



Summary



Photo provided courtesy of Northern Water



Summary



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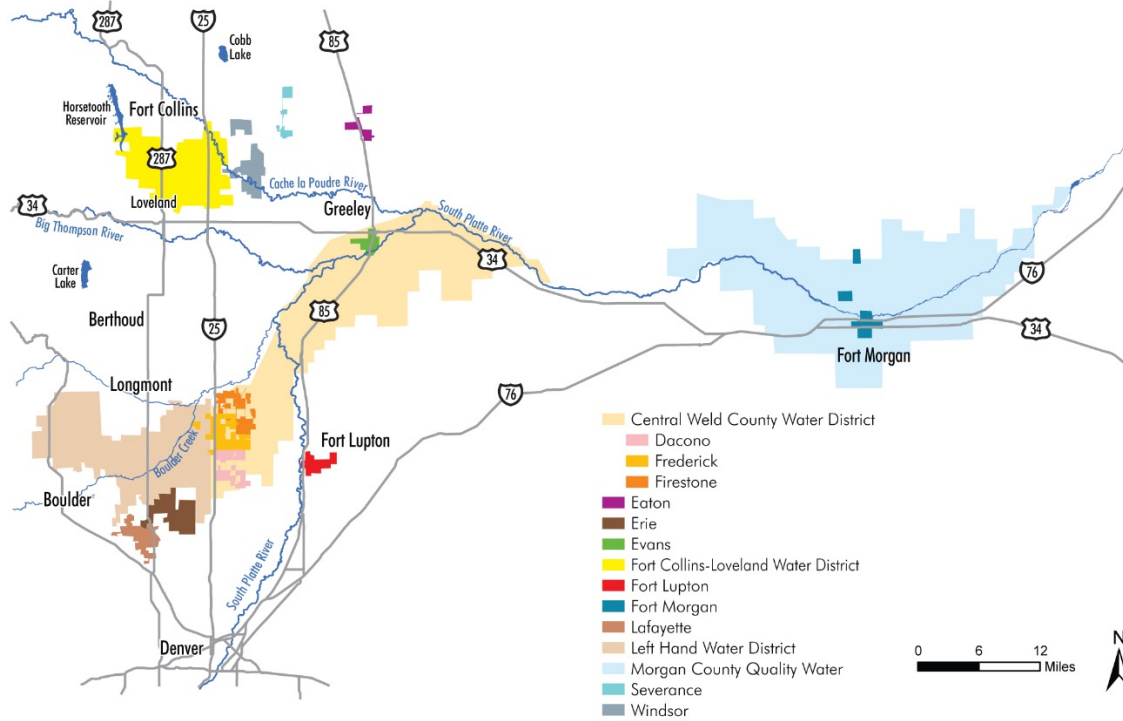
Summary

S.1 INTRODUCTION

The U.S. Army Corps of Engineers (Corps) issued this Final Environmental Impact Statement (FEIS) to describe the direct, indirect, and cumulative effects of a water supply project called the Northern Integrated Supply Project (NISP or Project). The Project proponent, Northern Colorado Water Conservancy District (Applicant or Northern Water), acting by and through the Northern Integrated Supply Project Water Activity Enterprise, notified the Corps in 2004 that it will seek a Section 404 permit for the Project. In 2008, Northern Water submitted an application for a Department of the Army Standard Individual Permit pursuant to Section 404 of the Clean Water Act (CWA) for NISP (Northern Water 2008). Northern Water sought authorization to discharge fill material into about 51 acres of potential waters of the U.S. and temporarily impact an additional 19 acres of wetlands and other waters at sites in Larimer and Weld Counties, Colorado. The Corps is neither a proponent nor opponent of any permit proposal. The FEIS and supporting documents are available at: <http://www.nwo.usace.army.mil/Missions/RegulatoryProgram/Colorado/EIS-NISP>.

NISP is a regional water supply project designed to serve the current and future water needs of 15 towns and water districts (the Participants) in Larimer, Weld, Morgan, and Boulder counties. The Participants are a group of communities and domestic water districts located throughout the Northern Colorado Water Conservancy District. The Participants are Central Weld County Water District, City of Dacono, Town of Eaton, Town of Erie, City of Evans, Town of Firestone, Fort Collins-Loveland Water District, City of Fort Lupton, City of Fort Morgan, Town of Frederick, City of Lafayette, Left Hand Water District, Morgan County Quality Water District, Town of Severance, and the Town of Windsor (Figure S-1). The proposed Project would be constructed and owned by Northern Water through its enterprise. While Northern Water through its enterprise would retain ownership and operational responsibility of the Project, the Participants would own a perpetual contractual right to a defined portion of the Project facilities and a defined portion of the water diverted by the Project.

Figure S-1. NISP Study Area and Participants.



S.2 PUBLIC AND AGENCY PARTICIPATION

The NISP EIS process began on August 20, 2004 when the Corps published a Notice of Intent to prepare an EIS in the Federal Register. The following are key dates in the NISP EIS process:

Date	Action
August 20, 2004	Notice of Intent to prepare an EIS (69 Fed. Reg. 51640)
September 21, 2004	Agency scoping meeting
September 20, 21, and 22, 2004	Public scoping meetings
March 30, 2005	Additional public scoping meeting for proposed U.S. 287 realignment
April 30, 2008	Notice of DEIS Availability (73 Fed. Reg. 23437) for review and comment
June 16, 17, and 19, 2008	Public hearings on DEIS
February 17, 2009	Notice of Intent to prepare a SDEIS (74 Fed. Reg. 7406)
June 19, 2015	Notice of SDEIS Availability (80 Fed. Reg. 35322) for review and comment
July 22 and 23, 2015	Public hearings on SDEIS

S.3 PURPOSE AND NEED

S.3.1 Purpose and Need Statement

The Corps and Northern Water (“the District” in the paragraph below) jointly developed the purpose and need statement as follows:

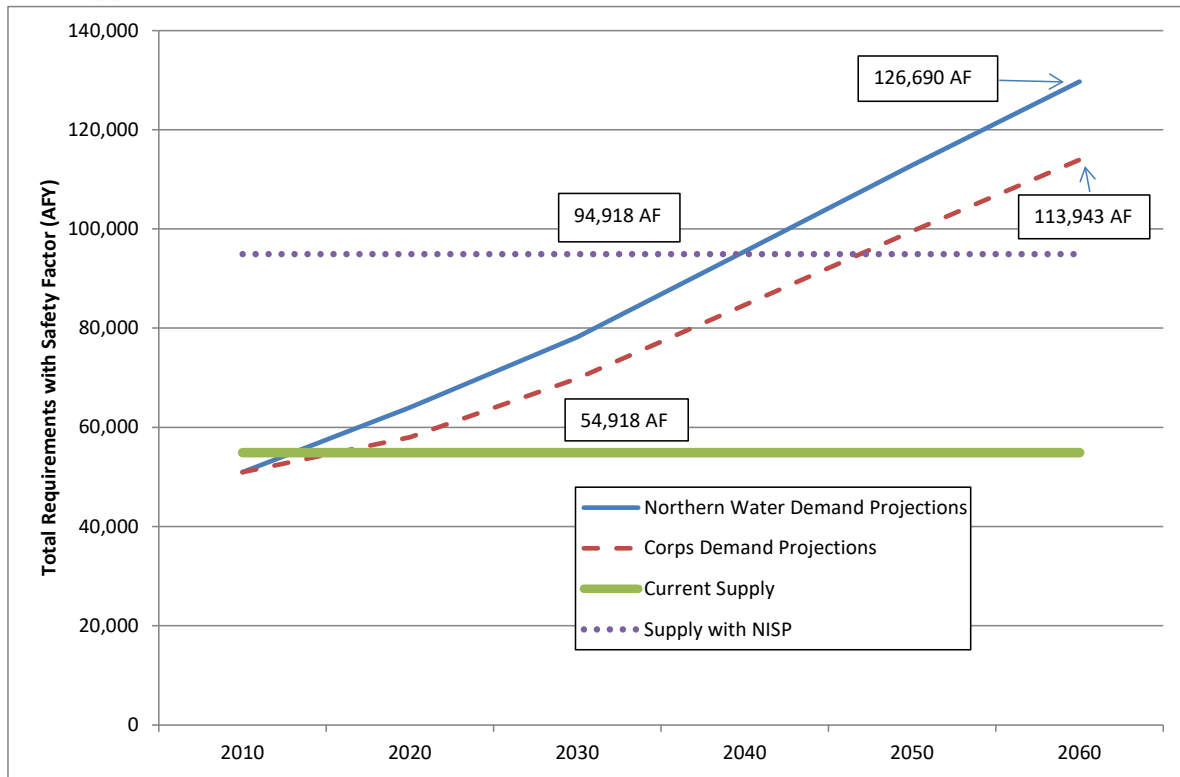
To provide the Project Participants with approximately 40,000 acre-feet of new reliable municipal water supply annually through a regional project coordinated by the District, which will meet a portion of the Participants’ current and reasonably projected future additional water supply needs.

The Corps uses the overall project purpose to evaluate whether less environmentally damaging practicable alternatives are available and to help make a decision whether to issue or deny a Section 404 permit. Determination of the overall project purpose is the Corps’ responsibility. The Corps defines the overall project purpose in light of an applicant’s stated objectives as well as the public’s perspective (33 CFR 325 Appendix B, Section 9(b)(4)). The NISP overall project purpose is synonymous with the purpose and need statement for NISP.

S.3.2 Project Need

Harvey Economics, on behalf of Northern Water, analyzed the Participants’ water supplies and projected future demands as of 2015. Northern Water’s demand projections developed for the Participants and Northern Water were independently reviewed by the Corps and its third-party contractor. That review led the Corps to also develop an alternate demand projection for the NISP Participants. Based on the demand projections developed by Northern Water, the combined total future water demand for the NISP Participants (including a safety factor) will exceed their combined existing annual firm yield (54,900 AF) by 2020 (Figure S-2). By 2040, the excess of combined demands over current firm supplies is predicted to exceed the 40,000 AF firm annual yield from NISP, and by 2060 projected demand over current firm supplies is projected to be almost 75,000 AF. From a combined standpoint, the Participants are projected to need the full yield and storage from NISP no later than 2040. The Participants would need additional supplies from that point forward. Under the Corps’ demand scenario, demands (including the safety factor) would reach the combined firm yield of NISP and the Participants’ existing supplies between 2040 and 2050, slightly later than under Northern Water demand projections.

Figure S-2. Comparison of Demand Scenarios (including Safety Factor) with Existing Supplies and Supplies with NISP.



S.3.3 Proposed Project

The proposed Project is a collaborative effort among 15 water providers (Participants) facilitated and coordinated by Northern Water. The proposed Project would provide about 40,000 AF of new reliable water supply, which would meet a portion of the Participants’ estimated 2060 water supply needs. The Participants are a group of rapidly growing communities and domestic water districts located throughout Northern Water. The proposed Project would not be constructed with federal funds, or owned or operated by the federal government. The proposed Project would be constructed and owned by Northern Water through its enterprise. While Northern Water would retain ownership and operational responsibility of the Project, the Participants would own a perpetual contractual right to a defined portion of the Project facilities and a defined portion of the water diverted by the project.

Northern Water would use two water rights in the proposed project. Northern Water has existing conditional water rights on the Poudre River (Grey Mountain water rights) with storage at the Glade Reservoir site. These water rights are junior water rights (May 2, 1980 priority), and divertible water is available primarily during high flows. Currently, the Grey Mountain water rights are not useable by Northern Water because no facility exists to store high flows. Northern Water proposes to construct Glade Reservoir to store these flows as a

component of NISP. Northern Water also has existing conditional water rights on the Poudre River and the South Platte River (South Platte Water Conservation Project or SPWCP rights) that could be used for NISP. These are the water rights for the proposed South Platte Water Conservation Project (SPWCP). The proposed SPWCP would capture storable flows in the lower Poudre River Basin and the South Platte River Basin using Northern Water's conditional water rights

S.4 ALTERNATIVES DEVELOPMENT

The National Environmental Policy Act (NEPA) requires that an EIS “rigorously explore and objectively evaluate all reasonable alternatives,” including the No Action Alternative (40 CFR 1502.14((a) and (d)). Reasonable alternatives, as defined by the CEQ, are “those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.” The Project is subject to the 404(b)(1) Guidelines, which define practicable alternatives as “available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes” (40 CFR 231.10(a)). These Guidelines are the substantive environmental standards by which all Section 404 Permit applications are evaluated. By integrating the alternatives analysis for actions subject to NEPA and the 404(b)(1) Guidelines early in the process, the Corps ensured that the range of alternatives carried forward for detailed analysis in the EIS process met the purpose and need, and were practicable and reasonable.

S.4.1 Alternative Screening

The Corps' alternative screening process used three broad screening criteria, purpose and need, environmental, and practicability, to develop a reasonable range of alternatives to be evaluated in the EIS. The Corps evaluated 16 Project concepts. A Project concept is defined as a source of potential water supplies able to meet a substantial portion of the NISP Participants' requests. Concepts included general strategies or classes of potential structural or nonstructural solutions (e.g., storage in the Cache la Poudre River Basin (Poudre Basin) foothills or dry-year leases) that could be incorporated into comprehensive alternatives for meeting NISP objectives. Three concepts were retained for detailed analysis in the FEIS and the other 13 were eliminated from detailed study. Most of the concepts were eliminated because they did not provide a long-term source of firm yield and did not meet the NISP purpose and need. Retained concepts were 1) water rights development because existing water rights owned by Northern Water could feasibly supply the water needed and meet the purpose and need; SPWCP because it met purpose and need and is a component of the Applicant's Preferred Alternative; and 3) agriculture-to-municipal transfers because the permanent removal of irrigation from agricultural lands and transfer of water rights to municipal and industrial use could feasibly meet a portion of the new firm yield required

for NISP. Agriculture-to-municipal transfers were considered in Northern Water's No Action Alternative; eliminated from detailed study for action alternatives.

An element is defined as a storage facility capable of containing a portion of the 40,000 AF of new reliable municipal water supply that would be required annually for NISP. Assuming a 4:1 storage-to-yield ratio, the total storage requirement to meet the NISP purpose and need is at least 160,000 AF. Elements were divided into the following categories:

- Reservoir rehabilitation or enlargement
- New reservoir
- Ground water
- Gravel lakes

A total of 215 potential elements were screened, which included 15 reservoir rehabilitation sites, 35 reservoir enlargement sites, 147 new reservoir sites, 6 ground water aquifers, and 12 gravel lakes. Following the screening and evaluation of 215 potential elements, 11 elements (all new reservoirs) remained. Elements associated with reservoir rehabilitation, reservoir enlargement, ground water, and gravel lakes were eliminated. In addition, the Corps evaluated and eliminated from detailed study alternatives suggested in comments on the DEIS and SDEIS. Alternatives suggested during the comment periods were eliminated because they did not meet the project's purpose and need and practicability screening criteria.

A "best fit" evaluation was performed to compare equivalent elements from the short list. Equivalent elements are new reservoir sites similar in capacity, general location, and river basin. The best fit evaluation was completed based on environmental factors and capacity comparisons. Upper Galeton Reservoir was retained as the best fit element in the lower South Platte River Basin because it had the fewest acres of wetlands among the equivalent elements. Cactus Hill Reservoir was retained as the best fit element in the Poudre Basin because it had the fewest acres of wetlands among the equivalent elements. The three retained concepts and retained best fit elements were then combined to develop a reasonable range of alternatives. The alternatives developed for evaluation reflect the combined retained concepts and elements.

In the DEIS and SDEIS, Northern Water proposed delivering water to most of the NISP Participants by entering into an excess capacity contract with the U.S. Bureau of Reclamation for carriage of NISP water through existing East Slope facilities of the C-BT Project. A Glade-to-Horsetooth Pipeline would have been used in the event that C-BT deliveries to the Poudre River dropped below the average volume of water that NISP would deliver to Participants by storage, carriage, exchange, or in-lieu delivery through C-BT. Based on DEIS and SDEIS comments about the effects on water quality and aquatic habitat in the Poudre River and in Horsetooth Reservoir, Northern Water refined its conveyance of NISP water supplies to the Participants in its Preferred Alternative, now Alternative 2M. Water quality analyses completed for the FEIS indicated that Alternative 2M without C-BT

exchanges had less effect on water quality and aquatic habitat in the Poudre River and in Horsetooth Reservoir than the Reclamation Action Option. Based on the FEIS water quality analyses, the Corps eliminated the Reclamation Action Option, including the use of the Glade-to-Horsetooth Pipeline, in Alternative 2. In Alternative 2, water would be conveyed to the Participants through the Carter Pipeline. Any further pursuit of a Reclamation contract for storage or conveyance of NISP water would require separate environmental compliance and federal agency approval.

S.4.2 Alternatives Analyzed in Detail

The three retained concepts and retained best fit elements were then combined to develop a reasonable range of alternatives. The alternatives developed for evaluation reflect the combined retained concepts and elements (Table S-1). The major features associated with the alternatives are summarized in Table S-2. The proposed new reservoirs and diversion locations proposed for the action alternatives are shown in Figure S-3.

Table S-1. Retained concepts and elements combined to develop alternatives.

Alternative	Concept	Element
No Action (Alternative 1)	Agricultural to municipal transfers	Cactus Hill Reservoir
Glade Reservoir with Modified Conveyance and SPWCP (Alternative 2M)	Water rights development and SPWCP	Glade Reservoir and Upper Galeton Reservoir
Glade Reservoir and SPWCP (Alternative 2)	Water rights development and SPWCP	Glade Reservoir and Upper Galeton Reservoir
Cactus Hill Reservoir, Poudre Valley Canal Diversion, and SPWCP (Alternative 3)	Water rights development and SPWCP	Cactus Hill Reservoir and Upper Galeton Reservoir
Cactus Hill Reservoir, Multiple Diversion Locations, and SPWCP (Alternative 4)	Water rights development and SPWCP	Cactus Hill Reservoir and Upper Galeton Reservoir

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NORTHERN INTEGRATED SUPPLY PROJECT EIS

Table S-2. Major characteristics of alternatives.

Characteristic	Alternative 1	Alternative 2M	Alternative 2	Alternative 3	Alternative 4
Water Supply Source	Acquisition and transfer of irrigated agricultural water rights and minor new junior water rights on the Big Thompson and Poudre Rivers	Existing water rights on the Poudre and South Platte Rivers	Same as Alternative 2M	Same as Alternative 2M	Same as Alternative 2M
Diversion Location	Historical diversion locations for the transferred agricultural water rights and exchanges to the Poudre Valley Canal when feasible No South Platte River diversions	Diversions from the Poudre River at the Poudre Valley Canal headgate and a new diversion upstream of the Mulberry Water Reclamation Facility outfall SPWCP diversion on the South Platte River	Diversions from the Poudre River at the Poudre Valley Canal headgate SPWCP diversion same as Alternative 2M	Same as Alternative 2 SPWCP diversion same as Alternative 2M	Diversions from the Poudre River at the Poudre Valley Canal and New Cache Canal headgates SPWCP diversion same as Alternative 2M
New Reservoirs	Cactus Hill 120,000 AF	Glade 170,000 AF Upper Galeton 45,624 AF	Same as Alternative 2M	Cactus Hill 190,000 AF Upper Galeton 45,624 AF	Same as Alternative 3
Pipelines and pump stations	114 miles of water pipelines and seven pump stations	85 miles of water pipelines and five pump stations	64 miles of water pipelines and four pump stations	131 miles of water pipelines and six pump stations	159 miles of water pipelines and eight pump stations
Infrastructure Relocation	U.S. 287 not affected Realignment of three 2-lane Weld County roads totaling 10.3 miles Realignment of 6.8 miles of a 230-kV electric transmission line	Realignment of a 7-mile segment of U.S. 287 Weld County roads not affected Realignment of four electrical transmission line structures totaling 0.6 mile	Same as Alternative 2M Same as Alternative 2M Same as Alternative 2M	Same as Alternative 1 Same as Alternative 1 Same as Alternative 1	Same as Alternative 1 Same as Alternative 1 Same as Alternative 1
Disturbance (acres)					
Permanent	2,595	3,797	3,797	5,669	5,671
Temporary	1,086	1,438	1,325	1,102	1,161

S.4.3 Enhancement Measures Common to All Action Alternatives

Northern Water submitted to the Corps a Conceptual Mitigation Plan, which includes Northern Water's State-adopted Fish and Wildlife Mitigation and Enhancement Plan (Appendix B). The plan describes avoidance, minimization, and enhancement measures that would be implemented in the alternatives. The plan also describes compensatory mitigation for unavoidable adverse effects. Northern Water would implement the following measures in each action alternative:

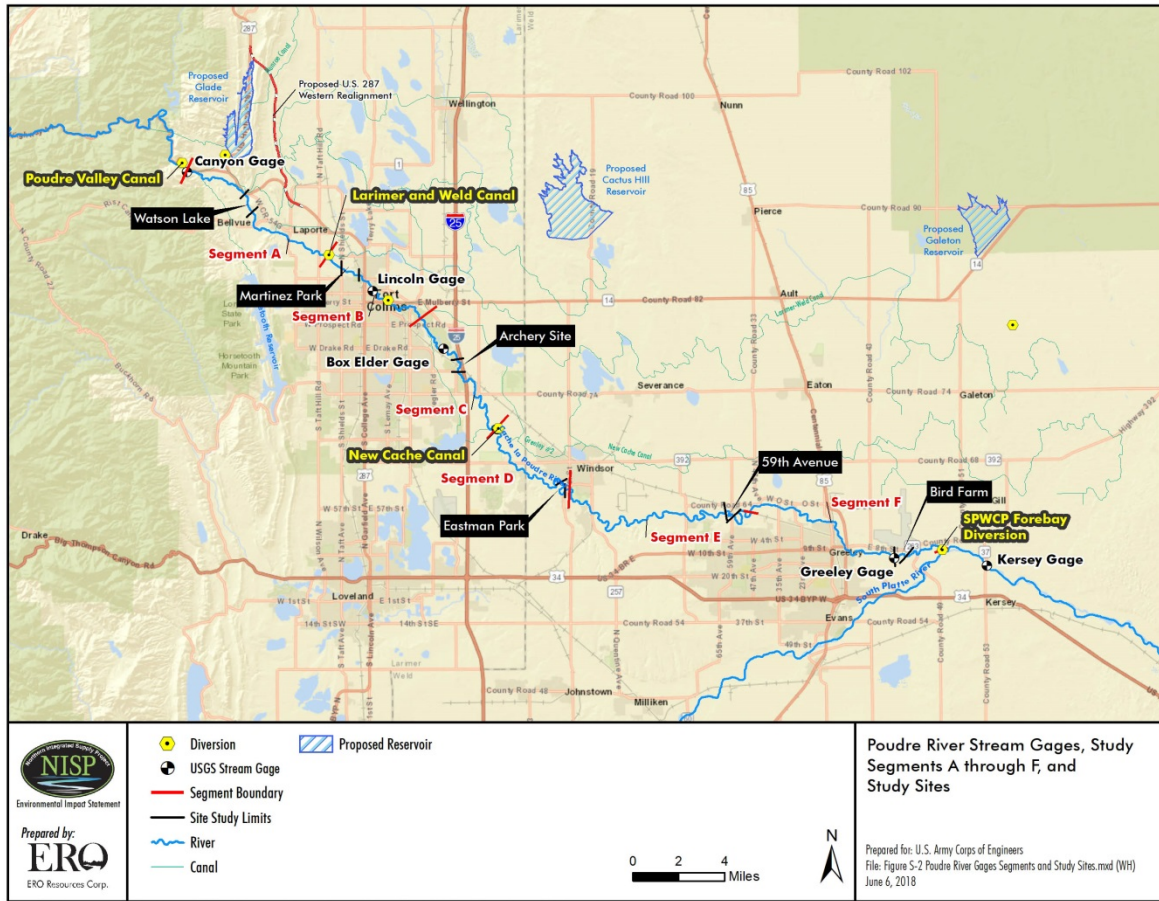
- Curtail diversions
- Replace Poudre Valley Canal diversion structure
- Ramp NISP diversions at Poudre Valley Canal
- Retrofit other existing Poudre River diversion structures
- Modify Hansen Supply Canal releases
- Conduct water quality monitoring
- Complete pre-construction surveys
- Implement construction best management practices
- Assess past and current oil and gas development at reservoir sites

S.5 AFFECTED ENVIRONMENT

The geographic scope of the EIS, referred to as the affected environment, is within the Cache la Poudre River and Middle South Platte River-Cherry Creek watersheds. The Poudre River study area covers 55 miles of the river from the canyon mouth to the confluence with the South Platte River. For analysis purposes, the Corp divided the Poudre River study area into six segments (A through F) for flow-related resource studies. Each segment had a representative study site (Figure S-3). The South Platte River study area includes the area downstream of the Poudre River confluence to the Kersey streamflow gage.

The affected environment associated with the action and No Action Alternatives consists of flow-based resources potentially affected by diversions or storage of water and land-based resources adjacent to proposed or realigned infrastructure, such as new reservoirs, new pipelines and realigned roads or transmission lines. Flow-based resources include rivers from which water would be diverted, such as the Poudre River and the South Platte River, canals that would be used in the operation of one or more of the alternatives, such as Larimer-Weld Canal, New Cache Canal and Home Supply Ditch, and reservoirs that would be used in the operation of one or more of the alternatives, such as Terry Lake, Big Windsor, and Timnath reservoirs. Flow-based resources also include the aquatic life, wetlands and riparian resources associated with these surface water resources, the morphology and sediment transport of the Poudre River and the South Platte River, and alluvial ground water adjacent to surface water resources and proposed reservoir sites.

Figure S-3. Poudre River Stream Gages, Study Segments A through F, and Representative Sites.



In the upper Poudre River watershed, the majority of the river flow is from snowmelt, with additional flow from overland storm runoff during summer and some ground water inflow. Natural flows are augmented by nine transbasin diversions that deliver water into the upper Poudre River. The Poudre River has 21 major diversions at multiple locations primarily for municipal water supply and agricultural use. These diversions occasionally result in dry-up points along the river that occur during winter and summer. The river is recharged downstream of the dry-up points by surface water discharges or by ground water inflows. Water is returned to the river through a variety of point and nonpoint discharges.

Reductions in streamflow have been greatest in the vicinity of Fort Collins; changes in the Poudre River channel associated with reductions in streamflow have been greater downstream of I-25. River morphology from the canyon mouth to around I-25 is flood-dominated. At most cross sections upstream of I-25, bankfull discharge rarely occurs. River morphology downstream of I-25 tends to be deposition-dominated. The Poudre River upstream of I-25 appears to be sediment supply-limited and downstream of I-25 appears to be sediment transport-limited.

Temperature in the Poudre River generally increases from upstream to downstream as cooler mountain waters and snowmelt reach the plains and is warmed by greater solar radiation. Temperatures are also affected by changes in flow rates from diversions, and contributions from wastewater treatment plant outfalls, tributaries, and ground water return flows. During higher flows, total metals, total organic carbon, and turbidity concentrations tend to be higher than during lower flows. During lower flows, total dissolved solids, sulfate, chlorophyll *a*, nutrient concentrations, and river temperature tend to be higher than during higher flows. Elevated total metal concentrations were generally associated with elevated turbidity, but at some downstream locations were also due to elevated dissolved metal concentrations as a result of ground water discharge to the river from local bedrock formations. Some of the natural contaminants to the river, such as selenium, are exacerbated by human activities, such as runoff from agricultural fields.

The affected environment spans from the foothills of the Rocky Mountains to open grasslands on the eastern plains. This eastern part of Colorado is part of the High Plains section of the Great Plains of the central U.S. Land within the NISP study area is known for its fertile soil and contains some of the most productive agricultural enterprises in Colorado. Certain soils are considered to be Prime Farmland if they are irrigated or meet other Prime Farmland criteria. The climate in the study area is heavily influenced by the proximity to the Rocky Mountains and the general topography of the area, which varies from hogbacks and valleys at the Glade Reservoir site to flat plains near Kersey, Colorado. The climate is semi-arid with precipitation gradually increasing from west to east.

Vegetation cover types occurring within the study area include grasslands, shrublands, woodlands, agricultural lands, revegetated areas, and disturbed areas, including areas with noxious weeds. Types of wetlands that occur in the study area include palustrine emergent wetlands dominated by grasses, sedges, and rushes; and palustrine scrub-shrub wetlands dominated by willows and other shrubs.

The affected environment (Chapter 3) is described for the following resources: surface water, surface water quality, stream morphology and sediment transport, ground water, geology, soils, vegetation, wetlands, riparian resources, and other waters, wildlife, special status species, aquatic biological resources, traffic and transportation, air quality, noise, recreation, land use, visual resources and aesthetics, cultural, historical and paleontological resources, socioeconomics resources, and hazardous materials. For reasons discussed in the next section, this Summary does not discuss all resources discussed in Chapter 3.

S.6 ENVIRONMENTAL CONSEQUENCES

Many of the effects associated with the alternatives are predicted to be similar. Differences in facilities, source water supply, diversion amounts, diversion locations, and other characteristics would result in some differences in predicted effects that can be used to differentiate the alternatives as discussed in the following sections. Because this summary focuses on the effects that can be used to differentiate the alternatives, the effects of all resources are not summarized. For example, the modeled changes to median daily flows at

the Kersey Gage are similar for all action alternatives, reflecting both the Poudre River and South Platte River diversions that are similar in frequency and magnitude. All alternatives would reduce average monthly flows on the South Platte River by less than 10% and the stage reductions are predicted to be small (up to 0.33 feet). Given the negligible reductions in flow and stage, none of the alternatives are predicted to affect wetland and riparian resources along the South Platte River. This summary does not discuss effects on resources along the South Platte River.

Some flow-related resources are on a trajectory that is predicted to continue with or without implementation of any of the NISP alternatives. The NISP alternatives may accelerate or reinforce the trajectory in a similar manner or to a similar degree. For flow-based resources, the No Action Alternative was not evaluated by comparison to 2010 Current Conditions hydrology. Based on uncertainty regarding the Participants' response and timing of actions if the NISP permit is denied and uncertainty of the availability of future water supplies, the Corps determined that the No Action Alternative would be evaluated based on a comparison to 2050 Future Conditions hydrology. With Future Conditions as a baseline, the maximum anticipated effect is disclosed, which will inform the decision-maker and the public of what may happen if the Corps denied the permit.

For each resource discussed in this summary, the direct and indirect effects are summarized followed by a discussion of cumulative effects. Direct impacts or effects are those that are caused by the action and occur at the same time and place as the action. Most direct effects would occur from facility construction, such as dams and pipelines, and inundation by reservoirs. Indirect effects are those that are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. The primary indirect effects of the NISP alternatives are flow changes in the Poudre and South Platte Rivers and effects on resources affected by such changes. All direct and indirect effects of the alternatives are described in Chapter 4.

A cumulative effect is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Past actions have resulted in cumulative effects, which continue to influence the present environmental conditions, which in turn are predicted to be affected by the NISP alternatives and reasonably foreseeable future actions. Section 5.1 discusses past and ongoing actions and the flow-related and land-based reasonably foreseeable future actions considered in assessing cumulative effects, including the flow-based reasonably foreseeable future actions included in the hydrologic modeling for cumulative effects. This summary focuses on the cumulative effects that can be used to differentiate the alternatives. All cumulative effects of the alternatives are described in Chapter 5.

The Corps used hydrologic modeling to predict the Poudre and South Platte rivers flow changes associated with the NISP alternatives, which was then used to analyze effects on flow-related resources. The following terms are used to describe the hydrologic model runs when discussing predicted effects for the flow-related resources:

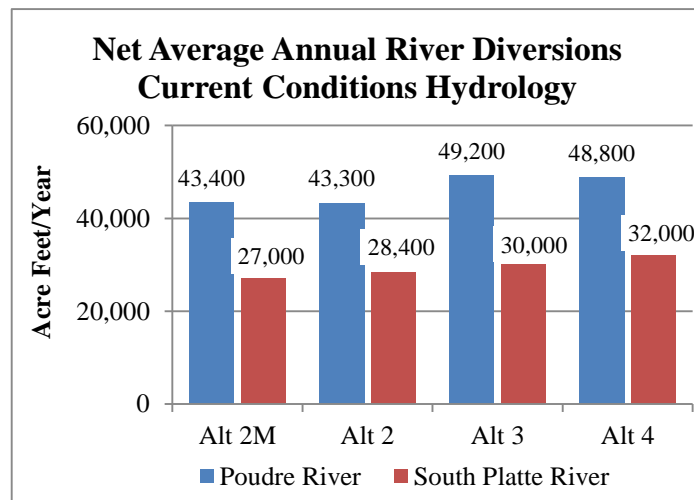
- Current Conditions (2010 flows)
- Current Conditions Effects (2010 flows with NISP alternatives)
- Future Conditions Effects (2050 flows with reasonably foreseeable future actions + NISP alternatives)
- Cumulative Effects (2050 flows with reasonably foreseeable future actions + Halligan Water Supply Project and Seaman Water Supply Project preferred alternatives + NISP alternatives)
- Alternative 1 Effects (2050 flows with reasonably foreseeable future actions + No Action Alternative)

S.6.1 Surface Water

S.6.1.1 Direct and Indirect Effects

Most of the flow-reducing changes associated with each of the NISP action alternatives would be concentrated in the reach from the Poudre Valley Canal headgate to the New Cache Canal headgate, a distance of about 23 miles, including the reach of the Poudre River traversing Fort Collins. In this reach, modeled changes in streamflow are attributable to use of the Grey Mountain right in combination with one or more of the SPWCP direct flow and reservoir exchanges. Downstream of New Cache Canal on the Poudre River, modeled changes in streamflow are limited to diversions under the Grey Mountain right, which are predicted to have very little effect on daily median flows outside of April through June due to the junior (1980) priority of the water right.

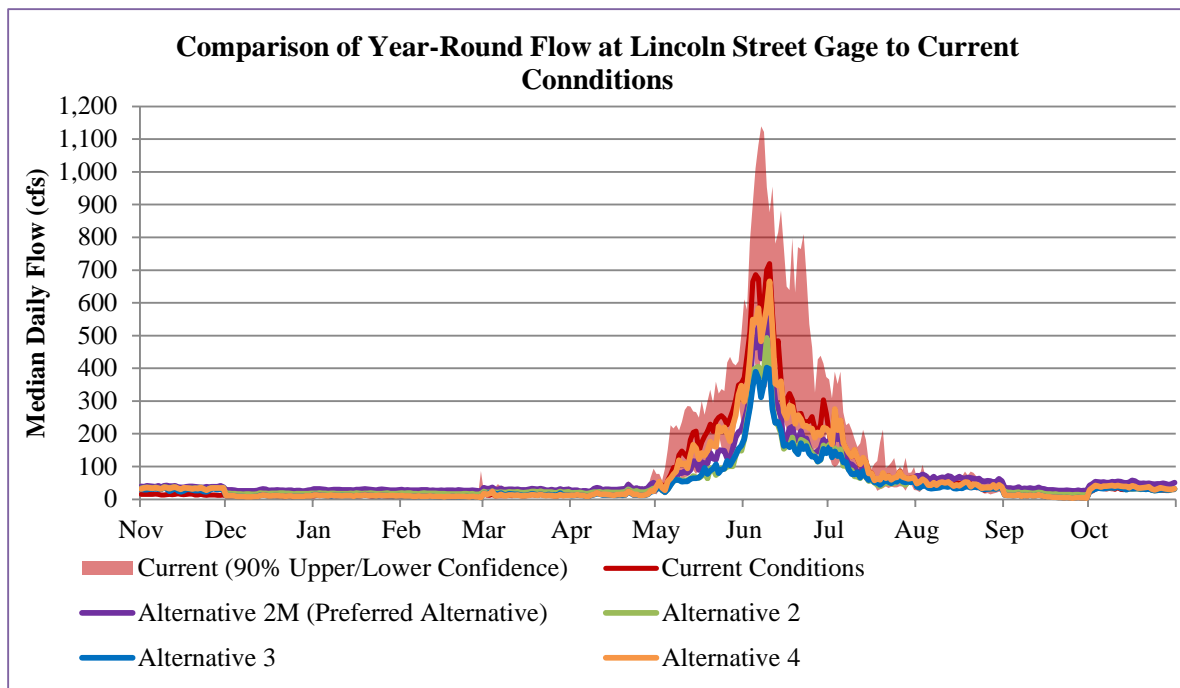
Alternatives 3 and 4 would have greater net diversions from both the Poudre River and the South Platte River compared to Alternative 2 and 2M. Increased diversions would be needed in Alternatives 3 and 4 to accommodate increased transit and storage losses (i.e., seepage and evaporation) associated with Cactus Hill Reservoir, while still delivering full project firm yield to the Participants.



The amount of Grey Mountain water and water exchanged from Larimer-Weld and New Cache canals would be similar in each of the action alternatives. For example, in Alternative 2M, NISP would divert about 20,500 AFY from each of those sources, with the balance of project yield coming from the SPWCP reservoir exchanges. Alternative 2 would divert about 1,300 AFY less Grey Mountain water than Alternative 2M and more from the Poudre River from SPWCP exchanges. Alternative 4 would divert about 1,300 AFY less Grey Mountain water than

Alternative 3, but would compensate by adjusting the source mix to divert 1,100 AFY more from Terry Lake, Big Windsor, and Timnath Reservoir. The mix of Poudre River water supply sources would be roughly 45% from the Grey Mountain right and 55% from the SPWCP exchanges in all action alternatives.

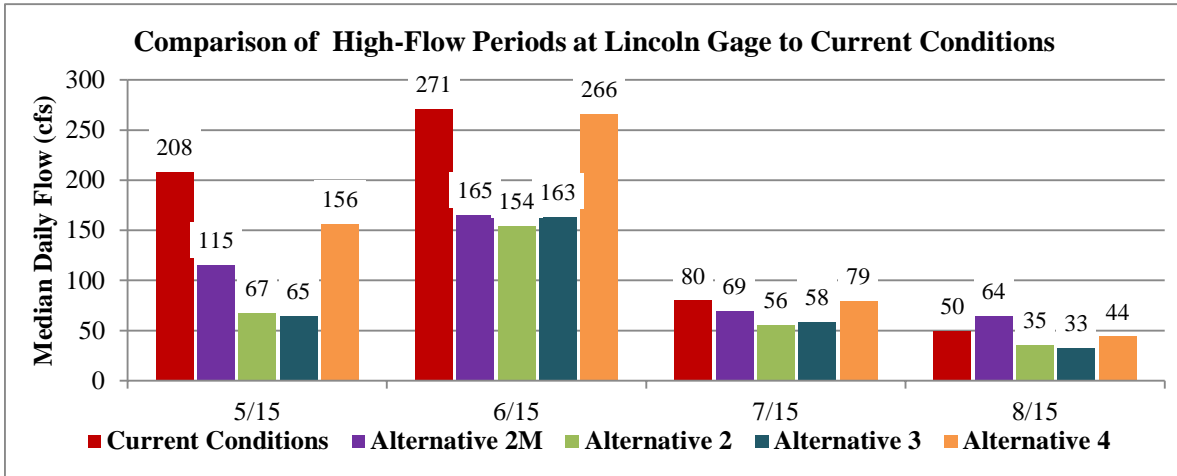
The Corps modeled streamflow changes at 50 locations on the Poudre River and one location on the South Platte River. The description of streamflow effects in this Summary focuses on two locations: the Canyon Gage just downstream of the Poudre Valley Canal that would be used to divert some or all of NISP water in all action alternatives, and the Lincoln Street Gage in Fort Collins. Gage locations discussed in this Summary are shown on Figure S-3. In general, diversions from the Poudre River in all action alternatives would occur primarily during the months April through August. Winter (November through March) diversions from the Poudre River by NISP would be rare, and when they did occur, would be very low volumes. NISP diversion would correspond to higher flows in the Poudre River



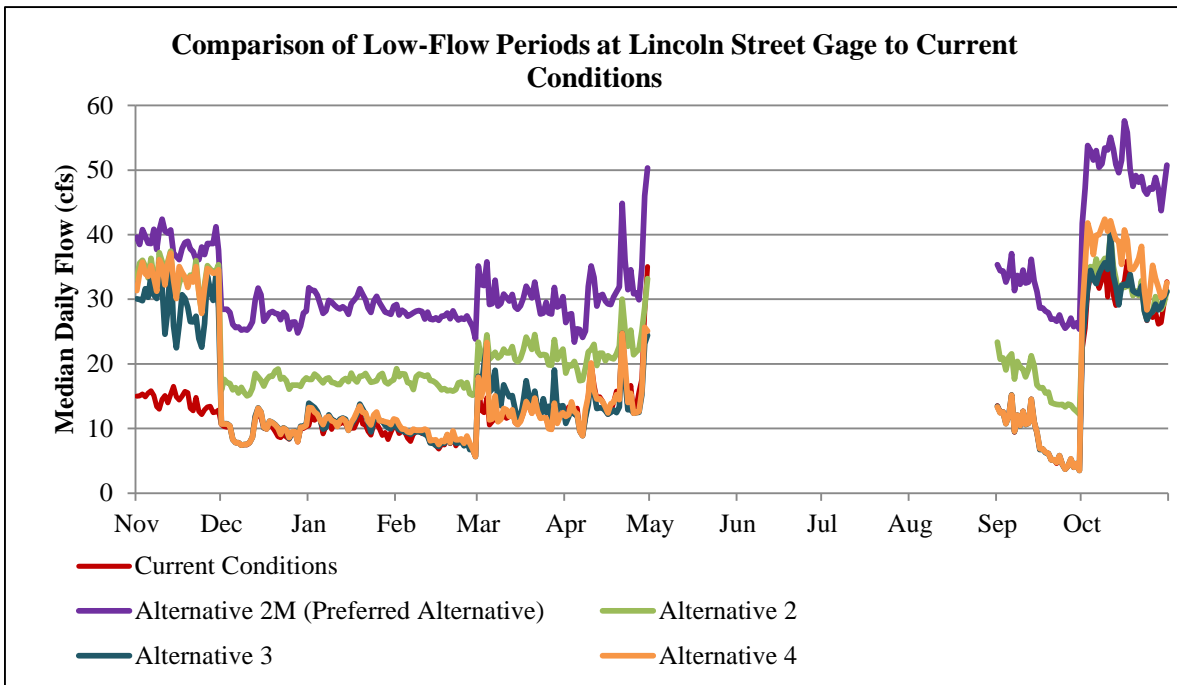
Flows would be reduced at the Canyon Gage from April through August for all action alternatives. Alternative 2M would have the least reduction as some flow would bypass the Poudre Valley Canal and remain in the river for diversion at the Poudre River Intake. Flow changes at the Lincoln Street Gage would be similar, with Alternative 4 having the least reduction. Alternative 4 also would keep additional flow in the river by diverting the New Cache exchange water farther downstream.

Because it is difficult to see a difference between the alternatives in the prior chart, the modeled flow at the Lincoln Street Gage during the middle of the four months (May through August) when diversions primarily would occur are shown in the chart below. Alternative 2M would use the river to convey a portion of the Grey Mountain right to a new

diversion at the Poudre River Intake. Similarly, Alternative 4 would keep additional flow in the river. Generally, Alternative 4 would have the least effect on Poudre River at the Lincoln Street Gage flow during the summer months. Alternatives 2 and 3, which would have similar effects, would have the greatest effect on Poudre River at the Lincoln Street Gage flow during the summer months.



At the Lincoln Street Gage, the Alternative 2M flows would be above current conditions for the non-summer months because releases from Glade Reservoir would use the Poudre River for conveyance and be rediverted at the Poudre River Intake. Alternative 2 would improve low flows November 1 through April 30 and September 1 through September 30, providing releases to maintain 10 cfs below the Larimer-Weld headgate and benefitting the reach from above the Larimer County Canal to the Timnath Inlet Canal headgate.



S.6.1.2 Future and Cumulative Effects

The No Action Alternative would require the least diversions from the Poudre River upstream of the New Cache Canal headgate. Nearly all effects to Poudre River flows associated with the No Action Alternative would occur in the nearly 23-mile reach of the Poudre River between the Poudre Valley Canal headgate and the New Cache Canal headgate between May and September. The greatest effect of the No Action Alternative would be in July, when the diversions would be the greatest and Poudre River flow is less than in May and June.

The differences in average annual diversions of Alternatives 2M, 2, 3, and 4 between Current Conditions Effects and Future Conditions Effects or Cumulative Effects would be small. Reasonably foreseeable future actions, primarily the Halligan Water Supply Project and Seaman Water Supply Project, would generally increase Poudre River diversions. The differences between NISP diversions with Future Conditions Effects and Cumulative Effects are subtle, consistent with the small differences in average annual diversion. The contributions of the Halligan and Seaman reservoir expansion projects to cumulative streamflow changes would be relatively small at all modeled locations.

S.6.2 Surface Water Quality

The water quality analysis described in Sections 4.3 and 5.3 used the following indicators to assess changes of the alternatives on water quality: water quality in new reservoirs; Poudre River water quality constituents, such as metals and nutrients, temperature, dissolved oxygen, periphyton (attached algae), wastewater treatment plant operations, water treatment plant operations, and Larimer-Weld and New Cache canals water quality and crop yield. This Summary discusses the effects on three indicators: water quality in new reservoirs; Poudre River water quality constituents, and temperature. The effect on other indicators was negligible or minor, the same for all alternatives, or both.

Model results were compared to water quality standards or interim numeric values where feasible to provide perspective and are solely used as a useful benchmark to evaluate potential water quality. Model results cannot be used to predict compliance with standards. Before the Corps issues a Record of Decision, Northern Water will submit water quality data and effects studies for its Preferred Alternative to the Colorado Department of Public Health and Environment in a Section 401 application. In making a decision, the Colorado Department of Public Health and Environment will consider antidegradation requirements, requirements contained in the basic standards and methodologies for surface water, the basic standards for ground water, as well as appropriate classifications and water quality standards, effluent limits, control regulations, Best Management Practices, water quality mitigation measures, and public comments.

S.6.2.1 Direct and Indirect Effects

S.6.2.1.1 New Reservoirs

Glade Reservoir water quality in Alternatives 2M and 2 is expected to be relatively good because it would receive high-quality source water. Concentrations of total phosphorus, total nitrogen, and chlorophyll *a* would likely be within applicable water quality interim numeric values, but there is potential for exceedances of the arsenic standard as well as fish consumption advisories due to mercury in fish tissue. Additionally, dissolved oxygen concentrations at the surface may be below the aquatic life use standard for short periods following fall turnover.

Upper Galeton Reservoir would be constructed in all action alternatives. Due to stratification, periods of low oxygen levels in the reservoir may occur during summer. Based on data from similar existing reservoirs that receive water from the South Platte River, concentrations of total phosphorus, total nitrogen, and chlorophyll *a* would likely exceed interim numeric values. Alternatives 2M and 2 would be most vulnerable to high chlorophyll *a* concentrations, while Alternative 4 would be least vulnerable. Additionally, the reservoir may have high specific conductivity, high pH in exceedance of the water quality standard, elevated selenium concentrations, but less than water quality standards, and low clarity. Mercury concentrations are not anticipated to result in listings for fish tissue or fish consumption advisories.

Cactus Hill Reservoir would be constructed in the No Action Alternative (120,000 AF) and Alternatives 3 and 4 (190,000 AF). Extremely low oxygen levels would likely occur each year while the reservoir was stratified. In-reservoir and outflow temperatures, dissolved oxygen, total organic carbon, and TDS concentrations would likely be similar for both alternatives. Nutrient and selenium concentrations would be noticeably higher for Alternative 4 than for Alternative 3 due to inflows from the New Cache Canal. Concentrations of total phosphorus and total nitrogen would likely be within the applicable numeric interim value for Alternative 3 but would exceed the interim numeric value for Alternative 4. Overall, water quality in Cactus Hill Reservoir would be better under Alternative 3 than Alternative 4.

Mercury in Glade Reservoir and Cactus Hill Reservoir is not expected to be of concern for drinking water treatment, but there is potential for mercury accumulation in fish tissue that could result in fish consumption advisories. There is not a known major source of mercury in either reservoir site. Mercury may enter the reservoirs from Poudre Valley Canal diversions, as well as atmospheric deposition. Northern Water would provide funding to CPW to monitor and manage mercury bioaccumulation in Glade Reservoir or Cactus Hill Reservoir.

S.6.2.1.2 Poudre River Water Quality Constituents

Thirty-seven water quality constituents were chosen for evaluation of the Poudre River based on concern for potential impacts and agency/public comments. Evaluated constituents consisted of metals, such as arsenic, iron and selenium; nutrients, such as total

nitrogen and total phosphorus; and other parameters, such as pH and *E. coli*. Alternatives 2M and Alternative 4 would have different effects and the least net adverse effect on the river. Alternatives 2M and 2 show a mixture of beneficial and adverse effects, which often differ by time of year and section of the river. This contrast makes it difficult to make direct net effect comparisons. In general, Alternative 2 would have more net adverse effect as compared to Alternative 2M. Alternative 3 is predicted to have the greatest net adverse effect. Only Alternative 3 would result in minor to moderate adverse effects and no beneficial effects on Poudre River constituents. Alternative 4 would have none-to-negligible impacts, either negative or positive.

Adverse effects in Alternative 2M generally would occur in May to August and are more pronounced below the Mulberry Water Reclamation Facility. When beneficial effects are predicted, they often occur in September through April and are more pronounced in the area affected by conveyance refinement flows (above Mulberry Water Reclamation Facility). When beneficial and adverse effects are predicted for the same constituent (at different times), the beneficial changes are generally larger in magnitude than the adverse effects.

When adverse effects are predicted in Alternative 2, they generally occur in May to August and are more pronounced below the extent of augmentation flows below Timnath Inlet Canal headgate. Adverse effects are similar in magnitude to Alternative 3 in June to August. When beneficial effects are predicted, they often occur in September through April and are more pronounced in the area affected by flow augmentation (above Timnath Inlet Canal headgate).

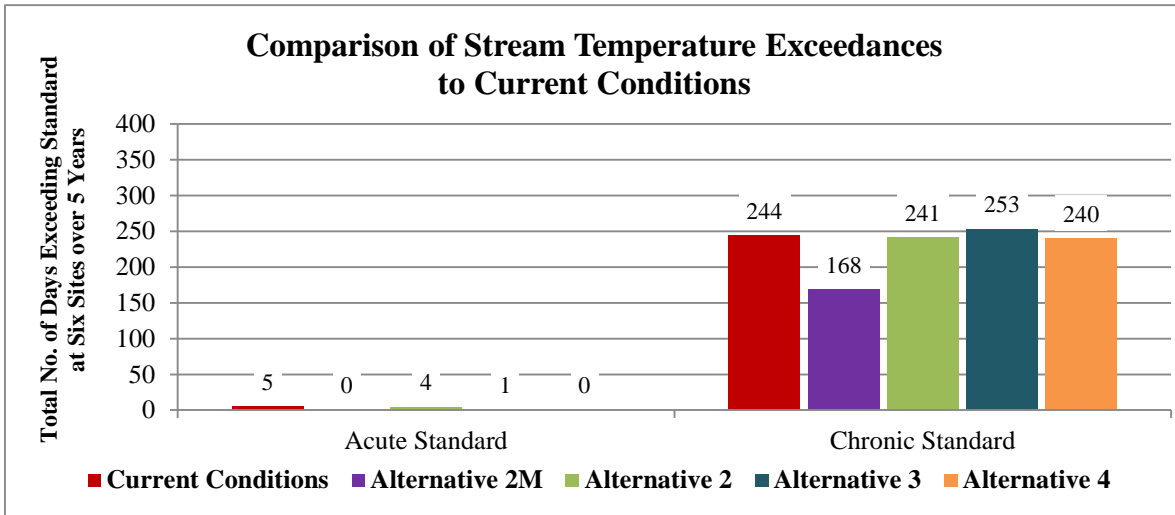
When effects are predicted in Alternative 3, they are predominantly adverse and are of minor-to-moderate magnitude. Adverse impacts generally would occur between May and August and in the portion of the river between Shields Street and the Greeley Gage. Constituents most affected would include metals, nutrients, and *E. coli*. Predicted effects in Alternative 4, either adverse or beneficial, are none-to-negligible. Essentially no changes, either positive or negative, are predicted. This is generally the case for all months and all locations.

S.6.2.1.3 Poudre River Temperature

The reach of the Poudre River selected for dynamic temperature modeling extends from the Poudre Valley Canal to Boxelder Gage. For each alternative, a subset of modeled years was simulated to capture a range of hydrologic conditions over the six-month simulation period (April through September). Five years representing dry, average, and wet conditions were simulated: 1981 and 1989 (dry), 1982 and 1991 (average), and 1995 (wet).

Adverse effects on Poudre River temperature would tend to be greater in dry years in all action alternatives but may also occur in average and wet years. Most of the simulated exceedances of standards would occur in July, August, and September. Effects would occur more commonly on the chronic temperature standard than on the acute standard. The locations most sensitive to temperature effects would be generally just upstream of cooling inflows from Hansen Supply Canal and Shields Street.

Alternative 2M is anticipated to have a minor adverse effect on Poudre River temperatures, with some beneficial effects. The simulated effects include occasional additional days of temperature standard exceedances and occasional exacerbation of existing exceedances. Compared to the other action alternatives, Alternative 2M would have greater beneficial cooling effects due to Glade Reservoir releases, particularly in April, August, and September. Alternative 2M would result in a net reduction in total simulated acute and chronic exceedances over the 5 simulated years.



Alternative 2 would have a moderate adverse effect on Poudre River temperature, with some beneficial effects. Effects include additional days of temperature standard exceedances and occasional exacerbation of existing exceedances. Increased exceedance counts were simulated to occur in the application run in dry, wet, and average years. The net project effect for all 5 years is a small decrease in the total number of exceedances over the six-month period.

Alternative 3 would have moderate to major adverse effects on Poudre River temperature, with some beneficial effects. The project effects include a net increase in the number of days exceeding the chronic standard in some months and a net average warming effect over the April through September period. Increased exceedance counts were simulated to occur in dry, wet, and average years. Simulated warming and increase exceedances occurred in the three segments evaluated (Segments 10a, 10b, and 11). While beneficial cooling effects due to NISP minimum in-stream flow rights were also simulated to occur, reducing temperatures and exceedance counts at times, net simulated warming effects were greater.

Alternative 4 would have minor to moderate adverse effects on Poudre River stream temperature, with some beneficial effects. The simulated project effects include occasional additional days of temperature standard exceedances and occasional exacerbation of existing exceedances over the simulated reach. The net project effect for all 5 years is a small decrease in the total number of exceedances over the 6-month period.

S.6.2.1.4 Avoidance and Mitigation

Northern Water would implement the following measures to avoid and minimize effects on water quality. Additional detail for these measures is presented in Appendix B.

- Establish a water quality monitoring network on the Poudre River
- Establish a water quality monitoring program for all reservoirs
- Reduce or curtail diversions as needed to eliminate or reduce exceedance of temperature standards
- Monitor temperature of future Overland Trail Gravel Pits to determine potential adjustments in NISP operation
- Protect morphological complexity of the reach upstream of Boxelder Creek
- Provide funding to CPW to monitor and manage mercury bioaccumulation in Glade Reservoir or Cactus Hill Reservoir

S.6.2.2 Future and Cumulative Effects

S.6.2.2.1 New Reservoirs

In the No Action Alternative, water quality in Cactus Hill Reservoir is likely to be similar to that described for Alternatives 3 and 4 including elevated total nitrogen, total phosphorus, and selenium concentrations, hypoxic (low oxygen) concentrations near the bottom in the summer, and summer algal blooms. Water quality in the new reservoirs under Future Conditions Effects and Cumulative Effects would be similar to water quality described for Direct and Indirect Effects. Establishment of numeric limits for nutrient concentrations in effluent discharged by certain wastewater treatment facilities, and the potential adoption of stream nutrient standards would be likely in the future. These new regulatory requirements would likely result in reduced nutrient concentrations in the South Platte River, reducing inflow nutrient concentrations into Upper Galeton Reservoir potentially benefiting water quality in Upper Galeton Reservoir.

S.6.2.2.2 Poudre River Water Quality Constituents

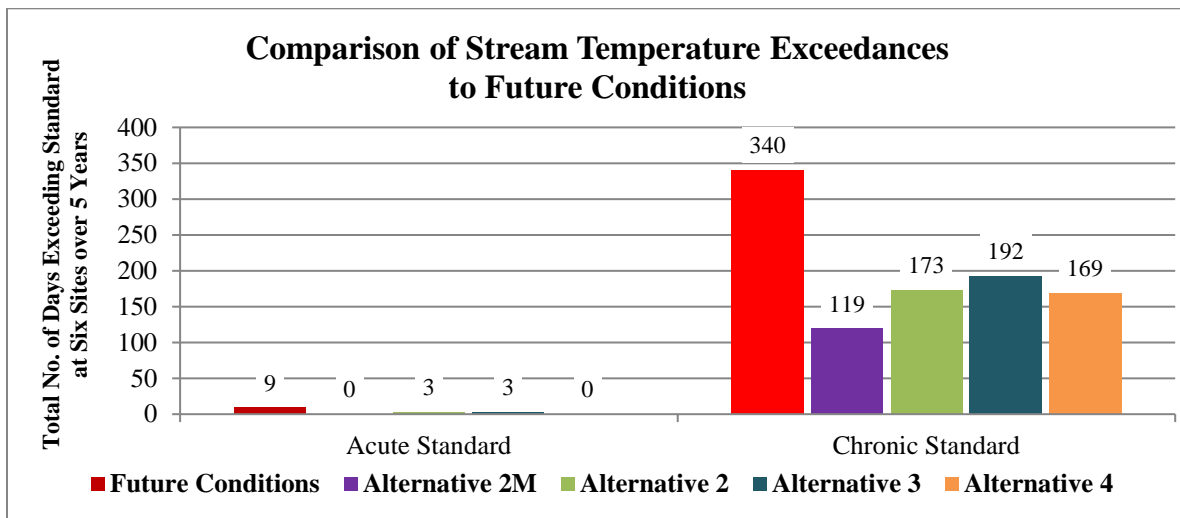
In Alternative 1, reduced flows in Segment 10 of the Poudre River would have a low potential for causing exceedances of water quality standards or interim numeric values for metals and nutrients. In Segment 11, selenium would continue to have a high potential for exceedance of standards, while other parameters would have a low potential for standard exceedance. Exceedance of total recoverable iron, ammonia, and selenium standards and total phosphorus interim numeric value in Segment 12 are likely, although, lower ground water return flows may reduce selenium concentrations.

Potential effects of the action alternatives on nutrients, metals, and other constituents in the Poudre River for Future Conditions Effects and Cumulative Effects are generally similar to those described under Direct and Indirect Effects. Alternatives 2M and 2 would have a mixture of adverse and beneficial effects for different locations and constituents. Alternative 3 effects on Poudre River water quality would be predominantly adverse and would be of minor to moderate magnitude. Alternative 4 generally would have no to

negligible effects on constituent concentrations. For Cumulative Effects, which includes the Halligan Water Supply Project and the Seaman Water Supply Project, the predicted results are similar to Future Conditions. A few constituents, for example, arsenic and total organic carbon, would be more adversely impacted under Cumulative Effects near the upper portion of the Poudre River study area due to less flow in the Poudre River originating above the North Fork Poudre River and increased flows from the North Fork Poudre River.

S.6.2.2.3 Poudre River Temperature

The location, conditions, and pattern of temperature effects on the Poudre River under Future Conditions Effects and Cumulative Effects for action alternatives are similar to those described under Direct and Indirect Effects for each alternative. For all alternatives, adverse effects would be greater in dry years, with the most simulated exceedances of standards from July to September. Chronic standards are exceeded more frequently than the acute standard. The most sensitive locations to temperature effects are above Hansen Supply Canal and at Shields Street. Increased diversions at the Poudre Valley Canal may result in lower flow rates and higher temperatures. Differences in impacts from those under Current Conditions hydrology are primarily related to future actions, the Halligan Water Supply Project and the Seaman Water Supply Project rather than NISP alternatives.



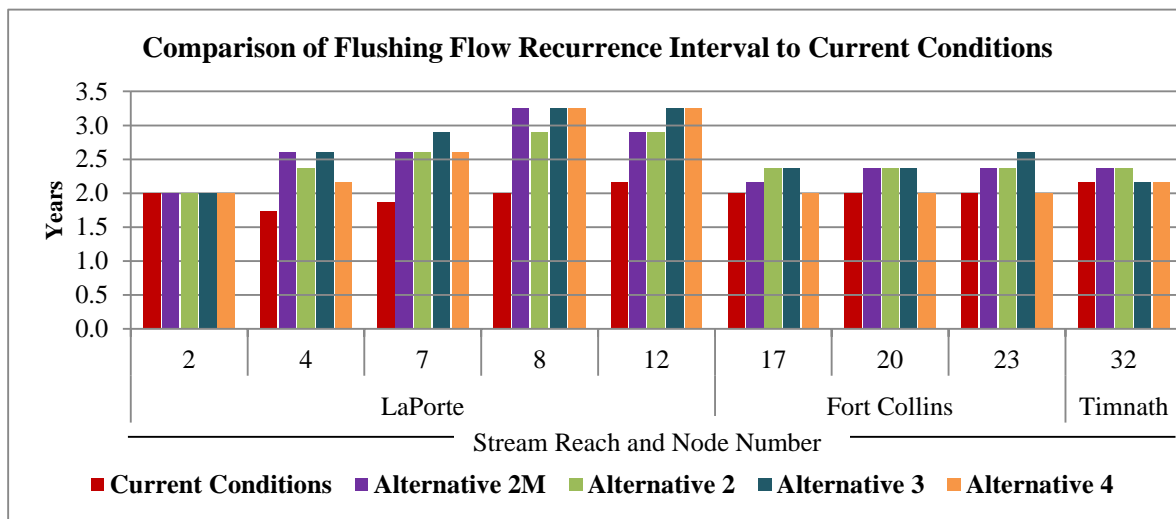
S.6.3 Stream Morphology and Sediment Transport

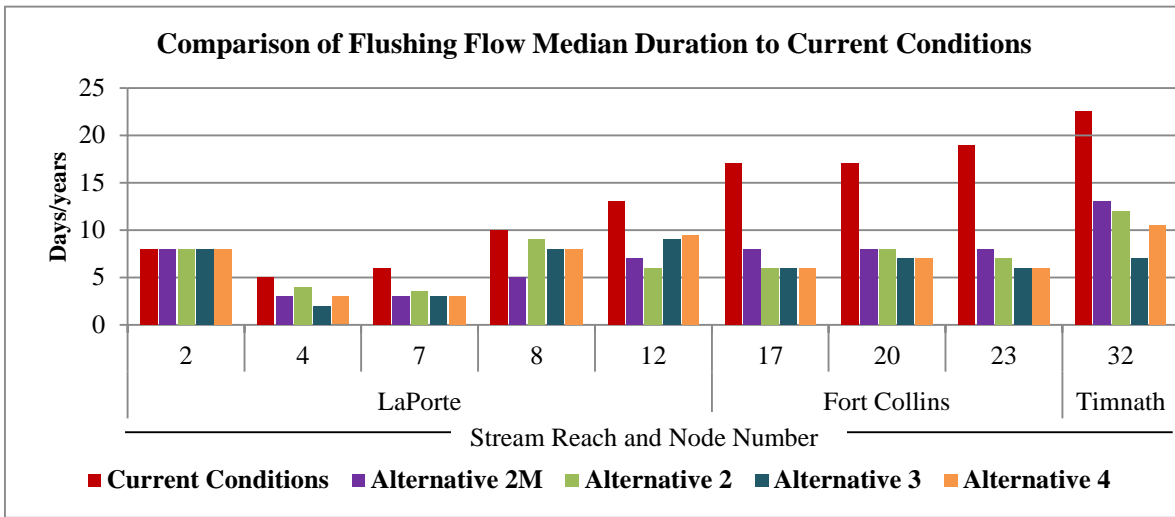
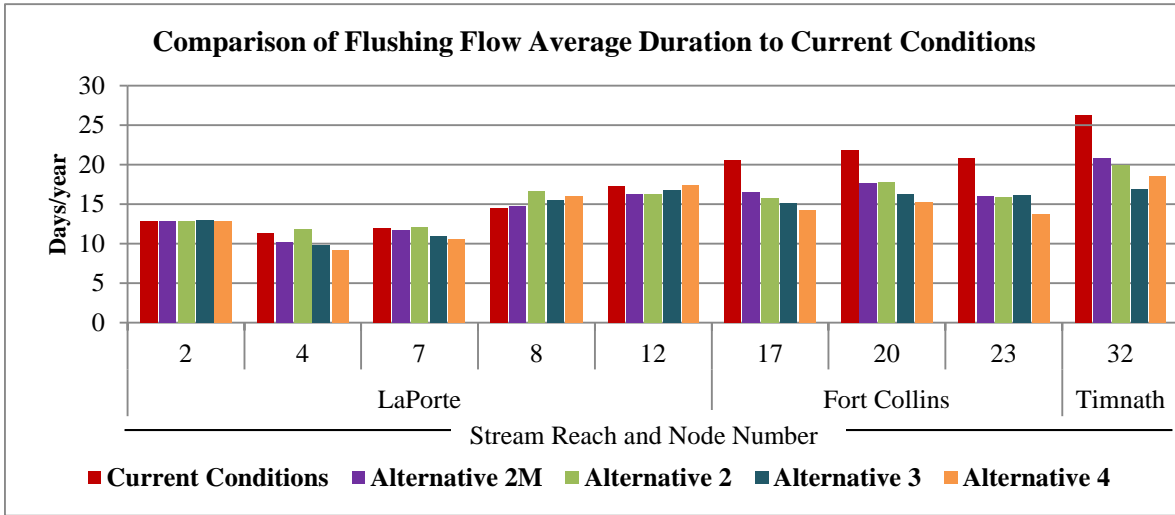
The analysis of stream morphology and sediment transport described in Sections 4.4 and 5.4 used the following indicators to assess changes of the alternatives on stream morphology and sediment transport in the Poudre River: 2% exceedance probability discharge, flushing flows, flows that mobilize coarse bed material, and overall sediment transport potential. This Summary discusses the effects of flushing flows due to numerous comments received during the scoping process. Flushing flows are flows that flush or move sediments (sands and gravels) resting on top of the coarse bed material matrix (or armor layer) in riffles. Flushing flows allow for surface cleaning of riffles necessary to support ecological functions of the river channel. The primary objective of the flushing flows is to

maintain spawning habitat for fish. Flushing flows also prevent fining of surficial material and reduce opportunity for vegetation encroachment. Baseline flushing flows identified for comparative assessments were defined as flows having a recurrence interval of 2 years relative to Current Conditions hydrology. A recurrence interval of 2 years means that a flow capable of flushing or moving sediments occurs on average every 2 years.

S.6.3.1 Direct and Indirect Effects

In the Laporte Reach, between the Poudre Valley Canal and the Larimer-Weld Canal (Flow Nodes 4, 7, 8 and 12), flushing flows under Current Conditions hydrology have an annual recurrence interval of 1.7 to 2.2 years. In all action alternatives, the recurrence interval would increase, indicating flushing flows would occur less often. Alternative 3 would have the greatest overall effect in the Laporte Reach. The other alternatives have similar effect, with Alternative 2 having the least effect. The average duration of flushing flows would be reduced by 1 day/year in Alternative 2M and up to 2.1 days in Alternative 4. The median duration would also be reduced in all action alternative, by up to 3.5 days in Alternative 4 and up to 7 days/year in Alternative 2M. The effect on recurrence interval would be less in all action alternatives in the Fort Collins and Timnath Reaches. The effect on average and median during in these two reaches would be greater than in the Laporte Reach. The impact of the alternatives would be minor upstream of I-25 and moderate downstream of I-25.





Due to the geographic location of Glade Reservoir, Northern Water would implement a Peak Flow Operations Program under Alternatives 2M and 2 in which NISP operations during peak flow conditions would be contingent upon general hydrologic conditions (streamflow forecasts) and NISP conditions (Glade Reservoir storage) (Appendix B). This program is intended to minimize the effects of NISP operations on peak flows and flushing flows in the Poudre River. Proposed operations under the program would assess the May 1 storage in Glade Reservoir, the snowpack and streamflow forecast, the likelihood that the reservoir would fill, and if the threshold flow of 2,800 cfs at the Canyon Gage had been reached in the previous 3 years to determine the amount of water bypassed, the number of days to bypass, and curtailments on the SPWCP exchange.

In all years, Northern Water would curtail the SPWCP exchanges for the predicted peak flows 3 days of the year. NISP diversions of the Grey Mountain water right during peak flow conditions would be dependent upon the classification of the year using the criteria above. A detailed description of the Peak Flow Operations Plan is presented in of the Conceptual Mitigation Plan (Appendix B).

Forgoing of diversions to implement the peak flow operation program is not intended to reduce overall project yield. To maintain firm yield of the project, Northern Water would increase diversions in the Poudre Valley Canal up to 1,700 cfs immediately following the peak flow operational period. Additional days of diversion at the end of the runoff hydrograph may be necessary to make up the bypassed volume. Compensation of the full bypassed volume would ideally be made up within the same year if conditions were favorable. If the bypassed volume was not recovered within the same year, it would be made up in subsequent years through increased diversions.

S.6.3.2 Future and Cumulative Effects

Reasonably foreseeable actions, primarily the Halligan Water Supply Project and the Seaman Water Supply Project, would further exacerbate and extend the trends and current trajectory of the river. The progression of impacts can be seen by comparing the effects predicted to occur with project alternatives compared to Current Conditions hydrology and the effects predicted to occur with Future Conditions and Cumulative Effects. For example, the annual flushing flow recurrence interval range would increase from a range of 1.7 to 2.0 years under Current Conditions hydrology, to 2.0 to 2.6 years under Future Conditions hydrology, to 2.4 to 3.7 years with Alternative 2M, and to 2.4 to 5.2 years with Cumulative Effects. The alternatives and cumulative effects would progressively exacerbate and extend the current trajectory of the river conditions reflected in continuing channel contraction, fining of surficial material, and loss of morphologic complexity. The future effects of Alternative 1 on flushing flows would be minor. The cumulative effects of the action alternatives on flushing flows would be moderate.

S.6.4 Ground Water

S.6.4.1 Direct and Indirect Effects

S.6.4.1.1 Reservoir Sites

Ground water level data collected near the Glade Reservoir site indicated that water levels vary by as much as 10 feet between seasons. Ground water levels reach their lowest level by late spring and then begin rising through the summer, remaining high through much of the winter. Although there are large variations within ground water levels in the area throughout the year, the residual trichloroethene near the source area appears to no longer affect downgradient areas, which is where the Glade forebay would be built. Trichloroethene concentrations in ground water are below Colorado ground water standards.

S.6.4.1.2 Poudre River

Changes in Poudre River flow and stage in all alternatives would affect alluvial ground water levels adjacent to the river. The difference between the alternatives in ground water level reductions associated with predicted maximum river stage reductions would be small.

For the four river segments that were analyzed (A, B, C, and F shown in Figure S-3), the predicted reductions in maximum river stage would range from about 1.8 feet to 3.0 feet. The effect of reductions in maximum river stage on ground water levels would be greatest adjacent to the river and decrease with increasing distance from the river. The predicted declines in ground water levels are for a maximum-case situation that may occur typically once in 26 years, as predicted by the hydrologic modeling. More frequently, the predicted reductions in river stage range from 0 to 1 foot, and less frequently, reductions range between 1 and 2 feet, depending on location and alternative. With predicted stage reductions of 1 to 2 feet, ground water level reductions in the alluvium in the vicinity of the river would be less than what is predicted for the maximum-case situation and would not likely be discernible by alluvial well owners, given the range of natural variability in water levels.

S.6.4.2 Future and Cumulative Effects

S.6.4.2.1 Reservoir Sites

The Future Conditions Effects at the Cactus Hill, Glade, and Upper Galeton reservoir sites would be the same as the Current Conditions Effects. Reasonably foreseeable future actions would not cumulatively affect ground water conditions at the Glade Reservoir or Upper Galeton Reservoir sites.

S.6.4.2.2 Poudre River

For the four river segments that were analyzed (A, B, C, and F shown in Figure S-3), the predicted reductions in maximum river stage would range from about 0.4 foot to 1.0 foot with Future Conditions Effects in the No Action Alternative. The No Action Alternative would reduce alluvial ground water levels, particularly in the near-bank areas, substantially less than the action alternatives.

In the action alternatives, the predicted reductions in maximum river stage would range from about 1.4 feet to 3.4 feet for the action alternatives with Future Conditions Effects and 2.0 feet to 3.2 feet with Cumulative Effects. The difference between the action alternatives in ground water level reductions associated with predicted maximum river stage reductions would be small.

S.6.4.2.3 No Action Irrigated Lands

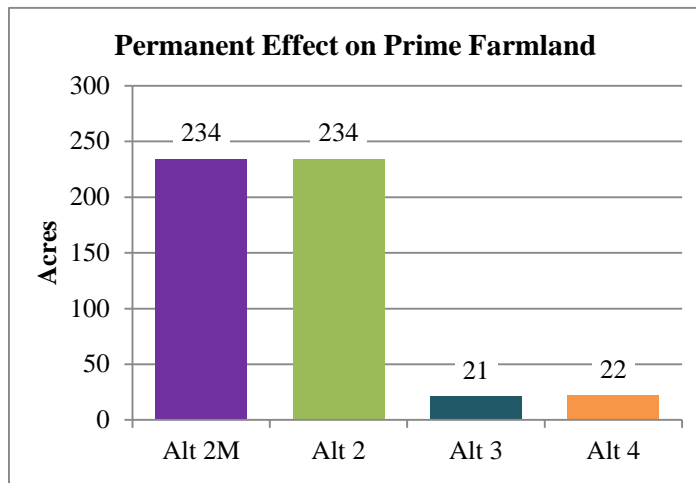
In the No Action Alternative, the NISP Participants would rely on transfers of irrigated agricultural water rights to provide their future water supply. Agricultural ditch transfers are projected to result in the “dry up” (i.e., removal of irrigation and revegetation or conversion to dryland farming) of 64,200 irrigated acres. Based on the current proportion of irrigated agricultural lands within the future planning areas of the NISP Participants, an estimated 24,000 irrigated acres could be taken out of production due to residential and commercial development. The No Action Alternative and future actions cumulatively would result in a large percentage reduction in irrigated land in the Participant’s service areas (88,200 acres), a portion of which is in the Poudre River basin. The reduction in irrigated land in the

Poudre River basin would likely result in a reduction in the current ground water return flows to the Poudre River, particularly during the mid to late summer, and possibly into the fall. As more water is diverted for water supply use, some of it would be returned to the river through wastewater treatment plants. Future transfers of irrigation water and/or increased use of alluvial ground water for irrigation or water supply may contribute to cumulative effects on ground water when combined with the No Action Alternative and reasonably foreseeable future actions. Depending on the degree of future transfers of irrigation water and increased use of alluvial ground water for irrigation or water supply the cumulative effect on ground water could range from minor to moderate.

S.6.5 Soils

S.6.5.1 *Direct and Indirect Effects*

The permanent effects on Prime Farmland would be greatest for the No Action Alternative because irrigation would be removed from 64,200 acres of irrigated land. While the total acreage cannot be determined because the exact location of the dry up is not known, between an estimated 1,705 acres (1%) and 17,050 acres (10%) of the total Prime Farmland in Larimer and Weld counties would no longer be soils classified as Prime



Farmland. The effect would be moderate. Permanent effects on Prime Farmlands for all action alternatives would be minor, with the impacts being less than 1% of Prime Farmland in Larimer and Weld counties. Alternatives 2 and 2M would have greater permanent effects on Prime Farmland than Alternatives 3 and 4 because of the amount of irrigated Prime Farmland at the Glade Reservoir site. The permanent effects on Prime Farmland for conveyance systems would be similar for all alternatives.

S.6.5.2 *Future and Cumulative Effects*

Future actions that would result in cumulative effects on Prime Farmland, when combined with the effects of the proposed project, include population growth and urban development, the North 1-25 improvement project, other construction projects that affect soils, oil and gas development, and proposed projects along the Poudre River. The construction of Chimney Hollow Reservoir and the expansion of the Halligan and Seaman reservoirs would not result in losses of Prime Farmland because the reservoir sites are in upland locations with no land currently farmed or irrigated.

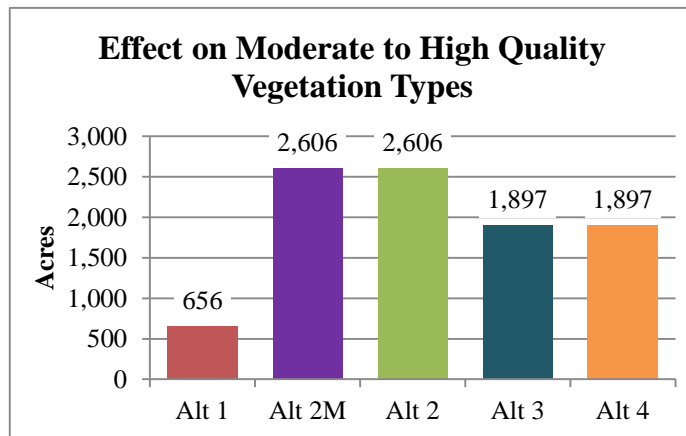
Population growth and urban development would have the most pronounced effect on Prime Farmland. The No Action Alternative is also expected to indirectly cause the dry up of 64,200 acres of agricultural lands, which would likely be converted to areas of dry land crops or uplands with mixed species. With future urban development, agricultural land and rangeland would be converted to residential, commercial, and industrial uses. Based on the current proportion of irrigated agricultural lands within the future planning areas of the Participants, an estimated 24,000 irrigated acres could be taken out of production due to residential and commercial development. While the total acreage of Prime Farmland lost cannot be determined because the exact location of the agricultural dry up and urban development is unknown, it is likely that more than 1% of the total acres of Prime Farmland in Larimer and Weld Counties would be lost in the No Action Alternative alone. The cumulative effects on Prime Farmland in the action alternatives would be considerably less, and the effect would be minor to moderate depending on the amount of future urban development.

Northern Water would implement the avoidance and minimization measures described in Appendix B to minimize effects on soil resources in all action alternatives.

S.6.6 Vegetation

S.6.6.1 Direct and Indirect Effects

All alternatives would have major effects on vegetation because of the total permanent loss of vegetation from inundation of reservoirs and other project components. No Action Alternative would have the least permanent loss from reservoirs because one reservoir would be constructed instead of two as in Alternatives 2M, 2, 3, and 4. The dry up of irrigated lands would



result in a greater effect on vegetation than the additional reservoir in the action alternatives. Alternatives 2M and 2 would cause the greatest loss of moderate to high quality vegetation types, such as Foothills Shrubland community that occurs in the Glade Reservoir site. Alternative 2 would also have the greatest effect on Mesic Mixed Shrublands and Mesic Mixed Woodlands, both of moderate to high quality habitat types. Other CNHP-ranked vegetation communities possibly associated with conveyance systems would likely be avoided during final design and after surveys confirm their location. Alternatives 3 and 4 have similar overall effects on vegetation and impact more acres of vegetation compared to Alternatives 2M, 2, and the No Action Alternative.

S.6.6.2 Future and Cumulative Effects

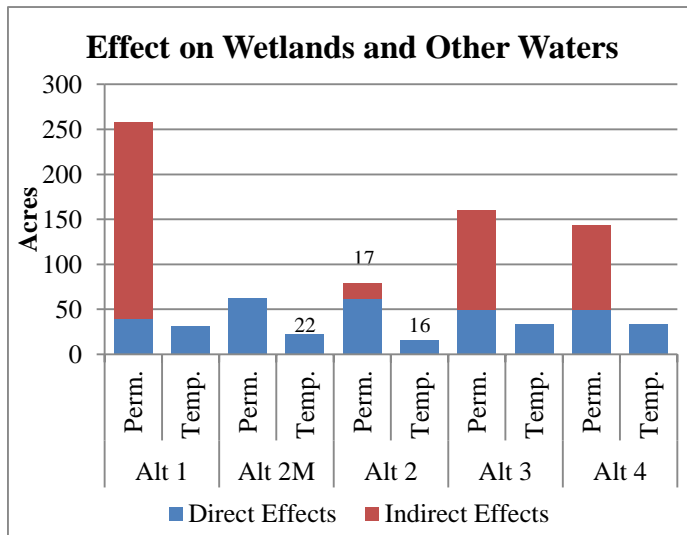
The No Action Alternative is also expected to indirectly cause the dry up of 64,200 acres of agricultural lands, which would likely be converted to areas of dry land crops or uplands with mixed species. With future urban development throughout the cumulative effects study area, agricultural land and rangeland would be converted to residential, commercial, and industrial uses. Based on the current proportion of irrigated agricultural lands within the future planning areas of the Participants, an estimated 24,000 irrigated acres could be taken out of production due to residential and commercial development. The cumulative loss of 88,200 acres of irrigated lands would not eliminate these lands from agricultural uses but would change the type of agriculture feasible on these lands.

Increasingly, lands throughout the northern Colorado Front Range and near Glade Reservoir have been developed to support increased demand for residential land uses. Vegetation communities would be lost from future residential development and may be converted to landscaped areas, disturbed areas, and developed areas. Glade Reservoir would affect the Foothills Shrublands community, and other development and construction projects near Glade Reservoir may impact additional stands of this shrub community. The incremental effect of implementing other future actions that contribute to cumulative effects would be similar to those described for the No Action Alternative.

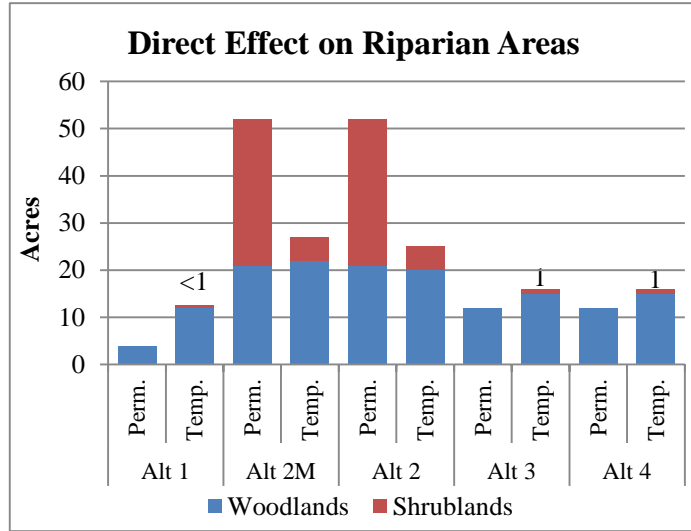
S.6.7 Wetlands, Riparian Resource and Other Waters

S.6.7.1 Direct and Indirect Effects

All alternatives would require filling of wetlands and waters. The No Action Alternative would have the greatest effect on wetlands and waters (258 acres), 218 acres of which are associated with the transfer of water from 64,200 acres of irrigated agricultural lands. Alternatives 2M and 2 are predicted to have the least permanent direct and indirect effect on wetlands and waters (62 acres). Alternatives 3 and 4 are predicted to permanently impact 162 and 145 acres of wetlands and waters, respectively, 94 acres of which are indirect wetland effects associated with the lining of the Poudre Valley Canal to convey water to Cactus Hill Reservoir.

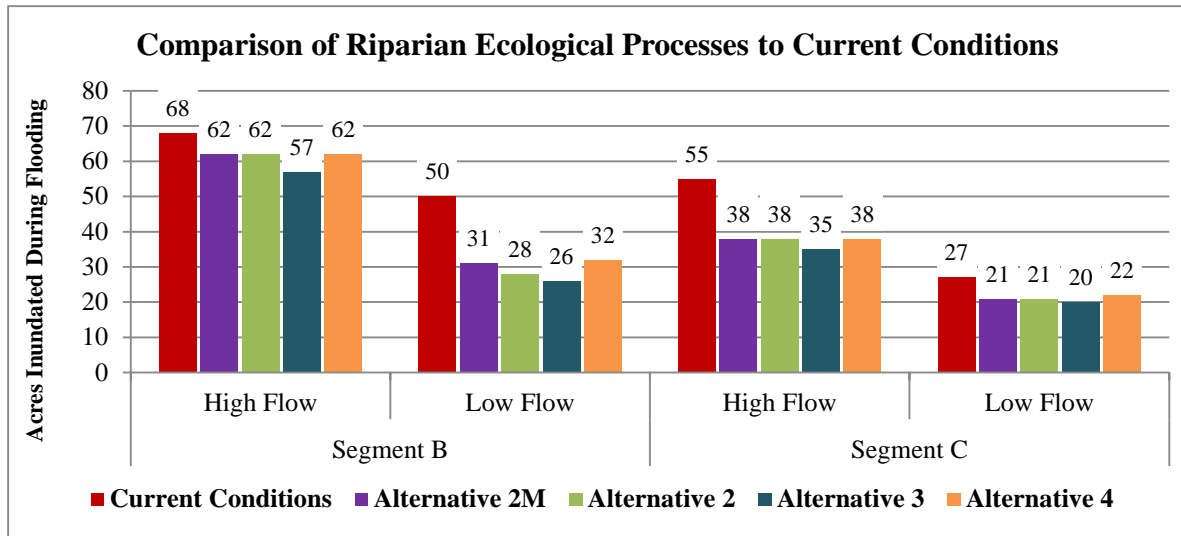


During reservoir and conveyance construction, all alternatives would affect riparian woodlands both permanently and temporarily, with the No Action Alternative affecting the least (16 acres) and Alternative 2M affecting the most (43 acres). Alternatives 1, 3, and 4 would affect an acre or less of riparian shrubland. Alternatives 2M and 2 would affect more riparian shrubland because of the presence of this vegetation type at Glade Reservoir. The No Action Alternative would result in the least amount of impact on riparian vegetation. Although most effects are temporary, restoration of woodlands following disturbance would take many years to reach the existing level of growth. The total riparian vegetation effect would be minor for the No Action Alternative and major for Alternatives 2M and 2.



All action alternatives would cause reductions in flows and river stage of the Poudre River, which are predicted to accelerate and/or reinforce the well-established trajectory for riparian and wetland resources along the Poudre River. At most locations, Alternative 3 has the greatest predicted declines in river stage. For most of the segments, Alternative 3 has a greater number of weeks and percentage of the period of record with a decline in ground water levels of 0.5 foot or greater. For river Segments B and C, Alternative 4 has the fewest number of weeks and percentage of the period of record with a decline in ground water levels of 0.5 foot or greater. Alternative 2M is predicted to have the least effects on ground water levels for Segments A and B when compared to the other action alternatives. Both Alternatives 2 and 3 are predicted to have an indirect effect on 17 acres of wetland vegetation along the Poudre River in Segment B from changes in river stage. These indirect effects are also accounted for in the effects shown in the Effects on Wetlands and Other Waters graphic.

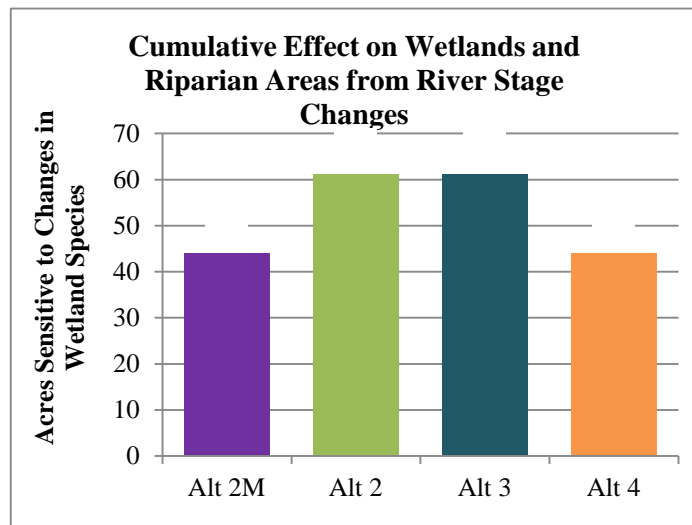
Flooding of riparian areas along the Poudre River can affect the associated riparian resources in different ways. Flooding can influence riparian vegetation by periodically providing water and nutrients to existing vegetation, providing suitable habitat for seedling germination and establishment, and providing a selection mechanism for riparian vegetation. Flooding of the riparian areas is also associated with a variety of ecological processes. Inundation tends to increase in a downstream direction. In general, the upstream study sites tend to have less area inundated by low or high flow events. All alternatives would reduce area inundated by low or high flow events. Segments B and C would have the greatest reduction in acres inundated from the alternatives. Effects on other segments are described in FEIS Section 4.9.



S.6.7.2 Future and Cumulative Effects

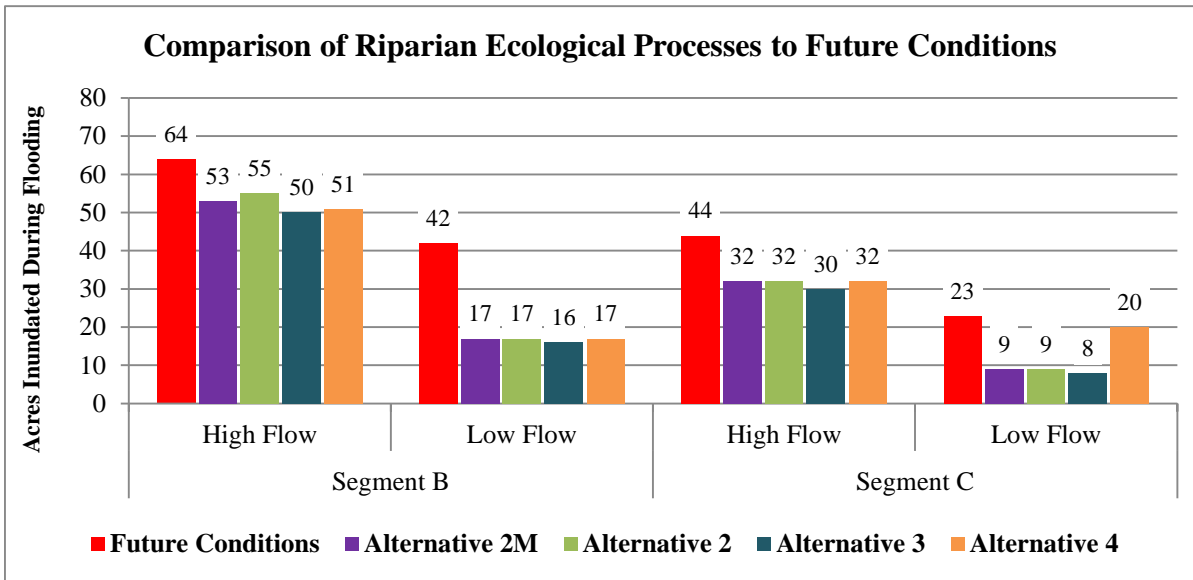
The NISP alternatives are predicted to affect river stage, ground water levels, and inundation. The current trend leading to shifts in woody riparian species composition along the Poudre River is expected to continue and to be affected by the NISP alternatives. The combined effects of the reasonably foreseeable future actions, NISP alternatives, the Halligan Water Supply Project, and Seaman Water Supply Project are predicted to further reinforce and/or accelerate the previously described trajectory of wetland and riparian resources along the Poudre River.

Generally, the No Action Alternative with Future Conditions Effects would have the least predicted flow-related indirect effect on wetland and riparian resources, and Alternative 3 would have the greatest predicted indirect effect on wetland and riparian resources along the Poudre River. Cumulatively, Alternative 3 would have the greatest number of weeks and percentage of the period of record with a decline in ground water levels of 0.5 foot or greater.



For river Segments A, B, and C, Alternative 4 consistently would have the fewest number of weeks and percentage of the period of record with a decline in ground water levels of 0.5 foot or greater among the action alternatives. Alternative 2M is predicted to have a cumulative effect on 44 acres of wetland vegetation along the Poudre River in Segment D from changes in river stage. Both Alternatives 2 and 3 are predicted to have a cumulative effect on 61 acres of wetland in Segments B and D.

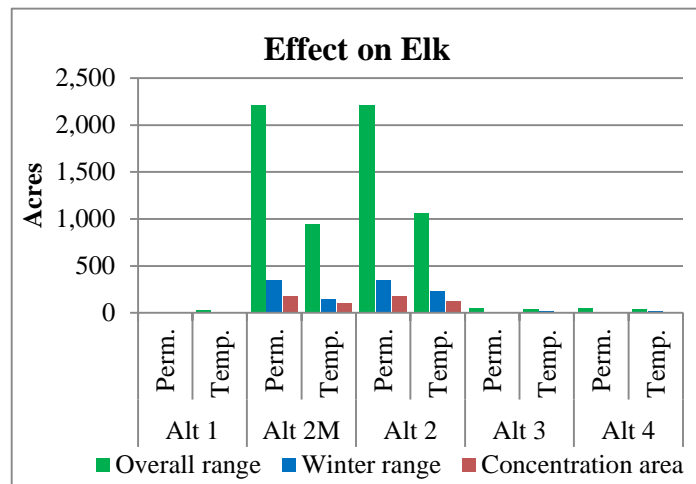
The action alternatives vary slightly in terms of the number of years in which inundation of wetland and riparian areas are estimated to occur. Under Cumulative Effects, Alternative 3 generally would decrease the number of years of inundation by about 1 more year for many of the Poudre River study site transects compared with Alternatives 2 and 2M. This slight decrease in the estimated number of years of inundation with Alternative 3 is to be expected because Alternative 3 would divert on average about 5,000 AFY to 6,000 AFY more from the Poudre River than Alternatives 2 and 2M. Cumulative the trend of less inundation and fewer connections with the river are predicted to continue and adversely affect flushing salts and pollutants from the flooded areas and exporting nutrients to downstream reaches.



S.6.8 Wildlife

S.6.8.1 Direct and Indirect Effects

The differentiating effects on wildlife are primarily associated with the size and location of proposed reservoirs. Key habitats analyzed were winter ranges, and winter concentration areas for deer and pronghorn, and overall and winter range and winter concentration areas for elk. These habitat components are typically the most critical or limiting for these species. The regional effects on big game ranges would be negligible for each alternative. Permanent effects on elk overall range and elk winter concentration areas would be greatest for Alternatives 2M and 2 because of the construction of Glade Reservoir and relocation of U.S. 287 that would



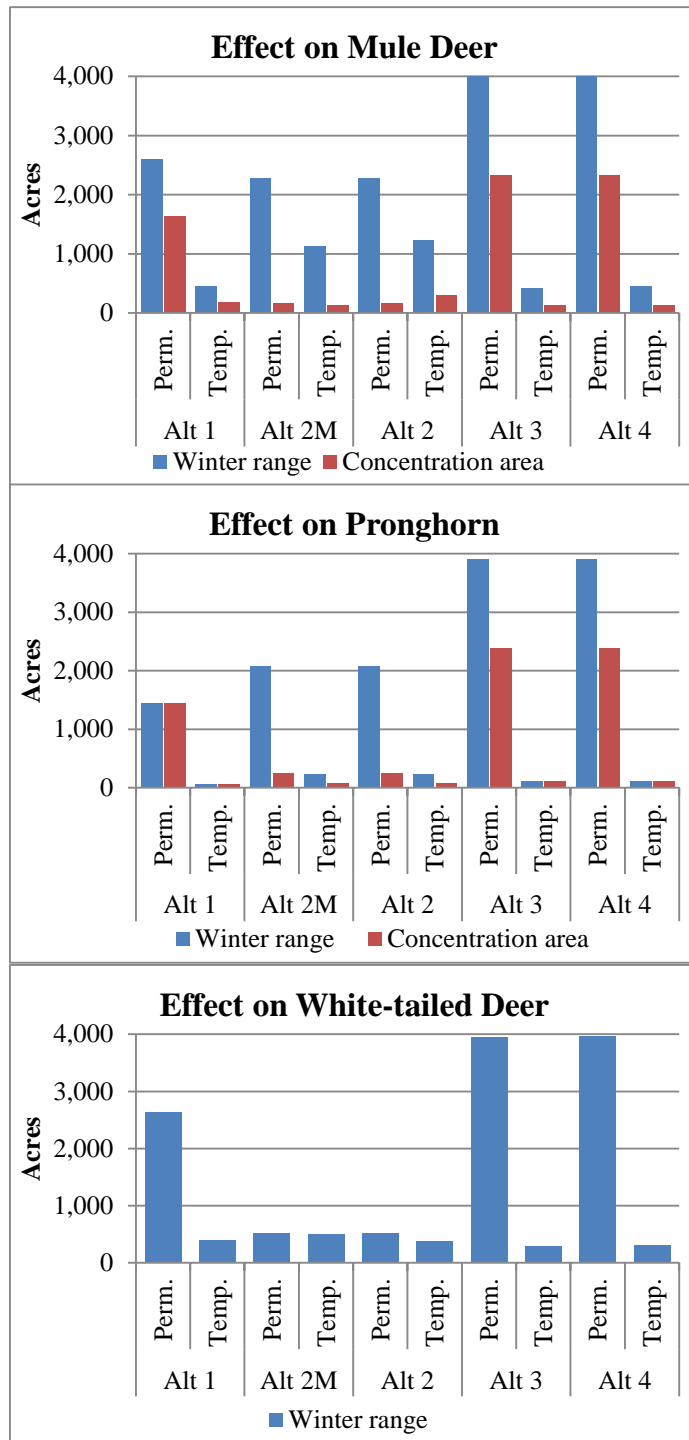
occur within elk habitats. Alternative 2 would have additional temporary effects on elk overall range and winter concentration area because of the Carter Pipeline. Alternative 2M and 2 would have a major effect on elk overall range, winter range and winter concentration area at a local scale. These effects would be most pronounced in the residential elk herd that occurs in this area year-round. Alternatives 3 and 4 would have a minor effect on elk overall range and winter range.

Effects on mule deer winter concentration areas would be greatest for Alternatives 1, 3, and 4 (35% to 40% loss at local scale), although the total acres of winter range lost would be greatest for Alternatives 3 and 4. All alternatives would have a major loss of mule deer winter range at a local scale. The No Action Alternative would have the least permanent effect on pronghorn winter habitats although still a major effect, and Alternatives 3 and 4 would have the greatest effect on pronghorn winter habitats due to a larger Cactus Hill Reservoir. For white-tailed deer, Alternatives 2M and 2 would result in the least permanent loss of winter range.

To avoid and minimize effects on wildlife resources, Northern Water would conduct pre-construction surveys. Following completion of the surveys, Northern Water would implement the actions described in the Conceptual Mitigation Plan (Appendix B).

S.6.8.2 Future and Cumulative Effects

In the No Action Alternative, the combined effects of human population growth, commercial and residential development, transportation improvements and water storage and delivery, including the loss or



degradation of 2,280 acres of grassland habitat due to the construction of a 120,000 AF Cactus Hill Reservoir would result in the loss or degradation of habitat, mortality from ground-disturbing activities and increased traffic, and creation or expansion of movement barriers. The No Action Alternative would not affect elk habitat and no cumulative effect would occur on elk.

Construction or expansion of Chimney Hollow, Halligan, and Seaman reservoirs (reasonably foreseeable future actions) would all occur within elk and mule deer winter range and winter concentration areas. Because different populations of big game occur in the plains grasslands (Cactus Hill and Upper Galeton Reservoir sites) compared to the Foothills grasslands (Chimney Hollow and Seaman Reservoir sites), the No Action Alternative and reasonably foreseeable future actions would not affect the same populations. On a regional scale, cumulative effects would be negligible for big game species because less than 1% of habitat available within each Game Management Unit established by CPW would be affected and the No Action Alternative and reasonably foreseeable future actions would not likely have a noticeable effect on big game populations or sex ratios at a regional scale. On a local scale, cumulative effects would be major for mule deer because effects on winter concentration areas would be greater than 20% and moderate for pronghorn and white-tailed deer because the moderate direct effect at Cactus Hill Reservoir Site and the loss of habitat associated with the reasonably foreseeable future actions would not result in the loss of more than 20% of the local habitat.

Cumulative effect of the action alternatives would be similar. On a regional scale, cumulative effects in all action alternatives would be negligible for big game species because these projects would not likely have a noticeable effect on big game populations or sex ratios at a regional scale. In Alternative 2, cumulative effects on a local scale would be minor for white-tailed deer and major for mule deer, pronghorn, and elk, particularly to local and resident herds in the Seaman to Glade/realigned U.S. 287 area because greater than 20% of the local habitat would be affected and more fragmented. In Alternatives 3 and 4, cumulative effects on a local scale would be major for mule deer, white-tailed deer, and pronghorn because the alternatives would cumulatively result in the loss of greater than 20% of the local-scale winter range, winter concentration area, and severe winter range.

S.6.9 Special Status Species

S.6.9.1 Direct and Indirect Effects

Permanent effects on Preble's meadow jumping mouse would be greatest for Alternatives 2M and 2, primarily due to construction of the Glade Reservoir, where 43 acres of occupied habitat would be permanently impacted. Alternatives 3 and 4 would have the greatest impact on special status species associated with prairie dog colonies and grassland communities. Construction of the Upper Galeton Reservoir, which would occur in all action alternatives, would permanently impact 215 acres of prairie dog colonies, 1,753 acres of

swift fox habitat, 777 acres of grassland habitat, and 964 acres of upland native shrublands potentially supporting numerous species of concern.

Construction of Cactus Hill Reservoir in Alternatives 3 and 4 would permanently impact 875 acres of prairie dog colonies, 3,319 acres of swift fox habitat, and 3,198 acres of grassland habitat. Alternatives 3 and 4 would also have the greatest effects on bald eagles. Construction of the Upper Galeton Reservoir would permanently impact 5 acres of habitat within 0.5 mile of a bald eagle nest, while construction of Cactus Hill Reservoir in Alternatives 3 and 4 and the No Action alternative would permanently impact an additional 9 acres. Permanent effects on bald eagles from construction of conveyances would be similar for all action alternatives. The greatest effects on wetland- and aquatic-associated special status species would occur in Alternatives 3 and 4, mostly due to lining of the Poudre Valley Canal. The greatest effects on wetland-associated special status species in Alternatives 2 and 2M would be from construction of the Glade Reservoir, where 42 acres of wetlands, 8 acres of aquatic habitat, and 16 acres of riparian woodland habitat would be permanently lost.

In Alternatives 2M and 2, effects on Bell's twinpod would be major from the permanent loss of 29 acres and the temporary loss of 45 acres of occupied habitat. Temporary losses would be minimized by limiting the work zone during construction. Alternatives 3 and 4 would have a negligible effect on Bell's twinpod because most or all effects could be avoided by establishing a no work zone around the population.

To avoid and minimize effects on special status species, Northern Water would conduct pre-construction surveys. Following completion of the surveys, Northern Water would implement the actions described in the Conceptual Mitigation Plan (Appendix B).

S.6.9.2 Future and Cumulative Effects

All alternatives would contribute to the loss of habitat for special status species. The cumulative effects of the alternatives on special status species would be similar to the effects described under Direct and Indirect Effects.

S.6.10 Aquatic Biological Resources

S.6.10.1 Direct and Indirect Effects

The differences in effects on streamflow between alternatives would change the effect intensity in Segments A, B, and C of the Poudre River. In Segments A and B, Alternatives 2M and 2 would have a minor to moderate beneficial effect on aquatic biological resources mainly due to additional flows through much of the year with Alternative 2M and in winter, early spring, and in September for Alternative 2. The conveyance refinement flows for Alternative 2M would have greater beneficial effect than the augmentation flows in Alternative 2. In Segment B, Alternative 3 would have a minor to moderate adverse effect due to reductions in runoff flows and no conveyance refinement

flows or winter flow augmentation. Alternative 4 would result in a minor adverse effect on aquatic biological resources in Segment A with reduced runoff flows and result in negligible effects on Segments B and C by allowing about 25% of the water that would have been diverted at the Poudre Valley Canal (with Alternatives 2M, 2, and 3) to flow through these segments before being diverted at the New Cache Canal. All action alternatives would have similar minor adverse effects in Segments D, E, and F of the Poudre River.

The relative effects of the action alternatives would not be substantially different; there would be similar effects in many segments, especially downstream of Segment C. The conveyance refinement flows and augmented low flows with Alternatives 2M and 2 respectively through parts of Segments A and B would result in beneficial effects through these segments compared to Alternatives 3 and 4. Alternative 3 would have no conveyance refinement flows or augmented low flows and a greater level of effect compared to the other action alternatives. Alternative 4 would also have no conveyance refinement flows or augmented flows but would have some of the water diverted after flowing through Segments A, B, and C and would have an intermediate level of effect compared to the other action alternatives.

The negligible to moderate effects on aquatic resources and their habitat with the action alternatives would not cause the crossing of a tipping point in the Poudre River. Segment A is predicted to continue to function as a coldwater stream segment supporting coldwater species of fish and macroinvertebrates. Brown trout, longnose dace, and suckers are expected to remain as the dominant fish species. Segment B is predicted to continue to function as a warmwater stream segment supporting a wide variety of both coldwater and warmwater species of fish and macroinvertebrates. Species relative abundance would change slightly, but brown trout, longnose dace, and suckers are expected to remain as some of the most common fish species along with numerous warmwater species. Segment C is predicted to continue to function as a warmwater stream segment supporting a wide variety of warmwater species of fish and macroinvertebrates and seasonally support some trout that move downstream from Segment B. Segment D is predicted to continue to function as a warmwater stream segment supporting a wide variety of warmwater species of fish including minnows, darters, and suckers and a somewhat degraded community of macroinvertebrates. There may be slight reductions in fish abundance but the numerous warmwater species would continue to be the dominant component of the fishery. Segments E and F are predicted to continue to function as warmwater stream segments supporting a wide variety of warmwater species of fish and a somewhat degraded community of macroinvertebrates. The contemporary fish community in these two segments is substantially different than the historical fish community. The fish community in these two segments has already crossed a tipping point, and nonnative species such as carp, gizzard shad, largemouth bass, and mosquitofish are common and only a few native species such as white suckers, fathead minnows, and green sunfish continue to be common. There may be slight reductions in fish abundance but the fishery in these segments would continue to have numerous species of native and introduced warmwater species.

All action alternatives would have a major beneficial effect on fish and macroinvertebrates with the creation of either Glade Reservoir (Alternatives 2M and 2) or Cactus Hill Reservoir (Alternatives 3 and 4). Upper Galeton Reservoir would create a minor beneficial effect for all action alternatives although, if implemented, the Galeton Reservoir Native Fish Rearing enhancement measure with CPW would result in a moderate to major beneficial effect.

S.6.10.2 Future and Cumulative Effects

The No Action Alternative would divert less water than the action alternatives and would have lower effect intensity than the action alternatives. The No Action Alternative would have negligible to minor effects in all six segments of the Poudre River. In Segment B, Alternatives 2M and 2 would have a moderate beneficial cumulative effect on aquatic biological resources mainly due to conveyance refinement flows for Alternative 2M and the augmented flows in winter, early spring, and in September for Alternative 2. The beneficial effect would be somewhat greater for Alternative 2M than for Alternative 2. In this segment, Alternative 3 would have a moderate adverse effect due to reductions in runoff flows and no winter flow augmentation. Alternative 4 would result in a minor adverse effect in Segment A with reduced runoff flows and result in negligible to minor cumulative effects on Segments B and C by allowing approximately 25% of the water that would have been diverted at the Poudre Valley Canal (with Alternatives 2M, 2, and 3) to flow through these segments before being diverted at the New Cache Canal. All three action alternatives would have similar negligible to minor adverse cumulative effects in Segment D and minor adverse cumulative effects in Segments E and F of the Poudre River.

All action alternatives would also include the construction of a reservoir (Glade in Alternatives 2M and 2) or Cactus Hill Alternatives 3 and 4) that, when coupled with the Chimney Hollow Reservoir of the Windy Gap Firming Project, would be a major beneficial cumulative effect to reservoir aquatic biological resources. The action alternatives would also have a minor beneficial effect with the construction of Upper Galeton Reservoir. The Participants did not propose developing fisheries or recreational facilities at Cactus Hill Reservoir in the No Action Alternative.

Several future actions are intended to improve riparian and instream habitat conditions and could help reduce predicted Cumulative Effects. The proposed Poudre River corridor restoration and conservation projects by Fort Collins and Greeley could improve habitat conditions over many miles of the Poudre River and improve habitat availability for many different species of aquatic organisms. Some of these projects have an objective of reconnecting the Poudre River floodplain with high flows in the river through reaches of Fort Collins which could improve spawning and rearing habitat availability for some of the native small-bodied fish species. Stormwater projects and post-fire restoration as well as updates to water quality standards could lead to improved water quality in the Poudre River. This could benefit the species of aquatic organisms in the river and may allow some sensitive species to become re-established. Improvements to diversion structures to allow

upstream fish passage could also benefit some species of fish that migrate to different sections of the river.

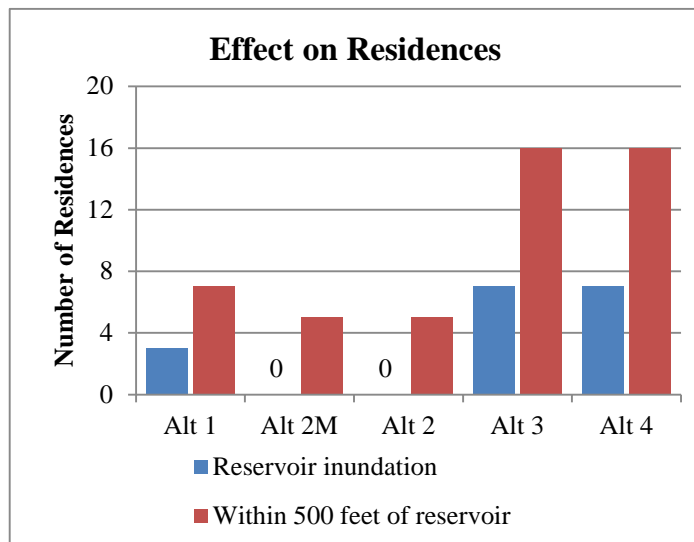
Population growth and development would continue along the Poudre River corridor along with the associated effects on riparian areas. Future development may worsen the existing effects on riparian vegetation, water quality, sedimentation, and channel geomorphology and have an adverse effect on aquatic organisms.

S.6.11 Land Use

S.6.11.1 Direct and Indirect Effects

The construction of Cactus Hill Reservoir would require the Participants in Alternative 1, and Northern Water in Alternatives 3 and 4 to fund Anheuser-Busch to find, purchase, and develop another location to dispose of wastewater associated with beer production. Glade Reservoir in Alternatives 2M and 2 would inundate portions of the Colorado State University/State Land Board parcel west of Glade Reservoir. Northern Water is negotiating with the State Land Board to acquire or trade 1,360 acres of State land in the Glade Reservoir study area. Most of the proposed Upper Galeton Reservoir in Alternatives 2M, 2, 3, and 4 would be within the Pawnee National Grasslands administrative boundary and would inundate about 1,751 acres of private land within the administrative boundary. The U.S. Forest Service does not actively manage the private lands within the administrative boundary and is unlikely to acquire private lands within the administrative boundary. The proposed SPWCP forebay would be south of the proposed Upper Galeton Reservoir, within the 67-acre Mitani-Tokuyasu SWA (managed by CPW) and would permanently impact about one-third of the land within the Mitani-Tokuyasu SWA, which is popular for hunting and trapping. The SPWCP forebay would also permanently impact about 3 acres of private land.

Based on current dam design and hydrologic modeling, all alternatives would have residences that would be inundated by a reservoir or be within 500 feet of the proposed Glade Reservoir. During final design, Northern Water would finalize the dam design and hydrologic modeling and determine which residences could be affected by operations. For affected residences not owned by Northern Water, the property owner would have the option of having their residence and associated buildings



purchased by Northern Water or relocated at Northern Water's cost. Northern Water would provide access to the new residences, if necessary. Northern Water would demolish affected residences owned by Northern Water.

S.6.11.2 Future and Cumulative Effects

Future residential development in response to population growth is likely to occur throughout the cumulative effects study area. The No Action Alternative would involve the transfer of water from 64,200 acres of irrigated lands for use by the Participants. Implementation of the No Action Alternative combined with future residential development in the cumulative effects study area would contribute to the ongoing regional trend of reduced agricultural lands. Future growth would result in the conversion of about 56,000 acres of land from agricultural use to municipal uses, of which 24,000 acres would be irrigated. The cumulative conversion of 88,200 acres of irrigated lands would not eliminate these lands from agricultural uses but would change the type of agriculture feasible on these lands.

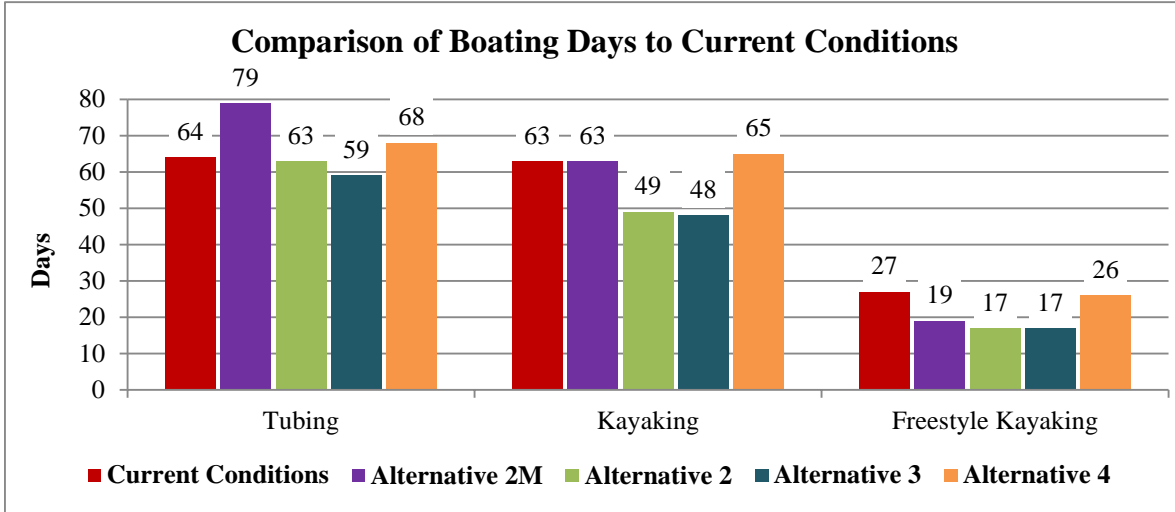
The loss of 300 to 620 acres of agricultural lands in the action alternatives would be a negligible contributor to the expected loss of 56,000 acres of agricultural land from future land development. Glade Reservoir in Alternatives 2M and 2 and Cactus Hill Reservoir in Alternatives 3 and 4, when coupled with the Chimney Hollow Reservoir of the Windy Gap Firing Project, would contribute to the region's parks and open space lands because they would be open to public recreation. The construction of Upper Galeton Reservoir in the action alternatives would further contribute to regional land use changes. Oil and gas development in the region is expected to continue to have local effects on land uses for at least the next 20 years. Cumulative effects on land use for the action alternatives are expected to be minor relative to the larger regional trend of increased development of rural agricultural lands.

S.6.12 Recreation

S.6.12.1 Direct and Indirect Effects

All action alternatives would have moderate effects on recreation at the Mitani-Tokuyasu SWA, which would be permanently impacted by the construction of the SPWCP forebay. The development of a fisheries at Glade Reservoir in Alternatives 2 and 2M and at Cactus Hill Reservoir in Alternatives 3 and 4 would be a new recreation opportunity that would be a major benefit; Upper Galeton Reservoir would not provide any new recreation. The flow changes in the Poudre River in all alternatives would alter flows suitable for boating (tubing, kayaking, and freestyle kayaking). Compared to Current Conditions hydrology, Alternatives 2M and 4 would increase the number of days suitable for tubing; a slight decrease would occur in Alternatives 2 and 3. Compared to Current Conditions hydrology, the number of days suitable for kayaking would increase for Alternative 4, remain the same under Alternative 2M, and decrease in Alternatives 2 and 3. All alternatives would decrease

the number of days suitable for freestyle kayaking. Poudre River flows changes would increase recreational fishing opportunities in Segments A and B in Alternatives 2M and 2, based on an increased abundance and overall health of recreational fish species, such as brown trout, that are sought by anglers. The effect on recreational fishing opportunities in Segments A and B in Alternative 3 would be moderate and adverse, and negligible in Alternative 4.



Although total boating days in Segment B would increase in Alternative 2M, the positive economic effect of additional tubing days would be nearly totally offset by the decrease in freestyling days because the economic value per visit for kayaking is estimated to be substantially higher than that of tubing. As a result, the net economic effect is estimated to be positive, less than \$4,000 annually, a minor benefit. Alternative 4 would have similar benefits. Alternatives 2 and 3 would reduce all forms of boating in Segment B, with the economic loss estimated to be \$40,000 in Alternative 2 and \$47,000 in Alternative 3.

Visitation at Glade Reservoir in Alternatives 2M and 2 is estimated to be 379,000 visitors annually at full development. Total economic effects of Glade Reservoir would be a major benefit and may range from about \$13 million per year to \$30 million per year. Visitation at Cactus Hill Reservoir is estimated to be nearly 820,000 visitors annually at full development, much higher than the number estimated for Glade Reservoir because of the larger surface area. Total economic effects of Cactus Hill Reservoir would be a major benefit and may range from about \$28.7 million per year to \$65.6 million per year. The proposed recreation provided by Glade Reservoir or Cactus Hill Reservoir would not be identical to the recreation potentially affected by reduced flows along the Poudre River.

To avoid and minimize effects on recreation and to provide enhanced recreational opportunities in Alternatives 2M and 2, Northern would:

- Northern Water would provide public access to the Glade Reservoir fishery and to land surrounding the reservoir. CPW would establish and manage Glade Reservoir for a cool water fishery with funding from Northern Water. Northern Water would

provide some funding to construct facilities dedicated to providing access to the Glade Reservoir fishery.

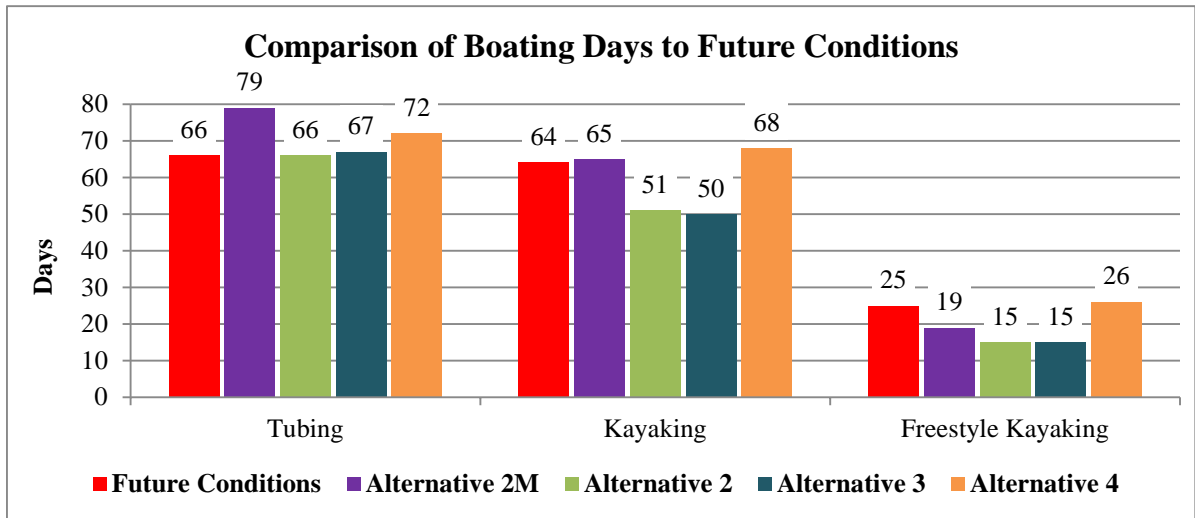
- Northern Water would seek an agency or agencies qualified to develop a recreation plan and manage recreation at Glade Reservoir. Northern Water would fund development of the recreation plan and approve the plan before implementation. Northern Water also would provide funding to CPW to increase fish hatchery capacity to accommodate the increased production of stocked fish as an enhancement measure.
- Northern Water would construct a visitor's center at the Glade Reservoir site.
- Northern Water would construct one trail on the west and north side of Glade Reservoir within 165 feet of the high-water line in the reservoir to allow fishing access open to foot travel only.
- Northern Water would implement a Recreation and Wildlife Adaptive Management Program to manage and monitor recreation at the Glade Reservoir site. As part of the program, Northern Water, CPW, and the recreational managing agency would develop a plan for allowing waterfowl hunting at certain locations in Glade Reservoir during waterfowl hunting seasons (generally October through February).

The Corps' analysis indicates that Cactus Hill Reservoir water quality in Alternatives 3 and 4 would be suitable to support both coldwater and warmwater recreationally important fish species (see FEIS Section 4.12.5.1). The reservoir would also be suitable for the establishment and management of a low- to medium-quality recreational fishery that could support populations of both stocked and self-sustaining fish species. Details about the Cactus Hill Reservoir fishery and surrounding recreation would be described in a revised Fish and Wildlife Mitigation and Enhancement Plan, which would require working in cooperation with CPW and plan submittal to the CPW Commission. Northern Water would provide public access to the Cactus Hill Reservoir fishery and to land surrounding the reservoir. CPW would establish and manage Cactus Hill Reservoir for a fishery with funding from Northern Water. Northern Water would provide some funding to construct facilities dedicated to providing access to the Cactus Hill Reservoir fishery. Northern Water would seek an agency or agencies qualified to develop a recreation plan and manage recreation at Cactus Hill Reservoir. Northern Water would fund development of the recreation plan and approve the plan before implementation. Because fish hatchery production of the species anticipated for the reservoir is near capacity, Northern Water would fund expansion of existing fish hatcheries to accommodate the stocking rates.

S.6.12.2 Future and Cumulative Effects

Compared to Future Conditions hydrology, the No Action Alternative would increase the number of days suitable for tubing and kayaking and would decrease the number of suitable days for freestyle kayaking. The effect would be negligible. Segment C would experience minor adverse cumulative effects on fishing from reduced spring runoff that would affect brown trout.

Cumulatively, number of days suitable for tubing and kayaking would remain the same or increase from those described under Direct and Indirect Effects. The number of days suitable for freestyle kayaking would be the same in Alternative 2M and 4 as those described under Direct and Indirect Effects and would be 2 days less in Alternatives 3 and 4. Economic effects would be similar to those described under Direct and Indirect Effects.



S.6.13 Visual Resources

S.6.13.1 Direct and Indirect Effects

The long-term direct effects on visual resources from Cactus Hill Reservoir Dam would be moderate in Alternatives 1, 3, and 4. The artificial form of the dam would be visible from multiple observation points, but the dam would appear relatively small in the context of the Cactus Hill Reservoir site. The presence of the reservoir would be a minor beneficial effect because water would add color and texture variety. Although Cactus Hill Reservoir would be smaller in the No Action Alternative than in Alternatives 3 and 4, the effects on visual resources would be similar. The visual effects from Glade Reservoir Dam in Alternatives 2M and 2 would be major because of the visual contrast with the surrounding landscape from various observation points, and in the context of the Glade Reservoir site, the dam would appear relatively large. The presence of the reservoir would be a minor beneficial effect because water would add color and texture variety.

S.6.13.2 Future and Cumulative Effects

The cumulative reduction of 88,200 irrigated acres from land use conversion and the purchase and dry-up of agricultural water rights in the No Action Alternative conversion of these areas to non-irrigated agriculture would result in a noticeable visual change to individual fields but would not be out of character with the broader region. The cumulative effect would be minor. The cumulative visual effects would be similar to those described under Direct and Indirect Effects.

S.6.14 Cultural, Historical and Paleontological Resources

S.6.14.1 Direct and Indirect Effects

The Corps has not made an eligibility determination for unassessed historic properties or an effect determination for any historic property identified within the Area of Potential Effect. All alternatives may result in an adverse effect on designated historic properties. Based on the best available information, the No Action Alternative yielded the least number of known eligible or potentially eligible resources that would be directly affected, while Alternatives 2 and 2M would affect the greatest number of known resources. Alternatives 1, 3, and 4 may result in the greatest number of indirect effects on sites.

None of the alternatives would have direct adverse effects on known paleontological resources. All alternatives have the potential to adversely affect significant paleontological resources that have not yet been documented and whose precise locations are currently unknown. The No Action Alternative would have moderate potential for effects on paleontological resources. Because Alternatives 2M and 2 include Glade Reservoir, Upper Galeton Reservoir, and the realignment of U.S. 287, these alternatives would have the greatest potential for adverse effects on paleontological resources. The potential effects on paleontological resources in Alternatives 3 and 4 would be the same under both alternatives, but less than Alternative 2M and 2 because there are fewer acres of paleontologically sensitive geologic units within the Cactus Hill Reservoir site, and the U.S. 287 realignment is not a component of Alternatives 3 and 4. Northern Water would conduct pre-construction cultural and paleontological resources surveys as described in the Conceptual Mitigation Plan (Appendix B). Following completion of the survey, Northern Water would follow the requirements of a Programmatic Agreement between the Corps and the State Historic Preservation Office.

S.6.14.2 Future and Cumulative Effects

Nearly all the historic properties potentially affected by the alternatives are individual sites and such sites would not be affected by future actions. Historic properties that are linear or are historic districts are the most likely to be affected by future actions. The distance of the future actions from the NISP cultural resources Area of Potential Effect makes cumulative effects on individual resources unlikely. Effects of the alternatives with future actions on cultural resources within the cumulative effects study area would be negligible, as areas of proposed ground disturbance would be surveyed for cultural, historical, or paleontological resources and impacts would be mitigated. The cumulative effects on cultural resources may also be beneficial to some degree, because many of the future actions would require cultural, historical, or paleontological resource surveys that can result in valuable data being collected that otherwise would not be collected until sometime in the future, if at all. The distance of the future actions from the NISP paleontological Area of Potential Effect makes cumulative effects on paleontological resources unlikely. The cumulative effects on paleontological resources would be negligible for each alternative.

S.6.15 Socioeconomic Resources

S.6.15.1 Direct and Indirect Effects

The No Action Alternative would have major effect on water rates and affordability for most Participants. Alternatives 2M and 2 would have minor effects on water rates and affordability for most Participants and Alternatives 3 and 4 would have moderate effects.

Alternative 1 would have no effect on property values in the study area. Alternatives 2M and 4 would have no effect on property values in Fort Collins and potential minor effects downstream of I-25 due to changes in flood risks. Alternatives 2 and 3 would have potential minor effect on a few properties close to river in Fort Collins and downstream of I-25 due to changes in flood risks. The proposed relocation of U.S. 287 would move the U.S. 287/SH 14 interchange 3 miles to the east and U.S. 287 traffic would no longer directly pass these businesses. If the customer traffic for these businesses is proportionate to the relative traffic volumes on U.S. 287 and SH 14, and their business consequently declines by as much as 2/3 with the relocation of U.S. 287, these businesses may no longer be viable. Both businesses would experience some offsetting positive benefits from recreational visitors to the proposed Glade Reservoir. During summer weekends, recreation at the proposed Glade Reservoir is projected to generate traffic through the area averaging 650 vehicles per day.

S.6.15.2 Future and Cumulative Effects

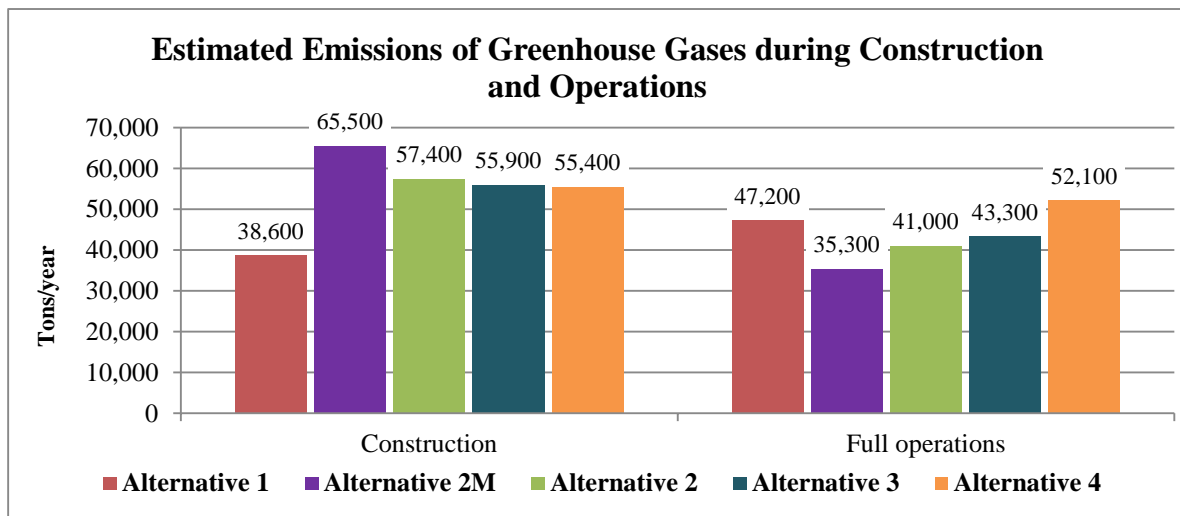
The No Action Alternative would transfer agricultural water rights from 64,200 acres of irrigated lands to provide a water supply to the Participants. Because dryland farming or revegetation are less economically productive, less labor and input intensive, and produce less revenue than irrigated farming, such changes in land use would have an impact on the region's economy. The annual total effect on economic output in the study area from agricultural water rights transfers under the No Action Alternative is estimated at \$68 to \$87 million, with a projected loss of 446 to 513 agriculture-related jobs. The low end of the effect range assumes all dried up acres are converted to dry land crop production, while the high end of the range assumes those acres are revegetated and no longer in commercial production. The other alternatives are predicted to have minor effects on agriculture from water exchanges to canals that could increase the salinity of irrigation water and affect production of crops most sensitive to increased salinity. In years with average proportions of SPCWP supplies and average rainfall, SPWCP would not affect crop yields. Under maximum case conditions (a high proportion of SPWCP supplies relative to native water supplies and low rainfall), yield reductions for dry beans and vegetables could result in decreased annual production value of about \$602,000 (in 2017 dollars). When compared to the total annual production value for crop farming in Weld County of about \$374 million, the maximum case loss in production value due to water quality changes resulting from SPWCP would amount to less than 0.2% of the total crop value in the county.

S.6.16 Hazardous Materials

Alternatives 1, 3, and 4 are not predicted to affect known hazardous sites. For Alternative 2, the proposed Glade forebay is near a known trichloroethene plume. Currently, no detectable trichloroethene occurs within the footprint of the proposed forebay and the trichloroethene plume is contracting. Soil containing trichloroethene is not expected within the footprint of the proposed forebay. All alternatives would have a reservoir site, either Cactus Hill or Upper Galeton, where past oil and gas development has occurred. Northern Water would assess past oil and gas development as described in the Conceptual Mitigation Plan (Appendix B) to minimize adverse effects of oil and gas development on reservoir water quality.

S.6.17 Energy Use and Greenhouse Gases

All alternatives would involve pumping to convey water. The pumping would require electrical energy and would generate greenhouse gases such as carbon dioxide. Alternative 2M would have greatest temporary estimated annual greenhouse gas emissions during construction. Alternative 2M would have the least long-term estimated annual greenhouse gas emissions during operations and Alternative 4 would have the greatest estimated annual greenhouse gas emissions. The estimated electrical energy used by the alternatives would be about 0.11% of the energy used in Colorado in 2016. The contribution to climate change would be a minor cumulative effect. Northern Water would investigate opportunities to develop small-scale hydropower facilities within NISP infrastructure. Opportunities may include configuring pumps at the Glade Reservoir Forebay pump station to operate in reverse direction to generate power or installation of small hydropower systems at the release locations of pipelines.



S.7 MITIGATION

The FEIS Chapter 4 identifies proposed mitigation and mitigation effectiveness for each resource. Appendix B is a conceptual mitigation plan proposed by Northern Water for all action alternatives. The conceptual mitigation plan outlines the proposed avoidance, minimization, enhancement, and compensatory mitigation measures for key environmental resources, including water quality, stream morphology, fish and other aquatic life, wetlands, riparian vegetation, and terrestrial wildlife. Avoidance, minimization, and enhancement measures described in the plan were incorporated into the effects analysis. If a permit is issued, a final mitigation plan would be submitted to the Corps.