3.10 VEGETATION (PLANTS AND NOXIOUS WEEDS) _______

Introduction

This Section will provide a brief description of the project; discuss assumptions and methodologies used in the analysis; identify existing inventories, monitoring, and research literature review used in the analysis; describe desired conditions; effects of alternatives; and recommended mitigation.

Key Assumptions and Methodologies

Scope of the Analysis – For direct, indirect effects to rare plants, the spatial (geographical) boundaries of the analysis are the treatment areas and proposed roads and timeframes is from the time of implementation to when the treatment area returns to present vegetative conditions. For direct, indirect effects to noxious weeds, the spatial (geographical) boundaries of the analysis are the treatment areas, proposed roads, and areas adjacent to these treatments areas. The timeframes are from the time of implementation to about two to five years at which time ground cover would provide effective competition to noxious weeds. For cumulative effects, the spatial boundaries for rare plants would be the existing range where potential habitat exists for these plants and the time frame will be about five years during which this project will be implemented. For cumulative effects, the spatial boundaries for noxious weeds would be within one mile of the outer boundary of the treatment units since these areas are the most likely seed source and the time frame will be about five years during which the project ground cover would provide effective competition to noxious weeds.

Key Assumptions and Methodologies – Several key assumptions and methodologies are used in this analysis. Survey areas are targeted areas of high potential habitat for the rare plants and noxious weeds within the project area. The survey methods followed national protocols. Method of analysis for rare plants is if the survey results in no plants found then the probability of impact to the species is low. If rare plants are found then the species viability is assessed based on effects of the project. For noxious weeds, the method of analysis is based on the potential for an infestation to get established in the project area.

The Wasatch-Cache Noxious Weed EIS (2006) describes the importance and mechanisms for noxious weeds. Results of uncontrolled weed spread are well documented in literature (Sheley et al. 1999a; Rice 2001; Tu et al. 2001). Without treatment, weeds increase approximately 14% a year under natural conditions (Forest Service 1991; Forest Service 1996a). The spread of weeds can be primarily attributed to human activities associated with vehicles and roads (Roche and Roche 1991), trails, contaminated livestock feed, contaminated seed, and ineffective revegetation practices on disturbed lands). Wind, water, birds, wildlife, and livestock also contribute to weed spread. According to a scientific assessment of the Interior Columbia River Basin, invading weeds can alter ecosystem processes, including productivity, decomposition, hydrology, nutrient cycling, and natural disturbance patterns such as frequency and intensity of wild fires (Quigley and Arbelbide 1997). Changing these processes can lead to displacement of native plant species, eventually impacting wildlife and native plant habitat, recreational opportunities, natural hydrologic processes, and scenic beauty.

The Revised Forest Plan (USDA Forest Service 2003, FEIS) describes effects on botanical resources from timber harvest, mechanical, fire and fuel treatments. Activities such as timber harvest can have impacts to plants and plant habitat through canopy removal, soil disturbance and erosion, and stream sedimentation. In addition, mechanical activities for vegetation treatment may require road building. Sudden changes in seral stage, or an abundance of early seral stages, also reduce the available habitats for those plants that require mid to late seral stages. However, those species that prefer openings, early-seral stages, or some ground disturbance, could benefit from moderate levels of mechanical activities. Activities that mechanically remove fuels and/or canopy cover can alter the microhabitat of various rare plant species.

Existing Inventories, Monitoring, and Research Literature Review - Several sources of information are used to analyze the effects of the proposed project and alternatives. For existing inventories and monitoring, the Utah Natural Heritage database is reviewed for existing occurrences of rare plants and USFS NRIS Terra Invasives database is reviewed for noxious weeds. An interdisciplinary field trip was taken to the project area on July 11, 2005 to review conditions in the project area. Rare plant and noxious weed surveys were conducted between June and August 2006 by the Forest Botanist and a vegetation crew and independent surveys were conducted by USU Invasive Species Mapping Crews and a graduate student from Brigham Young University who is doing a Floristic Survey of Rich County.

Affected Environment

This section contains information on site-specific existing resource conditions with enough detail to serve as the baseline for the effects disclosure.

Rare Plants

Rare plants that have the potential habitat in the project area are listed below. Target species were:

- *Arabis glabra* var. *furcatipilis* – Tower Mustard is a Wasatch-Cache NF recommended sensitive plant species. Typically found: Aspen and aspen/maple in limestone sandy clay; between 5,200 to 6,300 feet; May-June. [*Arabis glabra* was found a number of times throughout the analysis area but is considered to be the variety *glabra* and not the sensitive variety of *furcatipilis*.]
- *Draba maguirei* – Maguire draba is a Forest Service sensitive species. Typically found: Open areas in Spruce/fir forests on dolomite; between 8,000 and 9,500 feet; June-July
- *Draba burke* – Burke draba is a Forest Service sensitive species. Typically found: Talus slopes and rocky outcrops of quartzite, limestone or calcareous shale in duff-fir mixed conifer and maple/oak communities; between 5,500 to 9,200 feet; May-June. Only known from Box Elder, Weber, and Cache Counties – in the Wellsville Mountains and Northern Wasatch Range of Northern Utah.
- *Eriogonum brevicaule* var. *loganum* – Logan buckwheat is a Forest Service sensitive species. Typically found: Sagebrush-bunchgrass communities on rocky outcrops; between 4,800 to 6,700 feet; May-June.
- *Penstemon compactus* – Mt. Naomi Penstemon is a Forest Service sensitive species. Typically found: Openings in coniferous communities, growing with Monardella, clematis, columbine on limestone and dolomite; between 7,000 to 9,800 feet; June-August.
- *Astragalus jejunus var. jejunus* – Starveling milkvetch is a Forest Service sensitive species. Typically found: Sagebrush and sagebrush-juniper communities often on windswept ridge tops between 6,000 to 7,000 feet; May-July.
- *Cypripedium fasciculatum* – Clustered lady's slipper is Forest Service sensitive species. Suitable habitat is shade of coniferous forests. The largest and most vigorous populations found on Wasatch-Cache NF, on the Wasatch Range are found in mixed spruce/fir stands with relatively thick duff and little to no understory except Cypripedium (Red Pine Trail, Salt Lake Ranger District). Other smaller populations have been found in lodgepole pine stands with varying cover and shade. In contrast to the Red Pine population these populations are small, one to two small clumps and are not considered robust. This also contrasts to large populations on the Ashley NF that occur in the duff of moderately dense to dense lodgepole at 8,000 to 10,000 feet elevation (Goodrich). Although some of the area surveyed appeared to contain suitable habitat for *Cypripedium*, none was found.

Floristic surveys were done for rare plants in June – August 2006. The results of these surveys did not find any individuals or populations of Forest Service Threatened, Endangered, Sensitive, or Rare plants within the analysis area.

Noxious Weeds

Noxious weeds found in the project area:

- *Houndstongue* reproduces by seed, some of which may be dispersed over moderate to long distances by animals. Fire creates conditions that are favorable for establishment of houndstongue (i.e., open canopy, reduced competition, areas of bare soil), so if houndstongue seeds are present and competition minimal, it may be favored in the postfire community. Houndstongue plants may also survive fire, since nutrient reserves in the taproot acquired during the first year are sufficient for normal seed production the following year, even if the plants are completely defoliated early in the spring.
- *Musk thistle* can produce abundant seed and establish well in high light environments. Fire creates conditions that are favorable to the establishment of musk thistle (i.e., open canopy, reduced competition, areas of bare soil), so if musk thistle seeds are present and competition minimal, musk thistle may be favored in the postfire community
- *Bull thistle* reproduces by abundant seed, some of which may disperse over moderate distances by wind and some of which may remain dormant in the soil for several years (research thus far suggests up to five years). Fire creates conditions that are favorable for establishment (i.e., open canopy, reduced competition, areas of bare soil), so if bull thistle seeds are present and competition minimal, bull thistle may be favored in the postfire community. This is supported by several examples of bull thistles establishment within a few years after fire.
- *Canada thistle* reproduces vegetatively and by seed. Seed dispersal is primarily by wind.
  Canada thistle is adapted to both survive fire on site, and to colonize recently burned sites with exposed bare soil. The extensive root system gives it the ability to survive major disturbances. Similarly, the roots can survive fires of varying severity and produce new shoots. Additionally, there are numerous examples from the literature where Canada thistle seedlings established from wind-deposited seed, anywhere from two to nine years after fire.
  Canada thistle may change the fire ecology of the site in which it occurs by its abundant, flammable aboveground biomass.
- *Scotch thistle* is Biennial. Infestations of Scotch thistle reduce forage production and virtually prohibit land utilization for livestock. Dense stands of the large, spiny plants constitute a barrier to movement, almost totally excluding animals from grazing and access to water (Hooper et al. 1970; Sindel 1991).
  A scotch thistle plant can produce 8,400 to 40,000 seeds which are dispersed by wind; humans, water, livestock, and wildlife are involved in longer-distance dispersal. Soil disturbance and open canopy would create favorable habitat.
- *Dyers woad* is annual, biennial or short lived perennial. Each plant can produce from 350 to 500 seeds on average. Considered a rangeland weed, barring total shade and saturated soils, dyers woad can invade most habitat types. Seeds drop to the ground or are dispersed over long distances by sticking to animal fur, hikers, or machinery. Seeds are long lived and remain viable for several years. There appears to be a timing mechanism in seed germination with 1% of the F1 seeds germinating the year after development and 35% germinating in year two and so on. Reduced competition, and open canopy, and disturbance favors dyers woad establishment.

Surveys for noxious weeds were performed at the same time as rare plant surveys. Several noxious weeds were found in the analysis area as shown in Table 3.10.1. Houndstongue and Canada thistle were found within four treatment units, and will be discussed in the environmental consequences section.

Table 3.10.1. Noxious weeds found in the Big Creek analysis area.

Noxious Weed	Infested Acres
Bull thistle	0.12
Canada thistle	2.83
Dyers woad	0.04
Hounds tongue	0.40
Musk thistle	1.06
Scotch thistle	0.01

Issues and Indicators

Rare Plant Issue – The treatment of vegetation by timber harvest, mechanical, herbicide or prescribed fire has the potential to damage or kill rare plants. The indicator for rare plants is the presence of individuals or populations.

Noxious Weed Issue – The treatment of vegetation by timber harvest, mechanical, herbicide or prescribed fire has the potential to expand existing or introduce new weed infestations. The indicator for noxious weeds is the presence of existing infestations or potential vectors for introduction or expansion of infestations.

Environmental Consequences

The approach to analysis is to 1) review research the potential effects of treatments such as those proposed in this project, 2) describe the mitigation that is recommended for each alternative.

Recommended Mitigation

Develop a plan for treatment of known infestations of noxious weeds. Treat infestations prior to project implementation. Wash equipment prior to entering the forest to begin implementation. If equipment is removed from the Forest to work at another job site – it should be washed again prior to returning to the Forest.

a. Effects Common to Alternatives 1 and 3

1. Direct and Indirect Effects

There would be no direct or indirect effects of the proposed action on rare plants because no individuals or populations were found.

Motorized travel throughout the project area increases the potential for introduction and spread of noxious weeds. This potential exists with all alternatives. Efforts to implement the Wasatch-Cache NF Integrated Weed Management Strategy and Noxious Weed EIS will reduce the effects.

Direct and indirect effects to noxious weeds are similar to Alternative 1, but slightly reduced in Alternative 3. For noxious weeds under Alternative 1, without mitigation, an increase in houndstongue is expected in existing populations in Units 14, 23, and 59. For noxious weeds under Alternative 3, without mitigation, an increase in houndstongue is expected in existing populations in Units 11, 19, and 39. An increase in Canada thistle is expected in Unit 18 under Alternative 1 and Unit 15 under Alternative 3. (See Table 3.10.2). Noxious weeds within the analysis area are considered to be a seed source for new infestations. Without mitigation it would be expected that weeds would spread along new intermittent roads and temporary roads and in the treatment units.

Timber harvest activities that result in soil disturbance and management activities that include major reduction in native vegetation would create optimum habitat for noxious weeds and the greatest potential for weed establishment. Mitigation such as cleaning equipment, pretreatment of known infestations, and monitoring for early detection and eradication of new infestations will greatly reduce the risk and minimize the spread of noxious weeds.

Table 3.10.2. Noxious weeds found in or immediately adjacent to treatment units and the effects.

Alternative/Unit	Prescription	Cover	Current Infestation	Effects Without Mitigation
Alt. 1 Unit 59 (Alt. 3 Unit 39)	Irregular Shelterwood	Sagebrush	0.01 acre Houndstongue	Increase in current infestation size/ spread by harvest equipment/ more open habitat and decreased competition favors houndstongue
Alt. 1 Unit14 (Alt. 3 Unit 11)	Clearcut	Lodgepole/ mixed conifer	0.02 acre Houndstongue	Increase in current infestation size/ spread by harvest equipment and personnel / more open habitat and decreased competition favors houndstongue
Alt. 1 Unit 18 (Alt. 3 Unit 15)	Irregular Shelterwood	Lodgepole/ mixed conifer	0.01 acre Canada thistle	Increase in current infestation size/ spread by harvest equipment and personnel/more open stand would have more potential for wind spread of seeds/ more open habitat and decreased competition favors Canada thistle
Alt. 1 Unit 23 (Alt. 3 Unit 19)	Overstory removal	Lodgepole/ Mixed conifer/ Aspen	0.005 acre Houndstongue	Increase in current infestation size/ spread by harvest equipment and personnel / more open habitat and decreased competition favors houndstongue

b. Alternative 2 – No Action

1. Direct and Indirect Effects

The direct and indirect effects to rare plants would be that rare plants would remain unchanged from existing conditions because no treatments would be implemented. For noxious weeds, it is expected that infestations would increase.

c. Cumulative Effects

Because there are no direct or indirect effects to rare plants there will be no cumulative effects.
Direct and indirect effects from the proposed project to noxious weeds result in a slight increase in noxious weeds. Use of roads and trails by recreationists and others throughout the analysis and proposed treatment areas could result in new sources of infestation. Mitigation combined with implementation of the Forest Weed Management Strategy and adjacent BLM weed control efforts would result in minimal effects due to this project.

3.11 WATER RESOURCES

Introduction

This Section will provide a brief description of the project; discuss assumptions and methodologies used in the analysis; identify existing inventories, monitoring, and research literature review used in the analysis; describe desired conditions; water resource features and conditions; and effects of alternatives.

Assumptions and Methodologies of Analysis

Scope of the Analysis – For direct, indirect effects, the spatial (geographical) boundaries of the analysis are the treatment areas and adjacent water features and timeframes is from the time of implementation to about two years at which time ground cover would recover to effectively control sediment movement. For cumulative effects, the spatial boundaries will be the sixth-code hydrologic units that the treatment areas are within and the time frame will be two years for the same reasons as the direct and indirect effects.

Key Assumptions and Methodologies – A key assumption for the analysis is that Riparian Habitat Conservation Areas (RHCA) that are placed along intermittent and perennial streams, and ponds and lakes and reservoirs and wetlands provide a buffer zone that will trap sediment that may move during project implementation and keep sediment from entering streams and water features. Documents that support the effectiveness of RHCAs include but are not limited to:

- Seyedbagheri (1996): Idaho Forestry best management practices: Compilation of research on their effectiveness. This publication cites a number of studies dealing with this BMP87—Rule 4.b.i. Design to leave areas of vegetation between roads and streams (first Alternative). Study results varied widely. Travel distances varied based on obstructions, slope, soil types, number of diversion structures, moisture accumulation and the number of cross drains. Travel distances ranged from no flows over 50 feet to no flows over 900 feet. The maximum travel distances were associated with drainage collection structures like culverts.
- Environmental Protection Agency (2005): National management measures to control nonpoint sources pollution from forestry. Streamside management area widths vary based on slope of adjacent lands. Maximum recommended widths identified as 200 feet on lands with a greater than 46% slope. Lands with no slope identify a maximum width of 50 feet. Maine Forest Service as cited in the above lists a maximum width of 165 feet. On lands with no slope the width is identified as 15 feet.

The analysis method is to present the desired conditions for water resources; describe water resource features and conditions within the project area; present information on potential effects of the treatments; and then present recommended mitigation measures.

Existing Inventories, Monitoring, and Research Literature Review - Several sources of information are used to analyze the effects of the alternatives. An interdisciplinary field trip was taken to the project area on July 11, 2005 to review conditions in the project area. Information on water discharge and water quality was collected on May 5, and June 15, 2006 by the Forest Hydrologist and review of individual treatment units were reviewed during field trips on July 31 through August 2, 2006 by the Forest Hydrologist and Forest Soil Scientist. Papers were reviewed on the synthesis of current science regarding cumulative watershed effects of fuel management that was a result of a conference entitled Cumulative Watershed Effects of Fuel Management (April 5-6, 2005, Salt Lake City, UT).

Revised Forest Plan Direction – The Revised Forest Plan (USDA Forest Service 2003) standards and guidelines that apply to this project are listed in Chapter 1, Tables 1.7.1 and 1.7.2 and in the Water Resources Technical Report (Condrat 2008). Desired future conditions that apply to this project are listed in Attachment A at the end of the Water Resources Technical Report (Condrat 2008).

Mitigation Measures/Design Elements

The mitigation measures/design elements applicable to this project are listed in Chapter 2, under "Design Elements and Mitigation Measures Common to Alternatives 1 and 3," Table 2.2.1b.

Affected Environment

This section contains information on site specific existing resource conditions with enough detail to serve as the baseline for the effects disclosure.

Water Features and Conditions – Very little surface water occurs on National Forest System lands within the analysis area as indicated by the ephemeral streams and the few springs that occur. Very few wetlands and riparian areas occur on the National Forest System lands and they occur around the springs. The ephemeral channels are dry for much of the year and very little riparian vegetation grows along these streams. The headwater areas are in a karst area. A karst area is defined as a land area with vertical and underground drainage resulting in the absence of surface streams (Fairbridge 1968). The underground drainage is usually in limestone and solution cavities are formed from underground water dissolving the limestone. The headwater area has karst drainage type that has formed sink holes and few surface streams through the formation of solution cavities in limestone. This causes water to move underground and come to the surface at springs lower in the drainage. For example, Big Crawford Spring, Stove Spring, Valley Spring, Dry Fork Spring discharge water at a similar elevation about two miles from the ridge top and the land above the springs are dry and only ephemeral stream channels exist above these springs. Small pot holes about 20 feet across can be seen on the ground surface in many places in this area. Average monthly discharge on Big Creek near Randolph is about 13.6 cubic feet per second (cfs).

The only wetlands that are in the treatment units are those associated with Stove Spring a small spring area that is located in Unit 35. Unit 35 has a prescribed fire, herbicide and/or mechanical treatment. No other wetlands are found in the treatment units.

Floodplains have been defined in various ways but for this analysis, these areas are defined as flat areas adjacent to streams that are composed of unconsolidated depositional material derived from sediments transported by the related stream, based on definitions contained in (Fairbridge 1968). Most of the streams in the project area have no floodplains or very small areas adjacent to the stream where sediment may become deposited during high flows. This is because most of the channels are ephemeral and the steepness of the streams result in very few areas that would be considered a true floodplain in the sense that a floodplain is a relatively flat area on each side of a channel where flood flows spread out during flood events.

The water features that are in treatment units are perennial and ephemeral streams as shown in Table 3.11.1. Only two treatment units, 35 and 62, have perennial streams in them for a total length of total 0.41 miles; these treatment units have a prescription of prescribed fire, herbicide, and/or mechanical treatment and are included in Alternatives 1 and 3. No other treatments units have perennial streams through them. The differences in the amount of stream in the treatment units between Alternative 1 and 3 is reflective in the reduced conifer treatment area of Alternative 3 as shown at the bottom of the table.

Table 3.11.1. Length of streams in treatment units for Alternatives 1 and 3 for Big Creek EIS.

	Length (miles) of Ephemeral Stream (except Where Noted as Perennial) in Treatment Units by Prescription										
Treatment Unit Numbers	Clearcut	Conifer Removal Followed by Fire	Group Selection	Group Selection and Patches	Irregular Shelter wood Prep Cut	Overstory Removal and Clearcut with Reserves	Overstory Removal and Patches	Perennial Prescribed Fire/ Herbicide/ Mechanical	Prescribed Fire mosaic	Ephemeral Stream Prescribed Fire/ Herbicide/ Mechanical	Shelter wood Prep Cut
Laketown Canyon Subwatershed											
7											
64											
Otter Creek Subwatershed											
64											
2											
3	*0.37*										
4	*0.06*										
5	0.13										
6		0.17									
7											
58									0.30		
Little Creek Subwatershed											
1											
8											
9											
10	0.05										
11	0.17										
12											
13											
15						0.14					
16											
17											
18											
19											
20											
58									0.10		
59											
60									0.80		
61										0.48	
Lower Big Creek Subwatershed											
18											
22		0.31									
23							0.56				
61											
62								0.31		1.45	
Upper Big Creek Subwatershed											
14	0.28										
21					0.56						
24											*0.05*

	Length (miles) of Ephemeral Stream (except Where Noted as Perennial) in Treatment Units by Prescription										
Treatment Unit Numbers	Clearcut	Conifer Removal Followed by Fire	Group Selection	Group Selection and Patches	Irregular Shelter wood Prep Cut	Overstory Removal and Clearcut with Reserves	Overstory Removal and Patches	Perennial Prescribed Fire/ Herbicide/ Mechanical	Prescribed Fire mosaic	Ephemeral Stream Prescribed Fire/ Herbicide/ Mechanical	Shelter wood Prep Cut
25			0.16								
26											
27											
28											
29											
30			*0.07*								
31											
32			*0.05*								
33				*0.07*							
34											
35								0.09		1.90	
36											
37											
38											
39		*0.95*									
40											
41											
42										*0.11*	
43											
44											
45		*0.01*									
46										*0.34*	
47											
48											
49											
50		0.26									
51											
52										1.07	
53											
54		0.05									
55											
56											
57		0.84									
63										0.42	
Alt 1 Total	1.06	2.59	0.28	0.07	0.56	0.14	0.56	0.41	1.20	5.78	0.05
Alt 3 Total	0.49	1.63	0.16	0.00	0.56	0.14	0.56	0.41	1.20	5.32	0.00

Note: Red (shaded) and black values are in Alternative 1. Only black values are in Alternative 3. These values represent conditions before mitigation.

Several proposed temporary roads cross ephemeral streams in the project area as shown in Table 3.11.2. These road crossings are dry except during spring runoff.

Table 3.11.2. Temporary road crossings across ephemeral channels.

Treatment Unit	Number of Stream Crossings	Drainage	Subwatershed
2	1	Otter Creek	Otter Creek
3	2	Otter Creek	Otter Creek
14	1	New Canyon	Upper Big Creek
21	1	Pole Hollow	Upper Big Creek
57	1	Unnamed Trib to Big Creek	Upper Big Creek

Water Quality - The State of Utah has designated the streams draining the Bear River watersheds above the National Forest boundary as Antidegradation Segments. This indicates that the existing water quality is better than the established standards for the designated beneficial uses. Water quality is required by state regulation to be maintained at this level. The beneficial uses of streams within these watersheds, as designated by the Utah Department of Environmental Quality, Division of Water Quality, are:

- Class 2B – protected for recreation
- Class 3A – protected for cold water species of game fish and other cold water aquatic species
- Class 4 – protected for agricultural uses.

The numeric water quality standards can be found in Section R317-2, Utah Administrative Code, *Standards of Quality of Waters of the State* (Utah, State of 2006a). A search of these standards does not show a standard for tebuthiuron or picloram 2B, 3AS, or 4 classified waters. For 2,4-D the standard for water and organisms only for 3A classified waters is 2902 ug/l.

In the most recent assessment of water quality, the State of Utah has determined that the waters within the watersheds that drain the study area fully support their beneficial uses with the exception of pH, which exceeds State standards (Utah, State of 2006b). The water quality sample site for Big Creek is where Big Creek crosses Utah Highway 16 near Randolph and pH exceeded State standards when the site was sampled during the 2004 season, which was at the end of several years of drought. Although Big Creek is listed on the Utah TMDL list (Total Maximum Daily Load – water bodies that are listed by the State of Utah as impaired for a specific water parameter), the Utah Division of Water Quality considers this site a low priority for conducting a TMDL for pH since the water quality sampling in 2004 was the first time pH ever exceeded State water quality standards and they want to first verify if the measurements are correct (Personal conversation on February 7, 2007 between Charles Condrat, Wasatch-Cache National Forest Hydrologist and Tom Toole, Utah Division of Water Quality Environmental Scientist). It is not known what the source of the high pH is and it may be caused by high concentrations of algae, but it as not been verified (Utah, State of 2006c).

Several water quality measurements were taken in the Big Creek drainage during the springs of 2006 and 2007 as shown in Table 3.11.3. The pH of Randolph Creek, Big Creek, Pole Hollow, Dry Fork Creek, Dry Fork spring and Big Crawford spring was between 6.7 and 8.8 on these streams. Specific Conductivity ranges from 384 to 598 uS/cm^2, which indicates the amount of ions and cations in the water. These values are reasonable for natural waters in limestone geology. The dissolved oxygen values range from 7.3 to 11.2 indicating good oxygen levels in cold temperature waters. Most of the water discharge was in Big Creek, Randolph Creek, and Big Crawford Spring.

Table 3.11.3. Water quality data for several streams in Big Creek drainage collected in May and June 2006 and March 2007.

Location	Date	Water Temp ºC	pH	Spec Cond (uS/cm^2)	Diss Oxygen (mg/l)	Water Width (ft)	Water Depth (ft)	Water Velocity (fps)	Discharge (cfs)
Randolph Creek 01 AB Big Ck	05/03/2006	8.1	---	464	9.4	4.0	0.8	3.0	8.1
Randolph Creek 01 AB Big Ck	06/15/2006	8.5	8.5	442	9.4	6.0	0.7	2.0	7.1
Randolph Creek 01 AB Big Ck	03/26/2007	6.3	8.6	453	9.0	5.0	0.3	2.0	2.6
Randolph Creek 01 AB Big Ck	04/18/2007	8.3	8.6	440	9.1	5.0	0.3	2.0	2.6
Big Creek 01 AB Randolph Ck	05/03/2006	6.3	---	397	9.4	14.0	0.8	3.0	28.6
Big Creek 01 AB Randolph Ck	06/15/2006	8.0	6.7	428	9.2	15.0	2.5	1.5	47.8
Big Creek 01 AB Randolph Ck	03/26/2007	5.4	8.6	411	9.1	14.0	0.3	3.0	10.7
Big Creek 01 AB Randolph Ck	04/18/2007	6.9	8.6	416	8.8	14.0	0.5	2.5	14.9
Pole hollow 01	05/03/2006	7.3	---	384	9.3	1.0	0.2	2.0	0.34
Pole hollow 01	06/15/2006	8.4	8.1	429	8.7	1.5	0.5	2.0	1.3
Pole hollow 01	03/26/2007	9.5	8.5	415	7.7	1.0	0.2	1.5	0.3
Pole Hollow 01	04/18/2007	7.0	8.5	414	8.5	1.0	0.2	2	0.3
Randolph Ck 02	05/03/2006	7.4	---	406	9.6	2.0	0.3	2.0	1.0
Randolph Ck 02	06/15/2006	7.9	8.4	412	8.9	3.0	0.8	3.0	6.1
Randolph Ck 02	03/26/2007	7.4	8.6	427	8.2	3.0	0.3	2.5	1.9
Randolph Ck 02	04/18/2007	6.7	8.6	439	8.7	3.0	0.3	1.5	1.1
Big Creek @ Hwy 16	03/26/2007	11.5	8.8	467	11.2	9.0	1.0	2.0	15.3
Big Creek @ Hwy 16	04/18/2007	7.9	8.4	598	8.7	8.0	1.0	1.5	10.2
Dry Fk Creek AB Randolph Ck	06/15/2006	---	8.4	---	---	1.5	1.0	1.5	1.9
Dry Fk Creek AB Randolph Ck	03/26/2007	8.5	8.0	504	7.3	0.3	0.1	0.5	0.01
Dry Fk Creek AB Randolph Ck	04/18/2007	---	---	---	---	0.5	0.05	0.5	0.01
Dry Fk Spring 01	06/15/2006	10.3	7.6	427	9.7	2.0	0.3	0.5	0.3
Big Crawford Spring	06/15/2006	6.2	7.6	449	10.7	8.0	0.6	2.0	8.2

ISSUES

Water Resources Issue - Forest canopy removal and erosion following log skidding, prescribed burning, herbicide treatments, and/or road construction could lead to adverse effects on water quality, and for this project specifically, sedimentation of water and changes in pH of stream water. The indicators for this analysis are:

1. The amount of sediment entering streams or wetlands.
2. Estimated concentration of herbicides in receiving waters.
3. Changes in pH of stream water.

The issue of increased water flows adversely affecting stream banks or channels from vegetative treatments is not carried forward because the amount of water increase from the vegetation treatments would be very small compared to the size of the drainages. Based on research, conifer treatments increase water yield about 3 inches (Troendle and Nankervis 2000), and non-conifer treatments do not measurably increase water yield. For Alternative 1, conifer treatments would be done on 1,604 acres, and non-conifer treatments would be done on 3,186 acres. For a brief analysis, assume that most of the precipitation occurs in the headwaters on National Forest System lands in the analysis area of 21,000 acres and the average annual discharge of 13.6 cubic feet per second (9,846 acre-feet per year) at the bottom of Big Creek watershed represents the water yield from this area. If it were also assumed that 1,604 acres of conifer treatment yields 3 inch water increase, then the total increase in water for this headwaters area would be 401 acre-feet per year or an increase of 4.1 percent. Since these treatments are distributed over many drainages, it is expected that a small increase such as this would not adversely affect stream banks or channels.

The issue regarding flood plains from the proposed action and alternatives is not carried forward because floodplains do not occur in the treatment areas since the streams in the project area are very small, are located on relatively steep stream channel gradients (greater than 2%) that result in very few areas that would be considered a true floodplain in the sense that a floodplain is a relatively flat area on each side of a channel where flood flows spread out during flood events.

Environmental Consequences

The approach to analysis is to 1) review research the potential effects of treatments such as those proposed in this project, 2) describe monitoring of soil and water effects of vegetative treatment projects that have been completed on the Wasatch-Cache National Forest, 3) describe the mitigation that is recommended for each alternative, 4) show the proximity of the treatment units to water features, and 5) take into consideration the possible effects and mitigation, discuss the effects focusing on the main issue which is the effect to water quality using the indicators of amount of sediment entering streams and changes in pH of stream water.

Review of Research on the Potential Effects to Water Resources from Timber Harvest, Road Construction, Prescribed Fire, Herbicide and Mechanical Treatments –
U.S. EPA researchers (Fulton and West 2002) reviewed the impacts of forestry activities on water quality and several key points were made. Researchers have concluded that "there is the potential for forestry operations to adversely affect water quality if best management practices (BMP) are poorly implemented. ... Sediment concentrations can increase due to accelerated erosion, water temperatures can increase due to removal of overstory riparian shade, slash and other organic debris can accumulate in water bodies depleting dissolved oxygen, and organic and inorganic chemical concentrations can increase due to harvesting and pesticide applications. … These potential increases in contaminants are usually proportional to the severity of site disturbance … Impacts of silvicultural non-point source pollution depend on site characteristics, climatic conditions, and the forest practices employed."

Researchers (Fulton and West 2002) reviewed the effects of prescribed fire on water quality and several conclusions were reached. They found that "prescribed fire can impact water quality by heating the soil and killing soil organisms, thereby altering nutrient transformation rates and bio-availability. These impacts depend upon the severity and intensity of the fire. Prescribed burning of slash can increase erosion and sediment delivery to streams by eliminating protective cover and altering soil properties. …The degree of erosion after a prescribed burn depends on soil erodibility; slope; precipitation timing, volume, and intensity; fire severity; cover remaining on the soil; and speed of revegetation." They also stated "the following management measures were identified as ways to reduce the magnitude of the effects of fire on water quality: (1) limit fire severity, (2) avoid burning on steep slopes, and (3) limit burning on sandy or water repellent soils."

Research (Fulton and West 2002) has shown that the amount of adverse effects to water quality can be influenced by:

1. Amount of soil disturbance
2. Amount of ground cover on the soil
3. Amount of buffer that exists to act as a filter between upland areas and water bodies (stream channels, lakes, and ponds)
4. Amount of accumulation of slash and organic debris in water bodies
5. Removal of overstory riparian shade

6. Introduction of organic and inorganic chemicals from harvesting and pesticide applications.

The following is from a brief discussion on the effects of prescribed fire on pH by John Stednick of Colorado State University (Stednick 2006).

> "*Immediately after a fire, stream pH may be affected by direct ash deposition (Stednick, unpublished) as oxides form from the volatilization of metallic cations. In the first year after fire, increased soil pH may also contribute to increased stream water pH (Wells et al. 1979). In most studies pH values were little changed by fire and fire-associated events (Landsberg and Tiedemann 2000). Transient pH values up to 9.5 were measured 8 months after the Entiat fires in eastern Washington (Tiedemann 1973 and 1981).*
>
> *Measures that reduce on-site soil erosion and stream vegetative buffers, such as riparian areas, will minimize effects of fire on water quality."*

Monitoring of wildfire ash on a first order stream in the Gila River drainage showed that pH concentrations in the stream increased following ash input and then returned to normal in about 24 hours (Earl and Blinn 2003).

There are several effects to water quality and several factors affect herbicide movement to water features that could occur from herbicide use. The following general effects are from the Wasatch-Cache National Forest Noxious Weed EIS (USDA Forest Service 2006e).

> *"Herbicide use requires caution because herbicides are chemical compounds which, if not used properly, can negatively affect water quality and, subsequently, aquatic species and human health. The risk to groundwater resources from herbicide application depends on the type, extent, and amount of herbicide that is used, local soil characteristics, and depth to the groundwater table. The risk to surface water resources from herbicide application also depends on the type, extent, and amount of herbicide used, as well as the site's proximity to a stream or wetland, a stream's ratio of surface area to volume, and whether transport from the site is runoff or infiltration controlled."*

The U.S. EPA (Stavola 2004) assessed the environmental impacts of tebuthiuron use and states that:

> *With aquatic exposures resulting from terrestrial applications, the pesticide is not placed in immediate contact with the aquatic plant, but rather reaches the plant indirectly after entering the water and being diluted. Aquatic exposure is likely to be transient in flowing waters. However, because of the exceptions where terrestrially applied herbicides could have effects on aquatic plants, OPP does evaluate the sensitivity of aquatic macrophytes to these herbicides to determine if populations of aquatic macrophytes that would serve as cover for T&E fish would be affected. …For most pesticides applied to terrestrial environment, the effects in water, even lentic water, will be relatively transient. Therefore, it is only with very persistent pesticides that any effects would be expected to last into the year following their application. As a result, and excepting those very persistent pesticides, we would not expect that pesticidal modification of the food and cover aspects of critical habitat would be adverse beyond the year of application.*

USFS (DeGraff et al. 2007) conducted research on the movement of hexazinone in buffer strips in a forested environment. Hexazinone has similar properties of high water mobility and high persistence (*long-half-life)* as tebuthiuron and picloram. One of its main findings is that *"While hexazinone did penetrate into the buffer zone, it was well below concentrations of concern."* The conclusion of the report states:

"Both the Unit 505 monitoring and post-fire groundwater monitoring well results demonstrate that hexazinone used in reforestation efforts in the southern Sierra Nevada does enter unsaturated and saturated groundwater zones. Monitoring to date does not find those detected concentrations approaching or exceeding the initial State of California water quality goal of 200 µg/L or the later less restrictive value of 400 µg/L.

On the Sierra National Forest, Unit 505 monitoring demonstrated that hexazinone can penetrate a significant distance into the 7.6-m buffer on either side of a Class 4 channel centerline. The detectable concentrations are a full magnitude lower than the State of California water quality goal. The pattern of mobility at these sensitive sites clearly shows peak concentrations of hexazinone in surface water following the first storm event and a gradual rise to peak concentrations of hexazinone in the vadose zone water after several storm events.

On the Stanislaus National Forest, monitoring well results yielded persistence information that has implications for groundwater monitoring in future reforestation projects. Plans for monitoring of the saturated groundwater zone should extend for two years of sampling following the year of application to ensure detection of hexazinone. Once detected, hexazinone will likely persist for one to four more years."

The effects of the use of herbicides on water quality are discussed in the effects section, 4.3.2 Surface and Groundwater Quality Chemicals of the Wasatch-Cache National Forest Noxious Weed EIS (USDA Forest Service 2006e). This discussion includes two of the chemicals that are proposed to be used for this project - 2,4D (2,4-dichlorophenoxy acetic acid), and/or picloram (Tordon K®). Information on the herbicide tebuthiuron is obtained from an herbicide fact sheet by the Bonneville Power Administration (USDOE Bonneville Power Administration 2000). Tebuthiuron is moderately persistent with a moderate soil adsorption coefficient. The half-life of tebuthiuron is 360 days. There is a very high potential for tebuthiuron to leach into groundwater and a high potential for surface water runoff.

The WCNF Noxious Weed EIS analyzed four worst-case situations and evaluated the potential for chemical contamination of water resources and the potential risk to human health. The situations were: 1) the inadvertent entry of herbicides into surface water or groundwater through surface runoff (two scenarios are examined for large watersheds and two scenarios are examined for small watersheds); 2) leaching through soils (two scenarios are examined); 3) accidental spills; and 4) wind drift. The summary of the worst-case situations are presented below and concludes that if BMPs and mitigation measures are adhered to then the potential for adverse affects to surface and groundwater quality from chemical use will be minimized.

"The direct and indirect effects of chemical treatments under the Proposed Action would be expected to result in long-term improved streambank, riparian habitat conditions, and water quality. However, short-term disturbances may occur from vegetation removal and may have a slight negative effect on either water quality or aquatic resources in specific areas.

Disturbances may also arise from the inadvertent chemical contamination of water resources through surface runoff, leaching through soils, accidental spills, or wind drift. However, it is unlikely that any of the worst-case situations examined here would occur because of the implementation of BMPs, or use of a site-specific implementation process, decision tree, the treatment options table, or an adaptive strategy. If worst-case conditions did occur, several scenarios described previously involving herbicide runoff and possibly leaching of herbicides would result in exceedances of State and EPA water quality standards. Herbicide-specific buffers should reduce the moderate level of concern regarding the chance of a product entering the aquatic habitat.

Potential short-term impacts to water resources could occur if there were an accidental spill of a relatively toxic herbicide in or near a stream, or if application rates greater than those recommended given the worst-case scenarios presented above were to occur. Resultant effects may be localized *depending on various factors, including the volume of spill, dilution by the receiving water, soil type and precipitation events, etc. Adherence to BMPs and mitigation measures would reduce the likelihood of such a spill occurring, plus they would minimize or avoid the potential occurrence of wind-drift-related impacts on water quality."*

Monitoring of Vegetation Treatment Projects on the Wasatch-Cache National Forest – Monitoring on the Wasatch-Cache NF of timber harvest and prescribed fire has shown that these activities with best management practices in place can be accomplished with very little effect on soil and water resources. Vegetation treatment projects were monitored on several occasions as shown in Table 3.11.4.

Table 3.11.4. Vegetation treatment monitoring on the Wasatch-Cache National Forest.

Date	Monitoring Location and Type
06/04/2002	Review of post-harvest treatments of the Whiskey/Dahl Timber Sale in Dahlgreen Creek drainage of the WCNF.
03/23/2003	Review of timber harvest units in Dahlgreen Creek looking for indicators of sediment movement such as sediment deposition areas and rilling.
03/31/2003	Review of pre-fire conditions at a proposed prescribed fire location along Highway 150 near Samak, Utah.
05/14/2003	Review of post-fire conditions at a proposed prescribed fire location along Highway 150 near Samak, Utah.
07/02/2003	Review of post timber harvest in Bear Hodges area, Logan Ranger District, WCNF.
07/28/2003	Review of the West Duck Timber Sale in the East Fork Blacks Fork.
08/04/2003	Review of timber harvest and access road conditions of timber harvest area in Slideout Canyon, Logan Ranger District, WCNF.
10/15/2003	Review of feller/buncher timber harvest equipment use on private land in Mill Creek drainage of the Evanston Ranger District, WCNF.
06/29/2004	Review of post-wildfire conditions in Shepard Canyon north of Farmington, Utah.
07/15/2004	Review of timber treatment units that were thinned in the mid-1990s west of Coyote Hollow in the West Fork Bear River drainage.
08/05/2004	Monitoring prescribed fire that was conducted in 1999 in Rock Creek east of Logan, Utah.
01/26/2005	Monitoring report on stream channel shape for Bear Hodges Timber Sale in Slideout Canyon west of Meadowville, Utah.
07/31/2006 – 08/02/2006	Review of soil and water conditions in the 1980 Green Fork, 1983 Green Fork II, and 1998 Pole Canyon, and 1971 Old Canyon timber sales.

Timber harvest that took place in the West Fork Bear River drainage was monitored in October 2001 near Humpy Creek and in July 2004 in Coyote Hollow showed that skid trails and intermittent roads had dense vegetation growing on them and no signs of erosion or sediment movement. These areas were treated similar to those that are in this timber treatment proposal. In August 2003, a timber harvest area was monitored in Slideout Canyon east of Logan, Utah. These timber treatments were clearcuts and an intermittent service road was built in the canyon. Monitoring showed that slash was scattered across the harvest units as a best management practice to provide ground cover; the skid trails have revegetated quickly; no sign of erosion has been seen on the skid trails or across the harvest units; the drainage dips in the road were working properly to remove flowing water from the road and the road has remained in very good condition for several years; and no sediment movement to stream channels has been observed.

Field trips to past vegetation projects in Dahlgreen Creek took place on June 4, 2002 and March 23, 2004. The field trips showed that, after treatment, vegetation protected the ground and no accelerated erosion was seen in the area. Reviews of the West Duck Timber Sale on the East Fork Blacks Fork on July 28, 2003 showed that skid roads revegetate quickly and slash left on the ground provides very good ground cover for protecting soil.

In 2006, field trips to the 1980 Green Fork, 1983 Green Fork II, and 1998 Pole Canyon, and 1971 Old Canyon timber sales show that regeneration of lodgepole pine is excellent, ground cover in the harvest units is about 100 percent, very little erosion and sedimentation has occurred in the harvest units as indicated by no rilling or gullying, and the only place along the harvest logging roads that have accelerated erosion is at a drainage bottom in Old Canyon that needs a culvert. The main road in New Canyon shows accelerated erosion on the road surface and is in need of additional drainage dips to reduce the length of the water flowing on the road surface.

Monitoring of prescribed fires at Rock Creek and along Highway 150 near Samak, Utah in 2003 and 2004 showed that very little erosion and sedimentation occurred from these fires. The places where erosion and sedimentation did occur were in areas of steep slopes and high burn severity. A wildfire that occurred in Shepard Canyon in late October 2003 burned in a manner that would have been in a prescription for a prescribed fire. The results of monitoring showed that the following year showed that most of the burned area was low to moderate burn severity and vegetation grew back quickly. The only evidence of accelerated erosion and poor vegetative recovery was in a small area of high burn severity on a moderately-steep hillslope.

Table 3.11.5. Summary of stream channel length and area removed due to mitigation.

Prescription	Stream Channel in treatment areas - RHCA (miles) Alt 1	Stream Channel in treatment areas - RHCA meters (miles) Alt 3	Acres Removed from Treatment Areas (RHCA) Alt 1	Acres Removed from Treatment Areas (RHCA) Alt 3
Clearcut	1.1	(0.6)	14.0	8.2
Conifer Removal w/patch	0	0	0	0
Conifer Removal followed by Fire	2.6	1.6	89.2	52.3
Group Selection	0.3	0.2	11.0	6.6
Groups and Patches	0.1	0	3.8	0
Irregular Shelterwood	0.6	0.6	19.2	19.2
IRSW with groups / patches	0	0	0	0
Overstory Removals	0.7	0.7	8.4	8.4
Rx Fire / herb / mech	0.4[a] 5.8	0.4[a] 5.3	211.9	195.1
Rx Fire mosaic	1.2	1.2	16.0	16.2
Shelterwood Prep	0.1	0	0.8	0
Commercial Thin w/groups	0	0	0	0
Totals	13.0	10.7	374.3	306.0

[a] Distance [meters (miles)] of perennial stream within unit(s) all others ephemeral.

a. Alternative 1 – Proposed Action

1. Direct and Indirect Effects

The main issue for water resources is that forest canopy removal and erosion following log skidding, prescribed burning, herbicide or chemical treatments, and/or road construction could lead to adverse effects on water quality, and for this project specifically, sedimentation of water and changes in pH of stream water. The indicators for this analysis are:

- The amount of sediment entering streams or wetlands.
- Estimated concentration of herbicides in receiving waters.

- Changes in pH of stream water.

Several best management practices are part of the proposal so that adverse effects to soil and water resources from soil disturbance, reduced ground cover, and road construction listed above can be minimized. These BMPs are the type of harvest, standard operating procedures, and mitigation requirements that are used for harvest operations, road construction and maintenance, prescribed fire use, and herbicide application. Specifically, the BMPs are:

- Minimize soil disturbance through use of designated skid trails roads.
- Leave an adequate amount of ground cover on the soil through mosaic treatment pattern in the larger prescribed fire/herbicide/mechanically treated units.
- Harvest and treatment related activities would be limited to high-risk, individual tree cutting that will be left on site for woody debris recruitment. There will be no lighting of prescribed fire within the RHCA. Burning within RHCAs is not expected, however, there may be minimal low heat backing fires in some areas. This would provide a wide buffer that would act to minimize sediment movement to streams and springs and implementing a mosaic pattern that would leave areas that would act as a buffer to sediment movement.
- Leave an appropriate amount of slash and organic debris accumulation in water bodies.
- Locate treatment areas on land that is not steep.
- Minimize the introduction to water bodies of organic and inorganic chemicals from harvesting and pesticide applications by using pesticides or herbicides in accordance with manufacturer's specifications and allowing Riparian habitat Conservation Areas (RHCAs) that act as buffer zones to streams and springs.

For herbicide treatments, it is recommended that treatments will be tailored to mitigate for sensitive conditions of the site using a Decision Tree (Figure 1-3 in Chapter 1 of Wasatch-Cache National Forest Noxious Weed EIS (USDA Forest Service 2006e)) and then selecting an ecologically sound method that would achieve the management.

The direct effects of mechanical treatments are expected to be some soil disturbance and removal of vegetative cover. Since there will be a buffer strip between the treatment areas and riparian and stream zones, the direct and indirect effects of Alternative 1 is that no sedimentation of streams or springs is expected because the buffer zones in the RHCAs will catch any sediment that would move from the treatment units. Monitoring of timber harvest and prescribed fire treatments as listed in Table 3.11.4 show that when BMPs are implemented properly sediment does not move from the treatment area in timber harvest units, vegetation grows back quickly in areas of prescribed burns, roads have proper drainage and shed water into designated areas away from streams, and ground cover is provided by slash left in timber units. Herbicides will be used according to manufacturer's specification and RHCA buffer zones will provide added distance between treatment units and application areas.

Four main factors that affect herbicide movement are herbicide properties, soil properties, site conditions, and management practices (Hairston 1999). Regarding pesticide properties, the three herbicides that are proposed to be used (tebuthiuron, 2,4D (2,4-dichlorophenoxy acetic acid), and picloram) all have a high risk due to high water solubility, poor soil adsorption, and long persistence (long half-life) with the exception of 2,4D (2,4-dichlorophenoxy acetic acid) which has short persistence (short half-life). The soil properties and site conditions in the areas where herbicides would be used would have a low risk of contamination potential because the soil texture has moderate to low saturated conductivity (soil types SGF (3 acres)and SDF (15 acres) have high soil conductivity and herbicides will not used in areas with these soil types), abundant organic matter, and few macropores resulting in low leaching potential and the site conditions have relatively moderately deep depth to groundwater (greater than six feet), small volumes of rainfall, and no irrigation of the land. The fourth factor, management practices are expected to be low risk based on the requirement of following manufacturer's recommendations for use of the herbicide.

The implementation of mitigation that allows treatments only outside of RHCAs would minimize the likelihood of herbicides from moving into water features by providing a buffer between treatments and stream channels and springs. It is expected that some herbicide will move into the surface water and groundwater but the concentration of the herbicide will be very low and not adversely affect the health of riparian or aquatic vegetation or exceed water quality standards. Also, the buffer strips between the treatment area and riparian areas will slow the movement of herbicide to the point where the herbicide will break down before it reaches riparian or aquatic features. It is not expected that the worst-case situations described in the WCNF Noxious Weed EIS would occur because of the implementation of BMPs, or use of a site-specific implementation process, decision tree, the treatment options table.

The direct effects of the Alternative 1 to the level of pH in streams are expected to be very little increase in pH. The ephemeral channels flow only during spring runoff and surface runoff during the spring is expected to be relatively slow and in the case of prescribed fire where pH levels may increase from ash increases, a slight increase in pH in the ephemeral stream water may occur for a short time because the ash may float in the surface runoff. This increase is expected to be low because ash would be caught in the unburned areas of the treatment unit (mosaic burn pattern) and in the RHCAs buffer, and would probably occur for a short period of time, likely to be less than 24 hours. There will be no lighting of prescribed fire within the RHCA. Burning within RHCAs is not expected, however, there may be minimal backing fire in some areas.

No adverse effects are expected to wetlands (the only known wetland in the treatment units is Stove Spring) because the RHCA buffer would protect them.

b. Alternative 2 – No Action

1. Direct and Indirect Effects

The direct and indirect effects to water resources would be that water quality (sedimentation and pH) specifically would remain unchanged from existing conditions because no treatments would be implemented.

c. Alternative 3 – Reduced Treatment and Wildlife Emphasis

1. Direct and Indirect Effects

The direct and indirect effects to water quality would be the same as Alternative 1 because no sediment is expected to reach streams or springs and the prescribed fire units that have the potential to generate ash are also included in this alternative.

d. Cumulative Effects

The cumulative effects area for water resources is the sixth code hydrologic unit that the Proposed Action is within. These areas are from the headwaters of Otter Creek, Little Creek, and Big Creek to the Bear River. Other actions that may have an influence on soil, water, and aquatic resources are dispersed recreation, livestock grazing, fuel treatments, wildfire, prescribed fire, riparian fencing, motorized roads and trails, off-highway vehicle use. The list below contains a summary of other actions that have occurred in the past, are happening currently, and are expected to occur in the future.

- **Dispersed Recreation** – On BLM land, all recreation is dispersed recreation but Little Creek Reservoir has a campsite that has mostly day use for fishing in the reservoir and it has a winter use trailhead.
- **Livestock Grazing** – On Forest Service lands, sheep and cattle grazing is a permitted activity that has been occurring for over 100 years. A gradual improvement in land conditions have occurred as indicated by increased ground cover and absence of active soil erosion in most areas within grazing allotments. The cumulative effects area have ephemeral channels that flow only in the spring time prior to livestock going on to the allotment and perennial streams east of the U.S. Forest Service boundary have a relatively flat area adjacent to the stream channels that extends from 20 feet to 100 feet wide. Grazing is conducted on the WCNF under grazing standards and guidelines in the 2003 Revised Forest Plan such as utilization standards that limit the amount of forage consumed to protect soil resources and riparian stubble height standards to ensure adequate vegetation remains to stabilize stream banks.
- **Fuel Treatments –** On BLM land, allotments are New Canyon and Big Creek allotments. Many fuel treatments are planned within these allotments.
- **Wildfire –** On BLM land, about two or three wildfires have burned in the area in the past. Seven years ago a large wildfire burned the lower range and part of it went up on the Wasatch-Cache NF.
- **Prescribed Fire –** On BLM land, several prescribed fires have been set adjacent to the main roads. There is a very active Wildland Urban Interface (WUI) program in the area.
- **Riparian Fencing and Stream Conditions** – On BLM land, exclosure fences are in place along almost all of the perennial reaches on BLM land and gaps in the fencing occur on private land. Exclosure fences are located in Big Creek and Randolph Creek up to the USFS boundary and in Little Creek and Otter Creek. The areas that are in the exclosure are grazed periodically but they are mostly closed to grazing. The riparian areas on BLM land looked in fairly good condition with close to 100 percent sedge stream bank vegetation and some stream bank trampling. Cows grazing in the unfenced riparian area on private land, and for the most part, the sedge-vegetated stream banks in this area are stable. The stream banks along the deeper areas are not trampled and looked like they had overhanging banks.
- **Off Highway Vehicles (OHV) use –** On BLM land, the area has an OHV use plan and OHV use is limited to existing roads and trails and seasonal closures are in place in sensitive soil areas in Otter Creek, those being the white chalky hills that are highly erodible.

The cumulative effects from the Alternatives 1 and 3 are about the same. Very little effect to water quality is expected from Alternatives 1 and 3 since there would be very little incremental impact to streams or springs from sedimentation or increased pH from the proposed treatments. In addition, there is good protection of riparian areas on the important perennial reaches on BLM land and there are relatively good riparian conditions along the main perennial reaches off streams on private land which means that water quality in the cumulative effects area is expected to remain unchanged from the action alternatives.