All of the alternatives cross the East Cache fault zone, but none would directly affect the fault itself. The Blue Alternative would require constructing deep foundations and subsurface drainage features into the upper areas of specific geologic units (units GU-2 and GU-3 in Figure 4-5, Surface Soils Map) along the alignment. While these structures would temporarily affect the local areas of geologic units or subsurface soils, they would not be massive enough to jeopardize the integrity of the entire geologic unit or subsurface soil structure. Therefore the Blue Alternative would not affect the geologic units and subsurface soils.

The construction impacts of the action alternatives are discussed in Section 5.4.3.5, Topography, Surface Soils, and Geology.

How would the Action Alternatives affect geology?

The Action Alternatives would not permanently affect geologic conditions or subsurface soils.

Cumulative and Long-Term Effects. Because the action alternatives would not affect geologic conditions or subsurface soils in the study area, they would not create or contribute to cumulatively considerable adverse conditions related to subsurface soil disturbance.

Summary of Impacts and Mitigation

Because none of the alternatives would affect geologic conditions or subsurface soils in the study area, no mitigation is proposed.

5.3.6 Water Resources

This section discusses the expected permanent impacts of the project alternatives on water resources and the regulatory actions and authorities that apply to water resources. The specific water resources that are discussed in this section are surface waters (natural water courses, irrigation canals, and wetlands), water quality, stormwater, floodplains, groundwater resources, and water use and water rights. Construction impacts to water resources are discussed in Section 5.4.3.6, Water Resources.

5.3.6.1 Laws, Policies, and Direction

Table 2-1, Laws, Regulations, and Policies That Could Apply to the Proposed Action, lists the laws that apply to water resources. The following list summarizes the applicable laws and other policy and direction that apply to water resources in the study area.

- Section 401 of the CWA (Water Quality Certification for activity that is subject to authorization under Section 404 of the CWA)
- Section 402 of the CWA for construction activities (NPDES)
- Section 404 of the CWA
- Section 319 of the CWA
- Executive Order 11990, Protection of Wetlands
- Executive Order 11988, Floodplain Management
- NRCS General Manual Title 190, Part 410.26, Wetland Policy
- Utah Code 73, Water and Irrigation, Water Rights
- Utah Administrative Code, Rule R655-13, Stream Alteration
- Utah Administrative Code, Rule R317-2-3, Antidegradation Policy
- Utah Administrative Code, Rule R309-600, Drinking Water Source Protection

The *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) contains a number of subgoals, standards, and guidelines related to water resources. Standards are mandatory and guidelines are suggested. The Logan Ranger District has identified the following subgoals, standards, and guidelines as being applicable to the proposed action.

Consistency with some of these subgoals, standards, and guidelines is addressed in Section 5.4.3.6, Water Resources.

Subgoals

- **Subgoal 2b.** Maintain and/or improve water quality to provide stable and productive riparian and aquatic ecosystems.
- **Subgoal 2d.** Protect waters meeting or surpassing State water quality standards by planning and designing land-management activities to protect water quality.
- **Subgoal 2e.** Maintain and/or restore stream channel integrity, channel processes, and sediment regimes (timing, volume, and character of sediment input/transport) under which riparian and aquatic ecosystems developed.
- **Subgoal 2f.** Maintain water in streams, lakes, and wetlands of adequate quantity and quality to provide for in-stream flows and existing downstream uses including support of healthy riparian and aquatic habitats, stability and effective function of stream channels, ability to route flood discharges, and maintenance of recreation opportunities.

Standards

- **Standard 2.** Apply runoff controls during project implementation to prevent pollutants including fuels, sediment, and oils from reaching surface water and groundwater.
- **Standard 4.** Place new sources of chemical and pathogenic pollutants where such pollutants will not reach surface water or groundwater.
- **Standard 5.** Prior to issuing a permit or license for activities such as mining, hydropower development, snowmaking, or water-transmission facilities, in-stream flow determinations will be required of all future permitted and licensed activities. For existing authorized uses and activities, minimum in-stream flows will be established to meet the beneficial use of the stream and will be a condition of any licensing and permit renewal.
- **Standard 6.** Within legal authorities, ensure that new proposed management activities in watersheds containing 303(d)-listed water bodies improve or maintain overall progress toward beneficial use attainment for pollutants which led to listing; and do not allow additions of pollutants in quantities that result in unacceptable adverse effects. *Because the Logan River is not a 303(d)-listed water, this standard does not apply.*
- **Standard 20.** When constructing or maintaining roads, trails, and facilities, use BMPs to minimize sediment discharge into streams, lakes, and wetlands.

Guidelines

- **Guideline 2.** Projects in watersheds with 303(d)-listed water bodies should be supported by scale and level of analysis sufficient to permit an understanding of the implications of the project within the larger watershed context. *Because the Logan River is not a 303(d)-listed water, this standard does not apply.*
- **Guideline 3.** Proposed actions analyzed under NEPA should adhere to the State Nonpoint Source Management Plan to best achieve consistency with both Sections 313 and 319 of the Federal Water Pollution Control Act.
- **Guideline 5.** Do not allow activities that could result in water yield increases that would degrade water quality and impact beneficial uses.
- **Guideline 9.** Avoid soil-disturbing activities (those that remove surface organic matter exposing mineral soil) on steep, erosive, and unstable slopes, and in riparian areas, wetlands, floodplains, wet meadows, and alpine areas.
- **Guideline 10.** Encourage water users that divert, augment, or operate reservoirs to regulate discharges to prevent or reduce damage to downstream properties.
- **Guideline 11.** Use BMPs and soil and water conservation practices during project-level assessment and implementation to ensure maintenance of soil productivity and minimization of sediment discharge into streams, lakes, and wetlands to protect designated beneficial uses.
- **Guideline 45.** Access routes for heavy equipment should be selected to limit disturbance to riparian vegetation and to limit the number of stream crossings.

5.3.6.2 Surface Waters

Surface waters in the study area include the Logan River, Green Canyon Creek, and the LN and LHPS Canals. The study area also includes some wetland areas. These waters are all considered waters of the U.S. This section describes the expected effects of the project alternatives on surface water flows and physical features. Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

The No-Action Alternative would not have any new effects on surface waters. Before the 2009 landslide, the LN Canal provided a direct connection between the Logan River and Smithfield Creek (also known as Summit Creek) to the north. Under the No-Action Alternative, this connection would not be re-established. Sections of the canal would be abandoned for irrigation purposes and would remain in place but would not be used for conveying irrigation water. Sections of the canal would still be used for conveying stormwater.

Currently, about 2 cfs of water is diverted from the Logan River at the existing LN Canal POD and delivered to shareholders upstream of the Laub Diversion. Unused irrigation water is taken out of the LN Canal at the Laub Diversion and is returned to the Logan River using ditches and the city storm drain system. Under the No-Action Alternative, this diversion would continue. The canal system would not convey irrigation water downstream of the Laub Diversion.

Before the 2009 landslide, water in the LN Canal flowed from the LN Canal POD on the Logan River to the north, and some of the water discharged directly into Smithfield Creek. The canal was considered a water of the U.S. because of this connection. Because the connection would not be restored under the No-Action Alternative, USACE might no longer consider the canal to be a jurisdictional water.

The No-Action Alternative would not affect USFS-administered land, so none of the goals, standards, or guidelines in the *Revised Forest Plan for the Wasatch-Cache National Forest* would apply.

Purple Alternative

Logan River. The Purple Alternative would modify the existing LHPS Canal POD structure and an area adjacent to the structure along the Logan River. Short-term impacts during construction are discussed in Section 5.4.3.6, Water Resources.

Modifying the POD structure would affect about 1,000 square feet on the north bank of the river. This modification would require authorization under Sections 401 and 404 of the CWA, a Stream Alteration Permit from the Utah Division of Water Rights, and a special-use permit from USFS. The conditions of these authorizations would ensure that the impacts to the Logan River are minimized.

This alternative would require the diversion of additional water from the Logan River using the modified LHPS Canal POD. As discussed in Section 4.4.5.1, Topography, the Logan River flows are already substantially modified by existing diversions. For the Purple Alternative, the additional water that would be diverted into the LHPS Canal would be released past Second Dam. This increased amount of water that bypasses Second Dam would result in higher Logan River flows downstream of Second Dam to the LHPS Canal POD. The increased diversion of water at the LHPS Canal POD would require the State Engineer's approval and agreements between water users as discussed in Section 5.3.6.8, Water Use and Water Rights.

A portion of the Purple Alternative is on National Forest System land and is subject to the policies of the *Revised Forest Plan for the Wasatch-Cache National Forest* (Section 5.3.6.1,

How would the Purple Alternative affect surface waters?

The Purple Alternative would have a minor effect to the Logan River at the LHPS Canal POD, enclose 2.4 miles of the LHPS Canal, place 1 mile of the LN Canal in a pipe outside the canal easement between 400 North and 1500 North, and place 1 mile of the LN Canal in a pipe between the LN Canal POD and the Laub Diversion.

Laws, Policies, and Direction). Operating the Purple Alternative on National Forest System land would require a special-use permit from USFS. Special-use permit conditions have not been developed for any of the alternatives. The following paragraphs briefly discuss how the Purple Alternative would meet the subgoals, standards, and guidelines in the *Revised Forest Plan*.

NRCS and the SLO expect that USFS would conduct a review of site-specific construction and maintenance plans for the project elements that occur on USFS-administered land, including modifying the LHPS Canal POD on the Logan River and part of the LHPS Canal conveyance structure. The plans would address specific compliance with standards and guidelines, which include but are not limited to operating the POD to prevent damage to downstream properties, monitoring appropriate in-stream flows below the LHPS Canal POD on National Forest System land, and maintaining the integrity of the Logan River channel. Appendix C6, Compliance with the Standards and Guidelines in the *Revised Forest Plan for the Wasatch-Cache National Forest*, specifically addresses each of the standards and guidelines that USFS has stated would apply to activity on National Forest System land.

The standards and guidelines in the *Revised Forest Plan* regarding erosion and sediment control, construction access, materials staging, fuels management, and limits of disturbance are addressed in Section 5.4.3.6, Water Resources, which discusses the construction impacts of the Purple Alternative.

To meet the expected special-use permit conditions and to comply with the standards and guidelines in the *Revised Forest Plan*, USFS has recommended that an initial minimum flow of 5 cfs be allowed to pass the LHPS Canal POD to maintain in-stream flows (USFS 2011). This amount is roughly equivalent to the amount of water that would not be lost to seepage from the LHPS Canal and that reaches the river on USFS-administered land. The reduction in seepage losses would be due to the new box culvert conveyance, as discussed in Section 4.4.6.1, Surface Waters, and Section 5.3.6.6, Groundwater Resources.

The intent of the in-stream flow, as measured immediately below the LHPS Canal POD, would be to provide water in the Logan River to fill pools to allow fish to move between pools and to provide enough water for good circulation to maintain cool temperatures and dissolved oxygen content in the stretch of the Logan River between the LHPS Canal POD and the National Forest boundary during low-flow periods (August through October). Ensuring that the in-stream flow is adequate would require observing the depth of pools in the Logan River below the LHPS Canal POD under various flow rates above and below 5 cfs. NRCS and the SLO expect that USFS would specify a process through which fishery habitat requirements could be determined and met during low flows as part of the special-use permit for operating the Purple Alternative.

USFS has stated that the monitoring of various flow rates and river response would occur within the first year after the project is completed. After USFS determines the appropriate flows, that rate would become a requirement of the special-use permit for the Purple Alternative. The flow that passes the LHPS Canal POD would likely need to be monitored

and reported to USFS annually by the special-use permit holder(s) in accordance with special-use permit conditions. Further details on the in-stream flow requirements, reporting, and monitoring are discussed in Appendix C6.

The Purple Alternative would not affect any supporting intermittent natural streams.

What is a supporting intermittent stream?

A supporting intermittent stream is a stream that the Utah Division of Water Quality identifies as having a beneficial use.

LHPS and LN Canals. The Purple Alternative would modify 2.4 miles of the LHPS Canal and about 2 miles of the LN Canal. The affected reach of the LHPS Canal would be converted from an open irrigation channel to a box culvert. About 0.8 mile of the box culvert (between the Logan Golf & Country Club and Lundstrom Park) would have a stormwater channel adjacent to (either on top of or beside) the culvert. A new water-control structure at Lundstrom Park would affect about 20 linear feet of the canal (included in the total 2.4 miles affected). Modifying the LHPS Canal and installing the water-control structure would require authorization under Section 404 of the CWA since the LHPS Canal is a water of the U.S.

For operating the reach of the LHPS Canal on National Forest System land, USFS would issue a special-use permit. The use-permit process would include USFS review of the site-specific construction and maintenance plans for this reach of the LHPS Canal.

The Purple Alternative would affect two reaches of the LN Canal. Installing a pipeline between 400 North and 1500 North would change the historic flows of the LN Canal in this reach. The pipeline would be installed in the canal maintenance road or in the bottom of the canal, so it would not directly affect the canal alignment. However, new water-control structures at 400 North and 1500 North would directly affect about 20 feet of the canal at each structure. Because of this, constructing the water-control structures is subject to authorization under Section 404 of the CWA. The existing canal would continue to be used for conveying stormwater.

This alternative also includes installing 1 mile of 6-inch-diameter pipeline in the LN Canal between the LN Canal POD and the Laub Diversion. This would not directly affect the existing canal alignment, but, because the pipeline would be in the canal channel, it would require authorization under Section 404 of the CWA.

These modifications would not adversely affect the function or operation of the canals or service to shareholders.

Wetlands. As shown in Figure 4-10, Wetlands in the Study Area, there is one wetland along the south side of 1500 North at about 1250 East. Because the pipeline between the LHPS Canal and the LN Canal would be in the road at this location, it would not fill the wetland.

The presence of the pipeline would not affect wetland hydrology. The hydrology source of the wetland appears to be natural springs that emerge from the foot of the bluff to the east. Because the springs originate from groundwater that flows west, any construction to the north

would not affect the wetland hydrology. The wetland is close to the area that would be affected by construction, so Section 5.4.3.6, Water Resources, recommends measures to ensure that the wetland is protected during construction.

Cumulative and Long-Term Effects. The Purple Alternative would not cause adverse long-term effects to the Logan River, the LHPS and LN Canals, or the wetland along 1500 North. The canals have not been substantially changed since they were first constructed in the 1860s, and the changes proposed as part of the Purple Alternative would affect canal operations by moving LN Canal water to an improved LHPS Canal. However, operating the modified POD on the Logan River and the modifications to operating the LHPS Canal with increased flow would not cause or contribute to cumulative effects to the Logan River, the regional canal system, or canal water users.

Orange Alternative

Logan River and Green Canyon Creek. The Orange Alternative would modify the LHPS Canal POD structure and would change the Logan River flow below Second Dam and past the LHPS Canal POD during the irrigation season. The modifications would have short-term impacts during construction as discussed in Section 5.4.3.6, Water Resources, but would not have long-term adverse effects to the Logan River. The effects to the Logan River at the LHPS Canal POD would be the same as those from the Purple Alternative.

The Orange Alternative would cross Green Canyon Creek at about 1900 North in North Logan. Installing about 50 feet of new box culvert at the creek would modify the creek at this location to accommodate the new box culvert. Once the Orange Alternative is complete, this effect is not expected to cause long-term impacts to the flow or function of the creek upstream or downstream of the canal crossing. Crossing Green Canyon Creek with the LHPS Canal box culvert would require authorization under Section 404 of the CWA and a Utah Stream Alteration Permit. Crossing Green Canyon Creek with the pressure pipe in the LN Canal maintenance road would not require permitting because it would not directly affect the LN Canal conveyance structure.

The Orange Alternative would not affect any other supporting intermittent streams.

LHPS and LN Canals. The Orange Alternative would modify between 4.9 and 5.2 miles of the LHPS Canal and between 4.1 and 4.4 miles of the LN Canal. The affected reach of the LHPS Canal would be converted from an open irrigation channel to a box culvert. Between 3.3 and 3.6 miles of the box culvert would have a stormwater channel adjacent to (either on top of or beside) the culvert. New water-control structures on both canals at either 2900 North

How would the Orange Alternative affect surface waters?

The Orange Alternative would have a minor effect to the Logan River at the LHPS Canal POD, enclose between 4.9 and 5.2 miles of the LHPS Canal, cross over Green Canyon Creek, place 3.1 to 3.4 miles of the LN Canal in a pipe outside the canal easement, and place 1 mile of the LN Canal in a pipe between the LN Canal POD and the Laub Diversion.

or 3100 North and near the LN Canal at about 400 North could affect about 20 linear feet of each canal at each structure. The change to a box culvert and installing the water-control structures would require authorization under Section 404 of the CWA because these activities would permanently fill sections of the LHPS Canal, a water of the U.S. Similar to the Purple Alternative, for the operation of the LHPS Canal on National Forest System land, USFS would issue special-use permit. The use-permit process would include USFS review of the site-specific construction and maintenance plans for this reach of the LHPS Canal.

The Orange Alternative would affect two reaches of the LN Canal. Installing a pipeline in the canal maintenance road or in the bottom of the canal between 400 North and either 2900 North or 3100 North would change the historic flows of the LN Canal for 3.1 to 3.4 miles. Because the pipeline would be installed in the canal maintenance road, it would not directly affect the canal alignment. The existing LN Canal would continue to be used for conveying stormwater.

This alternative also includes installing 1 mile of 6-inch-diameter pipeline in the LN Canal between the LN Canal POD and the Laub Diversion. This would directly affect the existing canal alignment because the pipeline would be in the canal channel. These modifications would not adversely affect the function or operation of the canals or service to shareholders.

Wetlands. Because there are no jurisdictional wetlands along the Orange Alternative alignment, this alternative would not affect any wetlands.

Cumulative and Long-Term Effects. The Orange Alternative would not cause adverse long-term effects to the Logan River, Green Canyon Creek, the LHPS Canal, or the LN Canal. Activity resulting in changes to the Logan River and Green Canyon Creek outside the study area is regulated under State and Federal law. The canals have not been substantially changed since they were first constructed in the 1860s, and the changes proposed as part of the Orange Alternative would not affect canal operation. Operating the LHPS Canal POD at the Logan River crossing of Green Canyon Creek at 1900 North and operating the canals would not cause or contribute to cumulative effects to the Logan River, Green Canyon Creek, the regional canal system, or canal water users.

Blue Alternative

The Blue Alternative would not affect National Forest System land, so none of the standards and guidelines in the *Revised Forest Plan for the Wasatch-Cache National Forest* would apply.

Logan River. The Blue Alternative would modify the LN Canal POD structure on the Logan River so that water could be diverted into a new pipeline. This modification would have short-term impacts during construction as discussed in Section 5.4.3.6, Water Resources, but would not result in long-term effects to the Logan River.

How would the Blue Alternative affect surface waters?

The Blue Alternative would have a minor effect to the Logan River at the LN Canal POD and enclose about 1.7 miles of the LN Canal.

Modifying the POD structure would affect a maximum of 1,000 square feet on the north bank of the river. This would require authorization under Sections 401 and 404 of the CWA and a Stream Alteration Permit from the Utah Division of Water Rights. The conditions of these authorizations would ensure that the impacts to the Logan River are minimized.

The Blue Alternative would not affect any other supporting intermittent streams.

LN Canal. The Blue Alternative would modify 1.7 miles of the LN Canal by constructing a new pipeline in the canal alignment, a new stormwater channel along about 1.5 miles of the alignment (from Canyon Road to 400 North), and a water-control structure at 400 North in the canal. These modifications would not adversely affect the function or operation of the canals or service to shareholders.

Installing the new pipeline, stormwater channel, and water-control structure would directly affect the LN Canal. Because the canal is a water of the U.S., these effects would be subject to authorization under Section 404 of the CWA.

Wetlands. Although NRCS noted the presence of seeps and springs during its 2010 wetland delineation, NRCS did not find any jurisdictional wetlands along the LN Canal alignment that would be affected by the Blue Alternative. Because there are no jurisdictional wetlands along the Blue Alternative alignment, it would not affect any wetlands.

Cumulative and Long-Term Effects. The Blue Alternative would not cause adverse long-term effects to the Logan River or the LN Canal. Activity resulting in changes to the Logan River outside the study area is regulated under State and Federal law. The canal system has not been substantially changed since it was first constructed in the 1860s, and the minor changes proposed as part of the Blue Alternative would not affect canal operation. The changes to the Logan River at the LN Canal POD and to the canals would not cause or contribute to cumulative effects to the Logan River, the regional canal system, or canal water users.

Summary of Impacts and Mitigation

The action alternatives would not cause significant long-term adverse effects to flows or physical features of natural water courses. The postconstruction flows of the Logan River below Second Dam and below the LHPS Canal POD would increase as part of the action alternatives. The physical impacts to the Logan River and Green Canyon Creek would not cause adverse long-term effects to these resources. Modifications to the irrigation canals would not adversely affect the long-term function of the canals or service to water users.

Activity that would permanently affect surface water resources would be subject to authorization under Section 404 of the CWA. Activity on the Logan River and Green Canyon Creek would require a Stream Alteration Permit. Cache County and its contractor would ensure that long-term, permanent effects beyond those permitted would be prevented by applying requirements described in the conditions of these authorizations.

For the alternatives that would have facilities on National Forest System land, the design and operation of those facilities would require a special-use permit, compliance with USFS

standards and guidelines, and USFS review of plans and documents. Cache County and its contractor and special-use permit holders would be required to meet the conditions of the USFS special-use permit for activities conducted on National Forest System land.

Because none of the alternatives would have significant, long-term impacts to the Logan River, Green Canyon Creek, the LN and LHPS Canals, or wetlands in the study area, no mitigation is proposed.

5.3.6.3 Water Quality

This section describes the expected effects of the project alternatives on surface water quality. Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

Because the No-Action Alternative would not change natural water resources or the existing irrigation system, it would not affect surface water quality.

Purple Alternative

The Purple Alternative would modify the LHPS Canal POD and the Logan River, 2.4 miles of the LHPS Canal, and about 2 miles of the LN Canal. Modifying the existing diversion structure would not affect the long-term water quality of the Logan River.

Constructing and operating the new LHPS Canal POD structure would need to undergo a State of Utah antidegradation review for the Logan River. Because the Logan River in Logan Canyon is a Category 1 high-quality water, the Utah Division of Water Quality would need to review the planned modification and expected operation activities as part of an antidegradation review. If the Division of Water Quality finds that the proposal does not meet the State's antidegradation requirements, then Cache County or its contractor would need to work with the Division to change the plan so that it would meet the requirements.

A portion of the Purple Alternative is on National Forest System land and is subject to the policies of the *Revised Forest Plan for the Wasatch-Cache National Forest* (Section 5.3.6.1, Laws, Policies, and Direction). Operating the Purple Alternative on National Forest System land would require a special-use permit from USFS. The following paragraphs briefly discuss how the Purple Alternative would meet the subgoals, standards, and guidelines in the *Revised Forest Plan* and the expected special-use permit conditions related to water quality. Appendix C6, Compliance with the Standards and Guidelines in the *Revised Forest Plan for the*

How would the Purple Alternative affect water quality?

The Purple Alternative would not adversely affect water quality. Separating stormwater from irrigation water in 0.8 mile of the LHPS Canal and about 2 miles of the LN Canal would result in an irrigation water quality benefit.

Wasatch-Cache National Forest, addresses each appropriate standard and guideline in the *Revised Forest Plan*.

Because this alternative would not discharge water to the Logan River, the water quality and beneficial uses of the Logan River would not be affected.

Temporary construction impacts are discussed in Section 5.4.3.6, Water Resources. That discussion addresses the standards and guidelines in the *Revised Forest Plan* and the expected special-use permit authorizations regarding erosion and sediment control, construction access, materials staging, fuels management, and limits of disturbance.

The Purple Alternative would be located in the Bear River Watershed Management Unit for the State's Nonpoint Source Pollution Management Plan (Utah Department of Environmental Quality 2000). According to that plan, which was originally published in 2000 and supplemented by the State's integrated water-quality plan (Utah Division of Water Quality 2010), the Purple Alternative would not be located in an area that is subject to special nonpoint source pollution management. Voluntary nonpoint source pollution prevention activity is ongoing in the Cache Valley area, but this alternative would not affect or be affected by these voluntary activities.

The Purple Alternative would convey shares of LHPS Canal and LN Canal irrigation water in about 2.4 miles of enclosed box culvert. Between the Logan Golf & Country Club and Lundstrom Park, the box culvert would share the existing canal alignment with a separate stormwater system (either on top of or beside the box culvert). Stormwater runoff from urban areas such as those along the LHPS Canal can contain sediment, bacteria, nutrients, debris, and other contaminants. This change in the system would improve irrigation water quality in the LHPS Canal by keeping stormwater and irrigation water separated. The quality of the irrigation water would also be improved because the water would be conveyed in a closed conduit and would not be exposed to sediment from bank erosion and debris entering the existing open canals. This change would improve water quality for shareholders diverting water from the canals upstream of about 1500 North.

The Purple Alternative also includes delivering LN Canal water for about 1 mile to shareholders between 400 North and 1500 North and for about 1 mile between the LN Canal POD and the Laub Diversion using pipes that exclude stormwater. This would have similar irrigation water quality benefits for shareholders along these reaches of the canal as the benefits described for shareholders of the LHPS Canal.

Cumulative and Long-Term Effects. The long-term operation of the canal system would not adversely affect water quality in surface water resources or in the canals. Enclosing the LHPS Canal and separating stormwater would have a long-term benefit on irrigation water quality. Because water quality would be protected during construction and would not be affected in the long term, the Purple Alternative is not expected to cause or contribute cumulative effects to water quality.

Orange Alternative

The effects of the Orange Alternative on water quality would be similar to those from the Purple Alternative. The Orange Alternative would also affect National Forest System land, so it would need to comply with the standards and guidelines of the *Revised Forest Plan for the Wasatch-Cache National Forest* and would require a special-use permit to operate on National Forest System land.

Similar to the Purple Alternative, the Orange Alternative could cause temporary effects to the water quality of the Logan River and the irrigation canals during construction but would not cause long-term water quality effects.

Irrigation water quality would not be adversely affected, and the beneficial effects would be similar to those from the Purple Alternative. Construction effects are discussed in Section 5.4.3.6, Water Resources.

About 50 feet of box culvert crossing Green Canyon Creek in the LHPS Canal alignment would not cause long-term water quality impacts to Green Canyon Creek. Temporary (construction) impacts and application of BMPs during construction are discussed in Section 5.4.3.6, Water Resources.

The Orange Alternative would also improve irrigation water quality as described for the Purple Alternative. The Orange Alternative would provide a greater benefit because it would separate irrigation and stormwater in 3.3 to 3.6 miles of the LHPS Canal, 3.1 to 3.4 miles of the LN Canal between 2900 North or 3100 North and 400 North, and about 1 mile of the LN Canal between the LN Canal POD and 400 North.

Cumulative and Long-Term Effects. The long-term operation of the canal system would not adversely affect water quality in surface water resources or in the canals. Enclosing the LHPS Canal and separating stormwater would have a long-term benefit on irrigation water quality. Because water quality would be protected during construction and would not be affected in the long term, the Orange Alternative is not expected to cause or contribute to cumulative effects to water quality.

Blue Alternative

Similar to the Purple and Orange Alternatives, the Blue Alternative could cause temporary effects to the water quality of the Logan River and the LN Canal during construction (Section 5.4.3.6, Water Resources).

Irrigation water quality would not be adversely affected, and the beneficial effects would be similar to those from

How would the Orange Alternative affect water quality?

The Orange Alternative would not adversely affect water quality. Separating stormwater from irrigation water between about 3.3 and 3.6 miles of the LHPS Canal and between about 4.1 and 4.4 miles of the LN Canal would result in an irrigation water quality benefit.

How would the Blue Alternative affect water quality?

The Blue Alternative would not adversely affect water quality. Separating stormwater from irrigation water in the LN Canal between the POD and 400 North would result in an irrigation water quality benefit.

the Purple Alternative. The Blue Alternative would not affect National Forest System land, so the standards and guidelines in the *Revised Forest Plan for the Wasatch-Cache National Forest* would not apply to this alternative.

Constructing and operating the new LN Canal POD structure would need to undergo a State of Utah antidegradation review for the Logan River. Because the Logan River is considered a Category 3 water from the mouth of Logan Canyon downstream, the Utah Division of Water Quality would need to review the planned modification and expected operation schedule as part of an antidegradation review. If the Division of Water Quality finds that the proposal does not meet the State's antidegradation requirements, then Cache County would need to work with the Division to change the proposal so that it would meet the requirements.

The Blue Alternative would convey irrigation water separate from stormwater in about 1.7 miles of canal between the LN Canal POD and 400 North. At 400 North, the irrigation water and stormwater systems would be combined for delivering water to shareholders downstream. Because the Blue Alternative would separate stormwater and irrigation water for about 1.7 miles, this alternative would have less irrigation water quality benefit than the other action alternatives.

Cumulative and Long-Term Effects. The long-term operation of the LN Canal would not adversely affect water quality in surface water resources or in the canals. Enclosing 1.7 miles of the LN Canal and separating stormwater would have a long-term benefit on irrigation water quality. The Blue Alternative is not expected to cause or contribute to cumulative effects to water quality.

Summary of Impacts and Mitigation

The action alternatives could affect water quality during construction. For measures to address potential construction impacts, see Section 5.4.3.6, Water Resources.

The action alternatives would have the following irrigation water quality benefits:

- Separate irrigation and stormwater system for 0.8 mile of the LHPS Canal and 2 miles of the LN Canal (Purple Alternative).
- Separate irrigation and stormwater system for 3.3 to 3.6 miles of the LHPS Canal and 4.1 to 4.4 miles of the LN Canal (Orange Alternative).
- Separate irrigation and stormwater system for about 1.7 miles of the LN Canal (Blue Alternative).

The alternatives would not affect the long-term water quality of natural water courses, the Logan River, or Green Canyon Creek. No mitigation is proposed.

5.3.6.4 Stormwater Conveyance

Historically, the LN and LHPS Canals conveyed both irrigation water and urban stormwater runoff. Before the 2009 landslide, areas next to the canals would sometimes flood during the irrigation season when large storms produced high volumes of stormwater runoff that flowed into the canals. As discussed in Section 4.4.5.3, Geology, the combined irrigation water and stormwater could exceed the capacity of the canals.

This section describes the expected effects of the project alternatives on stormwater conveyance. Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

The No-Action Alternative would not affect the LHPS Canal, so the LHPS Canal would continue to convey stormwater as it currently does.

For the No-Action Alternative, stormwater and about 2 cfs of irrigation water would be conveyed from the LN Canal POD to the Laub Diversion. The LN Canal would not be used to deliver irrigation water downstream of the Laub Diversion, and the canal alignment could continue to be used by the Cities of Logan, North Logan, Hyde Park, and Smithfield and by Cache County for conveying stormwater. The Cities already use the canal system for conveying stormwater, but they would have more capacity for current and future stormwater discharges with the No-Action Alternative since the LN Canal would not carry any irrigation water (which would provide more capacity for stormwater).

The 2009 landslide area would not be repaired, so the existing LN Canal through the landslide area would remain discontinuous. If under the No-Action Alternative the LN Canal were managed as a municipal stormwater system downstream of the Laub Diversion, the canal and landslide area would require repair to reconnect the LN Canal.

Purple Alternative

The Purple Alternative would temporarily and permanently affect stormwater conveyance in the LN and LHPS Canals. There would be no permanent change to stormwater quality from the Purple Alternative. Section 5.4.3.6, Water Resources, describes the construction-related effects to stormwater from the Purple Alternative.

Under the Purple Alternative, about 0.8 mile of the reconstructed LHPS Canal between the Logan Golf & Country Club (near the Logan Canyon mouth) and Lundstrom Park would convey stormwater separately from irrigation water. At Lundstrom Park, the stormwater and irrigation water that would not be diverted to the LN Canal would be combined into the existing LHPS Canal and conveyed downstream, where the existing channel capacity is

How would the Purple Alternative affect stormwater conveyance?

The Purple Alternative would increase the stormwater capacity of the LN Canal between the POD and the Laub Diversion and between 400 North and 1500 North.

limited. The new stormwater facility would convey historic stormwater flows and would not increase the stormwater capacity of the LHPS Canal. The LHPS Canal could still be overwhelmed during large storms due to its dual functions of delivering irrigation water and conveying stormwater.

In the 1.6-mile reach of the LHPS Canal in Logan Canyon, the final culvert design would include drainage systems along with the new box culvert. These systems would be used to convey any collected water in the box culvert subgrade away from the canal alignment. The nature of the stormwater conveyance channel in the LHPS Canal would change because the stormwater channel would not convey any irrigation water and the channel would be dry most of the year except during storms.

The Purple Alternative would increase the LN Canal's capacity to convey stormwater from the LN Canal POD to about 1500 North, since most of LN Canal irrigation water would be removed from this reach of the canal. The existing nature of the LN Canal alignment could change slightly because of this. However, a minor flushing flow of about 2 cfs would remain in the LN Canal throughout the irrigation season. Irrigation water would be provided to shareholders by the new pressurized pipeline system or from the open canal. Therefore, the benefit of conveying more stormwater in this reach of the canal would not be as great as it would be under the No-Action Alternative.

The section of the LN Canal from the LN Canal POD to the Laub Diversion would contain a pipeline in the existing canal structure, which would remove irrigation water from the canal. This would provide some additional capacity for stormwater runoff from the hillside along this reach of the canal. The Logan & Northern Irrigation Company would abandon the LN Canal from the Laub Diversion to 400 North for irrigation purposes; however, stormwater and water from seeps and springs would continue to be discharged into the canal and would flow downstream. There would be no stormwater conveyance benefit for the segment of the LN Canal downstream of 1500 North since the irrigation water and stormwater would continue to be conveyed in the open canal.

Constructing three new water-control structures (one in the LHPS Canal at Lundstrom Park, one in and adjacent to the LN Canal at 1500 North, and one at 400 North) would not permanently affect the canal's stormwater conveyance capacity during operation and maintenance of the water-control structures since they would be designed to pass stormwater flows. Management of the LHPS Canal irrigation system would remain with the Logan, Hyde Park and Smithfield Canal Company and the Logan & Northern Irrigation Company. However, where there would be separate irrigation and stormwater conveyance systems, the stormwater system would also need to be operated and maintained as a stormwater facility. Where the canal system would convey both irrigation water and stormwater in the open canal, the system would be managed cooperatively by the municipalities and canal companies.

Cumulative and Long-Term Effects. The Purple Alternative would provide additional stormwater capacity for the municipalities to convey stormwater in the LN Canal between 400 North and 1500 North. This additional capacity would be a benefit to the municipalities

in the areas where stormwater is discharged to the LN Canal. The minor changes between 400 North and 1500 North to the LN Canal would have a minor long-term benefit but would not contribute to a cumulative effect on stormwater conveyance in the region.

Orange Alternative

The Orange Alternative would temporarily and permanently affect stormwater conveyance in the LN and LHPS Canals. There would be no permanent effects to stormwater quality from the Orange Alternative. Section 5.4.3.6, Water Resources, describes the construction-related effects to stormwater from the Purple Alternative.

With the Orange Alternative, between 4.1 and 4.4 miles of the reconstructed LHPS Canal between the Logan Golf & Country Club (near the Logan Canyon mouth) and either 2900 North or 3100 North would convey stormwater separately from irrigation water. At either 2900 North or 3100 North, the stormwater and irrigation water that would not be diverted to the LN Canal would be combined into the existing LHPS Canal and conveyed downstream, where the existing channel capacity is limited.

The new stormwater facility would be designed to convey historic stormwater flows and would not increase the stormwater capacity of the LHPS Canal. The LHPS Canal could still be overwhelmed during large storms due to its dual functions of delivering irrigation water and conveying stormwater. The nature of the stormwater conveyance channel in the LHPS Canal alignment would change because the stormwater channel would not convey any irrigation water and the channel would be dry most of the year except during storms.

The stormwater conveyance effects of the Orange Alternative in Logan Canyon and along the reach of the LN Canal between the LN Canal POD and the Laub Diversion would be the same as those for the Purple Alternative.

The Orange Alternative would improve the capacity for conveying stormwater in the LN Canal in a manner similar to that of the Purple Alternative. The benefit associated with the Orange Alternative would be greater since it would provide between 3.1 and 3.4 more miles of separate pipe between 400 North and either 2900 North or 3100 North. Similar to the Purple Alternative, the Orange Alternative would provide some additional stormwater capacity in the LN Canal from the LN Canal POD to 400 North.

There would be no stormwater conveyance benefit for the segment of the LN Canal downstream of 2900 North or 3100 North since the irrigation water and stormwater would continue to be conveyed in the existing open canal.

Constructing three new water-control structures (one in the LHPS Canal at either 2900 North or 3100 North, one in and adjacent to the LN Canal at 2900 North or 3100 North, and one at

How would the Orange Alternative affect stormwater conveyance?

The Orange Alternative would increase the stormwater capacity of the LN Canal between the POD and the Laub Diversion and between 400 North and 2900 North or 3100 North.

400 North) would not permanently affect the canal’s stormwater conveyance capacity during operation and maintenance of the water-control structures since they would be designed to pass stormwater flows. Discharge-control structures near the LN Canal at 2900 North or 3100 North could be designed to shut off irrigation water, and flows in the canal could be reduced downstream more quickly than under existing conditions, which would provide additional stormwater capacity.

As with the Purple Alternative, management of the LHPS Canal and LN Canal irrigation systems would remain with the Logan, Hyde Park and Smithfield Canal Company and the Logan & Northern Irrigation Company. Where the canal system conveys both irrigation water and stormwater in the open canal, the system would be managed cooperatively by the municipalities and canal companies.

Cumulative and Long-Term Effects. The Orange Alternative would provide additional stormwater capacity over the Purple Alternative for the municipalities to convey stormwater in the LN Canal between 400 North and either 2900 North or 3100 North. This additional capacity would be a benefit to the municipalities in the areas where stormwater is discharged to the LN Canal. This alternative would not increase capacity anywhere else in the study area. The changes between 400 North and either 2900 North or 3100 North to the LN Canal would result in a long-term benefit but would probably not contribute to a cumulative effect on the overall stormwater conveyance in the region.

Blue Alternative

The Blue Alternative would temporarily and permanently affect stormwater conveyance in the LN Canal. There would be no permanent change to stormwater quality from the Blue Alternative. Section 5.4.3.6, Water Resources, describes the construction-related effects to stormwater from the Blue Alternative.

The Blue Alternative would convert about 1.7 miles of the LN Canal to a pipe between the LN Canal POD and 400 North. About 1.5 miles of the canal would convey stormwater and irrigation water separately in the existing LN Canal alignment. At 400 North, both stormwater and irrigation water would enter the open canal.

Management of the LN Canal irrigation system would remain with the Logan & Northern Irrigation Company. However, because there would be about 1.5 miles of separate irrigation and stormwater conveyance systems, the stormwater system would also need to be operated and maintained as a stormwater facility. Where the canal system conveys both irrigation water and stormwater in the open canal, the system would be managed cooperatively by the City of Logan and the Logan & Northern Irrigation Company.

How would the Blue Alternative affect stormwater conveyance?

The Blue Alternative would not adversely affect stormwater conveyance.

Because the LHPS Canal downstream of 400 North would continue to convey irrigation water combined with stormwater, there would be no benefits to stormwater conveyance capacity in this segment of the LHPS Canal.

Cumulative and Long-Term Effects. The Blue Alternative would not increase stormwater conveyance capacity, so it would not affect how stormwater is conveyed in the long term or contribute to a cumulative change in regional stormwater management.

Summary of Impacts and Mitigation

The No-Action Alternative would provide additional stormwater conveyance capacity and would require management of the LN Canal system as a municipal stormwater system from the Laub Diversion downstream. Regrading of the 2009 landslide area and reconnecting the conveyance system through the landslide area would be required to operate the existing system as a stormwater conveyance channel.

The Purple and Orange Alternatives would include separate stormwater facilities on both the LHPS and LN Canals. These alternatives would increase the stormwater capacity in the LN Canal between 400 North and 1500 North (Purple Alternative) or between 400 North and either 2900 North or 3100 North (Orange Alternative). The Blue Alternative would include separate stormwater conveyance along the LN Canal between the LN Canal POD and 400 North but would not add stormwater capacity.

The following measures are proposed to ensure that the stormwater systems are managed safely:

- Cache County and its contractor would work with the Logan, Hyde Park and Smithfield Canal Company; the Logan & Northern Irrigation Company; the City of Logan; and the City of North Logan to develop a stormwater management and maintenance program for the LHPS Canal between the Logan Golf & Country Club and Lundstrom Park (Purple Alternative) or between the Logan Golf & Country Club and either 2900 North or 3100 North (Orange Alternative).
- Cache County and its contractor would work with the Logan & Northern Irrigation Company, UDOT, and the City of Logan to develop a stormwater management and maintenance program for the LN Canal between the LN Canal POD and 400 North (Blue Alternative).

5.3.6.5 Floodplains

This section describes the expected permanent effects of the project alternatives on floodplains. Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

Because the No-Action Alternative would not construct any new facilities, it would not affect any mapped FEMA floodplains. The existing LN Canal POD would continue to divert about 2 cfs of water into the LN Canal with no modifications to the POD, so it would not affect the Logan River’s FEMA floodplain.

Purple Alternative

The Purple Alternative would not cross any mapped FEMA floodplains. Because of this, it would not cause any short-term, long-term, or cumulative effects on floodplains.

How would the Purple Alternative affect floodplains?

The Purple Alternative would not affect any mapped floodplains.

Orange Alternative

The Orange Alternative would cross a mapped FEMA floodplain at Green Canyon Creek. About 50 linear feet of the new box culvert that would be constructed in the LHPS Canal would cross the Zone A floodplain of Green Canyon Creek (Figure 5-2). The LN Canal also crosses the Green Canyon Creek Zone A floodplain; however, installing the pipeline into the LN Canal maintenance road should have no effect on the floodplain in that location.

How would the Orange Alternative affect floodplains?

The Orange Alternative would cross the Green Canyon Creek floodplain but would be designed so that the box culvert structure would not adversely affect the function of this floodplain.

If construction and operation of the new LHPS Canal box culvert through the floodplain would affect the floodplain, Cache County might need to pursue a revision to the floodplain mapping and obtain a permit to construct the culvert. If this revision is necessary, it would need to be approved through the FEMA map revision process. Because the change would comply with FEMA regulations for development in the floodplain, it would not cause long-term effects to the floodplain or contribute to regional cumulative effects on the floodplain.

Figure 5-2. Green Canyon Creek Floodplain along LHPS Canal



Blue Alternative

The Blue Alternative would cross a mapped FEMA floodplains associated with the Logan River.

The Blue Alternative would modify the LN Canal POD structure on the Logan River. This structure is in a Zone A2 floodplain of the Logan River (Figure 5-3). If construction and operation of the structure would affect the base flood elevations in the floodplain, Cache County might need to pursue a revision to the floodplain map and obtain a permit to modify the structure. If this revision is necessary, it would need to be approved through the FEMA map revision process. Because the change would comply with FEMA regulations for development in the floodplain, it would not cause long-term effects to the floodplain or contribute to regional cumulative effects on the floodplain.

How would the Blue Alternative affect floodplains?

The Blue Alternative would require modifying the LN Canal POD structure in the Logan River floodplain. The new structure would be designed so that it would not adversely affect the function of this floodplain.

Summary of Impacts and Mitigation

The No-Action and Purple Alternatives would not affect any FEMA mapped floodplains. For the Orange Alternative, the box culvert in the LHPS Canal alignment would be constructed through the mapped Zone A floodplain for Green Canyon Creek. For the Blue Alternative, the LN Canal POD structure would be modified in the mapped Zone A2 floodplain of the Logan River.

Compliance with FEMA regulations for changes to the floodplain zone would prevent any permanent impacts. No mitigation is proposed.

Figure 5-3. Logan River Floodplain near LN Canal POD



5.3.6.6 Groundwater Resources

This section describes the expected effects of the project alternatives on groundwater resources. Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

Because the historic canal operations consisted of conveying irrigation water in lined and unlined open canals, seepage from the LN Canal has been documented. If the canal is abandoned for irrigation purposes, there would be no seepage of irrigation waters from the canal into the groundwater. NRCS estimates that about 4,000 acre-feet of seepage would not occur with the removal of irrigation water in the LN Canal through the study area (Section 4.4.6.5, Groundwater Resources). However, the irrigation water would remain in Cache Valley and would continue to be a source of groundwater recharge.

Purple Alternative

The Purple Alternative would have a permanent effect on groundwater resources by constructing conveyance structures, which reduce seepage losses.

Because the historic canal operations consisted of conveying irrigation water in lined and unlined open canals, both canals have historically lost water through seepage (Section 4.4.6.5, Groundwater Resources). Under this alternative, irrigation water would be conveyed in about 5 miles of closed box culvert and pressurized pipeline systems. As a result, less water would seep from irrigation canals into the groundwater and/or surface waters.

NRCS estimates that about 7,400 acre-feet of water per year would no longer be lost to seepage from constructing about 5 miles of closed systems and from no longer using the LN Canal through the Logan Bluff area. However, because this alternative would not create a closed system through the entire study area, water would continue to seep from the LHPS Canal north of Lundstrom Park and from the LN Canal north of 1500 North.

To meet special-use permit conditions and the *Revised Forest Plan for the Wasatch-Cache National Forest* standards and guidelines (specifically Standard 5), USFS recommends that an initial minimum flow of 5 cfs be allowed to pass the LHPS Canal POD (USFS 2011). This amount is roughly equivalent to the amount of water that was lost to seepage in the LHPS Canal and reached the Logan River on National Forest System land, as discussed in Section 4.4.6.1, Surface Waters, and Section 5.3.6.6, Groundwater Resources.

As discussed in Section 4.4.6.5, Groundwater Resources, the Utah Division of Water Resources estimates the annual groundwater recharge from all canals in Cache Valley to be 86,000 acre-feet. This recharge is only a part of all annual aquifer recharge, which is esti-

How would the Purple Alternative affect groundwater?

The Purple Alternative would prevent seepage of about 7,400 acre-feet of water per year from the LHPS and LN Canals to groundwater.

mated at about 222,000 acre-feet annually (Utah Division of Water Resources 2004). Reducing the annual recharge by a maximum of 7,400 acre-feet would be an annual reduction of about 3.3%.

Cumulative and Long-Term Effects. The Purple Alternative would have project-related long-term impacts to groundwater resources because there would be less surface water lost to seepage during the irrigation season. This effect is not expected to cause long-term groundwater shortages but could contribute to minor cumulative changes in groundwater levels when combined with other activities and natural processes that affect groundwater.

Orange Alternative

The Orange Alternative would affect groundwater resources by constructing conveyance structures, which reduce seepage losses.

Similar to the Purple Alternative, less water would be lost due to seepage from both the LN and LHPS Canals. Under this alternative, irrigation water would be conveyed in about 10 miles of box culvert and pressurized pipeline systems. As a result, less water would seep from irrigation canals into the groundwater.

The seepage losses on National Forest System land with this alternative would be similar to those with the Purple Alternative.

The Orange Alternative would conserve more surface water than the Purple Alternative due to the additional length of the closed canal system (5 miles more). NRCS estimates that about 13,000 acre-feet of water would no longer be lost to seepage from the canal systems each year. The reduction in overall groundwater recharge associated with this alternative would be about 6% annually.

Cumulative and Long-Term Effects. The Orange Alternative would have project-related long-term impacts to groundwater resources because there would be less surface water lost to seepage during the irrigation season. This effect is not expected to cause long-term groundwater shortages but could contribute to minor cumulative changes in groundwater levels when combined with other activities and natural processes that affect groundwater.

How would the Orange Alternative affect groundwater?

The Orange Alternative would prevent seepage of about 13,000 acre-feet of water per year from the LHPS and LN Canals to groundwater.

Blue Alternative

The Blue Alternative would permanently affect groundwater resources by constructing conveyance structures, which reduce seepage losses.

Under this alternative, a groundwater collection system would be installed through a section of the LN Canal alignment along the Logan Bluff to collect and convey groundwater to a new drainage channel located next to the pipeline. The subsurface drainage network would intercept perched groundwater and spring water immediately uphill of the pipeline and would increase the stability of the Logan Bluff where the new pipeline is located.

Irrigation water would not be lost due to seepage from the LN Canal in the segment from the LN Canal POD to 400 North (about 1.7 miles) because the water would be in a pipeline. Before the 2009 landslide, the amount lost to seepage was about 1,300 acre-feet of water per year in this section of the canal. The reduction in groundwater recharge associated with this alternative would be about 0.5% of the total annual recharge. The section of LN Canal downstream of 400 North would continue to lose irrigation water to seepage as it has in the past.

The Blue Alternative would not affect the overall groundwater resources in the study area because seepage from all the sections of the LHPS Canal and from the LN Canal north of 400 North would continue.

Cumulative and Long-Term Effects. The Blue Alternative would have project-related long-term impacts to groundwater resources because there would be less surface water lost to seepage during the irrigation season. This effect is not expected to cause long-term groundwater shortages. Because the annual amount is so small, it would probably not contribute to cumulative changes in groundwater levels when combined with other activities and natural processes that affect groundwater.

Summary of Impacts and Mitigation

All of the alternatives would change the canal systems in a way that would prevent seepage of water from the canals into the groundwater. These impacts would be as follows:

- About 4,000 acre-feet of canal water per year no longer lost from seepage (No-Action Alternative).
- About 7,400 acre-feet of canal water per year no longer lost from seepage (Purple Alternative).
- About 13,000 acre-feet of canal water per year no longer lost from seepage (Orange Alternative).
- About 1,300 acre-feet of canal water per year no longer lost from seepage (compared to pre-landslide conditions) (Blue Alternative).

How would the Blue Alternative affect groundwater?

The Blue Alternative would prevent seepage of about 1,300 acre-feet of water per year from the LN Canal to groundwater.

None of the alternatives are expected to cause long-term groundwater effects, based on information about groundwater conditions provided in the State’s 1999 Interim Cache Valley Ground-Water Management Plan (Utah Division of Water Rights 1999). All alternatives could contribute to cumulative groundwater impacts. This impact would be the greatest under the Orange Alternative, since this alternative would reduce seepage by the greatest amount. This cumulative impact is unavoidable. No mitigation is proposed.

5.3.6.7 Public Water Supply Wells

This section describes the expected effects of the project alternatives on public water supply wells. Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

Under the No-Action Alternative, delivery of irrigation water using the LN Canal would not be restored. Because this alternative would not discharge any pollutants to groundwater, physically affect any existing groundwater wells, or physically affect any public drinking water source protection zones, it is not expected to affect public water supply wells. If shareholders who formerly used LN Canal water on properties in public drinking water source protection zones change the long-term use of their properties, the municipality within which the properties are located would regulate future uses that could affect these zones to ensure that wells and protection zones are not adversely affected.

Purple Alternative

The Purple Alternative would not permanently affect public water supply wells from the long-term operation of the canal or pressurized pipeline systems. The LN and LHPS Canal alignments both cross public drinking water source protection zones. Local city ordinances restrict certain land-use activities within each protection zone.

The LHPS Canal alignment from the Logan Golf & Country Club to Lundstrom Park crosses well protection Zone 4 (15-year time of travel) of three water supply wells. The connecting pipe along 1500 North from the LHPS Canal to the LN Canal would cross a protection Zone 4 of one well. Finally, the LN Canal from 400 North to 1500 North is in a protection Zone 1 (a 100-foot radius from the well head) of one well and crosses a protection Zone 4 of one additional well.

Because the Purple Alternative would not discharge contaminants to groundwater and would not directly affect any well heads, operation of the enclosed canal along the LHPS Canal and operation of the pressurized pipeline system between the canals and along the LN Canal is likely an acceptable land-use activity within each of these well protection zones.

How would the Purple Alternative affect water supply wells?

The Purple Alternative would cross drinking water protection zones but would not adversely affect the wells associated with these zones.

The 10-inch-diameter pressure pipe in the LN Canal that would be constructed as part of the Purple Alternative would be near the City of Logan's 700 North supply well. Operation of the pipeline would not affect operation of the 700 North supply well. Section 5.4.3.6, Water Resources, describes potential construction impacts to this well.

Cumulative and Long-Term Effects. The Purple Alternative would cross several drinking water source protection zones but would not discharge any pollutants that would affect groundwater and would not otherwise affect groundwater flow in these areas. Because it would not affect groundwater quality in these areas, this alternative would not contribute to cumulative regional conditions that affect the quality of water used for drinking water well supplies.

Orange Alternative

The Orange Alternative would not permanently affect public water supply wells from the long-term operation of the canal or pressurized pipeline systems. The impacts from the Orange Alternative would be similar to those from the Purple Alternative except that the pipeline carrying water from the LHPS Canal to the LN Canal would not cross any drinking water source protection zones. The Orange Alternative would not cross any additional drinking water source protection zones.

How would the Orange Alternative affect water supply wells?

The Orange Alternative would cross drinking water protection zones but would not adversely affect the wells associated with these zones.

Cumulative and Long-Term Effects. The Orange Alternative would cross several drinking water source protection zones but would not discharge any pollutants that would affect groundwater and would not otherwise affect groundwater flow in these areas. Because it would not affect groundwater quality in these areas, this alternative would not contribute to cumulative regional conditions that affect the quality of water used for drinking water well supplies.

Blue Alternative

Operation of the Blue Alternative would not affect public water supply wells.

The soil buttress constructed as part of the Blue Alternative would be near the City of Logan's Crockett Avenue well. The limits of the soil buttress would be within Zone 1 (a 100-foot radius) of this well. Because the new pipeline would not discharge pollutants to groundwater, its operation would not affect the function of this well or the quality of the drinking water.

How would the Blue Alternative affect water supply wells?

The Blue Alternative would not affect any drinking water protection zones or any public water supply wells.

Cumulative and Long-Term Effects. The Blue Alternative would not cross any drinking water source protection zones, so it would not cause any long-term effects to drinking water

source wells or contribute to cumulative regional conditions that affect drinking water wells. Because it would not affect groundwater quality in these areas, this alternative would not have project-related cumulative and long-term impacts on public water supply wells.

Summary of Impacts and Mitigation

None of the alternatives would have any permanent effects on public water supply wells. Because the action alternatives would not discharge contaminants to the groundwater and would not directly affect any well heads, the operation of the canal or pressurized pipeline systems is an acceptable land-use activity within each of the well protection zones crossed by the alternatives.

Constructing the action alternatives could temporarily affect public water supply wells. Section 5.4.3.6, Water Resources, discusses these temporary impacts.

5.3.6.8 Water Use and Water Rights

This section describes the expected effects of the project alternatives on water use and water rights.

Construction impacts are discussed in Section 5.4.3.6, Water Resources.

No-Action Alternative

Under the No-Action Alternative, LN Canal shareholders would not be able to divert water from the LN Canal downstream of the Laub Diversion because the existing canal would not be repaired and would not carry irrigation water. This would affect about 133 cfs of water associated with water right numbers 25-3056, 25-6110, 25-6111, 25-6112, and 25-6113 (Utah Division of Water Resources 2010b).

Before the 2009 landslide, about 24% of the LN Canal water shares were used for municipal and industrial purposes. Before the landslide, the Cities of Logan, Smithfield, and Hyde Park obtained culinary water by exchanging canal water for spring water rights. The Logan & Northern Irrigation Company and the Logan, Hyde Park and Smithfield Canal Company own wells in the Smithfield area. Normally, water is pumped from these wells when canal water runs low in order to meet the exchange obligation (Utah Division of Water Resources 2010b). In addition, the City of Logan uses Dewitt Springs to meet a portion of its culinary water demands. At certain times of the year, the City's Logan River water use is in excess of its decreed water rights, and other water users supply the additional water.

Under the No-Action Alternative, some of the water rights could be changed to other PODs or other sources through the Utah Division of Water Rights' change application process. However, the feasibility of changing all water rights and the methods, infrastructure needs, and costs that would need to be used to obtain water (such as new Logan River diversions or additional groundwater withdrawals) and the associated effects were not investigated for this EIS. Predicting the process and results of such future exchanges is speculative, since the

Logan & Northern Irrigation Company; the Logan, Hyde Park and Smithfield Canal Company; the City of Logan; and the City of Smithfield have not investigated the feasibility of these types of water-right changes.

Purple Alternative

Water Use. Enclosing the LHPS and LN Canals for the Purple Alternative would conserve about 7,400 acre-feet of water per year (not lost to seepage). NRCS did not determine the beneficial use of this conserved water, but the Logan & Northern Irrigation Company and the Logan, Hyde Park and Smithfield Canal Company might be able to lease the water and realize a financial benefit.

With the construction of about 1 mile of pressurized pipeline system between 400 North and 1500 North, some shareholders would be able to access pressurized water without needing individual pumping systems. NRCS estimates that future conversion using sprinkler systems with an efficiency of about 85% would conserve more water compared to using the current flood irrigation system, which has an efficiency of about 50%. Some shareholders would receive an additional benefit in energy savings and reduced labor to maintain and service individual irrigation pumps if they are currently using pumps and sprinkler irrigation systems.

Water Rights. The Purple Alternative would require changing the diversion location of some water rights from the LN Canal POD to the LHPS Canal POD. The Logan & Northern Irrigation Company has submitted an application for this permanent change (a36298) to the Utah Division of Water Rights. This application is pending the Division's approval, and agreements between the canal companies and the City of Logan are discussed in Section 4.4.6.6, Water Use and Water Rights.

This alternative would also convey some water through the existing LN Canal POD, so the current water rights held at that POD for this water would not be affected.

Cumulative and Long-Term Effects. The Purple Alternative would not cause any adverse effects to water use or water rights. Current water rights would be maintained, even with a change in some of the rights currently associated with the LN Canal POD. Because the Logan River is highly regulated and because the rights would not be increased (only changed), the Purple Alternative would not cause any cumulative impacts on water use or water rights. The Purple Alternative would have a long-term beneficial effect on water use by conserving an estimated 7,400 acre-feet of surface water per year that is currently lost through seepage and by providing the ability to convert flood irrigation systems to pressurized sprinkler systems that are generally more efficient.

How would the Purple Alternative affect water use and water rights?

The Purple Alternative would have permanent and long-term benefits by conserving about 7,400 acre-feet of surface water per year that is currently being lost to seepage. The Purple Alternative would also provide opportunities for shareholders along about 1 mile of the LN Canal to convert from flood to sprinkler irrigation, which would also conserve water.

Orange Alternative

Water Use. Similar to the Purple Alternative, enclosing the LHPS and LN Canals would conserve water. The Orange Alternative differs in that it would conserve a total of 13,000 acre-feet per year through the use of more-efficient irrigation systems and by losing less water to seepage. This higher total amount of water would be conserved because a longer reach of the LHPS Canal would be changed to a box culvert, a longer section of the LN Canal would be changed to pressurized delivery, and shareholders could convert their systems from flood irrigation to sprinkler irrigation between 400 North and either 2900 North or 3100 North.

With the construction of between 3.1 and 3.4 miles of pressurized pipeline system, more shareholders would be able to access pressurized water and eliminate individual pumping systems. As described for the Purple Alternative, NRCS estimates that shareholders would be able to convert their irrigation systems to sprinkler systems with efficiency of about 85%, which is an improvement over the 50% efficiency of flood irrigation systems.

Water Rights. The Orange Alternative's effects on water rights on USFS-administered land would be the same as those from the Purple Alternative.

Cumulative and Long-Term Effects. The Orange Alternative would not cause any adverse effects to water use or water rights. Current water rights would be maintained, even with a change in some of the rights currently associated with the LN Canal POD. Because the Logan River is highly regulated and because the rights would not be increased (only changed), the Purple Alternative would not cause any cumulative impacts on water use or water rights. The Purple Alternative would have a long-term beneficial effect on water use by conserving an estimated 13,000 acre-feet of surface water per year that is currently lost through seepage and by providing the ability to convert flood irrigation systems to pressurized sprinkler systems that are generally more efficient.

How would the Orange Alternative affect water use and water rights?

The Orange Alternative would have permanent and long-term benefits by conserving about 13,000 acre-feet of surface water per year that is currently being lost to seepage. The Orange Alternative would also provide opportunities for shareholders along between 3.1 and 3.4 miles of the LN Canal to convert from flood to sprinkler irrigation, which would also conserve water.

Blue Alternative

Water Use. Enclosing 1.7 miles of the LN Canal would conserve about 1,300 acre-feet per year. This water would be conserved by reducing seepage and evaporation. The Blue Alternative would not provide any pressurized irrigation water to shareholders, so there would be no change in how shareholders use their water downstream.

Water Rights. The Blue Alternative would not change the existing water rights associated with the LN Canal POD. This alternative would not affect any other water rights.

Cumulative and Long-Term Effects. The Blue Alternative would not have any long-term effects on water use and would not affect water rights. The Blue Alternative is not expected to cause or contribute to cumulative impacts on water use or water rights in the region. This alternative would conserve a minor amount of water in the long term due to enclosing the LN Canal.

How would the Blue Alternative affect water use and water rights?

The Blue Alternative would have permanent and long-term benefits by conserving about 1,300 acre-feet of surface water per year that is currently being lost to seepage.

Summary of Impacts and Mitigation

The No-Action Alternative would not reconnect the LN Canal or otherwise provide water to LN Canal shareholders downstream of the Laub Diversion. This would permanently affect water use in the study area. The No-Action Alternative could also have an effect on water rights if the Utah Division of Water Rights determines that changes are not allowed.

The following paragraphs summarize the impacts to water use from the action alternatives:

- Enclosing the LHPS Canal between the LHPS Canal POD and Lundstrom Park and enclosing the LN Canal between 400 North and 1500 North would have permanent and long-term benefits by conserving about 7,400 acre-feet of surface water per year that is currently being lost to seepage (Purple Alternative).
- Enclosing the LHPS Canal between the LHPS Canal POD and either 2900 North or 3100 North and enclosing the LN Canal between 400 North and either 2900 North or 3100 North would have permanent and long-term benefits by conserving about 13,000 acre-feet of surface water per year that is currently being lost to seepage (Orange Alternative).
- Enclosing the LN Canal would have permanent and long-term benefits by conserving about 1,300 acre-feet of surface water per year that is currently being lost to seepage (Blue Alternative).
- Constructing the pressurized irrigation pipeline system in the LN Canal would conserve additional water as shareholders convert their flood irrigation systems to more-efficient sprinkler irrigation systems (Purple and Orange Alternatives).

While water conservation is not a primary focus of the EWPP, NRCS emphasizes water conservation in many of its programs. NRCS considers the expected water conservation of all of the action alternatives to be an environmental benefit.

Because none of the action alternatives would cause long-term adverse effects on water use or water rights, no mitigation is proposed.

5.4 Construction Impacts

This section describes the temporary construction impacts associated with each of the action alternatives and measures that could minimize construction impacts.

5.4.1 Land Use

5.4.1.1 Purple Alternative

Construction of the Purple Alternative would require temporary construction easements to accommodate construction site access and construction activity. Table 5-5 summarizes the expected construction easements required for the Purple Alternative.

Table 5-5. Construction Easements Required for the Purple Alternative

Reach	Total Easements Required	Easement Requirement by Type of Land Use ^a (acres)		
		Public Land ^b	Private Residential and Agricultural ^c	Private Non-residential ^d
LHPS Canal POD to Logan Golf & Country Club (golf course)	6	5.8	0.0	0.0
Golf course to Lundstrom Park	26	2.3	2.0	0.0
Lundstrom Park to LN Canal	66	3.4	8.2	2.3
LN Canal between 400 North and 1500 North	53	1.4	4.3	0.0

^a Acreages are estimated based on general zoning categories. Because data sources used to prepare these totals have different zoning categories, similar categories were combined to create the file from which these totals are derived.

^b Public land includes Federally owned land (such as USFS-administered land in Logan Canyon), parks, schools, roads, and other land managed by public entities.

^c Includes land developed for residential uses and agricultural land.

^d Nonresidential includes commercial and industrial land uses.

Construction activity on land temporarily used during construction could affect structures on private property such as fences, landscaping on public and private property along the project corridor, and public and private access routes. NRCS and Cache County would work with affected landowners to minimize effects to private structures and landscaping on private land that is not in the canal right-of-way and would repair driveways and access roads if they are

adversely affected during construction. NRCS and Cache County would also work with the Logan Golf & Country Club and the City of Logan to minimize temporary effects to landscaping at the golf course and Lundstrom Park, respectively.

5.4.1.2 Orange Alternative

Construction of the Orange Alternative would require temporary construction easements to accommodate construction site access and construction activity. Table 5-6 summarizes the expected construction easements required for the Orange Alternative.

Table 5-6. Construction Easements Required for the Orange Alternative

Reach	Total Easements Required	Easement Requirement by Type of Land Use ^a (acres)		
		Public Land ^b	Private Residential and Agricultural ^c	Private Non-residential ^d
LHPS Canal POD to golf course	6	5.8	0.0	0.0
Golf course to 2900 North	92	2.7	11.7	0.0
2900 North to 3100 North ^e	16	0.0	1.4	0.0
LN Canal to LHPS Canal				
LHPS Canal to LN Canal via 2900 North	7	0.0	7.2	0.0
LHPS Canal to LN Canal via 3100 North	22	0.0	7.2	0.0
LN Canal between 400 North and 2900 North	208	1.5	10.2	1.2
LN Canal between 2900 North and 3100 North ^e	3	0.0	0.7	0.0

^a Acreages are estimated based on general zoning categories. Because data sources used to prepare these totals have different zoning categories, similar categories were combined to create the file from which these totals are derived.

^b Public land includes Federally owned land (such as USFS-administered land in Logan Canyon), parks, schools, and other land managed by public entities.

^c Includes land developed for residential uses and agricultural land.

^d Nonresidential includes commercial and industrial land uses.

^e Would apply to the 3100 North option only.

Construction activity on land temporarily used during construction could affect structures on private property such as fences, landscaping on public and private property along the project corridor, and public and private access routes. NRCS and Cache County would work with affected landowners to minimize effects to private structures and landscaping on private land that is not in the canal right-of-way and would repair driveways and access roads if they are adversely affected during construction. In addition to working with the Logan Golf & Country Club and the City of Logan as described for the Purple Alternative, Cache County would also work with the City of North Logan to minimize temporary effects to landscaping at Elk Ridge Park.

5.4.1.3 Blue Alternative

Construction of the Blue Alternative would require temporary construction easements to accommodate construction site access and construction activity. Table 5-7 summarizes the expected construction easements required for the Blue Alternative.

Table 5-7. Construction Easements Required for the Blue Alternative

Reach	Total Easements Required	Easement Requirement by Type of Land Use ^a (acres)		
		Public Land ^b	Private Residential ^c	Private Non-residential ^d
LN Canal POD to Laub Diversion	22	0.6	3.0	0.0
Laub Diversion to 400 North ^e	41	0.4	3.0	0.0

^a Acreages are estimated based on general zoning categories. Because data sources used to prepare these totals have different zoning categories, similar categories were combined to create the file from which these totals are derived.

^b Public land includes land managed by USU, UDOT, and the City of Logan.

^c Includes land developed for residential uses only. There is no agricultural land along the Blue Alternative alignment.

^d Nonresidential includes commercial and industrial land uses.

^e Assuming that the alternative includes purchase of structures from 14 properties, then some of the easements between the Laub Diversion and 400 North would be from private land that is transitioned to public land. This table identifies the potentially affected parcels as private land.

Construction activity on land temporarily used during construction could affect structures on private property such as fences, landscaping on public and private property along the project corridor, and public and private access routes. Cache County would compensate affected landowners for effects to private structures and landscaping on private land that is not in the canal right-of-way and would repair driveways and access roads if they are adversely affected during construction. Cache County would also compensate USU for temporary effects to the Water Research Laboratory facility (landscaping and parking lot).

5.4.1.4 Mitigation for Construction Impacts to Land Use

Construction would cause temporary impacts to land along the canals, but these impacts would be short term and would not affect the long-term use of these properties. No mitigation is proposed.

5.4.2 Social and Economic Environment

5.4.2.1 Community Resources, Quality of Life, Landscape Resources, and Scenic Beauty

Temporary, construction-related effects such as noise, dust, and traffic interruptions could disturb people living near the alternative alignments and temporarily reduce their quality of life. Construction activity could also affect people using a number of community resources in the area. These resources include the following:

- USU facilities along 1400 North and 1500 North near the pipeline that would carry water from the LHPS Canal to the LN Canal (Purple Alternative)
- Churches at about 1600 East and 1260 North and at 1500 North and 1500 East (Purple Alternative) and a church near 800 North and 500 East (Purple and Orange Alternatives)
- USU Water Research Laboratory on Canyon Road (Blue Alternative)

People who normally use these facilities might be affected by access limitations or general disturbance while visiting the facilities.

Construction could also temporarily affect the flow of traffic on streets that cross or are near the construction area and privately owned driveways and access roads that cross both canals.

The construction-related effects would be short term and would not change the long-term use of community resources, including the local street network. The public might consider them a nuisance, but the temporary nature of these impacts would not cause any significant effects on community resources in the project area.

Construction activity associated with the action alternatives would temporarily affect landscape resources along the canal alignments. Construction equipment and materials would be staged in existing parking lots or on properties that are already disturbed and used for similar activity. People living near the canals or traveling through the construction area would see construction equipment, material stockpiles, and these staging areas. Construction impacts would be temporary and would not affect long-term views of or from the construction area.

The Purple and Orange Alternatives would require work on National Forest System land in Logan Canyon. This work would require a special-use permit from USFS. The permit conditions would specify how the landscape effects of construction activity should be treated during and after construction. For example, the permit would prescribe an acceptable duration of postconstruction visual impacts based on the landscape's ability to recover. Because the LHPS Canal would be on a hillside above the road, would follow the hillside contour, would be visible at only few points to people using US 89, and would be temporary, construction activity that affects the landscape along the canal is not expected to affect the scenic integrity

of this part of the canyon. The effects of construction activity would be temporary and would be the most visible during and immediately after construction.

Construction would also require removing vegetation along the edges of the canal alignments and the connection pipe alignments through Lundstrom Park and 2900 North/3100 North. This vegetation removal could increase the visual impact of any changes to the structure of the canal, since the changes would be more visible. However, these changes would not affect scenic forest landscapes and are not likely to affect overall recreation or agricultural settings.

Mitigation for Construction Impacts to Community Resources, Quality of Life, Landscape Resources, and Scenic Beauty. Because all of these construction impacts would be short term, they would not cause significant, long-term impacts. However, NRCS proposes the following potential measure for all of the action alternatives to minimize temporary construction impacts:

- Cache County or its contractor would develop a plan that specifies acceptable work hours and work days in areas that have sensitive receptors such as churches, areas near USU, and residential neighborhoods; describes how access to private properties and businesses in affected areas would be maintained; and describes how it would communicate information about the project construction schedule with USU and area residents.

5.4.2.2 Environmental Justice

Purple Alternative

Construction associated with the Purple Alternative could temporarily affect four block groups of low-income populations and three blocks of minority populations due to their proximity to the proposed canal alignment. Appendix C4, Demographics and Environmental Justice, includes detailed information about the effects to environmental justice populations living in these block groups and blocks. Under the Purple Alternative, only construction impacts are anticipated to low-income or minority populations. These construction activities would have temporary and minor effects on populations living near the Purple Alternative. Construction would affect all populations in the area in the same manner and magnitude regardless of their race, ethnicity, and income level. Therefore, low-income and minority populations near the Purple Alternative would not be affected in a disproportionately high and adverse manner.

Orange Alternative

Construction associated with the Orange Alternative could temporarily affect the same four block groups of low-income populations identified for the Purple Alternative and four blocks of minority populations, which include the three blocks identified for the Purple Alternative. Appendix C4 includes detailed information about the effects to environmental justice populations living in these block groups and blocks.

Under the Orange Alternative, only construction impacts are anticipated to low-income or minority populations. These construction activities would have temporary and minor effects on populations living near the Orange Alternative. Construction would affect all populations in the area in the same manner and magnitude regardless of their race, ethnicity, and income level. Therefore, low-income and minority populations near the Orange Alternative would not be affected in a disproportionately high and adverse manner.

Blue Alternative

Construction of the Blue Alternative could affect one block group that supports a low-income population (census tract 8.00, block group 1). Appendix C4 includes detailed information about the effects to the environmental justice populations living in this block group. As with the Purple and Orange Alternatives, only construction impacts are anticipated to low-income or minority populations under the Blue Alternative. These construction activities could have temporary and minor effects on people living near the Blue Alternative. Construction would affect all populations in the area in the same manner and magnitude regardless of their race, ethnicity, and income level. Therefore, no disproportionately high and adverse impacts to minority populations are anticipated under this alternative.

Mitigation for Construction Impacts to Environmental Justice Populations

Because none of the action alternatives would cause short-term, disproportionately high and adverse impacts to environmental justice populations, no mitigation is proposed.

5.4.2.3 Economics

Constructing any of the action alternatives would create temporary construction jobs and increase local spending. This short-term benefit is expected to have a positive effect on the local economy.

If construction activity occurs near existing businesses or adversely affects access to businesses, business operators could experience a loss of income from reduced customer visits. None of the action alternative alignments are near any formally developed business areas, and land around the alternatives is generally used for residential development and agriculture. Because there are so few businesses that would be affected in this manner, the short-term effect on business operations is expected to be minor.

Mitigation for Construction Impacts to the Economy. Because construction of any of the action alternatives would not cause any long-term adverse economic effects, no mitigation is proposed.

5.4.2.4 Recreation

Purple Alternative

Construction activity at the LHPS Canal POD on the Logan River might disturb people using the Riverside Trail, and construction along the canal alignment might disturb people using the Bonneville Shoreline Trail, Ray Hugie Park, the golf course, and Lundstrom Park. Because these impacts would be temporary, they are not expected to cause lasting, long-term effects to recreation use of these resources.

Construction activity along the reach of the LHPS Canal that is in Logan Canyon would be subject to the conditions of a USFS use permit. The permit would identify conditions to minimize construction-related impacts. Conditions would probably include work hour and access restrictions and postconstruction rehabilitation requirements to ensure that the new culvert is safe and compatible with recreation use of the canyon.

During the scoping phase of this proposed action, the golf course operator was concerned that the golf course would not be able to divert canal water for golf course use (such as turf irrigation and operating water features) during construction. If construction occurs when the canal is carrying water (between April and October), the Purple Alternative could affect the delivery of water to the golf course.

Constructing the water-control structure and a segment of pipeline at and through Lundstrom Park would temporarily increase noise levels at the park and could restrict access or cause the temporary closure of some areas of the park. Because these impacts would be temporary, they are not expected to cause lasting, long-term effects to recreation use of the park.

Currently, the LHPS Canal and LN Canal easements are used for unauthorized recreation activities such as walking and bicycling along the canal maintenance roads. Construction activity along the LHPS Canal between the golf course and Lundstrom Park and along the LN Canal between 400 North and 1500 North would cause noise and access restrictions that could temporarily affect these unauthorized uses. Constructing the 6-inch-diameter local-delivery pipeline between the LN Canal POD and the Laub Diversion would cause similar impacts to unauthorized recreation uses along this reach of the LN Canal.

Orange Alternative

Constructing the box culvert between the LHPS Canal POD and Lundstrom Park would cause the same impacts to people using National Forest System land (including the Riverside Trail), the Bonneville Shoreline Trail, Ray Hugie Park, the golf course, and Lundstrom Park as would the Purple Alternative. In addition, constructing a box culvert along the reach between Lundstrom Park and 2900 North/3100 North might cause temporary, construction-related disturbance to people using pocket parks associated with residential areas between about 2950 North and 3100 North. Constructing a water-control structure on the LHPS Canal might disturb people using the pocket parks. Because these impacts would be temporary, they would not permanently affect long-term use of the parks.

Construction along the LN Canal between 400 North and either 2900 North or 3100 North would cause noise and access restrictions that could temporarily affect unauthorized use of the canal easement for recreation. Construction could disturb people using Elk Ridge Park in North Logan. Constructing the 6-inch-diameter local-delivery pipeline between the LN Canal POD and the Laub Diversion would temporarily affect unauthorized recreation uses along that reach of the canal.

Blue Alternative

Construction activity associated with modifying the LN Canal POD at the Logan River could disturb people using the area along the river upstream and downstream, including at designated parks. People using the Boulevard Trail, which connects to 600 East near the western end of the Blue Alternative, could experience temporary impacts during construction. Because these impacts would be temporary, they are not expected to affect the long-term recreation use of the river corridor or the Boulevard Trail.

Mitigation for Construction Impacts to Recreation

Measures to minimize temporary impacts to recreation on National Forest System land in Logan Canyon would be included in the use permit issued by USFS. Because the remaining recreation areas and city parks are important community amenities, NRCS proposes the following measures to minimize temporary construction impacts:

- Cache County and its contractor would work with the Logan Golf & Country Club to ensure that this facility remains accessible during construction and that water delivery during construction meets the golf course operator's turf irrigation needs (Purple and Orange Alternatives).
- Cache County and its contractor would work with the City of Logan to ensure that Lundstrom Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas (Purple and Orange Alternatives).
- Cache County and its contractor would place signs on the segment of the Bonneville Shoreline Trail that inform the public of the work schedule, work activity, and potential temporary trail closures and detours. Signs would be placed at least 2 weeks before the start of construction activity that would affect the trail crossing (Purple and Orange Alternatives).
- Cache County and its contractor would work with the City of North Logan to ensure that Elk Ridge Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas (Orange Alternative).

5.4.2.5 Energy

Construction activities associated with any of the action alternatives might require the temporary use of energy. For example, construction signs intended to inform the public about construction activities would require energy to operate. The amount of energy required to support construction is not expected to cause long-term, significant impacts on the local energy supply.

Construction equipment would require fossil fuels to operate. The Orange Alternative would require the most fossil fuels because it would involve construction along the longest length of canal. However, because construction would probably be completed in one season, the effect is not expected to cause any long-term shortages in the availability of fossil fuels in the project area.

Construction activity on the Logan River could affect the river flow by temporarily reducing the amount of water diverted by Logan City Light and Power. Because any interruption in flow would be short term, it is not expected to significantly affect the amount of power generated by Logan City Light and Power during the construction period.

Mitigation for Construction Impacts to Energy. Because construction would not cause any significant construction-related energy impacts, no mitigation is proposed.

5.4.2.6 Utilities

Construction of any of the action alternatives could affect utilities along the canal alignments and at street crossings. The pipeline that would connect the LHPS Canal and the LN Canal could also affect utilities on undeveloped land along 1500 North for the Purple Alternative and for the Orange Alternative 2900 North option.

Utility impacts could include temporary or permanent relocation of utility lines (such as electrical lines, sanitary sewer, or culinary water lines) or structures that support facilities (such as poles or control boxes), which might cause temporary service interruptions to utility customers. Utility interruptions could include interruptions in the delivery of irrigation water to LN Canal and LHPS Canal shareholders.

Mitigation for Construction Impacts to Utilities. If an action alternative is selected, Cache County or its contractor would collect detailed information about the presence of utilities along the alternative alignments and estimate the potential effects to facilities or service. This standard practice includes contacting and working with service providers, contacting Blue Stakes before the beginning of construction, and restoring utility facilities to preconstruction conditions. Following this standard process would ensure that impacts to utilities are minimized during construction.

5.4.3 Natural Resource Environment

5.4.3.1 Agriculture

Purple and Orange Alternatives

Construction of these alternatives would directly affect land that is currently farmed near the proposed pipeline routes between the LHPS Canal and the LN Canal at about 1500 North for the Purple Alternative and at either 1900 North or 3100 North for the Orange Alternative. Construction could temporarily affect use of irrigated and nonirrigated farmland in all of these areas by restricting access or temporarily using farmland for construction staging. In the cases of the Purple Alternative pipeline and the Orange Alternative 2900 North pipeline, construction activity would occur along property lines that separate the farmed areas. The Orange Alternative 3100 North option would temporarily affect actively farmed land on the north and south sides of 3100 North by restricting access or temporarily using farmland for construction staging.

Construction could affect access to these farmed areas by blocking existing access points or by preventing large pieces of farm equipment from moving through active construction areas. Though the impacts might be inconvenient, they would not directly affect use of these areas for agriculture. Because the farmland areas that would be temporarily used during construction are along edges (either property lines or a road), construction is not expected to have any long-term effects on agricultural production.

Because the remainder of the areas along the canals that would be temporarily affected during construction do not include any irrigated or nonirrigated crops or farmland, construction is not expected to have any additional temporary effects on ongoing farming.

If construction occurs during the irrigation season, it could affect farming activity on any land that relies on irrigation water delivery through the LHPS and LN Canals if irrigation water delivery is temporarily suspended during construction. If the construction season is long and occurs at the same time as the irrigation season, these impacts could be significant even though they might be short term.

Blue Alternative

There are no actively farmed areas along the route of the Blue Alternative. Therefore, construction activities associated with the Blue Alternative would not directly affect agricultural production.

Mitigation for Construction Impacts to Agriculture

NRCS proposes the following measure to minimize impacts to agriculture if construction of the Purple or Orange Alternative occurs during the irrigation season:

- If construction would affect the delivery of irrigation water in a manner that would be harmful to shareholders who have been able to obtain some or all of their shares since the 2009 landslide, Cache County and its contractor would work with the Logan & Northern Irrigation Company; the Logan, Hyde Park and Smithfield Canal Company; the Cities of Logan and North Logan; USU; and other canal companies as appropriate to identify ways that the shareholders' allocated water can be delivered.

5.4.3.2 Biological Resources

Purple Alternative

Effects on Vegetation and Wildlife. Reconstruction of the LHPS Canal POD would directly affect riparian vegetation around the diversion structure. The direct effects would involve the loss of some riparian vegetation within the new footprint of the structure along with some temporary construction impacts (disturbance of vegetation) in the riparian zone. Normal post-construction restoration measures would ensure that disturbed areas would be stabilized and revegetated using native riparian species wherever possible.

These effects to riparian vegetation at the LHPS Canal POD would not affect the overall integrity of the Logan River riparian zone because the affected area would not be very large. To ensure that the area disturbed during construction at the POD is minimized, NRCS or its contractor would ensure that construction equipment does not travel outside a defined work zone, which should limit disturbance to riparian vegetation as much as possible.

Modifying the LHPS Canal POD could temporarily affect aquatic habitat in the Logan River. As described in Section 5.4.3.6, Water Resources, constructing the POD structure would affect a maximum of about 1,000 square feet. Heavy equipment should not need to work in the river for extended periods and could be operated from an adjacent pedestrian trail or roadway right-of-way. Any naturally occurring in-stream debris would not be removed unless this is necessary to place temporary or permanent structures. If construction were to require diverting some or all of the river, Cache County or its contractor would need to develop and implement measures to ensure that the temporary impacts do not harm fish or other aquatic species during construction. After construction, the affected area of the river would be returned to preconstruction conditions by removing any materials or structures (such as gravels or cofferdams) used during construction. Restoration to preconstruction conditions should prevent long-term effects to aquatic species.

The box culvert constructed in the LHPS Canal alignment in Logan Canyon would be placed in the existing canal. Construction might require minor excavation in the canal once the existing structure is demolished but would not require any additional cuts or fills on the

adjacent slopes. To construct the culvert, the contractor would place base material as needed and then backfill around the culvert once it is installed.

Construction activities associated with the Purple Alternative are expected to cause temporary construction impacts along both canals south of 1500 North. Placing the sections of the LHPS Canal into a box culvert or installing pipe into the service road along the LN Canal would disturb landscaped and upland vegetation on either side of the canals during construction. Some of the disturbed areas would be treated with erosion-control measures, such as reseeding, following construction. Some mature upland vegetation along the canals would be removed and would not be replaced, but most of the naturally occurring upland vegetation that would be removed consists of common, low-growing species (such as grasses and herbaceous plants) that would probably re-establish on their own once the project is complete.

Most of the vegetation that would be removed is located along the LHPS Canal between the canyon mouth and Lundstrom Park, but some common shrub or small tree species could also be removed or cut back if necessary from the sections from the LHPS Canal POD to the canyon mouth. This alternative might also remove some residential landscaping between 700 North and 400 North along the LN Canal for the pressure pipe because there is no service road through this section.

Construction activity could disturb locally common wildlife species using upland habitats along reaches of the canals that pass through less-developed areas. These effects would be temporary, and affected wildlife would likely return to the area once activities have stopped.

Residents have planted vegetation along both canals along the Purple Alternative's route. In most cases, the land that this vegetation is planted on is not part of these residents' properties. However, during the final design phase of the project, Cache County and its contractor would consider ways to avoid impacts to residential landscaping that is on private property, such as restricting disturbance where possible and showing restricted areas on construction plans. NRCS and Cache County would work with landowners for impacts to landscaping on their properties. However, NRCS and the County would probably not replace residential landscaping features along the canals that are in the established canal easement. The canal easement would need to be maintained for maintenance access in the future, so re-establishing landscaping features would not be an appropriate use of the easement.

No wildlife habitats would be affected by the construction of the connecting pipe between the LHPS Canal and the LN Canal. The section of pipeline would be placed mostly under existing streets but would affect a landscaped area associated with Lundstrom Park, agricultural land (currently a safflower field and a livestock paddock), and previously disturbed areas associated with low-density development. These areas do not provide good habitat for locally common wildlife and are dominated by non-native vegetation.

Effects on Noxious Weeds and Invasive Species. Construction activity can contribute to the spread of noxious weeds if equipment is not cleaned after working in areas known to support the weeds. Construction can also introduce noxious weeds if imported material contains weed seeds. Cache County or its contractor would apply BMPs during construction to ensure that

new species are not introduced and existing populations do not spread. These BMPs would include cleaning construction equipment and using weed-free straw, seed, or soil for any restoration activities. Cache County and its contractor would ensure that box culvert cover soil is seeded with a native seed mix, if available, as soon as possible after construction is completed. If a native mix is not available, the contractor would try to obtain a weed-free seed mix. The intent would be to prevent the establishment of noxious weeds after construction.

If herbicide treatments are necessary for weed control after construction on National Forest System land, such treatment should comply with USFS Intermountain Region's Forest Service Manual 2080, *Supplement #R4 2000-2001-1*, and should not occur during the flowering period of any known threatened, endangered, or sensitive plant population in the application area. If these BMPs are applied, the Purple Alternative should not spread or introduce new noxious or invasive weed species.

Orange Alternative

Effects on Vegetation and Wildlife. Under the Orange Alternative, the construction-related impacts to vegetation and wildlife would be similar to those from the Purple Alternative except that the effects along the canals would occur over a larger area in the valley. The Orange Alternative would affect riparian and aquatic habitat along and in the Logan River at the LHPS Canal POD, landscaped and upland vegetation growing along the LHPS Canal downstream of the Logan Canyon mouth, and possibly common upland vegetation and landscaping along the LN Canal.

Constructing the connecting pipe between the two canals would not affect any native vegetation or important habitat. The 3100 North option would be entirely within a road right-of-way, but agricultural fields and residential landscaping along the road could be temporarily affected during construction. The 2900 North option would travel along the boundaries of several parcels, most of which are used for agriculture. Temporary impacts to these areas are discussed in Section 5.4.3.1, Agriculture. Cache County would return areas disturbed during construction (but not permanently converted to canal easement) to preconstruction conditions, so these temporary effects would not cause long-term effects to planted vegetation associated with agriculture.

Effects on Noxious Weeds and Invasive Species. The effects of the Orange Alternative on noxious weeds and invasive species would be similar to those from the Purple Alternative. The area of ground disturbance would be larger under the Orange Alternative, but BMPs should prevent the spread of existing or the introduction of new noxious weeds or invasive species.

Blue Alternative

Effects on Vegetation and Wildlife. Under the Blue Alternative, reconstructing the diversion structure at the LN Canal POD just below First Dam would affect riparian vegetation along the Logan River. Cache County or its contractor would ensure that disturbance to the riparian

area and the river is minimized, and areas disturbed during construction would be restored after construction using native riparian species.

Modifying the LN Canal POD could temporarily affect aquatic habitat in the Logan River. If construction were to require diverting some or all of the river, Cache County or its contractor would develop and implement measures to ensure that the temporary impacts do not harm fish or other aquatic species during construction. As described for the Purple Alternative, the affected area of the river would be returned to preconstruction conditions by removing any materials or structures (such as gravels or cofferdams) used during construction. Restoration to preconstruction conditions should prevent long-term effects to aquatic species.

The Blue Alternative would have some temporary construction impacts along the slopes above and below the existing canal through the construction zone (between the LN Canal POD and about 400 North). The area has pockets of vegetation interspersed with open slopes. The vegetation provides habitat for locally common wildlife. These areas would be disturbed by removing the original canal structure and constructing the drainage channel and pipeline. Disturbed areas that are not part of the new pipeline and supporting structures would be restored using standard BMPs following construction (such as reseeding and possibly some limited planting for erosion control), but some areas of vegetation would be permanently lost during construction.

Construction activity would also affect seeps along the hillside, but other areas of similar habitat would still be available nearby and in the region. Wildlife could still access the Logan River and the existing riparian area. Locally common wildlife would be temporarily disturbed by construction activities and would likely return to the area once construction activities have stopped.

Effects on Noxious Weeds and Invasive Species. As with the Purple Alternative, BMPs would be used during construction to ensure that new species of noxious weeds or other invasive plants are not introduced and existing populations do not spread.

Mitigation for Construction Impacts to Biological Resources

The effects to biological resources associated with construction activities would be as follows:

- Temporary effects to the Logan River and riparian vegetation at the LHPS Canal POD (Purple and Orange Alternatives) and at the LN Canal POD (Blue Alternative)
- Vegetation clearing along the LHPS Canal and LN Canal (all action alternatives)
- Temporary disturbance of locally common wildlife during construction (all action alternatives)
- Potential spread of noxious weeds or invasive species (all action alternatives)

NRCS proposes the following mitigation measures to avoid and minimize impacts to biological resources during construction:

- Before the start of construction at the LHPS Canal POD (Purple and Orange Alternatives) or the LN Canal POD (Blue Alternative), Cache County or its contractor would prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. The plan would include details about dewatering or temporarily rerouting the river, construction limits near the river, standards for equipment use near the river, and postconstruction restoration of disturbed areas along the river. . This plan would be reviewed and approved by the Utah Division of Water Rights in compliance with a Stream Alteration Permit before construction in or near the river could begin (all action alternatives). USFS would review construction plans associated with the Purple and Orange Alternatives.
- Cache County or its contractor would define a work zone along the alternative alignment within which all activity is to take place. The contractor would not remove vegetation or unnecessarily disturb areas outside of the work zone. The defined construction area would be shown on construction plans, and the construction contractor would make sure all workers know the boundary location. The contractor would provide extra protection measures for sensitive areas such as private residential landscaping and public parks to ensure that impacts to surrounding vegetation are avoided (all action alternatives).
- Cache County or its contractor would apply BMPs to ensure that construction does not introduce noxious weeds or invasive species or does not cause the spread of exiting populations of noxious weeds or invasive species. BMPs would include actions such as bringing in clean equipment, cleaning equipment before it leaves the work area, and using materials that are weed-free (all action alternatives).

5.4.3.3 Special-Status Species

Purple Alternative

Only one sensitive plant species, Logan buckwheat (*Eriogonum loganum*), could be directly affected by constructing the box culvert through the Logan Canyon section. USFS identifies this plant as an Intermountain Region management indicator species, but the plant is not listed as threatened or endangered under the ESA (Appendix D2, Sensitive Species List). There is a known population of Logan buckwheat downslope of the canal near the mouth of Logan Canyon. However, damage to this species could be avoided by verifying the extent of the population and by using environmental fences or other barriers to prevent the population from being disturbed by construction. Because construction would be limited to the existing canal structure, Logan buckwheat habitat and population viability would not be affected.

The canal and adjacent areas in Logan Canyon were surveyed for the threatened plant species Maguire's primrose (*Primula maguirei*) on May 10, 2010, by Steve Wilcox (NRCS/UDWR Habitat Biologist), and no species or habitat were observed (USDA NRCS 2010a). The LHPS Canal POD in Logan Canyon is closer to a known population, but those individuals are out of the footprint of the construction area for this POD. Because construction would be limited to the work area immediately surrounding the new POD structure and would not affect cliff habitats to the south, Maguire's primrose habitat and population viability would not be affected.

Migratory birds are protected from harm by the Migratory Bird Treaty Act. The migratory bird nesting period starts in late April and extends through the end of August. Vegetation clearing along the canals conducted during the nesting season could disturb or harm migratory birds protected by the Migratory Bird Treaty Act. Cache County or its contractor would need to conduct surveys for nesting migratory birds if clearing were to take place during the nesting season.

There are no records of bald eagles roosting in the part of Logan Canyon that is along the LHPS Canal. However, if work along the canyon reach of the LHPS Canal were to occur in December through February, then Cache County or its contractor would need to ensure that construction would not disturb bald eagles.

No other sensitive species, Federally listed species, State-listed species, or USFS management indicator species would be affected by the Purple Alternative.

Orange Alternative

The effects of the Orange Alternative on special-status species would be the same as those from the Purple Alternative. Construction of the Orange Alternative would avoid disturbing the known population of Logan buckwheat in Logan Canyon and would avoid the known population of Maguire's primrose but could affect migratory birds and roosting bald eagles.

Blue Alternative

No special-status or sensitive species are known to live along the Blue Alternative alignment. Construction activity could harm migratory birds or their nests if vegetation is cleared during the nesting season. As with the Purple Alternative, Cache County or its contractor would conduct surveys for nesting birds if clearing occurs during the nesting season.

Mitigation for Construction Impacts to Special-Status Species

The effects to special-status associated with construction activities would be as follows:

- Potential damage to a known Logan buckwheat population (Purple and Orange Alternatives)
- Potential disturbance during construction to nesting birds protected by the Migratory Bird Treaty Act (all action alternatives)

- Potential disturbance of nesting bald eagles (Purple and Orange Alternatives)

NRCS proposes the following mitigation measures to avoid and minimize impacts to special-status species during construction:

- To ensure that the known population of Logan buckwheat is not disturbed during construction, Cache County or its contractor would verify the extent of the existing population before construction begins. This verification would take place when the plant is conspicuous and identifiable. If the verification finds that the population has spread into the expected work area, Cache County or its contractor would work with USFS to develop and implement a plan to protect the population. If the verification finds that the plant is still present but outside the work area, Cache County or its contractor would place protective fences around the population and ensure that work crews avoid the area (Purple and Orange Alternatives).
- If construction work occurs during the nesting period (between April 30 and August 31), Cache County or its contractor would conduct a survey for nesting migratory birds in areas to be cleared no sooner than 1 week prior to the start of clearing. If an active nest is found, the nest would be protected from construction activities until the young have fledged (all action alternatives).
- If work in Logan Canyon occurs in December through February, Cache County or its contractors would coordinate with USFS and/or USFWS to determine if a survey for bald eagles in or near the work zone is needed. If a survey is needed, the results of the survey would determine whether Cache County or its contractor needs to restrict construction times to avoid disrupting any bald eagles that might be roosting along the Logan River (Purple and Orange Alternatives).

5.4.3.4 Cultural and Tribal Resources

In accordance with 36 CFR 800.5 of the implementing regulations of Section 106 of the NHPA, construction activities that would be part of any of the action alternatives would be assessed for their potential to adversely suspect known or suspected historic properties within the APE. Specifically, the regulations define adverse effects as activities that "...may alter, directly or indirectly, any of the characteristics that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, and association."

Although a pedestrian inventory of the action alternatives remains to be completed, preliminary assessments indicate that both the LN Canal and the LHPS Canal are eligible for listing on the NRHP. One or more of the 14 residential structures located along Canyon Road might also be determined eligible for listing on the NRHP after NRCS completes formal evaluations. If these structures are eligible, NRCS would resolve the adverse effects to historic properties during construction by developing a treatment plan according to 36 CFR 800.6. For information about how the treatment plan would be developed, see Section 5.3.4.1, Laws, Policies, and Direction.

The treatment plan would list the measures that would be used to minimize and mitigate the adverse effects to historic properties as a result of construction activities. Once the treatment plan and measures to minimize and mitigate the adverse effects are agreed on by the consulting parties, a MOA would be executed and implemented pursuant to Section 106. NRCS would recommend that the proposed action be allowed to proceed after the conditions of the MOA have been satisfactorily executed.

Mitigation for Construction Impacts to Cultural Resources. The pedestrian inventory of the action alternatives would emphasize the identification and documentation of cultural resources that might be present within the APE and that are available for visual inspection. Construction activities might still uncover unanticipated archaeological materials beneath the modern ground surface. Implementing the following measure would minimize potential impacts related to this discovery:

- In the event of an unanticipated discovery of archaeological materials during construction, work would cease and the SLO or its contractor would contact the NRCS Cultural Resources Specialist (CRS). NRCS would investigate the discovery and would enter into consultation per 36 CFR 800.6 to develop the appropriate methods for treating the discovery. Construction in the area of the discovery might need to be halted throughout this review and consultation process. After a discovery, continuation of work would be contingent on approval by the NRCS CRS in consultation with the Utah SHPO and other consulting parties (all action alternatives).

5.4.3.5 Topography, Surface Soils, and Geology

Purple and Orange Alternatives

Constructing these alternatives would affect land along the LHPS Canal that is in a steep canyon. Because of the steep topography of the canyon, construction activity would be confined to the existing canal alignment. Construction would not change the topography of adjacent areas.

These alternatives would each temporarily disturb at least 1 acre of surface soil during construction, which would require compliance with the CWA Section 402 general construction permit for Utah. Construction on National Forest System land would also need to meet the standards and guidelines in the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003). Using the soil-protection and erosion-control measures described in the SWPPP required as part of CWA Section 402 general construction permit compliance would prevent erosion from the construction areas; these same measures would ensure the protection of soil productivity as required by Guideline 11 in the *Revised Forest Plan*. Because soil would be disturbed only within the active construction area, this alternative would not affect the health and productivity of soils used for agricultural production. Disturbed areas would be reseeded and protected from postconstruction erosion as needed to protect the soil from future erosion.

The Orange and Purple Alternatives would not repair the 2009 landslide area. However, structures through the Logan Bluff where there have been historic landslides (between about 750 East and 1100 East) would be purchased. The Purple and Orange Alternatives would not cause any temporary construction-related effects to major geologic features such as geologic units, topography, or surface soils.

Blue Alternative

The Blue Alternative would be constructed along the Logan Bluff, an area of known instability. Construction activity would need to be carefully planned and carried out to ensure that equipment use on the steep, unstable slope would not trigger potentially damaging events such as landslides. Because NRCS and Cache County would purchase structures in the approximate Zone 2 area (the area between about 750 East and 1100 East; Figure 3-8, Blue Alternative), people would not be living below the work zone during construction. This would prevent risks to human life and property through this area.

Construction of the Blue Alternative would disturb native surface soil and import additional soil during construction. The disturbed area would exceed 1 acre. As with the Purple and Orange Alternatives, using the soil-protection and erosion-control measures described in the required SWPPP would prevent the loss of soil. Because soil would be disturbed only within the active construction area, these alternatives would not affect the health and productivity of soils used for agricultural production.

For the Blue Alternative, the existing 2009 landslide area would be reshaped and graded with soils that would be brought to the site in order to construct the irrigation pipeline and drainage systems in the existing LN Canal alignment. The SWPPP would apply to these construction activities. For example, placing straw rolls would prevent the loss of imported and native soils from the construction site.

Constructing the soil buttress would require about 130,000 cubic yards of gravelly material to be brought to the area. The gravelly material would be placed and blended in a manner that would ensure protection of the native and imported soil. The measures specified in the SWPPP that would stabilize the gravelly material include slope terracing, grading, stability measures, and drainage-control structures. Disturbed areas would be reseeded as needed after construction to protect the soil from erosion. Construction of the Blue Alternative would not affect soils in the study area.

Mitigation for Construction Impacts to Topography, Soils, and Geology

The contractor would comply with the requirements of Section 402 of the CWA and would apply measures described in the required SWPPP. Because of this and because construction impacts would be short term, construction would not cause any long-term effects to topography, surface soils, and geology. No mitigation is proposed.

5.4.3.6 Water Resources

Purple Alternative

The reach of the Logan River that is in the study area and on National Forest System land is subject to the policies, standards, and guidelines of the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) in addition to existing State and Federal regulations. The following discussions address potential construction-related effects on water resources and compliance with existing plans and regulations.

Surface Waters. The Purple Alternative could temporarily affect the Logan River at the LHPS Canal POD during construction of a new diversion structure. Construction might require partial dewatering of the channel but would not result in any long-term effects to the river. Areas disturbed along the river bank during construction would be restored as described in Section 5.4.3.2, Biological Resources.

The existing LHPS Canal diversion structure on the Logan River would be modified so that it could accommodate up to 130 cfs, a rate that is higher than what has been historically diverted at this POD. This POD modification would affect a maximum of 1,000 square feet on the north bank of the river. Constructing a new diversion structure would require authorization under Sections 401 and 404 of the CWA, a Stream Alteration Permit from the Utah Division of Water Rights, compliance with USFS standards and guidelines, and compliance with USFS special-use permit conditions (which would include construction plan review by USFS). The conditions of these authorizations would ensure that impacts to the Logan River are minimized and comply with the standards, guidelines, or requirements of the regulating agencies.

Construction activity along and in the LHPS and LN Canals could temporarily affect the canal companies' ability to use the canals for conveying irrigation water. Cache County and its contractor would work closely with the canal companies to develop a construction plan to minimize the impact of interruptions in the delivery of shareholders' water.

In general, Cache County or its contractor would implement BMPs during construction to reduce the amount of sediment that is transported to the Logan River, thereby protecting this surface water. The timing of the construction, methods of construction, and duration of construction all require consideration to reduce the amount of sediment discharged from construction areas to the Logan River. Because construction activity would require site grading, Cache County or its contractor would need to install erosion-control measures and revegetate the disturbed river banks. The disturbed banks would be revegetated by planting them with native grasses and shrubs. For more information about protecting the Logan River during construction, see the section titled Water Quality below.

As shown in Figure 4-10, Wetlands in the Study Area, there is one wetland along the south side of 1500 North at about 1250 East. Because the pipeline between the LHPS Canal and the LN Canal would be in the road at this location, it would not fill the wetland. However, because the wetland is close to the construction area, it could be temporarily affected during

construction if it were not protected. Under the Purple Alternative, the construction contractor would need to ensure that the wetland is protected from disturbance and that activity would not affect the existing hydrology in a way that could affect the wetland.

Water Quality. Construction of the Purple Alternative would disturb more than 1 acre of land, so construction activity would need to comply with Utah's general construction permit for stormwater discharges (required as a part of CWA Section 402) and the standards and guidelines in the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003). Compliance with Section 402 would include completing a SWPPP that would include specific measures designed to protect water quality during and following construction; these same measures would ensure water quality protection as described in the USFS standards and guidelines. Other measures that would be identified in the SWPPP include the location of construction access points, limits of disturbance, material storage areas, and material handling procedures, all of which would be focused on preventing pollution from entering surface waters during and after construction. NRCS and the SLO expect that a condition of the USFS special-use permit would be a construction plan review; the SLO or its contractor would ensure that this review would meet those requirements.

Modifying the diversion structure to allow the diversion of up to 130 cfs could cause temporary impacts to the water quality of the Logan River at the LHPS Canal POD below Second Dam from increased sediment entering the river during construction. Application of standard BMPs and establishing clear limits on equipment use in or near the river would minimize such effects. Cache County and the construction contractor would apply appropriate BMPs for sediment and erosion control during construction. This would ensure compliance with the CWA Section 402 permit from the Utah Division of Water Quality and the *Revised Forest Plan* standards and guidelines.

Constructing the new LHPS Canal POD structure would need to undergo a State of Utah antidegradation review for the Logan River. Because the Logan River in Logan Canyon is a Category 1 high-quality water, the Utah Division of Water Quality would need to review the planned modification as part of an antidegradation review.

Stormwater Conveyance. Because most precipitation falls between late fall and early spring, which is a time when construction activity is generally limited, the potential unavailability of the canals to collect and convey stormwater might not be significantly affected. To ensure that the stormwater could be safely and efficiently conveyed during construction, Cache County and its contractor would need to work closely with the City of Logan to develop a temporary stormwater-conveyance plan that would be used during the construction period.

Floodplains. The Purple Alternative would not affect any floodplains.

Groundwater. Construction of the Purple Alternative would not affect groundwater. All construction-related discharges would be managed on the construction site, and polluted water would not penetrate into the groundwater. NRCS and the SLO expect that the USFS special-use permit would require detailed review of the construction plans by USFS. This

would include review of practices proposed as part of construction to ensure that chemicals and pollutants would not reach groundwater.

Water Supply Wells. The 10-inch-diameter pressure pipe in the LN Canal that would be constructed as part of the Purple Alternative would be near the City of Logan's 700 North supply well. During construction, the construction contractor would need to take additional measures to protect the well house and well from potential contamination.

Water Use and Water Rights. Construction activity would temporarily affect operation of the LHPS Canal and the reach of the LN Canal between the LN Canal POD and the Laub Diversion. These effects would be short term but could affect shareholders' ability to use their water at critical times if construction occurs during the irrigation season. If the canals cannot be used for an extended period of time during the irrigation season, this impact could significantly affect the shareholders. Construction activity would not affect the water rights of others.

Orange Alternative

Surface Waters. The Orange Alternative would have the same construction effects to the Logan River at the POD as would the Purple Alternative.

The Orange Alternative would also cross Green Canyon Creek. This activity would require authorization under Sections 401 and 404 of the CWA and a Stream Alteration Permit from the Utah Division of Water Rights.

There are no wetlands along the Orange Alternative alignment.

Water Quality. The Orange Alternative would have the same construction effects to water quality as would the Purple Alternative and would require the same regulatory agency authorizations and reviews. The affected reaches of the LHPS and LN Canals would be longer, but the types of water quality protection measures applied under this alternative would be the same as those for the Purple Alternative.

Stormwater Conveyance. Construction activity associated with the Orange Alternative would affect stormwater conveyance in a way that is similar to the Purple Alternative. Under the Orange Alternative, longer sections of both canals could be affected, and the Cities of North Logan and Logan would need to be involved in any temporary stormwater conveyance planning.

Floodplains. The Orange Alternative would cross a floodplain associated with Green Canyon Creek in North Logan. To ensure that the floodplain is not affected during construction, the contractor would ensure that construction equipment and materials would not be staged in the floodplain. Construction activity would not otherwise affect the function and limits of the floodplain.

Groundwater. Construction of the Orange Alternative would not affect groundwater. All construction-related discharges would be managed on the construction site, and polluted water would not penetrate into the groundwater. As described for the Purple Alternative, the

conditions of the USFS special-use permit would include USFS review of the construction plan details that describe BMPs to prevent groundwater pollution.

Water Supply Wells. Construction of the Orange Alternative would occur near the City of Logan's 700 North well. During construction, the construction contractor would need to take additional measures to protect the well house and well from potential contamination.

Water Use and Water Rights. The temporary water-use effects of the Orange Alternative are similar to those from the Purple Alternative. The Orange Alternative would affect a longer reach of the LHPS Canal, so temporary effects caused by service interruptions during the irrigation season could be greater under this alternative. Construction activity would not affect the water rights of others.

Blue Alternative

Surface Waters. The Blue Alternative would modify the LN Canal POD structure on the Logan River. This would cause temporary impacts to the river and to streamside areas similar to those described for the Purple Alternative's modification of the LHPS Canal POD. The LN Canal POD modification would affect about 1,000 square feet and would be subject to authorization under Sections 401 and 404 of the CWA and a Stream Alteration Permit from the Utah Division of Water Rights. Conditions of these authorizations would ensure that the downstream impacts to the Logan River are minimized.

Construction activity along and in the LN Canal could temporarily affect the Logan & Northern Irrigation Company's ability to use that part of the canal that is currently being used for conveying water. Cache County and its contractor would work closely with the Logan & Northern Irrigation Company and UDOT to develop a construction plan to minimize the impact of interruptions in delivering shareholders' water.

Because the Blue Alternative would not affect USFS-administered land, there would be no special-use permits or review by USFS.

There are no wetlands along the Blue Alternative alignment.

Water Quality. Construction of the Blue Alternative would also disturb more than 1 acre of land, so construction activity would need to comply with CWA Section 402 and Utah's general construction permit for stormwater discharges and would need to be conducted according to measures prescribed in a SWPPP.

Utah's Antidegradation Rule considers the reach of the Logan River that would be affected during construction of the new diversion structure at the LN Canal POD to be a Category 3 protected water from the mouth of Logan Canyon downstream. Because of this, the Utah Division of Water Quality would need to review the planned modification as part of an antidegradation review.

Stormwater Conveyance. Construction activity associated with the Blue Alternative would affect stormwater conveyance in a way that is similar to the Purple Alternative. The Blue Alternative differs in the location of the affected section of the LN Canal and in that the Blue

Alternative would not affect stormwater conveyance in the LHPS Canal. Cache County and its contractor would need to work with the City of Logan to develop a stormwater-management plan to be applied during construction.

Floodplains. The Blue Alternative would cross a floodplain associated with the Logan River at the LN Canal POD construction site. To ensure that the floodplain is not affected during construction, the contractor would ensure that construction equipment and materials would not be staged in the floodplain. Construction activity would not otherwise affect the function and limits of the floodplain.

Groundwater. Construction of the Blue Alternative would not affect groundwater. All construction-related discharges would be managed on the construction site, and polluted water would not penetrate into the groundwater.

Water Supply Wells. The soil buttress constructed as part of the Blue Alternative would be near the City of Logan's Crockett Avenue well. Construction would not directly affect this well. During construction, the construction contractor would need to take additional measures to protect the well house and well from potential contamination.

Water Use and Water Rights. Construction activity would temporarily affect operation of the LN Canal between the POD and the Laub Diversion. This effect would be short term but could affect shareholders' ability to use their water at critical times if construction occurs during the irrigation season. If the canals cannot be used for an extended period during the irrigation season, this impact could significantly affect the shareholders along this 1.7-mile reach by preventing water delivery to their properties. Construction activity would not affect the water rights of others.

Mitigation for Construction Impacts to Water Resources

All of the action alternatives could temporarily affect water resources. Construction effects to water resources would be as follows:

- Potential impacts to the Logan River channel and stream bank during construction of the POD structure depending on the final design of the POD structure (all action alternatives)
- Potential impacts to the jurisdictional wetland along 1500 North if the wetland is not avoided (Purple Alternative)
- Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented (all action alternatives)
- Potential effects to the Green Canyon Creek floodplain if materials and equipment are stored in the floodplain (Orange Alternative)
- Potential effects to the Logan River floodplain if materials and equipment are stored in the floodplain (Blue Alternative)

- Potential effects to the City of Logan’s 700 North well if construction disturbs the well head (Purple and Orange Alternatives)
- Potential effects to the City of Logan’s Crockett Avenue well if construction disturbs the well head (Blue Alternative)
- Potential interruption in delivery of irrigation water to shareholders during construction (all alternatives)

Applying the measures described in the required SWPPP would minimize or prevent many of the impacts to water resources, in compliance with Utah’s general construction permit for stormwater discharges. Additionally, the following measure from Section 5.4.3.2, Biological Resources, would address impacts to the Logan River at the POD construction areas:

- Before the start of construction at the LHPS Canal POD (Purple and Orange Alternatives) or the LN Canal POD (Blue Alternative), Cache County or its contractor would prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. The plan would include details about dewatering or temporarily rerouting the river, construction limits near the river, standards for equipment use near the river, and postconstruction restoration of disturbed areas along the river. This plan would be reviewed and approved by the Utah Division of Water Rights in compliance with a Stream Alteration Permit before construction in or near the river could begin (all action alternatives). USFS would review construction plans associated with the Purple and Orange Alternatives.

Applying the following measures would further minimize or mitigate some of the temporary impacts:

- The construction contractor would protect the wetland along 1500 North by excluding all equipment from the area, not storing materials in the area, and ensuring that construction workers know to avoid the area. The contractor would fully fence the area so that workers understand the limits of the wetland. Areas that provide wetland hydrology outside of the delineated wetland would also be protected from excavation or other ground-disturbing activities. Cache County and its contractor would ensure that the area identified for protection is large enough to protect the wetland feature and maintain the wetland’s hydrology in compliance with CWA Section 404. The boundaries of the wetland area would be shown on construction plans for the alternative (Purple Alternative).
- The construction contractor would not stage equipment or store materials in mapped floodplains. The boundaries of the flood zones would be shown on construction plans, and construction workers would be made aware of the limitations on equipment and material storage (Orange and Blue Alternatives).

- The construction plans would identify the location of the 700 North well head. The construction contractor would ensure that the well head is protected from disturbance during construction (Purple and Orange Alternatives).
- The construction plans would identify the location of the Crockett Avenue well head. The construction contractor would ensure that the well head is protected from disturbance during construction (Blue Alternative).
- Cache County and its contractor would work with the Logan, Hyde Park and Smithfield Canal Company to develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season. Cache County would also work with the Logan & Northern Irrigation Company and UDOT to develop a delivery plan for the short reach of the LN Canal (between the LN Canal POD and the Laub Diversion) if construction occurs during the irrigation season. The plan would attempt to identify expected construction schedules and expected service interruptions (all action alternatives).
- Cache County and its contractor would work with the canal companies and municipalities to develop a temporary stormwater-conveyance plan for the canals during construction. The plan would attempt to identify expected construction schedules, expected impacts to stormwater conveyance systems, and potential temporary bypass measures (all action alternatives).

5.4.3.7 Noise and Other Construction Impacts

Construction plans would identify staging areas, construction footprints, environmental protection standards, and mitigation measures adopted in the Record of Decision. Several NRCS, local, State, and USFS general standards would apply to construction. The specific USFS standards included in the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) identified by the Logan Ranger District that would apply to the Orange and Purple Alternatives are the following:

- **Guideline 46.** Specify and control locations for water-supply points, service areas, and any other needs for road and facility construction projects.
- **Guideline 47.** Waste material should be handled in a manner to avoid sidecasting materials to areas where they may enter a stream.

Cache County and its contractor would specify staging areas and water-supply points on final construction plans for any of the action alternatives. None of the action alternatives would generate significant amounts of construction waste other than minor amounts of day-to-day waste generated by the contractor and vegetation removed through clearing and grubbing. The construction contractor would ensure that all waste is properly disposed of. No waste would be placed in streams, canals, wetlands, or floodplains.

Construction activities associated with the action alternatives would cause temporary noise impacts to people recreating on National Forest System land and at established recreation

facilities, people visiting businesses and community facilities in and near the construction areas, and people living near the construction areas.

Construction noise impacts would be temporary, and the magnitude would vary depending on the type of activity. For example, clearing vegetation might require using chainsaws, which can create highly disturbing short-term noise impacts, but use of quieter equipment could affect people for a longer period of time. Construction scheduling and restrictions on equipment use could address some of the noise impacts. The construction noise impacts would be short term and would not change the long-term noise environment.

Mitigation for Construction Impacts to Noise. The following measures could reduce the construction-related noise impacts of the action alternatives:

- Before starting construction, Cache County and its contractor would develop a work plan that identifies hours and days of work and limitations in areas close to highly sensitive receptors at specific times, if warranted. The plan would identify the highly sensitive receptors, which would include but might not be limited to public recreation areas, churches, and residential areas that are very close to the construction areas. Cache County or its contractor would communicate its construction schedule with people at sensitive receptors and would work with potentially affected parties to identify appropriate work time restrictions (all action alternatives).
- The construction contractor would apply BMPs that would reduce construction-related noise impacts. These measures might include restrictions on equipment idling and restrictions on types of equipment in noise-sensitive areas (all action alternatives).

5.4.3.8 Air Quality

Under the action alternatives, construction activities would generate dust, which could affect people recreating on National Forest System land and at established recreation facilities, people visiting businesses and community facilities in and near the construction areas, and people living near the construction areas. Emissions from construction equipment could also temporarily reduce air quality.

The Federal Clean Air Act identifies six common air pollutants that are found all over the United States and that can injure health, harm the environment, or cause property damage. EPA has established National Ambient Air Quality Standards (NAAQS) for each of these pollutants. If the air quality in a geographic area meets the NAAQS, it is called an *attainment area* (because the standards are being attained). Areas that do not meet the NAAQS are called *non-attainment areas*, and the State must develop a comprehensive plan to reduce pollutant concentrations to a safe level.

Cache Valley has a long history of air quality problems at certain times of the year. These problems are influenced primarily by weather and topography. In its 2007 report on potential non-attainment areas for PM_{2.5} (particulate matter that is 2.5 microns in diameter or less), the

Utah Division of Air Quality identified Cache Valley as a potential non-attainment area for this pollutant. EPA has recognized Cache Valley as a non-attainment area for PM_{2.5} using its 2006 national standards for particulate matter.

Because Cache Valley is a non-attainment area, the State must develop a statewide implementation plan that addresses how the pollutant will be managed to bring the area into attainment by 2012. Municipalities in the valley have already implemented some measures to address PM_{2.5} pollution, but none of these measures address construction activities.

Mitigation for Construction Impacts to Air Quality. The following measure should help reduce air quality impacts during construction:

- Before starting construction, Cache County and its contractor would develop an air-quality-management plan that identifies dust-control measures for equipment use along the construction corridor, appropriate staging locations and measures to reduce dust at those locations, and potential restrictions (such as idling restrictions and limitations on the types of equipment that could be used) during times when the State determines that the air quality is unhealthy. Cache County or its contractor would communicate its construction schedule with people living, working, and recreating near the construction area so that all potentially affected people are aware that construction activity could temporarily reduce local air quality.

5.5 Cumulative Effects

This section discusses the cumulative effects analysis required by CEQ regulations (40 CFR 1500–1508). Consideration of cumulative effects that could result from the Federal action is required for each project alternative that would result in adverse impacts to the built and natural environment. The cumulative effects analysis considers the direct effects and indirect effects of each alternative and the effects of other past, present, and reasonably foreseeable future actions in the vicinity of each alternative. The analysis considers the magnitude of the cumulative effect on the resource health. *Resource health* refers to the general overall condition, stability, or vitality of the resource and the trend of that condition.

What are cumulative effects?

Cumulative effects are the resulting impacts from the proposed action combined with impacts from other past, present, and reasonably foreseeable future actions.

5.5.1 Methodology

The CEQ regulations for implementing NEPA define *cumulative effects* as:

the impact on the environment which results from the incremental impact of the [proposed] action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7)

NRCS does not have specific guidance for conducting cumulative effects analyses. Title 190, Part 410.11(E), of the NRCS General Manual directs the agency to apply the requirements of the CEQ regulations.

Impacts Considered in This Cumulative Analysis

The first step in evaluating cumulative effects is to identify the direct and indirect effects that would result from the Federal action. Sections 5.1 through 5.4 of this chapter discuss the expected environmental effects of the alternatives. In summary, the analyses found that the action alternatives could have short-term (construction-related), minor adverse effects on many resources, including land use along the canals, the quality of life and scenic resources in the area, recreation, utilities, agricultural production, biological resources, water resources, noise levels, and air quality. Most of these short-term impacts could be minimized or mitigated by applying the measures described in Section 5.4, Construction Impacts. Construction could also cause some beneficial effects to the local economy. Because the adverse impacts would be short term, most areas in which construction would occur are not subject to much other construction work that would cause similar impacts. Because these construction impacts can be mitigated, they are not further evaluated for cumulative effects on resource health.

The analyses found that the alternatives could affect the following resources:

- **Land use:** minor conversions of land to canal easement; minor conversions of residential land to nonresidential uses (all action alternatives)
- **Community resources, quality of life, and scenic beauty:** relocation of residents living in structures that would be acquired and demolished; changes in appearance of canals and related effects on residents' quality of life (all action alternatives)
- **Recreation:** permanent loss of unauthorized recreation use of the LHPS Canal in a reach historically used for floating (Purple and Orange Alternatives)
- **Agriculture:** minor conversions of irrigated and nonirrigated farmland to canal easement (Purple and Orange Alternatives)
- **Biological resources:** permanent losses of riparian and upland vegetation; possibility of fish entrapment; loss of open canal for use by wildlife (all action alternatives)

- **Cultural resources:** permanent effects to NRHP-eligible resources; impacts would be mitigated through a MOA with the Utah SHPO, but resources would still be permanently changed (all action alternatives)
- **Topography, soils, and geology:** possibility of rock fall damage to culvert in Logan Canyon (Purple and Orange Alternatives); hazards associated with East Cache fault zone (all alternatives); hazards associated with ground shaking and seismically induced flooding and subsidence (all action alternatives); hazards associated with landslide-induced flooding
- **Water resources:** effects to stormwater conveyance during large storms during the irrigation season; groundwater recharge reduced because canal water would not be lost to seepage (all action alternatives)

None of the effects described above are significant, but some are unavoidable (Section 5.10, Summary of Mitigation Measures and Adverse Environmental Impacts That Cannot Be Avoided).

If an alternative would not cause direct or indirect impacts on a resource, it would not contribute to a cumulative impact on the resource. The following sections discuss only those resources that could be directly affected and how such impacts might contribute to a cumulatively considerable effect on resource health.

Past, Present, and Reasonably Foreseeable Actions

The second step in evaluating cumulative effects is to determine a reasonable geographic area for the analysis and to identify the past, present, and reasonably foreseeable actions that might affect the natural and built environment in ways that are similar to the proposed action. For the purpose of this analysis, the area of focus is Cache Valley and Logan Canyon up to Third Dam (Figure 5-4).

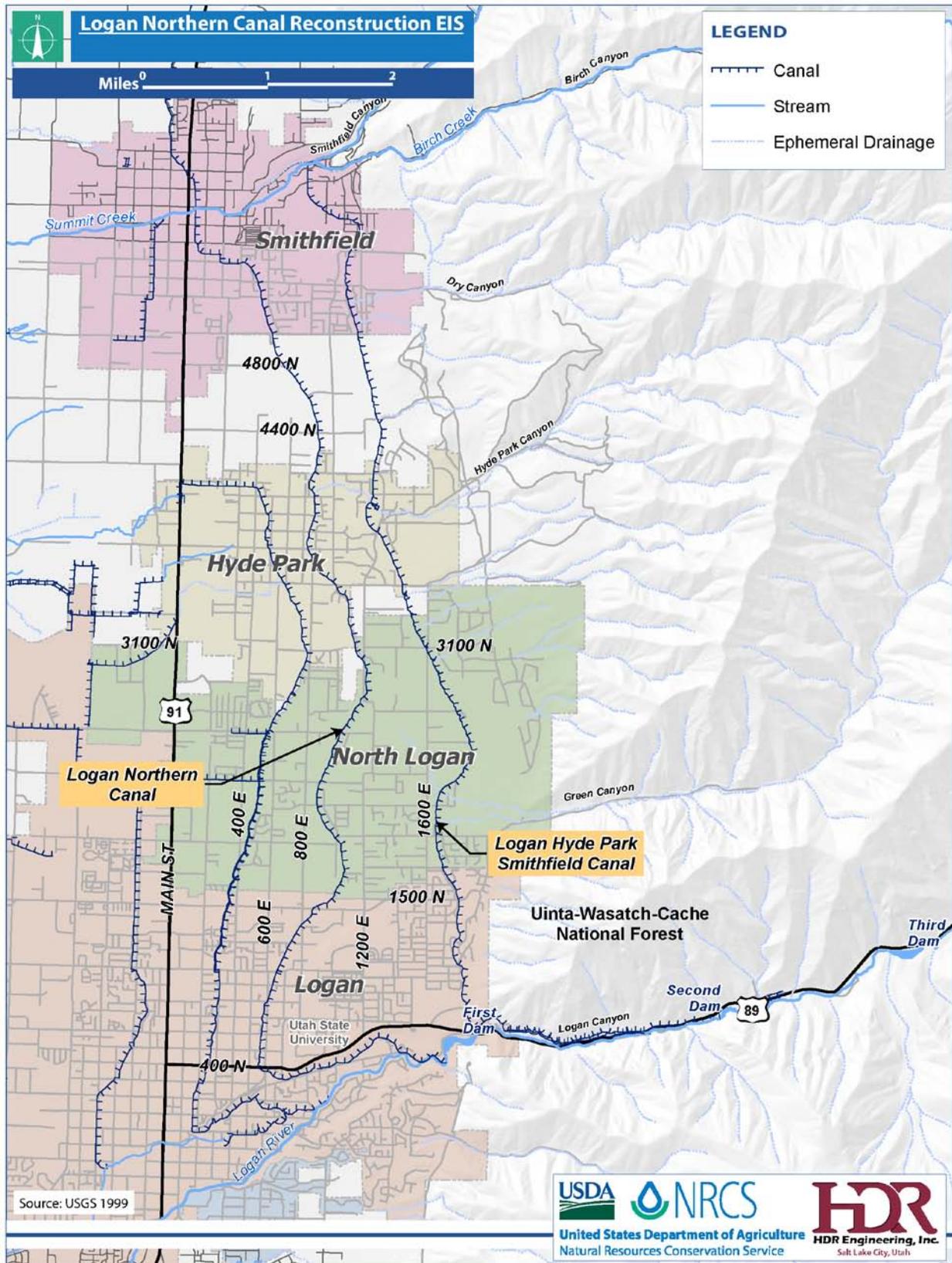
The Cache Valley canal system was originally built in the middle to late 1800s. The impacts associated with construction of these canals are not considered because they occurred so long ago and because so much of the surrounding environment has changed. The canals have not experienced many changes in the recent past other than routine maintenance and minor modifications to some water-control structures.

This analysis does not consider any past canal projects in the cumulative effects study area. There are no other projects on the canal system in process. Future improvements to the system are reasonably foreseeable, especially improvements that would add to those implemented through the proposed action. For example, the canal companies might choose to extend enclosed conveyance structures and improve stormwater conveyance in the canal system.

What past, present, and reasonably foreseeable actions does this cumulative effects analysis consider?

This cumulative analysis considers regional growth, groundwater development, large-scale road construction, and regional stormwater management.

Figure 5-4. Cumulative Effects Study Area



The past, present, and reasonably foreseeable actions considered in this analysis include the following:

- **Regional Growth.** Like other places in Utah, recent population growth in Cache Valley led to higher demands for housing and new commercial establishments and community facilities. The Envision Cache Valley planning process identifies a future development plan for the area (Cache Valley Regional Council and others 2010). This plan focuses on expected growth in the region. Very recent economic conditions have contributed to a slowing of the growth, but the Envision Cache Valley process predicts a continuation of development and describes potential scenarios through 2040. The process compared three scenarios to a baseline scenario that predicts how the valley would grow if recent and existing trends were to continue. The final vision focused on compact development in existing developed areas, preserving the character of existing neighborhoods, blending uses, and providing housing choices while meeting market demand.
- **Groundwater Development.** Groundwater in the valley is managed through the State's Interim Cache Valley Ground-Water Management Plan (Utah Division of Water Rights 1999). This plan describes the expected future groundwater conditions in the valley. Historic, ongoing, and reasonably foreseeable development in the valley affects the amount of groundwater available in the region. Water supply has not limited growth to date, but local municipalities and State agencies recognize that water could affect future development beyond the lifetime of regional water-management plans such as the groundwater-management plan.
- **Large-Scale Road Construction.** Recent road construction projects in Cache Valley have not been large scale and for the most part have been focused on improvements to existing roads rather than constructing new roads. One State highway project of considerable size, the State Route 252 project (also known as 1000 West or 10th West), is currently in the design stage. A project on State Route 30 is also being studied and is a reasonably foreseeable project. Both of these projects are in Logan but west of the project study area.
- **Stormwater Management.** The Cities of Logan and North Logan recognize that the current stormwater systems will need improvements as the area continues to grow. Both Cities have stormwater-management plans that are based at least in part on continued use of the canal system for some stormwater management. The Cities plan to continue using the canals as part of their stormwater systems.

5.5.2 Analysis

5.5.2.1 Land Use

All of the action alternatives would cause minor changes in land use by converting the use of some land to permanent canal easements and by removing up to 14 properties from the regional residential land supply.

Past projects have not caused a decline in the health of Cache Valley housing resources or the availability of land available for development. As in other areas of Utah, recent population growth in Cache Valley stimulated residential subdivision development, but this growth has also contributed to the loss of open spaces in the form of undeveloped land.

Converting a very minor amount of undeveloped land to canal easement would not significantly contribute to regional losses in undeveloped land. The areas to be converted are along property lines, and the acquisitions would not bisect any properties in a manner that would make them unusable. Areas on either side of the easements could remain open or could be developed in the future. If these properties are developed, the easements could provide a strip of open space in an otherwise developed area. The conversion of land to canal easements would not contribute to a cumulatively adverse loss of open space.

Given the availability of residential properties in the region, the loss of 14 residential properties that would be acquired as a part of the action alternatives would not contribute to a cumulatively considerable adverse effect on the availability of residential properties in Cache Valley. Past, current, and reasonably foreseeable actions are not expected to cause shortages in land available for housing. The City of Logan has already acquired some of the properties in the same general area and removed them from the residential property supply because of safety concerns. Removing an additional 14 properties from the housing property supply would not cause or contribute to a cumulatively adverse condition.

What resources does this cumulative analysis consider?

This analysis considers the potential cumulative effects on resources that could be affected by any of the action alternatives. These resources include land use; community resources; quality of life, landscape resources, and scenic beauty; recreation; agriculture; biological resources; cultural resources; geologic hazards; water resources; and air quality.

5.5.2.2 Community Resources, Quality of Life, Landscape, and Scenic Beauty

All of the action alternatives would involve relocating people who live in the structures on 14 properties. Affected residents might feel that relocating to another home or area would be a significant adverse effect on their quality of life. However, recent, present, and reasonably foreseeable actions in the valley are not expected to relocate large numbers of people in general. Large-scale construction projects might cause some isolated relocations, but the numbers associated with these projects would not be high, since the improvements would focus on improving existing roads rather than building new roads through developed areas.

Housing availability in Cache Valley is sufficient to allow people to remain in the area, and, while they might feel the negative effects of losing their particular home and setting, this effect is not expected to cause or contribute to a cumulative adverse effect on regional quality of life.

Historic, present, and expected development in Cache Valley has affected and will continue to affect community resources, quality of life, and scenic beauty in the valley. As population increases, these changes are inevitable. Some long-time residents might feel that these changes are adverse, but newer residents might feel that the development patterns described through the Envision Cache Valley process will create a place that will remain scenic and where they will continue to experience a positive quality of life.

Changes to the canal system under any of the action alternatives would have the greatest effects on people living along the canals. While they personally might feel that these effects are significant, these effects are not expected to worsen cumulatively adverse conditions that reduce regional quality of life.

5.5.2.3 Recreation

The LHPS Canal has historically been used for in-canal recreation between the LHPS Canal POD below Second Dam and the Logan Golf & Country Club. During the summer when the canal is carrying irrigation water, people float in the canal for recreation. Because the canal is privately maintained and the easement is not a developed, public recreation feature, this use is unauthorized and unregulated. Entities who manage the land around this reach of the canal have been and continue to be concerned about public safety, since the canals are not specifically designed and maintained for recreation use.

USFS and UDOT recently installed a fence on US 89 in Logan Canyon to discourage this unauthorized use. However, people are still able to access the canal, so the use still occurs. The Purple and Orange Alternatives would completely enclose the canal and prevent this use from occurring at all.

Cache Valley has many public and private recreation facilities that the public can access and use safely. Removing unauthorized use of the LHPS Canal between the LHPS Canal POD and the golf course would not significantly affect recreation in the valley. People could still access, wade in, and float in the Logan River from many parks in Logan and could still access other canals that would remain open. The loss of this unauthorized recreation activity would not cause or contribute to a cumulative loss of recreation associated with past, present, or reasonably foreseeable actions in Cache Valley.

5.5.2.4 Agriculture

The Purple and Orange Alternatives would convert minor amounts of irrigated and nonirrigated farmland to canal easement. In both cases, the amount of land converted is a small fraction of the total farmland in the valley.

Ongoing farmland conversion is a regional and national concern. Because farmland often has gentle topography that is suited for other types of development, recent developments in Cache Valley have involved converting some farmland. Future development is also expected to convert more farmland. The Envision Cache Valley process projected farmland conversion associated with different development scenarios. Under the final vision, about 10,100 acres of farmland would be converted and developed for other uses (Cache Valley Regional Council and others 2010).

The farmland that would be converted to canal easement could possibly still be used to support agriculture, but it would probably not be used for agricultural production. The easement would need to remain undeveloped with any type of use to facilitate access to the pipeline that would travel through agricultural land. Because this easement would be along property boundaries and would not bisect any active farms, it could probably be used by farmers to access properties and move equipment. The reduced amount of acreage would not significantly contribute to the expected regional loss of farmland under the Cache Valley vision.

5.5.2.5 Biological Resources

Vegetation Removal

All of the action alternatives would permanently remove minor amounts of riparian vegetation at either the LHPS Canal or LN Canal POD structures on the Logan River and common vegetation along the canal alignments.

Most of the effects to riparian vegetation at the PODs would be mitigated by postconstruction restoration of areas not permanently affected by the structure. However, some vegetation would need to be permanently removed. The areas around the PODs are not heavily vegetated because the canal companies need to maintain access to the structures.

Recent and ongoing activities that have minor effects on riparian vegetation are public trail and private property maintenance. The Riverside Trail, which follows the river in Logan Canyon, is a wide trail, but it still needs some routine maintenance to ensure that the public can access the trail. This type of maintenance does not significantly affect the Logan River riparian zone. Residents who live along the river might also do some seasonal clearing of vegetation, but this minor amount of clearing probably does not affect the overall integrity of the Logan River riparian zone.

Large-scale road development and ongoing regional growth have not affected large areas of riparian vegetation and are generally not expected to affect riparian zones in the future. The City of Logan places much value on maintaining the river as an amenity in the city, so future riverside development that might remove riparian vegetation is expected to be limited.

Recent, ongoing, and future development in the region has removed and will probably continue to remove common native vegetation when such development occurs in areas that are undisturbed. In urban areas, the developments include landscaping that provides similar benefits to what was provided by the vegetation that existed before the development.

Large future developments on the east side of Cache Valley could cause significant losses in the amounts of vegetation on the foothills of the mountains.

The amount of vegetation that would be removed under any of the alternatives is minor, and, if Cache County and the Cities eventually establish greenways or linear parks along the canals, the amount of vegetation present along the canal alignments could increase.

Vegetation removal under any of the alternatives is not expected to significantly contribute to regional losses of similar vegetation because the amounts lost would be small.

Fish Entrapment

Any of the action alternatives would require reconstructing a POD structure on the Logan River. The existing structures are not screened to prevent fish from entering the canals or to prevent them from becoming trapped in or by the structure.

Logan River flows have historically been affected by the construction of dams and the diversion of water through legal water rights. While flow changes have affected aquatic species in the past, they have not recently caused the loss of large numbers of fish or other aquatic organisms. Because the modified POD structures would need to be screened to prevent debris from entering the culvert or pipe system, these screens could be designed to prevent fish from entering the canal system.

NRCS and Cache County expect that the POD structure design would include measures to ensure that fish do not become trapped by the structure and do not enter the canal. If the POD structure at the LHPS Canal requires modification, then these measures must also comply with NRCS Standard 396, which requires the prevention of fish entrainment by installing screening devices. The POD structure would probably be constructed using a flat plate fish screen (similar to the screen recently installed on the East Fork of the Bear River) or similar device. Because of this, the potential for fish entrapment is not expected to contribute to historic cumulative effects on fish and other aquatic species in the Logan River.

Use of Canals by Wildlife

During the summer, wildlife can use the open canals to drink from or, in the case of waterfowl, to rest in. The canals have provided this benefit for many years.

Wildlife also use other water resources in the valley including the Logan River, intermittent streams, natural and human-made ponds, and livestock-watering facilities. Enclosing the canals would prevent wildlife from using them as a water source, but wildlife would still be able to access and use other water sources.

Past and present regional development has not substantially affected the availability of water resources for wildlife use, and in many cases development has established new water sources. Because people value open-water resources such as ponds, future development might continue to provide new water sources that could be used by locally common wildlife.

The loss of the open canals might cause some local effects to wildlife's access to water, but wildlife would move to find other water sources, which are plentiful. None of the action alternatives would cause or contribute to a cumulative loss in water sources for wildlife.

5.5.2.6 Cultural Resources

Although a pedestrian inventory of the action alternative alignments remains to be completed, preliminary assessments indicate that both the LN Canal and the LHPS Canal are eligible for listing on the NRHP. One or more of the 14 residential structures located along Canyon Road might also be determined eligible for listing on the NRHP after NRCS completes formal evaluations. If these structures are eligible, then all three action alternatives considered for this proposed action would have adverse effects on historic properties.

Under each action alternative, both the LN Canal and the LHPS Canal would be substantially altered by modifying PODs (both canals), installing pipes and box culverts (LHPS Canal), installing pipes (LN Canal), and abandonment (LN Canal). Although each canal has been subject to regular maintenance and upgrades since it was initially constructed, all of the action alternatives would modify the canals in a way that is likely to exceed previous maintenance activities. The cumulative effects to the canal system would therefore likely be a loss of integrity with particular regard to the design, materials, workmanship, feeling, and association of the canals.

If any of the 14 structures are determined eligible for the NRHP, demolishing the structures would be a complete loss. Demolition would cause a loss of those characteristics that make the structures eligible for listing on the NRHP. This would contribute to the cumulative loss of historic properties in the cumulative effects study area.

5.5.2.7 Geologic Hazards

Rock Fall

In the cumulative effects study area, rock fall occurs mostly on the north side of Logan Canyon, which has a history of rock fall. The LHPS Canal often captures the rocks that fall. Historically, the Logan, Hyde Park and Smithfield Canal Company has had to clean rocks out of the canal to ensure that the irrigation water flows freely and does not unnecessarily spill or cause flooding.

Enclosing this reach of the canal under the Purple and Orange Alternatives would prevent future blockage of the canal from rock fall. The box culvert would be designed to prevent damage to the culvert from rock fall, but large-volume falls of very large rocks could still damage the culvert and fall to the slope and, possibly, to the road below.

The reach of the LHPS Canal in Logan Canyon has not been modified by recent projects and is not expected to have additional changes in the future. Rock fall has always occurred in Logan Canyon, and the Purple and Orange Alternatives would not change the incidence of

rock falls in the canyon. Because of this, these alternatives are not expected to cause or contribute to adverse cumulative effects associated with rock falls in Logan Canyon.

Faulting and Seismically Induced Ground Shaking

The LHPS and LN Canals cross the East Cache fault zone. Construction associated with all alternatives would not affect this major geologic feature, but the canals would continue to cross the fault zone.

Fault zones can be affected by very large projects that have extensive, deep excavation. No past, present, or reasonably foreseeable activity along this part of the East Cache fault zone has been or would be of a nature that could disturb the fault. Because the alternatives would not affect the fault and because no other projects have affected or will affect the fault, the continued crossing of the fault zone is not expected to cause or contribute to cumulative effects associated with faulting.

All of the action alternatives would be at risk of damage from seismically induced ground shaking causing landslides, flooding, and subsidence from fault rupture. The design of the canal systems could provide some protection from damage, but large earthquakes could still adversely affect the systems. Damage from ground shaking could rupture a canal, which could cause local flooding.

Ground shaking could also affect other nearby structures. Past development in Cache Valley has generally not been designed to withstand seismic hazards. Present and future construction will consider designs that would withstand seismic hazards, and, in some cases, such designs are required by law.

Construction of the action alternatives would not cause or contribute to ground shaking, but a ground-shaking event could cause regional damage that, when combined with potential flooding from a ruptured canal, could cause a cumulatively considerable adverse condition. The likelihood of such an event is unlikely given the historic incidence of seismic activity in this part of Cache Valley.

Landslides

In the cumulative effects study area, landslides occur mostly along the Logan Bluff, which has a history of landslides. Because of the geologic history of the area and the inability of NRCS to use EWPP funds to solve watershed or natural problems that existed before the 2009 landslide, NRCS assumes that the Logan Bluff will continue to have landslides regardless of the alternative chosen for the proposed action. All alternatives include the provision to remove structures that would be most at risk of damage, thereby reducing potential risks to life and property. However, because of the history of landslides along the Logan Bluff, landslide-related risks to life and property would remain in the area historically subject to landslides.

The Blue Alternative would construct a new pipeline through the Logan Bluff area and would protect that pipeline as practicable. However, the future risk of landslides occurring and possibly damaging the pipeline would remain. This alternative would also reintroduce a water delivery facility across this unstable area. Future landslides could rupture the pipe and cause flooding and debris flows that could damage property and cause injury or death. With the Blue Alternative, damage could be a result of landslides and canal rupture. The Blue Alternative would contribute to an adverse cumulative effect associated with potential landslide damage along the Logan Bluff.

5.5.2.8 Water Resources

Stormwater

The Cities of Logan and North Logan rely on the canal system to collect and convey some of the stormwater that is generated in areas near the canals. Both Cities have requirements for new development to safely establish stormwater conveyance. In some cases, future development identified through the Cities' general plans might contribute additional stormwater to the canal system.

The Purple and Orange Alternatives would change the way stormwater is captured and conveyed but would not provide additional stormwater capacity. The reach of the LN Canal that would be affected by construction of either of these alternatives (400 North to 1500 North for the Purple Alternative or 400 North to 3100 North for the Orange Alternative) would be available to capture additional stormwater if shareholders choose to take their water from the proposed pressure pipe instead of taking their water directly from the canal. (Water not taken from the pressure pipe would discharge into the canal and flow back downstream, where it would be available for use by other shareholders.)

During large storms during the irrigation season, both canals can become overwhelmed if they are carrying high volumes of irrigation water and must also collect and convey high volumes of stormwater. This has historically caused flooding downstream of the cumulative effects study area. Additional water volume that could be conveyed in the LHPS Canal under the Purple and Orange Alternatives could worsen this condition. The Cities and canal company would take steps to mitigate downstream flooding impacts in the event of a large storm during the irrigation season, but the flooding could still happen. Both the Purple and Orange Alternatives could contribute to this cumulatively adverse condition, but expected future planning will probably result in some downstream improvements that could prevent this condition from worsening.

Groundwater Recharge

As described in Section 4.4.6.5, Groundwater Resources, and Section 5.3.6.6, Groundwater Resources, the LN and LHPS Canals along with other irrigation canals contribute to groundwater recharge in Cache Valley. All three of the action alternatives would reduce

seepage from the canals, which would reduce the amount of water that percolates into the groundwater.

According to the Interim Cache Valley Ground-Water Management Plan, groundwater development in the valley is not limited and is currently being managed by the State Engineer.

The Orange Alternative would have the greatest amount of reduced seepage at 13,000 acre-feet per year. The Purple Alternative would prevent seepage of about 7,400 acre-feet, and the Blue Alternative would prevent seepage of about 1,300 acre-feet. Because most of the water not lost to seepage either would be applied to land as irrigation water or would remain in area waterways, it would still be available for groundwater recharge. The patterns of recharge might be different, but they are not expected to cause or contribute to large reductions in recharge in Cache Valley because the amount of water conserved is estimated to be less than 6% of the overall annual recharge amount. The loss of recharge from any of the alternatives would probably not combine with other ongoing groundwater development conducted consistent with the interim plan to adversely affect future groundwater appropriation.

5.5.2.9 Air Quality

As described in Section 5.4.3.8, Air Quality, Cache Valley is a non-attainment area for $PM_{2.5}$. Construction could cause air quality impacts in the form of dust and emissions. While dust and emissions can be reduced by applying standard BMPs, any impacts during periods of very poor air quality could contribute to this cumulatively considerable adverse condition in Cache Valley.

For the most part, construction-related air quality impacts would be local and would occur intermittently for varying periods during construction. Much of the area around the cumulative effects study area is already developed, so construction of an action alternative concurrent with other nearby construction projects is not likely. Additionally, because noise and dust emissions are temporary (that is, they do not persist in the environment), recently constructed projects that do not emit large amounts of particulate matter (such residential development) probably do not contribute to the existing nonattainment condition in the valley. None of the action alternatives are expected to contribute to cumulative air quality impacts when considered along with other past projects.

Based on information presented in the Envision Cache Valley report, continued residential development is expected in and near the cumulative effects study area. One area along the LHPS Canal that is currently under construction and will continue to have construction activity in the near future is residential development east of the canal between about 1350 North and Green Canyon Drive (1900 North). This future residential development would be near the reconstruction zone for the LHPS Canal under the Orange Alternative. If both projects were constructed simultaneously, the potential cumulative impacts could contribute to poor air quality.

The larger regional road projects identified in Section 5.5.1, Methodology, could also contribute to regional air quality impacts during construction. These projects are west of the cumulative effects study area but could still combine with the effects of canal reconstruction to make air quality worse during poor air quality days.

5.6 Hazard Potential of Each Alternative

The NRCS General Manual states that an EIS must include a description of the hazard potential of each alternative (Title 190, Part 410.11[e]).

In general terms, a *hazard* is any source of potential damage, harm, or adverse health effects on humans or the environment under certain conditions or exposure or vulnerability to injury or loss. In short, a hazard can cause harm or adverse effects. *Risk* is the chance or probability that a person or an environmental resource will be harmed or experience an adverse effect if exposed to a hazard (CCOHS 2010).

This section examines the hazards associated with each alternative and the resulting risks. This section also describes how potential hazards might be mitigated and how hazards might contribute to cumulatively considerable hazardous conditions along the action alternative alignments.

As described in Section 4.4.5.4, Geologic Hazards, the geologic hazards in the study area include rock fall, landslides, and effects associated with seismic ground shaking (earthquakes). These hazards are compounded by existing geologic conditions such as landslide areas, soils, and faulting. Hazardous conditions can also be created by human activity or inactivity.

The following discussions address the hazard potential of each alternative associated with the following potential situations:

- Flooding as a result of lack of maintenance or as a result of the canals' conveyance capacities becoming overwhelmed with stormwater
- Rock fall damaging conveyance structures
- Landslides damaging conveyance structures
- Surface fault ruptures damaging conveyance structures
- Damage from ground shaking, including liquefaction, earthquake-induced flooding, seismically induced landslides, and subsidence

What is a hazard?

A *hazard* is any source of potential damage, harm, or adverse health effects on humans or the environment under certain conditions or exposure or vulnerability to injury or loss.

What is a surface fault rupture?

A *fault* is a break in Earth's crust along which blocks of rock slide relative to one another. A *surface fault rupture* is the displacement seen on the ground surface when the sides of the fault have moved up or down as a result of a large earthquake.

5.6.1 No-Action Alternative

Under the No-Action Alternative, most of the LN Canal would be abandoned in place, and irrigation water delivery would not be restored. Most of the LN Canal structure could still be used to convey stormwater and water from seeps and springs. The reach of the canal between the LN Canal POD and the Laub Diversion would continue to be used to deliver about 2 cfs of irrigation water. This alternative would not repair the landslide site or purchase structures below the historically unstable part of the Logan Bluff.

5.6.1.1 Flood Hazards Associated with Lack of Maintenance and Insufficient Conveyance Capacity

Because the LN Canal would no longer carry irrigation water downstream of the Laub Diversion, it would have more capacity available to convey stormwater. The City of Logan, the City of North Logan, or UDOT would need to assume maintenance of the LN Canal as a stormwater facility to ensure that it could carry stormwater. If the Cities or UDOT did not assume or perform regular maintenance, the canal could become obstructed by debris, which could result in local flooding during large storms.

Normally, irrigation canals get smaller as they travel away from water sources, since shareholders take water along the way and less water is required in the canals. The LN Canal was originally designed as an irrigation delivery system, but it has also historically been used to capture and convey stormwater. Without irrigation water, the LN Canal would be less likely to be overcome by stormwater during large storms than it was before the 2009 landslide. However, the canal could still become overwhelmed during large storms, and downstream flooding as a result of insufficient capacity of the overall system could still occur.

5.6.1.2 Damage from Rock Fall in Logan Canyon

The section of the LHPS Canal that is in Logan Canyon follows a contour through a steep, rocky hillside between the LHPS Canal POD and the mouth of the canyon. This section of hillside experiences regular rock fall, especially during the winter thaw. In its current condition as an open canal, the LHPS Canal catches much of this debris, which prevents the rocks from falling down the slope and onto US 89 and the canyon floor.

The No-Action Alternative would not affect the LHPS Canal in Logan Canyon. The canyon reach of the LHPS Canal would continue to catch rocks and other debris that falls down the

What hazards are associated with the No-Action Alternative?

- Flooding from a lack of adequate canal maintenance
- Flooding from stormwater flows and limited downstream canal capacity
- Damage to property and people from future landslides along the Logan Bluff
- Flooding from potential surface fault rupture since the LN Canal crosses the East Cache fault zone near the POD
- Flooding from seismic-induced ground shaking, liquefaction, landslides, and subsidence

hillside above the canal. This area in Logan Canyon that currently has rock fall would continue to have rock fall under the No-Action Alternative.

5.6.1.3 Landslide Risk

Under the No-Action Alternative, the unstable hillside along the Logan Bluff would continue to remain unstable and subject to landslides due to existing soil and groundwater conditions. The No-Action Alternative would not stabilize the Logan Bluff area, and, given the history of landslides along the bluff, future landslides are expected to occur. The landslides could be triggered by local soil conditions or seismic activity. Information about historic landslides along the LN Canal between about 750 East and 1100 East indicates that this area of the Logan Bluff has about a 12% chance of having a landslide in any given year. As described in Section 3.2.4.2, Structural Features and Control Measures, and as shown in Figure 3-8, Blue Alternative, the historic landslide area is about 4,400 feet long and includes the area where 11 landslides have been historically documented.

People living along Canyon Road below this part of the Logan Bluff would continue to experience risk associated with the hazard of the inherent instability of the slope. Under the No-Action Alternative, the reach of the LN Canal downstream of the Laub Diversion would not carry any irrigation water, so that area would be at lower risk of flooding from a break in the canal and a sudden release of irrigation water. The reach of the canal upstream of the Laub Diversion and within the landslide zone would still carry stormwater and water from seeps and springs. If a landslide occurred when the canal is carrying water, the area along Canyon Road could experience some local flooding. However, since the volume of water in the canal would be less than if irrigation water were in the canal, and since water from seeps and springs flows from adjacent areas at a low rate, any release of water due to landslide damage would probably not cause extensive flooding along Canyon Road.

The reach of the canal between the LN Canal POD and the Laub Diversion would continue to carry water, but, because this part of the canal is upstream of the historic landslide zone, it would be less likely to be damaged by a landslide. If anything, a landslide could fill the canal, cause water to back up, and cause local flooding. Regardless of whether water is present or not, future landslides along the historically unstable part of the Logan Bluff could damage property, cause human injury, or cause loss of life.

5.6.1.4 Hazards Associated with Surface Fault Rupture

The LN Canal crosses the East Cache fault zone near its POD below First Dam on the Logan River. Under this alternative, the LN Canal would carry about 2 cfs of irrigation water in the section between the LN Canal POD and the Laub Diversion. Therefore, the area between the LN Canal POD and the Laub Diversion could be at risk of flooding from irrigation water if the canal were damaged as a result of a surface fault rupture.

As discussed in Section 4.4.5.3, Geology, the predicted recurrence interval suggests that the probability of a surface fault rupture within the lifetime of this project is low. Because of this, the probability of flooding as a result of surface fault rupture is also low.

5.6.1.5 Damage from Seismic Events

Under the No-Action Alternative, the LN Canal would not be used to convey irrigation water downstream of the Laub Diversion. Because of this, ground-shaking hazards such as landslides and subsidence would not be likely to result in flooding from irrigation water downstream of the Laub Diversion. The reach of the canal between the LN Canal POD and the Laub Diversion, which would carry about 2 cfs of irrigation water, stormwater, and water from seeps and springs, could be subject to hazards associated with landslides and subsidence. Damage to this reach of the canal could cause local flooding.

The liquefaction potential is low for the LN Canal alignment downstream of about 400 North and very low for the Logan Bluff area. Even with the removal of irrigation water, the presence of stormwater and water from seeps and springs could continue to pose some risk of canal failure due to liquefaction of soils during seismic activity.

Because the LN Canal would still collect stormwater and water from seeps and springs, areas along the canal could still be subject to damage from ground shaking when the canal is carrying water. This could result in some local flooding. However, since the volume of water in the canal would be less than if irrigation water were in the canal, and since water from seeps and springs flows from adjacent areas at a low rate, any release of water due to ground-shaking hazards would probably not cause extensive flooding along the canal.

5.6.2 Purple Alternative

The Purple Alternative would modify the LHPS Canal between the LHPS Canal POD and Lundstrom Park, add a pipeline between the LHPS Canal and the LN Canal, modify the LN Canal between 400 North and 1500 North and between the LN Canal POD and the Laub Diversion (about 1200 East), abandon a section of the LN Canal between the Laub Diversion and 400 North, and purchase structures from 14 parcels along Canyon Road at the toe of the Logan Bluff.

5.6.2.1 Flood Hazards Associated with Lack of Maintenance and Insufficient Conveyance Capacity

Under the Purple Alternative, lack of adequate maintenance of the LHPS Canal downstream of Lundstrom Park could result in conditions that might cause flooding. For example, debris in the open part of the canal could cause water to back up after it flows out of the box culvert, resulting in local flooding. This flooding could take place anywhere along the alignment downstream of the park depending on where the blockage is located. This hazard would occur with or without construction of this alternative.

The Purple Alternative could also affect flood hazards along the LHPS Canal downstream of Lundstrom Park as a result of the combined increase in irrigation water flow and stormwater discharges during large storms. Like the LN Canal, the LHPS Canal was originally designed as an irrigation delivery system, but it has also historically been used to capture and convey stormwater. Water in the LHPS Canal occasionally causes flooding downstream because the smaller capacity of the canal is unable to convey both irrigation water and stormwater during large storms that occur when the canal is carrying irrigation water.

The Cities in the area that is usually affected by this flooding recognize the problem and have identified potential mitigation measures to prevent future flooding due to inadequate capacity in the canal during the irrigation season. Under the Purple Alternative, the LHPS Canal upstream of Lundstrom Park would be designed to safely convey a maximum of 130 cfs, 90 cfs of which could remain in the canal downstream of the park (the remaining amount, which would be about 40 cfs, would be conveyed to the LN Canal). The additional stormwater carried during large storms during the irrigation season could overwhelm the canal sooner than it might be overwhelmed under existing conditions, since the downstream reach of the canal would carry more irrigation water after construction.

What hazards are associated with the Purple Alternative?

- Flooding from a lack of adequate canal maintenance
- Flooding from combined stormwater and irrigation water flows and insufficient downstream canal capacity
- Damage to property and people or flooding from rock fall in Logan Canyon
- Landslide risk along Logan Bluff
- Flooding from surface fault rupture
- Seismic-induced hazards including flooding, ground shaking, liquefaction, landslides, and subsidence

The Cities that might be affected could work with the Logan, Hyde Park and Smithfield Canal Company to revise existing plans for management during high flows so that the additional water could be handled in the canal. Measures to control flow might include flow relief at places downstream (that is, transferring some of the water in the canal into an auxiliary system to relieve the main canal), enlarging the canal downstream, or developing a new stormwater system that would not use the canal.

Under the Purple Alternative, the existing LN Canal between the POD and about 1500 North would not be used to convey irrigation water. As described for the No-Action Alternative, this reach of the canal would be used to convey stormwater and to capture water from seeps and springs. This reach of the canal is in Logan, and, if the City or UDOT assumes maintenance of the canal as a stormwater facility, it would need to ensure that the canal could carry stormwater during storms. If the future owner did not assume or perform regular maintenance, the canal could become obstructed by debris, which could result in local flooding during large storms. However, even without irrigation water in the reach between the POD and about 1500 North, the LN Canal could still become overwhelmed during large storms and cause downstream flooding as a result of the insufficient capacity of the overall system.

5.6.2.2 Damage from Rock Fall in Logan Canyon

The section of the LHPS Canal that is in Logan Canyon follows a contour through a steep, rocky hillside between the POD and the mouth of the canyon (Photo 5-1). This section of hillside experiences regular rock fall, especially during the winter thaw. In its current condition as an open canal, the LHPS Canal catches much of this debris, which prevents the rocks from falling down the slope and onto US 89 and the canyon floor.

This type of rock fall has historically resulted in local flooding and canal damage closer to the canyon mouth, but the canal's open structure has generally prevented rocks from landing on the highway or property that is in use at the toe of the slope (such as the Logan City Light and Power Hydro 2 facility). If the LHPS Canal is enclosed, rocks would not be captured in the canal and could continue to fall downslope and could travel to the canyon floor.

The new box culvert in the Logan Canyon reach of the LHPS Canal would remain susceptible to falling rocks from the steep slopes above the canal. To prevent damage to the box culvert, the Purple Alternative proposes to cover the structure with dirt to minimize the potential for damage to the culvert from falling rocks.

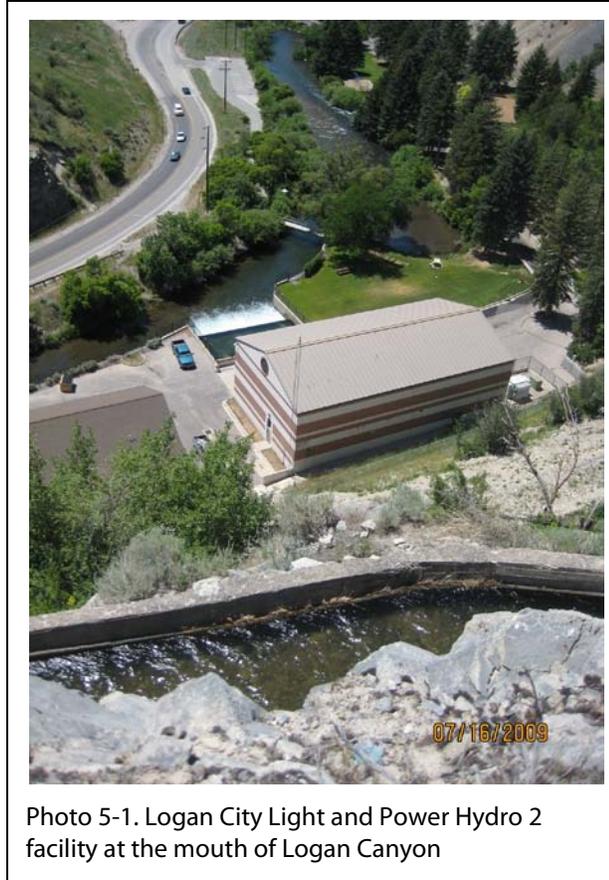


Photo 5-1. Logan City Light and Power Hydro 2 facility at the mouth of Logan Canyon

Although it is unlikely, large-volume rock falls could travel over the covered box culvert all the way to the Logan River in places where the slope is particularly steep and rocky. This could reduce the water quality in the river or affect the flow in a way that might damage the river channel.

5.6.2.3 Landslide Risk

The Purple Alternative would not address the 2009 landside site or the instability of the hillside along the entire canal alignment through the Logan Bluff. The landslide site would remain in its current condition and would be subject to erosion due to stormwater runoff. The risk of future landslides would be the same as with the No-Action Alternative.

This section of the LN Canal would not carry any irrigation water, only stormwater and water from seeps and springs, so the effect of flooding from future landslides would be reduced. However, future landslides along the historically unstable area of the Logan Bluff could cause property damage, human injury, and loss of life.

The Purple Alternative includes the purchase of structures from 14 properties in the historic landslide zone, which would address some of the risk to life and property. After the 2009 landslide, the City of Logan purchased five residential properties along the canal between

about 750 East and 1100 East. However, because the Purple Alternative does not address the risk associated with landslides along other areas of the Logan Bluff, other properties along Canyon Road would continue to be at risk of damage from future landslides.

5.6.2.4 Hazards Associated with Surface Fault Rupture

The LHPS Canal crosses the East Cache fault zone at about 1000 North. As described for the No-Action Alternative, the LN Canal crosses the same fault zone near the LN Canal POD on the Logan River. As described in Section 4.4.5.3, Geology, the amount of displacement that faulting could generate is between 1.6 and 6.2 feet as a result of earthquake magnitudes in the range of 6.6 to 7.1 (Solomon and Unger 2010).

The risk associated with damage to the canal, whether it is an open system or a closed system, would not change from the existing condition. If the SLO desired additional assurance that the box culvert along the LHPS Canal and 6-inch-diameter pipe in the LN Canal could withstand the expected displacement, the construction plans could consider the special design elements based on the results of a site-specific fault investigation. However, as stated for the No-Action Alternative, the predicted recurrence interval suggests that the probability of a surface fault rupture within the lifetime of this project is low.

Surface fault rupture associated with an earthquake could cause a break in the LHPS and LN Canals and result in local flooding. The degree of flooding would depend on the amount of water in the canal at the time of the break and the amount of time required to stop the flow of irrigation water in this section of the canal. If the break occurred between about November 1 and March 31 when the canal is not being used to deliver irrigation water, flooding might be minor, since the only water that could be in the canal systems would be stormwater and water from seeps and springs. However, if the break occurred during the irrigation season, the degree of flooding along the LHPS Canal could be severe if the canal is at or near capacity.

Because the LN Canal would not carry any irrigation water upstream of 1500 North, potential flooding in this reach would be reduced. However, minor local flooding could still occur if a surface fault rupture damaged this reach of the LN Canal when the canal is carrying stormwater and water from seeps and springs. Such flooding would probably be minor since the volume of stormwater and water from seeps and springs would probably be quite low, especially compared to reaches that also carry irrigation water. The LHPS and LN Canals, which are part of all the alternatives, have always crossed the East Cache fault zone, and the surface-based construction of a box culvert in this section of the canal is not expected to cause or contribute to any activity that might affect the fault now or in the future.

5.6.2.5 Damage from Seismic Events

The LHPS and LN Canals have always been at risk of damage from ground shaking associated with seismic events. The new box culvert system in the LHPS Canal, the new pipeline between the LHPS Canal and the LN Canal at about 1500 North, and the new pipeline in the LN Canal maintenance road between 400 North and 1500 North would continue to be at risk of damage from ground shaking. Ground shaking could rupture these systems. To reduce the potential for hazards associated with ground shaking, the new system would be designed to withstand the ground accelerations documented in Table 4-12, Anticipated Ground Accelerations for the Study Area, with adjustments to accommodate soil amplification if necessary.

If an earthquake occurs during irrigation season, the irrigation system would be at risk of rupturing, and areas near the rupture site would subsequently be at risk of flooding. Because the LHPS Canal would carry more water with the Purple Alternative than it does currently, the potential for damage associated with flooding could be greater than it has been historically. To prevent damage to the box culvert and to prevent the flooding that could result, the box culvert would be designed to withstand the anticipated ground accelerations in the study area. This alternative would not require additional special design elements due to the expected low flow rates in the LHPS Canal and the ability to close pipeline system valves to stop the flow in the event of an emergency.

5.6.3 Orange Alternative

The Orange Alternative would modify the LHPS Canal between the LHPS Canal POD and either 2900 North or 3100 North, add a pipeline between the LHPS and LN Canals, modify the LN Canal between 400 North and either 2900 North or 3100 North and between the LN Canal POD and the Laub Diversion (about 1200 East), abandon a section of the LN Canal between the Laub Diversion and 400 North, and purchase structures from 14 parcels along Canyon Road at the toe of the Logan Bluff.

The hazards described for the Purple Alternative would also apply to the Orange Alternative. The Orange Alternative differs in that it would have longer conveyance systems. The lengths of the box culvert in the LHPS Canal and the pipeline in the LN Canal would be longer with the Orange Alternative. However, the risks would be the same as with the Purple Alternative through the study area. That is, the risks related to ground

What hazards are associated with the Orange Alternative?

- Flooding from a lack of adequate canal maintenance
- Flooding from combined stormwater and irrigation water flows and insufficient downstream canal capacity
- Landslide risk along Logan Bluff
- Flooding from surface fault rupture
- Flooding from seismic-induced ground shaking, liquefaction, landslides, and subsidence
- Flooding associated with the Green Canyon Creek floodplain

shaking, landslides, flooding, liquefaction, and subsidence with the Purple Alternative also apply to the Orange Alternative.

In addition to these hazards, the Orange Alternative would present a hazard from flooding associated with Green Canyon Creek. As described in Section 5.3.6.5, Floodplains, FEMA has mapped a regulatory floodplain along the reach of Green Canyon Creek that crosses the LHPS Canal at about 1900 North. FEMA describes the flood hazard as an area that could be inundated by a 100-year flood, as generally determined using approximate methods (Approximate Zone A). In other words, this reach of the creek has a 1% chance of flooding each year. The additional water in the LHPS Canal could contribute to the risk of flooding if a 100-year flood associated with Green Canyon Creek occurred at the same time as a seismic event that affects the same reach of the LHPS Canal when the canal is carrying irrigation water. The combination of water flowing in the creek and water flowing in the canal could cause flooding along the canal.

5.6.4 Blue Alternative

The Blue Alternative would modify the LN Canal between the LN Canal POD and 400 North/600 East. Under this alternative, the existing LN Canal structure would be replaced with a pipe for about 1.7 miles, the 2009 landslide area would be repaired, and structures from 14 parcels along the Logan Bluff would be purchased. This is the only alternative that would direct irrigation water through the area that was damaged during the 2009 landslide and put irrigation water back into the historic LN Canal alignment.

5.6.4.1 Flood Hazards Associated with Lack of Maintenance and Insufficient Conveyance Capacity

The Blue Alternative could result in flooding due to lack of adequate maintenance of the LN Canal resulting in a buildup of debris. This flooding could take place anywhere downstream of about 400 North, which is where the canal would transition from a pipe to an open conveyance structure depending on where the canal might be obstructed. Also, similar to the other alternatives, stormwater entering the canal system during irrigation season could overwhelm the LN Canal due to the limited capacity of the canal.

5.6.4.2 Damage from Rock Fall

The Blue Alternative would not affect the LHPS Canal in Logan Canyon; the canyon reach of that canal would continue to catch rocks and other debris that falls down the hillside above

What hazards are associated with the Blue Alternative?

- Flooding from a lack of adequate canal maintenance
- Flooding from combined stormwater and irrigation water flows and insufficient downstream canal capacity
- Landslide risk along the Logan Bluff
- Flooding from surface fault rupture
- Flooding from seismic-induced ground shaking, liquefaction, landslides, and subsidence

the canal. This area in Logan Canyon that currently has rockslides would continue to have rockslides.

5.6.4.3 Landslide Risk

Under the Blue Alternative, the unstable hillside along the Logan Bluff would continue to remain unstable and be subject to landslides due to existing soil and groundwater conditions. The Blue Alternative would not stabilize the Logan Bluff area beyond what would be needed to construct the new pipeline. Given the history of landslides along the bluff, future landslides are expected to occur.

The Blue Alternative would include the purchase of 14 structures to reduce the risk to life and property. This purchase is consistent with the objective of the EWPP, which requires NRCS to implement recovery measures that relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed (7 CFR 624.2). The Blue Alternative differs from the Purple and Orange Alternatives in that the purchase of the structures is required not only to remove future risk but also to accommodate the reconstruction of the LN Canal.

Because of EWPP program limitations, NRCS cannot fund stabilization of the entire Logan Bluff area. NRCS can fund stabilization of the Logan Bluff area only to the extent needed to reconstruct the LN Canal as proposed under this alternative (Photo 5-2).



Photo 5-2. Site of 2009 landslide and affected LN Canal

As described in Chapter 3, Alternatives, the Blue Alternative includes several control measures that would address some of the hazard associated with future landslides. These measures include a drainage system to capture and convey water flowing from seeps and springs along the proposed new pipeline, buttressing of slopes along the pipeline, methods to monitor the stability of the hillside and pipeline, and emergency response planning.

However, even with these measures in place, landslides along the Logan Bluff could still damage the pipeline and cause flooding and debris flows (that is, the movement of soil and other materials picked up as the soil moves) that could result in environmental damage, property damage, and injury or death. Because this alternative includes the purchase of 14 structures, the risk to people living along the canal would be reduced, since people would not be living along the most unstable part of the bluff. If the new pipeline were to fail and cause flooding and debris flow, people living near the pipeline (such as people living on the south side of Canyon Road or downstream of a new landslide) might still experience damage, injury, or death. The pipeline design would include a shut-off valve, but the pipeline would still convey water in the system downstream of the shut-off valve. Even this limited amount of water could cause damage after the flow is stopped at the shut-off valve.

5.6.4.4 Hazards Associated with Surface Fault Rupture

The LN Canal crosses the East Cache fault zone near the LN Canal POD. As described in Section 5.6.2.4, Hazards Associated with Surface Fault Rupture, faulting could generate earthquake magnitudes in the range of 6.6 to 7.1, which could cause surface displacement. The risk associated with damage to the canal would not change from the existing condition. If the SLO desired additional assurance that the canal could withstand the expected displacement, construction plans for the pipeline in the LN Canal could consider special design elements based on the results of a site-specific fault investigation.

Surface fault rupture associated with an earthquake could cause a break in the LN Canal and result in local flooding. The degree of flooding would depend on the amount of water in the canal at the time of the break and the amount of time required to stop the flow of irrigation water in this section of the canal. If the break occurred between about November 1 and March 31 when the canal is not being used to deliver irrigation water, flooding might be minor, since the only water in the canal systems would be stormwater and water from seeps and springs. However, if the break occurred during the irrigation season, the degree of flooding could be severe if the LN Canal is at or near capacity. However, as described in Section 4.4.5.3, Geology, the predicted recurrence interval suggests a low probability that a surface fault rupture would occur within the lifetime of this project.

5.6.4.5 Damage from Seismic Events

The LN Canal has always been at risk of damage from ground shaking associated with seismic events. The new conveyance structures associated with the Blue Alternative (new irrigation pipeline from LN Canal POD to 400 North, new stormwater conveyance channel,

and new pipeline in the LN Canal from the POD to the Laub Diversion) and the remainder of the LN Canal downstream of 400 North would continue to be at risk of damage from ground-shaking hazards related to liquefaction, flooding, landslides, and subsidence. To reduce the potential for hazards associated with ground shaking, the new pipeline could be designed to withstand ground accelerations documented in Table 4-12, Anticipated Ground Accelerations for the Study Area, with adjustments to accommodate soil amplification if necessary.

If an earthquake occurred during irrigation season, the irrigation system would be at risk of rupturing, and areas near the rupture site would be at risk of flooding. Because the LN Canal would carry irrigation water along the historic alignment, the potential for damage associated with flooding would be the same as it has been historically.

The Blue Alternative alignment passes through areas that are mapped as having very low to low liquefaction potential. If the SLO desired additional assurance that the new structure could withstand damage as a result of liquefaction, the design of the new conveyance system could evaluate special elements to address this hazard.

Landslides due to seismic activity could affect the new LN Canal pipeline and stormwater channel through the historically unstable area of the Logan Bluff. An earthquake-induced landslide could cause pipeline failure and result in catastrophic flooding if the failure occurred when the pipeline was carrying irrigation water. As proposed, the Blue Alternative includes several measures to reduce potential landslide-related hazards (with or without seismic activity) and includes the purchase of structures along Canyon Road between about 750 East and 1100 East to reduce the threat to life and property from future landslides.

5.6.5 Summary of Hazard-Related Impacts and Mitigation

The No-Action Alternative would not cause human exposure to or environmental damage related to new geologic hazards. The historic landslide hazards along the Logan Bluff would remain, as would the potential for minor flooding associated with delivering 2 cfs of irrigation water between the LN Canal POD and the Laub Diversion and with the presence of stormwater and water from seeps and springs.

The following beneficial and adverse effects would be associated with the action alternatives:

- Removing irrigation water from the LN Canal alignment along the Logan Bluff between 400 North and about 1100 East would reduce the risk of landslide-induced floods in this area. This is considered a benefit (Purple and Orange Alternatives).
- The box culvert constructed in the LHPS Canal in Logan Canyon would be susceptible to damage from falling rocks (Purple and Orange Alternatives).
- Although the proposed alternatives might include measures to reduce the damage from surface fault ruptures, the reaches of the LHPS and LN Canals that cross the East Cache fault zone would continue to be at risk of damage from surface fault ruptures (all alternatives).

- Although the proposed alternatives might include measures to reduce damage associated with ground shaking, areas along the LN and LHPS Canals would continue to be at risk of damage from ground-shaking hazards (flooding and subsidence) associated with a large seismic event (all alternatives).
- Although the proposed alternatives might include measures to reduce damage associated with liquefaction, areas along the LN and LHPS Canals would continue to be at a low to very low risk of damage from liquefaction from ground shaking associated with a large seismic event (all alternatives).
- The area along the Logan Bluff would continue to be at risk of damage associated with landslides (all alternatives).
- The area along the Logan Bluff would be at risk of damage associated with flooding as a result of landslides and seismically induced landslides (Blue Alternative).

Application of the following measures would minimize or mitigate the effects of geologic hazards:

- If the SLO desires additional assurance that the proposed changes to the canal system could withstand damage associated with fault rupture, Cache County or its contractor could complete a site-specific fault investigation for the segment of box culvert in the LHPS Canal and that part of the LN Canal that cross the East Cache fault zone. The investigation could characterize the zone of deformation, evaluate earthquake history, and recommend special design elements. Construction plans for this reach of the canal could consider the investigation results and incorporate the recommendations in the report (all alternatives).
- The final design of the box culvert in the LHPS Canal alignment through Logan Canyon could consider a layer of soil to protect the structure from rock fall (Purple and Orange Alternatives).
- If the SLO desires additional assurance that the proposed changes to the canal system could withstand damage associated with liquefaction, the box culvert in the LHPS Canal could be designed to withstand the anticipated ground accelerations related to seismic activity and to withstand the effects of liquefaction in the study area. This would prevent damage to the box culvert and reduce the potential for flooding (Purple and Orange Alternatives).
- If the SLO desires additional assurance that the proposed changes to the canal system could withstand damage associated with ground shaking, the new parts of the irrigation water delivery system could be designed to withstand the potential subsidence and ground accelerations documented in Table 4-12, Anticipated Ground Accelerations for the Study Area, with adjustments to accommodate soil amplification if necessary (all alternatives).

The following naturally occurring hazards could not be avoided by any alternative in the study area:

- The LHPS and LN Canals cross the East Cache fault zone. The canals would continue to be at risk of damage from a surface fault rupture caused by a large earthquake.
- Rupture of the LHPS or LN Canal as a result of a landslide or a strong earthquake when the canals are carrying irrigation water could cause flooding.
- The Logan Bluff is unstable due to geologic properties, topography, and drainage. Based on the long history of landslides in this area and the characteristics of the bluff, future landslides are likely.

5.7 Consistency with Approved Regional Plans for Water Resource Management

The proposed action would occur in an area that is addressed in the following regional plans for water-resource management:

- *Bear River Basin: Planning for the Future* (January 2004) and Bear River Basin State Water Plan (January 1992)
- Interim Cache Valley Ground-Water Management Plan (effective September 1, 1999)
- Logan general plan (2007)
- North Logan general plan Element IV: Infrastructure (October 2002, as amended through June 2007)

Why does this EIS consider approved regional plans for water resource management?

Title 190, Part 410.11(E), of the NRCS General Manual requires an EIS to include “information identifying any approved regional plans for water resource management in the study area and a statement on whether the proposed project is consistent with such plans.”

This section describes the basic goals or policies of each plan and reviews the consistency of the project alternatives with those goals or policies. In cases where the consistency of the action alternatives does not differ among the options, this section presents combined discussions for the action alternatives.

5.7.1 Bear River Basin Planning Documents

The entire study area for the Logan Northern Canal Reconstruction EIS is located in the Bear River Basin. *Bear River Basin: Planning for the Future* (Utah Division of Water Resources 2004) describes the current state of the Bear River Basin and explores potential water-management approaches. This document supplements the original Bear River Basin State Water Plan (Utah Division of Water Resources 1992). The 2004 document does not include goals or recommended specific actions but does include a discussion about potential ways to

manage the basin's water supply. Specific areas of focus include water supply, water conservation, water transfers, and efficient management of developed supplies, water development, and water quality in the Bear River Basin.

The 1992 plan does not list specific goals for water management in the Bear River Basin but does include some specific direction for future management that could apply to the proposed action. The water conservation chapter of the plan makes several recommendations that could apply to water use in the study area (page 17-9 of the 1992 plan). These recommendations include:

- Each community should evaluate its situation regarding current water supplies, current per-capita use, anticipated future growth, and availability of new supplies and prepare a water-conservation plan that provides a long-term water supply at the optimum cost.
- Irrigation companies should also prepare water-conservation plans after reviewing their own water supply situations. The plan should provide economic benefit to the farmers and the irrigation companies. The canals should continue to be lined and maintained to reduce seepage losses, and users should be encouraged to convert to sprinkler irrigation when such conversion is economically feasible. The irrigation companies should further improve irrigation scheduling, with a goal of identifying optimum times.

In general, the plan states that two basic water-conservation strategies are to reduce demand by using supplies more efficiently and to increase supplies by operating storage and delivery facilities more efficiently (page 2-9 of the 1992 plan).

5.7.1.1 Consistency of the No-Action Alternative

Under the No-Action Alternative, less water would be lost from the LN Canal due to seepage and evaporation because the canal would no longer be used for irrigation purposes. This would be consistent with the Bear River Basin Plan, but only for the LN Canal. Under the No-Action Alternative, the LHPS Canal would continue to be used as it has historically and would continue to lose large amounts of water from seepage (and evaporation). This alternative would also not address any of the other recommendations of the plan, including preparing a water-conservation plan or encouraging users of the irrigation water to convert to sprinkler irrigation.

5.7.1.2 Consistency of the Purple and Orange Alternatives

Both the Purple and Orange Alternatives would be consistent with the Bear River Basin Plan because they would reduce loss from seepage and evaporation by enclosing some of the LHPS Canal in a box culvert and by supplying water to some users of the LN Canal through a pressure pipe (which would facilitate converting to sprinkler irrigation). Under both of these alternatives, the section of the LN Canal from the POD below First Dam to 400 North would

no longer be used, which would prevent loss from seepage and evaporation from that section of the canal.

The Purple and Orange Alternatives would install a pressure pipe to serve LN Canal users upstream of about 1500 North and 3100 North, respectively. This conversion would encourage shareholders to convert to sprinkler irrigation since the pressurized line would provide enough pressure to support sprinkler irrigation systems. The proposed 0.5-mile-long, 6-inch-diameter line between the LN Canal POD and the Laub Diversion would be a gravity line, so it would not provide the opportunity for users to use pressure from the line to convert to sprinkler irrigation.

The biggest difference between the Purple and Orange Alternatives is the distance of the canals that would be either enclosed or piped. The Orange Alternative would be more consistent with the plan because it would enclose a greater distance of the LHPS Canal in a box culvert (between 4.6 and 4.9 miles) and would enclose a greater distance of the LN Canal in a pressure pipe (about 3.8 miles).

5.7.1.3 Consistency of the Blue Alternative

The Blue Alternative would be consistent with the Bear River Basin Plan for the section of the LN Canal between the POD below First Dam and 400 North; only that section would be enclosed in a pipe. Because the rest of the LN Canal would continue to operate as it has historically, with large amounts of water lost to seepage and evaporation, the Blue Alternative would not be consistent with the water-conservation goal of the Bear River Basin Plan. The LHPS Canal would not be affected by this alternative, so it would continue to operate as it has historically with large amounts of water lost to seepage and evaporation.

5.7.2 Interim Cache Valley Ground-Water Management Plan

The Utah Division of Water Rights established the Interim Cache Valley Ground-Water Management Plan (Utah Division of Water Rights 1999) effective September 1, 1999. This interim plan sets forth the framework for future management of groundwater resources in Cache Valley and is based on the State Engineer's estimate that "potential withdrawals of 25,000 acre-feet is a reasonable quantity of additional water to be developed to meet future demands for water over the next 20 years."

As a 20-year plan, it is expected to be effective through about 2019 (which is 20 years from the plan's effective date). The plan includes specific guidance regarding the maximum amount of groundwater that can be diverted under each new appropriation, how applications will be considered and processed, and how impacts to existing users will be addressed.

5.7.2.1 Consistency of the No-Action Alternative

Under the No-Action Alternative, LN Canal shareholders would not receive water and would rely on other sources, including culinary water and groundwater. This alternative could increase the number of applications to legally withdraw groundwater. Applicants would need to meet the requirements described in the interim plan. These requirements address the maximum amount of water that applicants can request, the conditions under which they can ask for more water, and the effects on prior users.

Although the No-Action Alternative could increase the demand for groundwater in Cache Valley, is not inconsistent with the interim plan because the conditions of the interim plan would control the amount of groundwater appropriated to applicants.

5.7.2.2 Consistency of the Action Alternatives

All three of the action alternatives would provide LN Canal water to shareholders and would not rely on replacement using groundwater. The future appropriation conditions of the interim plan would not apply to the action alternatives.

5.7.3 Logan General Plan

The Logan general plan (City of Logan 2007) includes some general principles, goals, and actions addressing water conservation. According to the resource-conservation principles statement on page 2-4 of the plan:

- Resource conservation will encourage innovative stormwater management. New resource conservation practices will be less consumptive and more protective of natural resources. Conservation can maintain or improve air quality and enhance water quality and quantity for future generations.
- Water conservation is a necessity and a major emphasis of City policy.

The general plan also includes the following water-related resource sustainability goal and action (page 6-3 of the plan):

- Goal 2. Conserve, protect, and improve the quality of environmental resources and the natural functions they perform (i.e. water, air, wildlife habitat, wetlands, etc.).
- Action 2. Improve and monitor environmental quality (i.e. air, water) and reduce resource consumption (i.e. water).

The plan also identifies the following directive under its section titled “Preserving and Improving the Historic Downtown” (page 8-5 of the plan):

- Find ways to use existing water features to enhance the quality of downtown. Downtowns with water features such as creeks, rivers, ponds, and lakes often take advantage of this natural setting with lakeside parks or riverside walks.

5.7.3.1 Consistency of the No-Action Alternative

The No-Action Alternative would not change the canal systems within the Logan city limits. This alternative would indirectly conserve water, since water would not flow in the LN Canal, where it could be lost to seepage and evaporation. However, the No-Action Alternative would not improve the way stormwater is managed, would not improve water quality, and would not reduce water demand (existing LN Canal shareholders would switch to culinary water, which would place additional demands on the existing culinary water system). The No-Action Alternative could, however, enhance the quality of the Logan River in the city since water historically diverted just below First Dam would remain in the river and potentially increase river flow.

The No-Action Alternative is inconsistent with some parts of the City of Logan's water-resource-management approach (stormwater management, water quality, and water demand), but it is consistent with others (water conservation and river enhancement).

5.7.3.2 Consistency of the Purple and Orange Alternatives

These alternatives would modify the LHPS Canal in a manner that would conserve water by reducing losses from seepage and evaporation and improve water quality by separating irrigation water and stormwater and keeping debris out of the irrigation water. These alternatives would divert the LN Canal water upstream of its historical diversion location, which could change Logan River flows in the river reach between the new and historic PODs. This difference would affect a short stretch of the river in the city and should not affect the quality of the Logan River or the experience of people using the existing parks along the river.

These alternatives include improvements to LN Canal service upstream of 1500 North. Users between about 400 North and 1500 North would receive water using a pressure pipe that would improve water conservation and water quality in a manner similar to that described for the LHPS Canal.

The Orange and Purple Alternatives would allow the City of Logan to continue to use the LN Canal to manage stormwater in the city but would not involve any innovative improvements to the city's stormwater system. The historic alignment of the LN Canal would be available to collect and convey stormwater upstream of about 1500 North, since most of the irrigation water would be placed in a pipe between about 400 North and 1500 North. The LN Canal section between the historic POD and about 400 North would not be repaired but would remain available to collect and convey stormwater and incidental water if the City chooses to use it.

The Purple and Orange Alternatives are consistent with the Logan general plan's water-resource-management approach.

5.7.3.3 Consistency of the Blue Alternative

The Blue Alternative would conserve water and improve water quality along the LN Canal between the POD just below First Dam and about 400 North. Enclosing the LN Canal would prevent seepage and evaporation and would prevent debris from entering this section of the canal. This alternative would allow stormwater to continue to be collected and conveyed but would not involve any innovative improvements to the city's stormwater system.

The Blue Alternative would not affect Logan River flows or the appearance of the Logan River in the city. The Blue Alternative is consistent with the City's water-resource-management approach.

5.7.4 North Logan General Plan

The North Logan general plan Element IV: Infrastructure (City of North Logan 2002) contains guidelines addressing water use associated with commercial and economic development and how to manage drainage and floodplains. According to guideline 4.3.1:

It is the goal of North Logan City to encourage the wise use of our water resources. Increased demand is anticipated on culinary water as residential and commercial land uses increase. The City should encourage conservation and xeriscaping. Water rights should remain with the land. Secondary water systems should be considered to provide for outside irrigation for lawns, landscaping, gardens, open spaces, etc.

Guideline 4.5.13 addresses using the canal system as part of the storm drain system. This guideline states:

The City should develop a storm drainage system as the plan (emergency procedures) describes. This is critical because the conventional storm drainage system based on channeling runoff water to the Bear River is not cost effective. City officials should negotiate with the involved canal companies to provide the necessary agreements to implement this system.

5.7.4.1 Consistency of the No-Action, Purple, and Blue Alternatives

These alternatives would not affect land or water use in North Logan. North Logan would continue to encourage its residents to conserve water and to work with the canal companies to develop stormwater agreements.

5.7.4.2 Consistency of the Orange Alternative

The Orange Alternative would affect sections of the LN Canal and LHPS Canal in North Logan. This alternative would convert segments of both canals from open systems to closed systems.

The modifications to the LN Canal and LHPS Canal in North Logan are not likely to affect types of uses but could cause some users to switch from flood irrigation to sprinkler irrigation. This alternative is not likely to encourage water conservation beyond that associated with switching from flood to sprinkler irrigation and would not increase xeriscapes. The modifications would not affect water rights associated with land in North Logan. Existing shareholders would use continue to use water for outside irrigation as they have in the past.

The new pressurized system along the LN Canal might encourage shareholders to irrigate more efficiently. For users who also rely on culinary water, a more efficient (pressurized) delivery system might provide enough improvement that users can reduce their use of culinary water.

The Orange Alternative would include provisions allowing the canals to collect and convey stormwater in a manner similar to the way in which the canals performed this function in the past. The Logan & Northern Irrigation Company and the Logan, Hyde Park and Smithfield Canal Company would continue to work with the City of North Logan to develop stormwater-management agreements. The stormwater system included as part of the Orange Alternative would be able to convey historic levels of stormwater but would not improve the City's stormwater system.

The Orange Alternative is consistent with the City of North Logan's water-resource-management approach.

5.8 Relationship between Short-Term Uses and Long-Term Productivity

NEPA requires consideration of “the relationship between short-term uses of [the] environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). This includes using all practicable means and measures to foster and promote the general welfare, to create and maintain conditions under which people and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (National Environmental Policy Act, Section 101). This means that short-term uses are those that determine the present quality of life for the public. Timber harvest, recreation, livestock grazing, and some mineral extraction are considered short-term uses. Long-term productivity of the land refers to the capability of the land to provide resources such as forage, timber, wildlife habitat, and high-quality water. Maintaining soil productivity and water quality will ensure maintenance of long-term productivity.

Short-term uses of the action alternatives would include consuming fossil fuels during construction, local effects of using land in the project area for construction staging, and spending EWPP funds and local match funds. These short-term uses would enable enhanced

long-term productivity of land irrigated with water delivered through the proposed action, which would support the long-term health of the local economy.

Other long-term benefits of the Purple and Orange Alternatives include water conservation realized by converting between 2.4 and 5.2 miles of the open LHPS Canal and between 1 and 4.4 miles of the open LN Canal, improved public safety by enclosing the open canals, and improved water quality by separating stormwater from irrigation water along 2.4 to 5.2 miles of the LHPS Canal and 1 to 4.4 miles of the LN Canal.

The Orange Alternative would also result in a long-term energy conservation benefit. The Orange Alternative is the only alternative that would provide this benefit.

5.9 Irreversible and Irretrievable Commitments of Resources

This section describes the expected irreversible and irretrievable commitments for each resource evaluated in this EIS. NEPA requires that environmental analyses identify any irreversible and irretrievable commitments of resources that would occur as a result of implementing a proposed alternative. Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources could have on future generations. Irreversible commitments are those that consume a resource that cannot be replaced within a reasonable timeframe. Irretrievable commitments are those that consume a resource that is neither renewable nor recoverable for use by future generations.

What are irreversible and irretrievable commitments?

Irreversible commitments are those that consume a resource that cannot be replaced within a reasonable timeframe.

Irretrievable commitments are those that consume a resource that is neither renewable nor recoverable for use by future generations.

5.9.1 Social and Economic Environment

5.9.1.1 Agriculture

Under the Purple Alternative, construction of the proposed pipeline route between the LHPS Canal and the LN Canal at about 1500 North would require an irretrievable commitment of about 0.3 acre of farmland. Construction of the proposed pipeline route along 2900 North in the Orange Alternative would require a commitment of about 3.1 acres of farmland. The Blue Alternative would not affect any farmland.

5.9.1.2 Energy

The Purple and Orange Alternatives would require a change in the Logan & Northern Irrigation Company's water rights currently assigned to the LN Canal POD below First Dam.

The Logan & Northern Irrigation Company and Logan City Light and Power are currently discussing ways to ensure that the needs of both parties could be met if the LN Canal irrigation water were to be diverted at the LHPS Canal POD. However, because the parties do not have a formal agreement in place, this is considered an irretrievable commitment.

The Orange Alternative would result in a net energy savings by facilitating conversion from flood irrigation (which requires pumping) to sprinkler irrigation along the reach of the LN Canal that would be placed into a pressurized pipeline system.

5.9.1.3 Easements

The action alternatives would require the following new permanent easements:

- Purple Alternative: 2.6 acres associated with the pipeline between the LHPS Canal and the LN Canal and about 4,000 linear feet in local roads
- Orange Alternative: 3.6 acres associated with the 2900 North option pipeline between the LHPS Canal and the LN Canal and about 3,100 linear feet in local roads
- Blue Alternative: no permanent easements

The land under these easements would remain undeveloped, but allowable future uses would be restricted because of the presence of the underground pipeline. Because of this, these permanent easements would be considered an irreversible and irretrievable commitment.

5.9.1.4 Property Acquisitions

All of the action alternatives would require purchasing structures on 14 residential lots on the north side of Canyon Road. This purchase would be an irretrievable commitment of financial resources. The City of Logan has already purchased five residences in this area. The City will not allow residential development on the six properties it owns and would not allow development on the additional 14 properties from which NRCS would buy structures as part of the action alternatives. Permanently removing the affected properties from the residential land supply would be an irretrievable commitment of the land.

5.9.1.5 Recreation

The Purple and Orange Alternatives would convert open sections of the LHPS Canal to a closed system. The entities that manage the land on which the canals are located and the irrigation companies that operate the canals have not authorized recreation use of the canal alignments. However, the ability to use the open sections for recreation activities such as floating in the canals, wading in the canals, and hiking and mountain biking along the canals would be lost as a result of these alternatives. This would be an irretrievable commitment of the canal system to a use that would not accommodate some types of recreation or might not accommodate other types in the same manner.

A short section of the LN Canal would be converted from an open system to a closed system under the Blue Alternative. An unauthorized trail along this reach of the LN Canal has historically been used for hiking and mountain biking. Construction of the Blue Alternative could result in the irretrievable loss of this amenity if Cache County and/or the City of Logan do not establish a trail along the new canal pipeline.

5.9.2 Natural Resource Environment

5.9.2.1 Construction Materials

Using materials in construction activities would be an irreversible and irretrievable commitment. Construction activities would require the following materials, which would need to be manufactured and transferred to the project site.

Purple Alternative

- 2.4 miles of 6-foot-by-6-foot concrete box culvert
- 0.8 mile of 12-foot-by-5-foot concrete box culvert
- Metal headgates for individual shareholders along the concrete box culvert
- 1.2 miles of 42-inch-diameter plastic pressure pipe
- 1 mile of 10-inch-diameter plastic pressure pipe
- 1 mile of 6-inch-diameter plastic pipe
- Concrete and metal water-control structures at the LHPS Canal POD, LHPS Canal at Lundstrom Park, LN Canal at 1500 North, and LN Canal at 400 North
- Metal used in valves, flow meters, gages, manholes, etc.

Orange Alternative

- 2.4 miles of 6-foot-by-6-foot concrete box culvert
- 3.3 to 3.6 miles of 12-foot-by-5-foot concrete box culvert
- Metal headgates for individual shareholders along the concrete box culvert
- 0.5 to 0.6 mile of 36-inch-diameter pressure pipe
- 2.1 to 2.4 miles of 26-inch-diameter plastic pressure pipe
- 1 mile of 10-inch-diameter pressure pipe
- 1 mile of 6-inch-diameter plastic pipe

- Concrete and metal water-control structures at the LHPS Canal POD, LHPS Canal at either 2900 North or 3100 North, LN Canal at 2900 North or 3100 North, and LN Canal at 400 North
- Metal used in valves, flow meters, headgates, gages, manholes, etc.

Blue Alternative

- 1.7 miles of 60-inch-diameter to 72-inch-diameter steel pressure pipe
- 1 mile of 6-inch-diameter plastic pipe
- Concrete used to construct a 1.7-mile-long drainage ditch
- Imported gravel and soil for runoff-control berm and soil buttress
- Concrete, metal, and plastic used for water-control structures at the LN Canal POD and LN Canal at 400 North, drilled shaft foundations, and horizontal drains
- Metal used in valves, flow meters, headgates, etc.

5.9.2.2 Fossil Fuels

Consumption of petroleum, mostly diesel fuel, to operate construction equipment would be an irreversible and irretrievable commitment of a nonrenewable resource, although this is expected to be a trivial quantity.

5.9.2.3 Water

All of the action alternatives would re-establish water delivery to existing shareholders of the LN Canal. The Purple and Orange Alternatives would divert up to 130 cfs to serve shareholders of the LN and LHPS Canals, and the Blue Alternative would divert 80 cfs to serve shareholders of the LN Canal. The proposed action would continue this use of water for irrigation into the foreseeable future. Because the irrigation companies' water rights are specific and because all of the Logan River water is appropriated, the amount of water diverted at the PODs would not change.

5.10 Summary of Mitigation Measures and Adverse Environmental Impacts That Cannot Be Avoided

Table 5-8 presents the potential mitigation measures for each of the action alternatives.

NEPA states that an agency must disclose and describe any adverse effects that cannot be avoided. The remainder of this section following Table 5-8 presents the adverse effects that cannot be avoided for each alternative. All impacts are less than significant. The measures listed in Table 5-8 would avoid, minimize, or mitigate some of the expected impacts. The text following the table identifies those impacts that cannot be avoided and for which mitigation is not proposed. Because they would not be affected under any of the alternatives, wetlands are not included in the table.

Table 5-8. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Long-Term or Permanent Impacts on Land Use							
General Land Use	None.	Permanent easements from about 2.6 acres of land for the pipeline between the LHPS Canal and LN Canal, in about 4,000 linear feet of local roads, and from about 10 properties along the LHPS Canal. Convert 14 properties from residential use to use-restricted undeveloped land.	None proposed.	Permanent easements from about 3.6 acres of land for the pipeline between the LHPS Canal and LN Canal, in about 3,100 linear feet of local roads, and from about 27 properties along the LHPS Canal. Convert 14 properties from residential use to use-restricted undeveloped land.	None proposed.	Convert 14 properties from residential use to use-restricted undeveloped land.	None proposed.
Land-Use Plans, Policies, and Controls	None.	Would require new USFS special-use permit.	None proposed.	Would require new USFS special-use permit.	None proposed.	None.	None proposed.
Long-Term or Permanent Impacts on Social and Economic Conditions							
Community Resources	None.	Modification of one road-crossing structure. Acquire 14 at-risk properties along Canyon Road and relocate residents.	None proposed.	Modification of four road-crossing structures. Acquire 14 at-risk properties along Canyon Road and relocate residents.	None proposed.	Acquire 14 at-risk properties along Canyon Road and relocate residents.	None proposed.
Quality of Life	Shareholders along LN Canal would not be able to access water from the canal system; some consider open canals a safety risk, others consider them a social amenity.	Enclose about 1 mile of LN Canal and 2.4 miles of LHPS Canal. Adjacent property owners and other area residents might view enclosure as positive or negative. Improve safety by removing structures from 14 at-risk properties along Canyon Road. Allow agricultural production to continue.	None proposed.	Enclose about 3.1 or 3.4 miles of LN Canal and 4.9 or 5.2 miles of LHPS Canal. Adjacent property owners and other area residents might view enclosure as positive or negative. Improve safety by removing structures from 14 at-risk properties along Canyon Road. Allow agricultural production to continue.	None proposed.	Enclose about 1.7 miles of LN Canal. Adjacent property owners and other area residents might view enclosure as positive or negative. Repair the 2009 landslide site and address some of the instability along the LN Canal alignment, which could improve safety. Further improve safety by removing structures from 14 at-risk properties along Canyon Road. Allow agricultural production to continue.	None proposed.
Economics	No shareholder access to water from the canal system. About \$21 million in lost agricultural revenue over 50 years.	No adverse effects. Could provide opportunity for some shareholders to switch from flood irrigation to sprinkler irrigation between 400 North and 1500 North along the LN Canal. Otherwise the energy cost associated with pumping would remain the same.	None proposed.	No adverse effects. Would provide opportunity for shareholders to switch from flood irrigation to sprinkler irrigation between 400 North and 2900 North or 3100 North along the LN Canal. This would result in an energy savings of about \$48,000 per year associated with no pumping costs.	None proposed.	None.	None proposed.
Recreation	None.	Canal structures would be constructed on or would cross National Forest System land, Logan Golf & Country Club, Ray Hugie Park, Lundstrom Park, and Bonneville Shoreline Trail. Loss of unauthorized recreation use of LHPS Canal.	None proposed.	Canal structures would be constructed on or would cross National Forest System land, Logan Golf & Country Club, Ray Hugie Park, Lundstrom Park, Riverside Trail, and Bonneville Shoreline Trail. Loss of unauthorized recreation use of LHPS Canal.	None proposed.	Would not affect any formal recreation resources and would probably not affect unauthorized use of the LN Canal easement between the LN Canal POD and 400 North.	None proposed.
Scenic Beauty and Landscape Resources	Potential aesthetic degradation due to loss of irrigation practices and less-scenic land development.	Would modify the LHPS Canal, a change that would be noticeable to people living and recreating along the affected canal reach. Removing the structures from 14 properties would affect the appearance of the affected area.	None proposed.	Same as Purple Alternative.	None proposed.	Would modify the LN Canal between the POD and 400 North, a change that would be noticeable to people living along this reach. Removing the structures from 14 properties and constructing a soil buttress would significantly affect the appearance of the area.	None proposed.

Table 5-8. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Energy	Potential energy savings from decreased pumping from the canal system; potential increased energy consumption from accessing other water sources; no effect to water available to Logan City Light and Power.	Minor energy conservation benefits if shareholders along the LN Canal between 400 North and 1500 North choose to convert to pressurized systems. Could cause minor effects to power generation at the Logan City Light and Power Hydro 2 facility if the City and Logan & Northern Irrigation Company do not reach an agreement.	None proposed.	Substantial energy conservation benefits because shareholders could use the pressurized line along the LN Canal between 1500 North and 2900 North/3100 North instead of pumping. Could cause minor effects to power generation at the Logan City Light and Power Hydro 2 facility if the City and Logan & Northern Irrigation Company do not reach an agreement.	None proposed.	None.	None proposed.
Long-Term or Permanent Impacts on Natural Resource Conditions							
Agriculture	Decrease agricultural production. Shareholder access to irrigation water from the LN Canal system would not be restored.	Permanent loss of 0.3 acre of irrigated farmland.	None proposed.	2900 North option would cause the loss of about 3.0 acres of irrigated farmland and about 0.1 acre of nonirrigated farmland. The 3100 North option would not cause the loss of any farmland.	None proposed.	None.	None proposed.
Biological Resources – Habitat, Vegetation, and Wildlife	Potential spread of noxious weeds affecting habitat on or near the nonmaintained canal alignment and the landslide area that would not be repaired.	Permanent loss of riparian vegetation at the LHPS Canal POD. Potential entrapment of fish at the LHPS Canal POD. Permanent loss of vegetation along the LHPS Canal between the golf course and Lundstrom Park. Loss of use of the open canal by locally common wildlife during the irrigation season between the LHPS Canal POD and Lundstrom Park.	Use native riparian plants for restoration where possible. Modification of the LHPS Canal POD structure would include a device to prevent fish from entering the canal or from becoming trapped at the POD structure. Modifications to the LHPS Canal would include components that would allow the installation of low-flow irrigation systems to serve land in the canal easement.	Permanent loss of riparian vegetation at the LHPS Canal POD. Potential entrapment of fish at the LHPS Canal POD. Permanent loss of vegetation along the LHPS Canal between the golf course and 2900 North/3100 North. Loss of use of the open canal by locally common wildlife during the irrigation season between the LHPS Canal POD and 2900 North/3100 North.	Same as Purple Alternative.	Permanent loss of riparian vegetation at the LN Canal POD. Potential entrapment of fish at the LN Canal POD. Permanent loss of vegetation along the LN Canal between the POD and 400 North. Loss of use of the open canal by locally common wildlife during the irrigation season between the LN Canal POD and 400 North.	Use native riparian plants for restoration where possible. Modification of the LN Canal POD structure would include a device to prevent fish from entering the canal or from becoming trapped at the POD structure. Modifications to the LN Canal would include components that would allow the installation of low-flow irrigation systems to serve land in the canal easement.
Cultural and Tribal Resources	None.	Modify potentially NRHP-eligible structures including the LHPS Canal POD, 2.4 miles of the LHPS Canal, and 1 mile of the LN Canal. Remove structures from 14 properties; requires consultation with Utah SHPO to determine if any of the structures are NRHP-eligible.	NRCS/SHPO MOA will specify required mitigation.	Modify potentially NRHP-eligible structures including the LHPS Canal POD, between 4.9 and 5.2 miles of the LHPS Canal, and 1 mile of the LN Canal. Remove structures from 14 properties; requires consultation with Utah SHPO to determine if any of the structures are NRHP-eligible.	Same as Purple Alternative.	Modify potentially NRHP-eligible structures including the LN Canal POD and 1.7 miles of the LN Canal. Remove structures from 14 properties; requires consultation with Utah SHPO to determine if any of the structures are NRHP-eligible.	Same as Purple Alternative.
Topography, Soils, and Geology	None.	None.	None proposed.	None.	None proposed.	Topographic impacts from regrading the 2009 landslide area and constructing the 0.5-mile-long soil buttress. No impacts to soils or geology.	None proposed.
Water Resources – Surface Waters: Logan River and Green Canyon Creek	Connection between Logan River and Smithfield Creek would not be restored. Logan River would continue to receive return flow from irrigation diversion above Laub Diversion.	Minor effect to the Logan River at the LHPS Canal POD. Enclose 2.4 miles of the LHPS Canal. Place 1 mile of the LN Canal in a pipe outside the canal easement between 400 North and 1500 North. Place 1 mile of the LN Canal in a pipe between the LN Canal POD and the Laub Diversion.	None proposed.	Minor effect to the Logan River at the LHPS Canal POD. Enclose between 4.9 and 5.2 miles of the LHPS Canal. New culvert would cross over Green Canyon Creek. Place 3.1 to 3.4 miles of the LN Canal in a pipe outside the canal easement. Place 1 mile of the LN Canal in a pipe between the LN Canal POD and the Laub Diversion.	None proposed.	Minor effect to the Logan River at the LN Canal POD. Enclose about 1.7 miles of the LN Canal.	None proposed.
Water Resources – Water Quality	None.	Potential improvement of irrigation water quality in LN and LHPS Canals due to separating stormwater from irrigation water in 0.8 mile of the LHPS Canal and about 2 miles of the LN Canal.	None proposed.	Potential improvement of irrigation water quality in LN and LHPS Canals due to separating stormwater from irrigation water in about 4.1 to 4.4 miles of the LHPS Canal and in about 4.1 to 4.4 miles of the LN Canal.	None proposed.	Potential improvement of irrigation water quality in LN Canal due to separating stormwater from irrigation water between the LN Canal POD and about 400 North.	None proposed.

Table 5-8. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Water Resources – Stormwater	Beneficial effect because of increased stormwater capacity of the LN Canal.	Increase LN Canal stormwater capacity in the LN Canal between the LN Canal POD and the Laub Diversion and between 400 North and 1500 North. Separate stormwater system in LHPs Canal alignment would require maintenance as a stormwater facility.	Develop a stormwater management and maintenance program for the LHPs Canal between the Logan Golf & Country Club and Lundstrom Park.	Increase LN Canal stormwater capacity in the LN Canal between the LN Canal POD and the Laub Diversion and between 400 North and either 2900 North or 3100 North. Separate stormwater system in LHPs Canal alignment would require maintenance as a stormwater facility.	Develop a stormwater management and maintenance program for the LHPs Canal between the Logan Golf & Country Club and 2900 North or 3100 North.	Separate stormwater system in LN Canal alignment would require maintenance as a stormwater facility.	Develop a stormwater management and maintenance program for the LN Canal between the LN Canal POD and 400 North.
Water Resources – Floodplains	None.	None.	None proposed.	Construction of box culvert in LHPs Canal alignment through the Green Canyon Creek Zone A floodplain (designed to avoid adverse effects). Construction of the 2900 North connecting pipe would cross the Green Canyon Creek Zone A floodplain (designed to avoid adverse effects).	None proposed.	Construction of new LN Canal POD in Logan River Zone A2 floodplain (designed to avoid adverse effects).	None proposed.
Water Resources – Groundwater	About 4,000 acre-feet of canal water per year no longer lost from seepage.	7,400 acre-feet of irrigation water would no longer be lost to seepage due to canal enclosures, resulting in a 3% reduction in annual groundwater recharge.	None proposed.	13,000 acre-feet of irrigation water would no longer be lost to seepage due to canal enclosures, resulting in a 6% reduction in annual groundwater recharge.	None proposed.	1,300 acre-feet of irrigation water would no longer be lost to seepage due to canal enclosures, resulting in a 0.5% reduction in annual groundwater recharge.	None proposed.
Water Resources – Public Water Supply	None.	Would cross one drinking water source protection Zone 1 and five Zone 4s; operation of the system would not affect any drinking water source protection zone.	None proposed.	Same as Purple Alternative.	None proposed.	Construction of the soil buttress would be within one drinking water source protection Zone 1.	None proposed.
Water Resources – Water Use and Water Rights	Limited shareholder use of water from the LN Canal.	Conservation of 7,400 acre-feet of water per year due to canal enclosures. Provide opportunities for shareholders along about 1 mile of the LN Canal to convert from flood to sprinkler irrigation, which would conserve water.	None proposed.	Conservation of 13,000 acre-feet of water per year due to canal enclosures. Provide opportunities for shareholders along between 3.1 and 3.4 miles of the LN Canal to convert from flood to sprinkler irrigation, which would conserve water.	None proposed.	Conservation of 1,300 acre-feet of water per year due to canal enclosure.	None proposed.
Construction Impacts							
Land Use	None.	About 151 construction easements required on public land, private residential/agricultural land, and private nonagricultural land.	None proposed.	About 354 construction easements required on public land, private residential/agricultural land, and private nonagricultural land.	None proposed.	About 63 construction easements required on public land and private residential/agricultural land.	None proposed.
Social and Economic Environment – Community Resources, Quality of Life, and Scenic Beauty	None.	Short-term, construction-related effects such as noise, dust, and traffic interruptions.	Develop a plan that specifies acceptable work hours and days, describes how access to private properties and businesses would be maintained, and describes how the contractor would communicate with area residents.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Social and Economic Environment – Environmental Justice	None.	Temporary effects to four block groups of low-income populations and three blocks of minority populations; effects would be the same as those on non-environmental justice populations.	None proposed.	Temporary effects to four block groups of low-income populations and four blocks of minority populations; effects would be the same as those on non-environmental justice populations.	None proposed.	Temporary effects to one low-income block group; effects would be the same as those on non-environmental justice populations.	None proposed.
Social and Economic Environment – Economics	None.	Short-term benefit to local economy during construction.	None proposed.	Same as Purple Alternative	None proposed.	Same as Purple Alternative.	None proposed.

Table 5-8. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Social and Economic Environment – Recreation	None.	Construction activities along the canal alignments might temporarily affect use of or access to the Riverside Trail along the Logan River, USFS-administered land, Bonneville Shoreline Trail, Ray Hugie Park, the golf course, and Lundstrom Park. Could temporarily interrupt water delivery to golf course if construction takes place during irrigation season. Would temporarily affect unauthorized recreation use of the maintenance roads along both canals.	Work with Logan Golf & Country Club to ensure that this facility remains accessible during construction and that water delivery during construction meets the golf course operator’s turf irrigation needs. Work with the City of Logan to ensure that Lundstrom Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas. Place signs on the segment of the Bonneville Shoreline Trail that would be affected to inform the public of the work schedule, work activity, and potential temporary trail closures and detours.	Construction activities along the canal alignments might temporarily affect use of or access to the Riverside Trail along the Logan River, USFS-administered land, Bonneville Shoreline Trail, Ray Hugie Park, the golf course, Lundstrom Park, pocket parks between 2950 North and 3100 North, and Elk Ridge Park. Could temporarily interrupt water delivery to golf course if construction takes place during irrigation season. Would temporarily affect unauthorized use of the maintenance roads along both canals.	Work with Logan Golf & Country Club to ensure that this facility remains accessible during construction and that water delivery during construction meets the golf course operator’s turf irrigation needs. Work with the City of Logan to ensure that Lundstrom Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas. Place signs on the segment of the Bonneville Shoreline Trail that would be affected to inform the public of the work schedule, work activity, and potential temporary trail closures and detours. Work with the City of North Logan to ensure that Elk Ridge Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas.	Construction activities along the LN Canal alignment might temporarily affect use of or access to public recreation areas along the Logan River and the Boulevard Trail. Would temporarily affect unauthorized use of the maintenance road along the LN Canal.	None proposed.
Social and Economic Environment – Energy	None.	Construction activities would require energy and fuel for equipment.	None proposed.	Same as Purple Alternative.	None proposed.	Same as Purple Alternative.	None proposed.
Social and Economic Environment – Utilities	None.	Construction activities could affect utilities and/or require temporary utility service interruptions.	Contact Blue Stakes and utility owners to ensure that impacts to utilities and utility service are minimized during construction.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Natural Resources – Agriculture	None.	Temporarily affect use of irrigated and nonirrigated farmland in some areas along the alternative alignment by restricting access or temporarily using farmland for construction staging. If construction occurs during irrigation season, could disrupt irrigation water service to LHPS Canal and LN Canal shareholders.	If necessary, work with the Logan & Northern Irrigation Company; the Logan, Hyde Park and Smithfield Canal Company; the Cities of Logan and North Logan; USU; and other canal companies as appropriate to identify ways that the shareholders’ allocated water can be delivered during construction.	Same as Purple Alternative.	Same as Purple Alternative.	None.	None proposed.
Natural Resources – Biological Resources	None.	Construction activities would require removing riparian vegetation at the LHPS Canal POD on the Logan River and upland and landscaped vegetation along the canal alignments. Modifications to the LHPS Canal POD could temporarily affect aquatic habitat in the Logan River. Temporary effects to locally common wildlife. Construction and restoration activities could contribute to the spread of noxious weeds.	Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. Define a work zone along the alternative alignment within which all activity would take place. Provide extra protection measures for sensitive areas such as private residential landscaping and public parks to ensure that impacts to surrounding vegetation are avoided. Apply BMPs to ensure that construction does not introduce noxious weeds or invasive species and does not cause the spread of existing populations of noxious weeds or invasive species.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.

Table 5-8. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Natural Resources – Special-Status Species	None.	<p>Construction could damage a known population of Logan buckwheat in Logan Canyon.</p> <p>Construction could disturb birds protected under the Migratory Bird Treaty Act.</p> <p>Construction could disturb nesting bald eagles, if any are present in Logan Canyon.</p>	<p>Verify extent of Logan buckwheat populations in order to avoid them during construction activities.</p> <p>If construction activities occur between April 10 and August 31, conduct survey for nesting migratory birds in the work areas; if nesting migratory birds are found, protect active nests from construction activities until the young have fledged.</p> <p>If construction activities occur during December to February in Logan Canyon, coordinate with USFWS to determine if a survey for bald eagles is needed. If a survey is needed, the results would determine whether construction restrictions are imposed to protect nesting bald eagles.</p>	Same as Purple Alternative.	Same as Purple Alternative.	Construction could disturb birds protected under the Migratory Bird Treaty Act.	If construction activities occur between April 10 and August 31, conduct survey for nesting migratory birds in the work areas; if nesting migratory birds are found, protect active nests from construction activities until the young have fledged.
Natural Resources – Cultural and Tribal Resources	None.	No additional effects to NRHP-eligible or listed resources not already identified as permanent effects under <i>Long-Term or Permanent Impacts on Natural Resource Conditions, Cultural and Tribal Resources</i> above in this table for the Purple Alternative.	In the event of an unanticipated discovery of archaeological materials during construction, work would cease and Cache County or its contractor would contact the NRCS Cultural Resources Specialist. NRCS would investigate the discovery and would enter into consultation per 36 CFR 800.6 to develop the appropriate methods for treating the discovery.	No additional effects to NRHP-eligible or listed resources not already identified as permanent effects under <i>Long-Term or Permanent Impacts on Natural Resource Conditions, Cultural and Tribal Resources</i> above in this table for the Orange Alternative .	Same as Purple Alternative.	No additional effects to NRHP-eligible or listed resources not already identified as permanent effects under <i>Long-Term or Permanent Impacts on Natural Resource Conditions, Cultural and Tribal Resources</i> above in this table for the Blue Alternative.	Same as Purple Alternative.
Natural Resources – Topography, Soils, and Geology	None.	Construction activities would disturb more than 1 acre and require soil protection and erosion-control measures and restoration for compliance with CWA Section 402.	None proposed.	Same as Purple Alternative.	None proposed.	Construction activities would disturb more than 1 acre and require soil protection and erosion-control measures and restoration for compliance with CWA Section 402. Construction activities would affect the topography of the Logan Bluff along the LN Canal.	None proposed.

Table 5-8. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Natural Resources – Water Resources	None.	<p>Potential impacts to the Logan River channel and stream bank during construction of the LHPS Canal POD structure depending on the final design of the POD structure. Construction activity would require compliance with Sections 401 and 404 of the CWA and would require a USFS special-use permit.</p> <p>Potential impacts to the jurisdictional wetland along 1500 North if the wetland is not avoided.</p> <p>Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented.</p> <p>Potential effects to the City of Logan’s 700 North well if construction disturbs the well head. Potential interruption in delivery of irrigation water to shareholders during construction.</p>	<p>Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place.</p> <p>Protect the wetland along 1500 North by excluding all equipment from the area, not storing materials in the area, and ensuring that construction workers know to avoid the area. The contractor would fully fence the area. Wetland hydrology outside the delineated wetland would also be protected from excavation or other ground-disturbing activities. The boundaries of the wetland area would be shown on construction plans.</p> <p>Develop a temporary stormwater-conveyance plan for the canals during construction.</p> <p>Construction plans would identify the location of the 700 North well head, and the construction contractor would ensure that the well head is protected from disturbance during construction.</p> <p>Develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season.</p>	<p>Potential impacts to the Logan River channel and stream bank during construction of the LHPS Canal POD structure depending on the final design of the POD structure. Construction activity would require compliance with Sections 401 and 404 of the CWA and would require a USFS special-use permit.</p> <p>Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented.</p> <p>Potential effects to the Green Canyon Creek floodplain if materials and equipment are stored in the floodplain.</p> <p>Potential effects to the City of Logan’s 700 North well if construction disturbs the well head.</p> <p>Potential interruption in delivery of irrigation water to shareholders during construction.</p>	<p>Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place.</p> <p>Develop a temporary stormwater-conveyance plan for the canals during construction.</p> <p>Equipment or materials would not be stored in mapped floodplains. The boundaries of the flood zones would be shown on construction plans, and construction workers would be made aware of the limitations on equipment and material storage.</p> <p>Construction plans would identify the location of the 700 North well head, and the construction contractor would ensure that the well head is protected from disturbance during construction.</p> <p>Develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season.</p>	<p>Potential effects to the Logan River floodplain if materials and equipment are stored in the floodplain.</p> <p>Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented.</p> <p>Potential effects to the Logan River floodplain if materials and equipment are stored in the floodplain.</p> <p>Potential effects to the City of Logan’s Crockett Avenue well if construction disturbs the well head.</p> <p>Potential interruption in delivery of irrigation water to shareholders during construction.</p>	<p>Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place.</p> <p>Develop a temporary stormwater-conveyance plan for the canals during construction.</p> <p>Equipment or materials would not be stored in mapped floodplains. The boundaries of the flood zones would be shown on construction plans, and construction workers would be made aware of the limitations on equipment and material storage.</p> <p>The construction plans would identify the location of the Crockett Avenue well head. The construction contractor would ensure that the well head is protected from disturbance during construction.</p> <p>Develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season.</p>
Natural Resources – Noise	None.	<p>Temporary noise impacts to people recreating near, visiting businesses and community facilities in, and living near construction areas.</p>	<p>Develop a work plan that identifies hours and days of work and limitations in areas close to highly sensitive receptors at specific times, if warranted. The plan would identify the highly sensitive receptors that are very close to the construction areas. Cache County or its contractor would communicate its construction schedule with people at sensitive receptors and would work with potentially affected parties to identify appropriate work time restrictions.</p> <p>Apply BMPs to reduce construction-related noise impacts.</p>	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Natural Resources – Air Quality	None.	<p>Construction activities could generate dust and particulate matter. This impact would be short term.</p>	<p>Develop an air-quality-management plan that identifies dust-control measures for equipment use along the construction corridor, appropriate staging locations and measures to reduce dust at those locations, and potential restrictions during times when the State determines that the air quality is unhealthy. Communicate the construction schedule with people living, working, and recreating near the construction area so that all potentially affected people are aware that construction activity could temporarily reduce local air quality.</p>	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.

5.10.1 Land Use

The permanent changes to land use as a result of the alternatives would be as follows:

- Convert 2.6 acres of undeveloped land to canal easement; permanent change from residential to development-restricted nonresidential use on 14 parcels (Purple Alternative).
- Convert 3.6 acres of undeveloped land to canal easement; permanent change from residential to development-restricted nonresidential use on 14 parcels (Orange Alternative).
- Permanent change from residential to development-restricted nonresidential use on 14 parcels (Blue Alternative).

5.10.2 Social and Economic Resources

- Relocate residents living in structures on 14 properties along the north side of Canyon Road between about 750 East and 1100 East (all action alternatives).
- Change in how the LHPS Canal integrates with the Logan Golf & Country Club (Purple and Orange Alternatives).
- Change in the appearance of the canal would affect people's perception of the scenic quality of their properties and their perception of quality of life (all action alternatives).
- Permanently change an open section of the LHPS Canal that has historically been used for tubing between the LHPS Canal POD and the Logan Golf & Country Club by enclosing the canal in a box culvert (Purple and Orange Alternative).
- Removing residential structures from along the north side of Canyon Road between about 750 East and 1100 East would change the way the area looks from adjacent properties (Purple and Orange Alternatives).
- Removing residential structures from 14 properties and constructing a soil buttress below the LN Canal along the reach between about 750 East and 1100 East would substantially change the visual appearance of the slope from surrounding areas (Blue Alternative).

5.10.3 Natural Resources

- Permanent loss of 0.3 acre of farmland under the Purple Alternative and 3.1 acres of farmland under the Orange Alternative 2900 North option.
- Permanent loss of vegetation where POD structures are enlarged and along canals where vegetation clearing is required to construction the improvements (all action alternatives).
- Loss of use of open canal by locally common wildlife (all action alternatives).
- Adverse effects to cultural resources that are probably eligible for listing on the NRHP. Potential impacts could be mitigated through data recovery efforts, but the effect would still be adverse and unavoidable since the resources would be modified or removed.
- Because the LHPS Canal crosses the East Cache fault zone, the canal will continue to be at risk of damage from a surface fault rupture caused by a large earthquake. This impact, while unlikely, is unavoidable (Purple and Orange Alternatives).
- The Logan Bluff is unstable due to soil properties, topography, and drainage. Based on the long history of landslides in this area and the characteristics of the bluff, future landslides are likely. Measures to protect the new pipeline are identified in Section 3.2.4, Blue Alternative: Reconstruct LN Canal, but these measures would not prevent future landslides along the bluff or damage to the new pipeline (Blue Alternative).
- The Logan Bluff is unstable due to soil properties, topography, and drainage. Based on the long history of landslides in this area and the characteristics of the bluff, future landslides are likely. These landslides could cause property damage or result in injury or death (Purple and Orange Alternatives).
- Water not lost to seepage would not recharge local groundwater. The amounts not lost to seepage would be 7,400 acre-feet for the Purple Alternative, 13,000 acre-feet for the Orange Alternative, and 1,300 acre-feet for the Blue Alternative.