Cache la Poudre Wildfire/Watershed Assessment

Prioritization of watershed-based risks to water supplies

Final Report V3 • November 2010

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City of Fort Collins and City of Greeley

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http://www.jw-associates.org/Projects/Poudre_Main/Poudre_Main.html

On the cover - a posterized photograph of a beach at Horsetooth Reservoir near Fort Collins

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INTRODUCTION

This watershed assessment is designed to identify and prioritize sixth-level watersheds based upon their hazards of generating flooding, debris flows and increased sediment yields following wildfires that could have impacts on water supplies. It is intended to expand upon current wildfire hazard reduction efforts by including water supply watersheds as a community value. The watershed assessment follows a procedure prescribed by the Colorado Watershed Protection Data Refinement Work Group (2009).

Following the prioritization of watersheds and identification of Zones of Concern, some basic information was analyzed within the Zones of Concern to complete an initial screening of potential opportunities for watershed protection. The results of the identification of potential opportunities is presented in the *Opportunities & Constraints* section of this report.

Another goal of this assessment is to gather the key water supply stakeholders to communicate the suggested process, listen to any suggested changes, and build collaborative support for the assessment. Four stakeholder meetings have created a diverse group of stakeholders (Appendix A) that have been engaged in the process.

WATERSHED DESCRIPTION

The Cache la Poudre watershed is a Front Range watershed that typically begins at the continental divide and ends at the start of the western edge of the plains. It is a tributary to the South Platte River. The Cache la Poudre watershed is one fourth-level[1] (eight-digit) watershed (HUC 10190007) that is 1,219,038 acres in size and contains 53 sixth-level watersheds.

This watershed assessment is designed to assess hazards from wildfire to water supply. Therefore, the subwatersheds that are entirely on the plains to the east were eliminated from this watershed assessment. For this watershed assessment, 20 sixth-level watersheds were eliminated based upon their wildfire hazard, ruggedness, and forested area. The plains watersheds would have skewed the results of the assessment because they are relatively flat, have higher road densities and very different fire regimes.

The Cache la Poudre watershed used in this analysis is 648,045 acres, contains eight fifth-level watersheds and 33 sixth-level watersheds, which are the analysis units for this assessment (Colorado Watershed Protection Data Refinement Work Group 2009). The Cache la Poudre watershed and its fifth-level and sixth-level watersheds are shown on Figure 1 and listed in Table 1.

Smoke plume from the Picnic Rock Fire in 2004 (Photographic courtesy of John Kabot)

[I] The watersheds that were used are part of the existing national network of delineated watersheds. Hydrologic Unit Codes (HUCs) are nested watersheds and are designated numerically by levels (Federal Geographic Data Committee 2004). Sixth-level HUCs or watersheds, use the 11th and 12th digits in the HUC code. Fifth-level HUCs use the ninth and 10th digits in the HUC code.

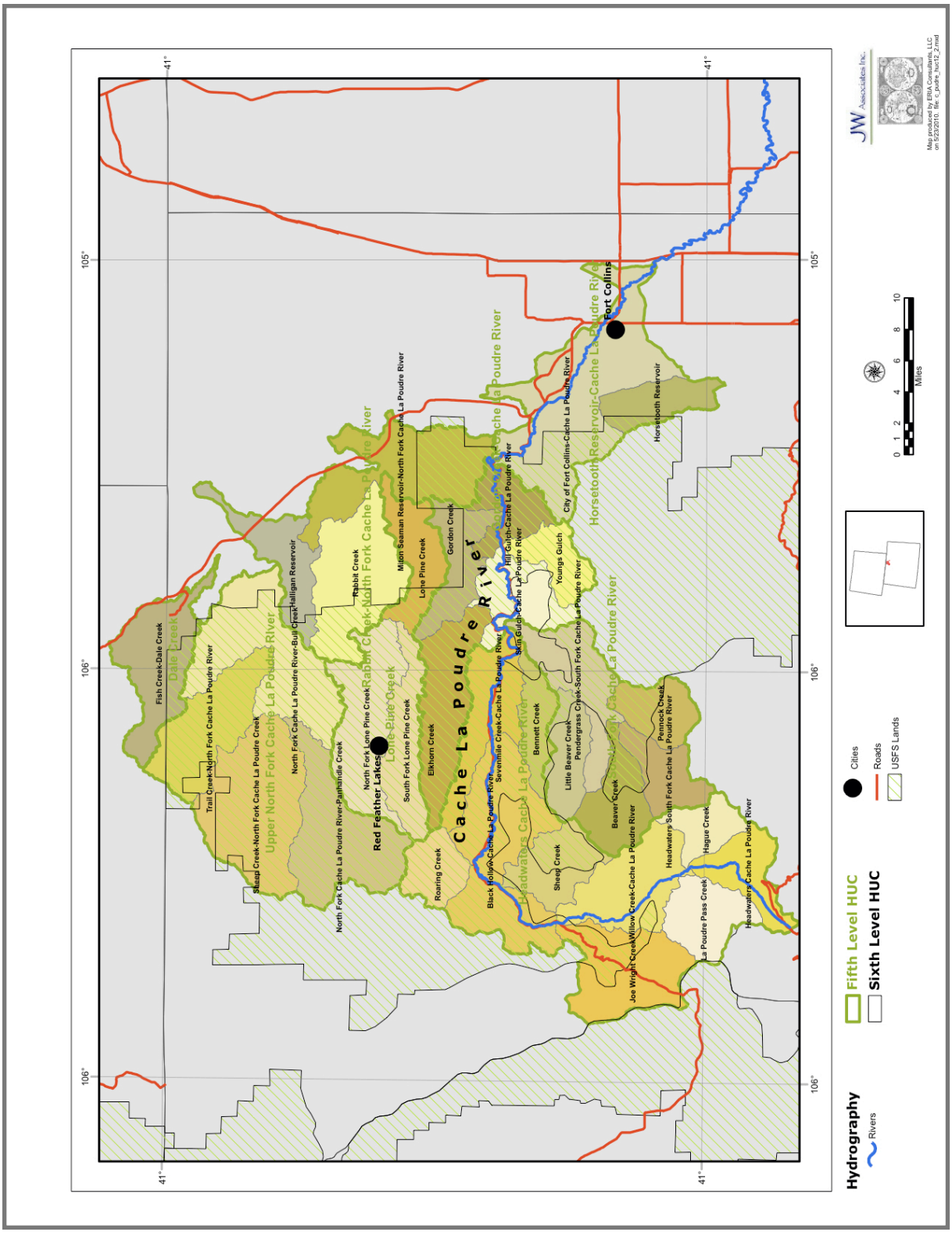

Figure 1. Cache la Poudre Watershed Analysis Area[2]

[2] The sixth-level watersheds can be seen in this figure outlined in gray lines.

Table 1. Fifth-level and Sixth-level Watersheds Analyzed in the Cache la Poudre Watershed Assessment[3]

Fifth-level Watershed	Sixth-level Watershed	Watershed Area (acres)	Hydrologic Unit Code (HUC)	Map #
South Fork Cache La Poudre River HUC 1019000701	Beaver Creek	14,135	101900070101	305
	Headwaters South Fork Cache La Poudre River	11,094	101900070102	306
	Pennock Creek	11,068	101900070103	307
	Little Beaver Creek	11,562	101900070104	308
	Pendergrass Creek-South Fork Cache La Poudre River	18,639	101900070105	309
Headwaters Cache La Poudre River HUC 1019000702	Hague Creek	8,685	101900070201	310
	Headwaters Cache La Poudre River	12,709	101900070202	311
	La Poudre Pass Creek	14,066	101900070203	312
	Joe Wright Creek	24,468	101900070204	313
	Willow Creek-Cache La Poudre River	21,936	101900070205	314
	Sheep Creek	13,966	101900070206	315
	Roaring Creek	9,938	101900070207	316
	Black Hollow-Cache La Poudre River	37,738	101900070208	317
	Bennett Creek	9,210	101900070209	318
	Sevenmile Creek-Cache La Poudre River	18,640	101900070210	295
Gordon Creek-Cache La Poudre River HUC 1019000703	Elkhorn Creek	22,259	101900070301	296
	Youngs Gulch	9,823	101900070302	297
	Skin Gulch-Cache La Poudre River	14,920	101900070303	298
	Gordon Creek	13,908	101900070304	299
	Hill Gulch-Cache La Poudre River	11,161	101900070305	300
Upper North Fork Cache La Poudre RIver HUC 1019000704	North Fork Cache La Poudre River-Panhandle Creek	29,786	101900070401	301
	Sheep Creek-North Fork Cache La Poudre Creek	35,586	101900070402	302
	North Fork Cache La Poudre River-Bull Creek	34,294	101900070403	303
	Trail Creek-North Fork Cache La Poudre River	23,034	101900070404	304
Dale Creek 1019000705	Fish Creek-Dale Creek	23,097	101900070503	327
Lone Pine Creek HUC 1019000706	South Fork Lone Pine Creek	16,305	101900070601	319
	North Fork Lone Pine Creek	25,269	101900070602	320
	Lone Pine Creek	14,153	101900070603	321
Rabbit Creek-North Fork Cache La Poudre River HUC 1019000707	Halligan Reservoir	15,127	101900070701	322
	Rabbit Creek	28,860	101900070702	323
	Miton Seaman Res.-North Fork Cache La Poudre River	30,516	101900070704	324
Horsetooth Reservoir HUC 1019000708	Horsetooth Reservoir	10,974	101900070802	325
	City of Fort Collins-Cache La Poudre River	51,119	101900070805	326
	Total Area	**648,045**		

[3] Map numbers are used in Figures 2, 5 and 8

WATERSHED ASSESSMENT

The potential of a watershed to deliver sediments following wildfire depends on forest and soil conditions, the physical configuration of the watersheds, and the sequence and magnitude of rain falling on the burned area. High-severity fires can cause changes in watershed conditions that are capable of dramatically altering runoff and erosion processes in watersheds. Water and sediment yields may increase as more of the forest floor is affected by fire.

The Cache la Poudre Watershed Assessment considers four components that are integral in evaluating hazardous watershed conditions: wildfire hazard, flooding or debris flow hazard, soil erodibility and water uses. This section of the report presents the watershed assessment analysis that results in prioritization of sixth-level watersheds. It also discusses the technical approach for each component and the process used to assemble the watershed ranking.

The Cache la Poudre Watershed Assessment was developed through a stakeholder review process. The stakeholder group included representatives from water providers; federal, state and local land management agencies; counties; towns and other interested groups (Appendix A). Four stakeholder meetings were conducted to get the groups involved in the process, provide some local expertise to check and adjust the draft results and to understand how the assessment can be useful to the various stakeholder organizations.

The results for each component are categorized into five categories that are used throughout the analysis. The categorization procedure is the one prescribed by the Colorado Watershed Protection Data Refinement Work Group (2009). The categories are used in this analysis for the purpose of comparing watersheds to each other within the Cache la Poudre Watershed. Comparisons with other watershed assessments are not valid because this approach prioritizes watersheds by comparing them to the other sixth-level watersheds only in this watershed assessment area.

The calculation of ranking for each sixth-level watershed is completed as follows:

1. Use the hazard based on the percentage of each sixth-level watershed (or other metrics).
2. Scale the results so that they fall within five equal categories.
3. Round the scaled result to the nearest whole number (retain the actual number for use in the Composite Hazard Ranking).
4. Create a map of the results using the following scheme:

    Category 1 – Lowest

    Category 2

    Category 3

    Category 4

    Category 5 – Highest

Component 1 - Wildfire Hazard

The forest conditions that are of concern for this assessment are the wildfire hazard based on existing forest conditions. The wildfire hazard (Flame Length) was determined using the Fire Behavior Assessment Tool (FBAT) (http://www.fire.org) which is an interface between ArcMap and FlamMap. The input spatial data were collected from LANDFIRE project (http://www.landfire.gov/).

After a mountain pine beetle outbreak there are substantial increases in the amount of fine dead fuels in the canopy. The majority of these fuels remain in the canopy for 2-3 years post outbreak (Knight 1987, Schmid and Amman 1992). Therefore, certain input spatial data sets were updated based on Mountain Pine Beetle (MPB) mortality conditions using USDA Forest Service, Rocky Mountain Region Aerial Detection Survey (ADS) Data from the years 2002-2007 (http://www.fs.fed.us/r2/resources/fhm/aerialsurvey/). The assumptions used in the FBAT model are presented in Appendix B.

The flame length results were divided into five categories of wildfire hazard ranging from lowest (Category 0) to highest (Category 4). The flame length categories that were used are;

Flame Length Category 0 - 0 meters

Flame Length Category 1 - 1 to 10 meters

Flame Length Category 2 - 11 to 25 meters

Flame Length Category 3 - 26 to 40 meters

Flame Length Category 4 - >40 meters

Figure 2 shows the results of the wildfire hazard modeling. The results were categorized by sixth-level watershed into five categories that are used throughout the analysis (see Table C-1 in Appendix C) using the following formula.

Wildfire Hazard Ranking = (Percentage in Category 3 + Percentage in Category 4 * 2)

The categorized wildfire hazard by sixth-level watershed was mapped (Figure 3). The map shows that the highest hazards are in the following sixth-level watersheds: Willow Creek-Cache La Poudre River, Headwaters Cache La Poudre River, Little Beaver Creek, Pendergrass Creek-South Fork Cache La Poudre River, Pennock Creek, Sheep Creek, and La Poudre Pass Creek. Eight watersheds were ranked as Category 4, which is the next highest category (Appendix C).

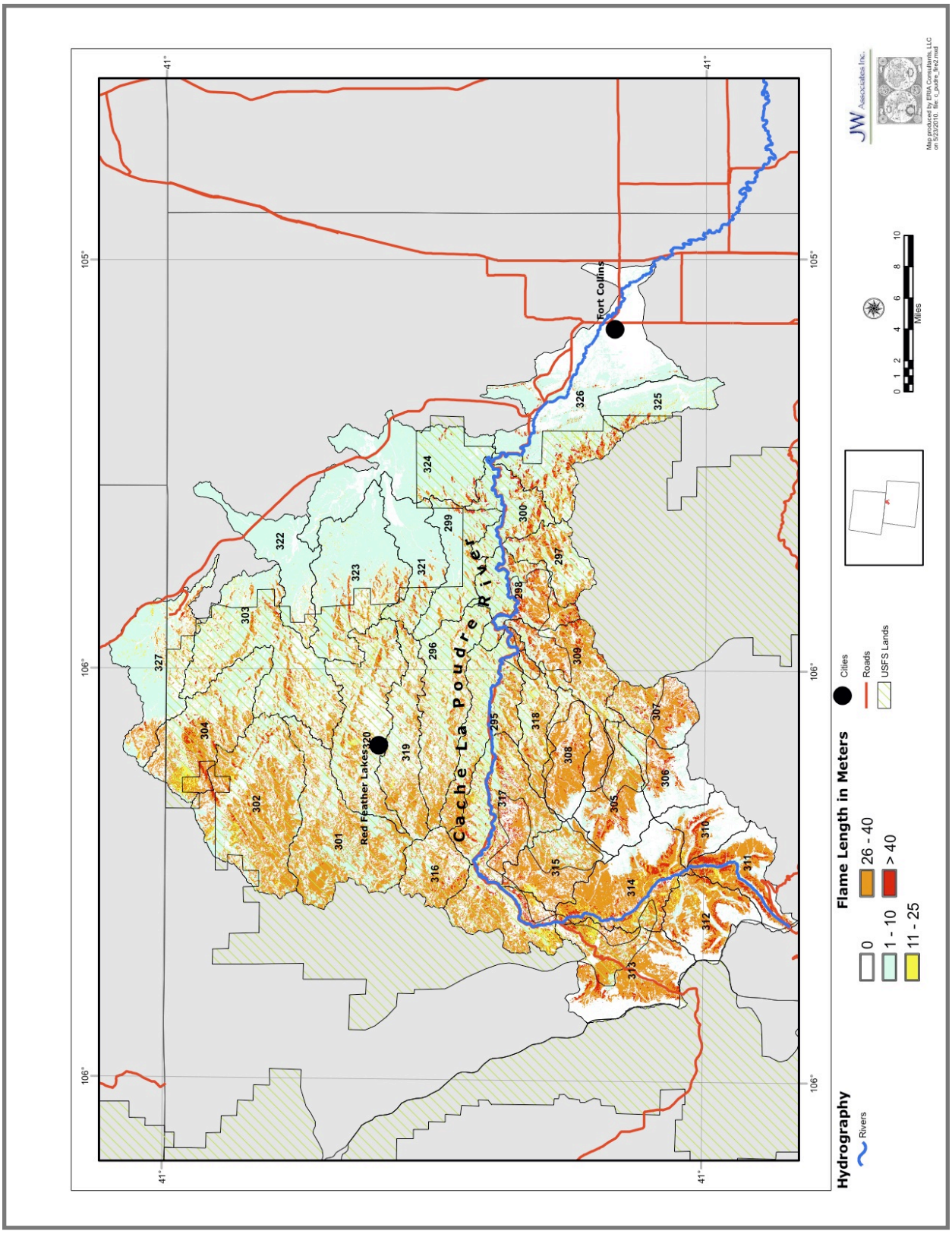

Figure 2. Cache la Poudre Watershed Wildfire Hazard Modeling Results

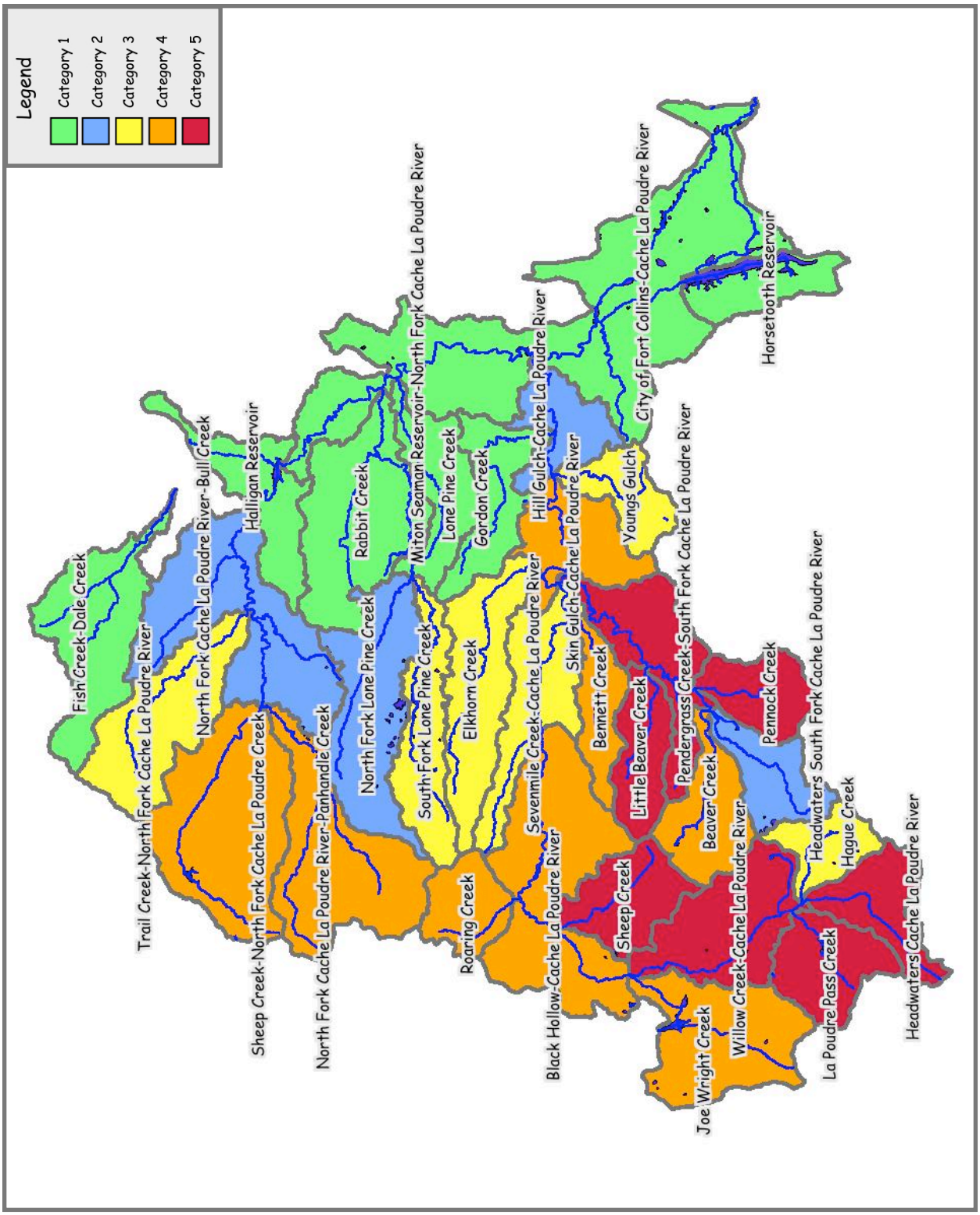

Figure 3. Cache la Poudre Watershed Wildfire Hazard Ranking

Component 2 - Flooding or Debris Flow Hazard

A combination of ruggedness and road density (miles of road per square mile of watershed area) was used to assess the flooding or debris flow hazard portion of the assessment. The two components, ruggedness and road density, are described below.

Ruggedness

Watershed steepness or ruggedness is an indicator of the relative sensitivity to debris flows following wildfires (Cannon and Reneau 2000). The more rugged the watershed, the higher its sensitivity to generating debris flows following wildfire (Melton 1957). The Melton ruggedness factor is basically a slope index.

Melton (1957) defines ruggedness, R, as;

$$R = H_b A_b^{-0.5}$$

Where A_b is basin area (square feet) and H_b is basin height (feet) measured from the point of highest elevation along the watershed divide to the outlet.

The ruggedness result in some watersheds was adjusted because they do not accurately reflect the slope in those watersheds. Those situations are most common in composite watersheds because they are disconnected from their headwaters. These watersheds can have a high hazard for debris flows because they contain a main stem of a creek or river with several steep first order streams as tributaries. In those situations, the ruggedness calculation was adjusted up by reducing the watershed area. These adjustments were completed on the following watersheds; Sevenmile Creek-Cache La Poudre River, Pendergrass Creek-South Fork Cache La Poudre River, Skin Gulch-Cache La Poudre River, Hill Gulch-Cache La Poudre River, and Elkhorn Creek.

Figure 4 displays the categorized ruggedness for the Cache la Poudre Watershed. The tabular results are presented on Table C-2 in Appendix C. The map (Figure 4) shows that the most rugged sixth-level watersheds are Headwaters South Fork Cache La Poudre River, Sevenmile Creek-Cache La Poudre River, Pendergrass Creek-South Fork Cache La Poudre River, Hague Creek, Skin Gulch-Cache La Poudre River, and Bennett Creek.

Headwaters South Fork Cache La Poudre River was skewing the categorization because of its high ruggedness value. The ruggedness value for this watershed was manually given a score slightly higher than the next lowest score (Table C-2 in Appendix C).

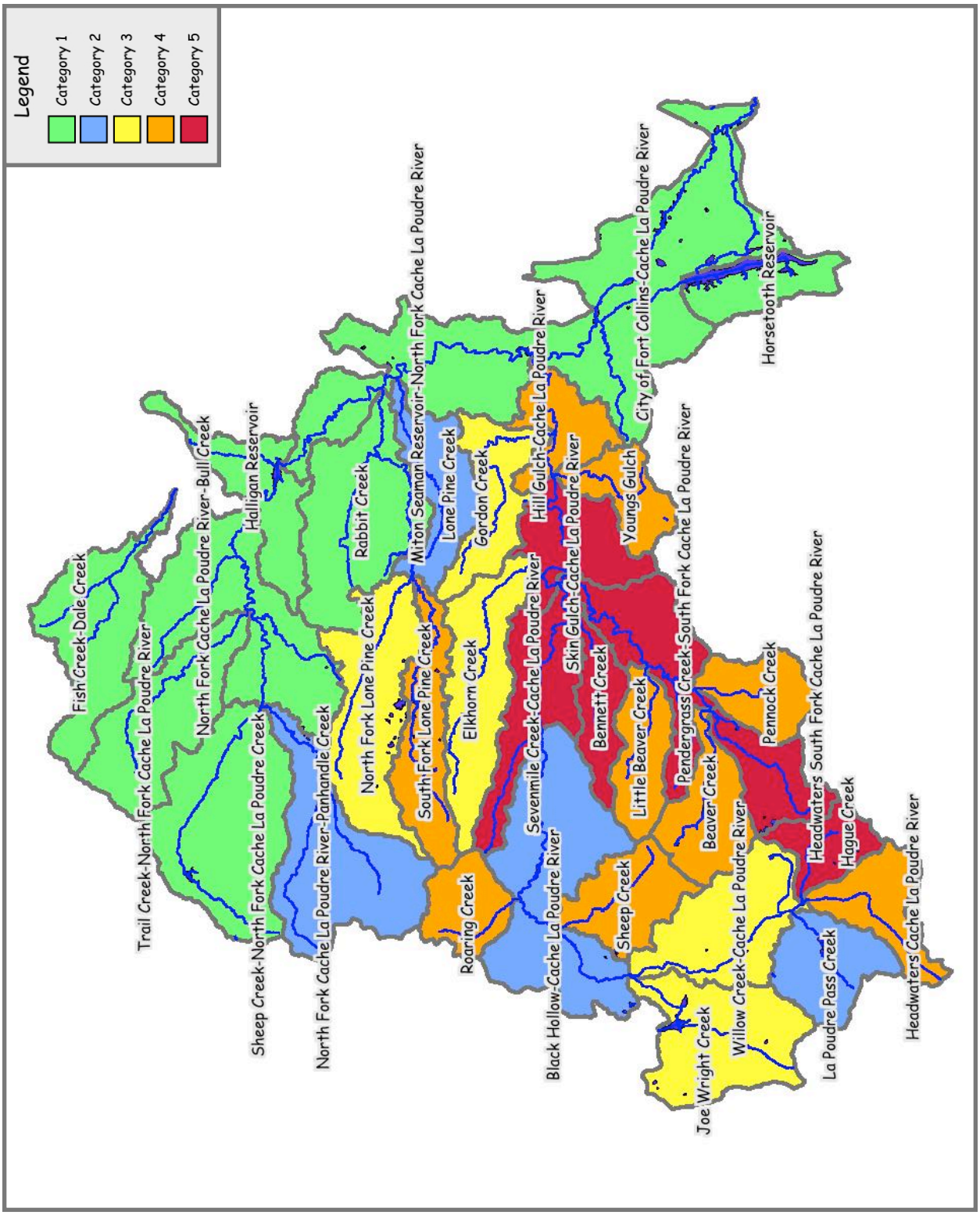

Figure 4. Cache la Poudre Watershed Ruggedness Ranking

Road Density

Roads can convert subsurface runoff to surface runoff and then route the surface runoff to stream channels in ditches, which can increase peak flows (Megan and Kidd 1972, Ice 1985, and Swanson et al. 1987). Therefore, watersheds with higher road densities have a higher sensitivity to increases in peak flows following wildfires. Road density in miles of road per square mile of watershed area was used as an indicator of flooding hazard. The U.S. Forest Service roads data was used on National Forest System (NFS) lands because it is the most accurate roads data for those roads in the forest. On all other lands the U.S. Census Bureau's Tiger database was used because it is a consistent roads data layer (Figure 5).

Road densities were adjusted in some watersheds for two separate reasons. One reason for adjusting the road density was the situation where a watershed had a much higher road density than the next highest value, so that watershed was skewing the categorization. In that situation, the watershed was manually given a road density slightly higher than the next highest score.

The other situation where road density was adjusted is where some of the roads within a watershed were within towns, developed areas, or outside the forested areas of the watershed. The roads that are of interest in this analysis are those roads that would increase the risk of flooding or debris flows following wildfires in forested areas. The watersheds were all examined by looking at the roads data overlain on digital images and vegetation mapping. If it was found that there were significant lengths of road outside forested areas, the road density in those watersheds was adjusted down based on ocular estimates.

Road density in the North Fork Cache La Poudre River-Panhandle Creek, Gordon Creek, Horsetooth Reservoir, and City of Fort Collins-Cache La Poudre River watersheds were all adjusted down. The adjustments are displayed on Table C-3 in Appendix C.

Figure 6 displays the categorized road density for the Cache la Poudre Watershed and tabular results are presented in Appendix C (Table C-3). Figure 6 shows that the highest rankings are in North Fork Cache La Poudre River-Panhandle Creek, Gordon Creek, North Fork Lone Pine Creek, and Horsetooth Reservoir.

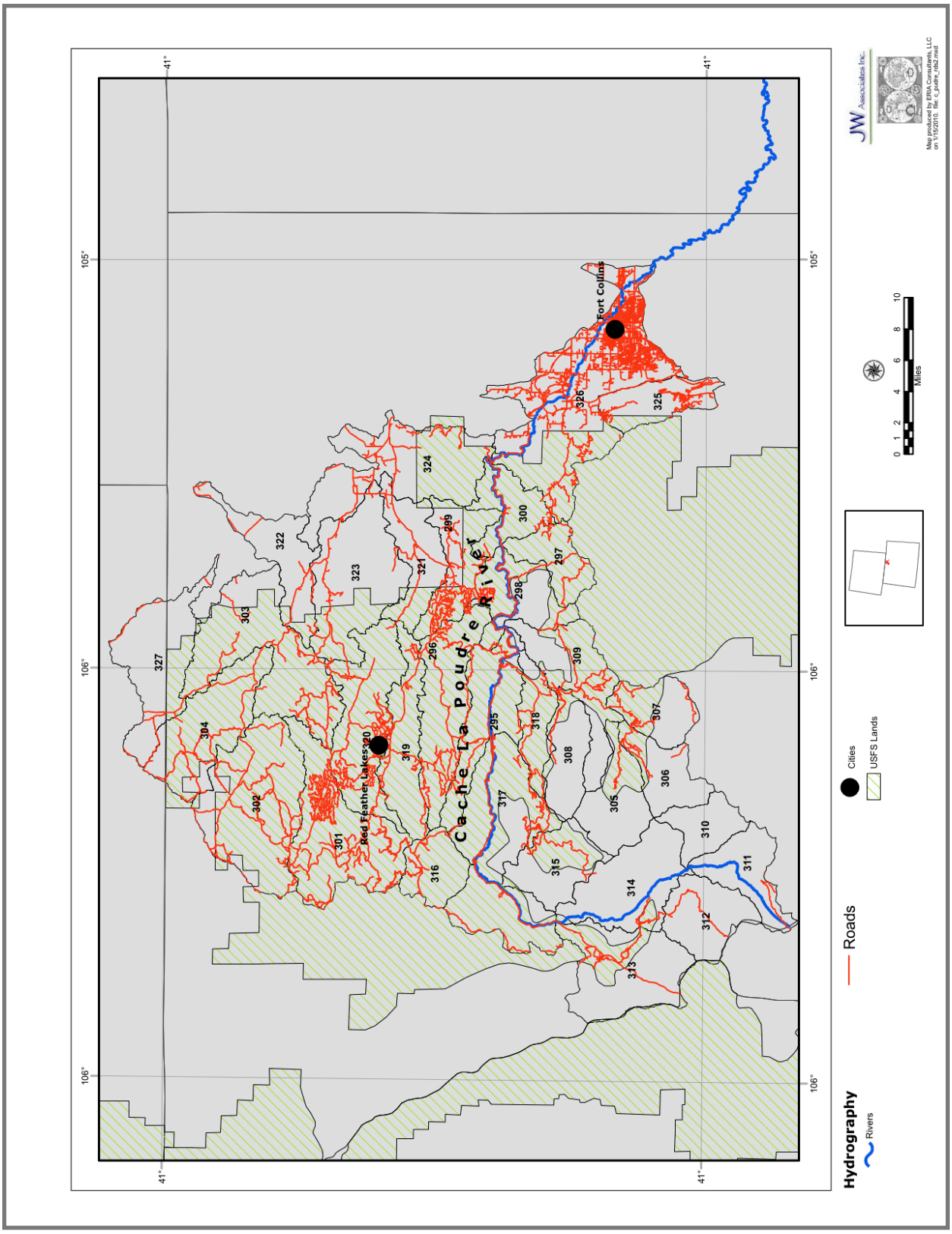

Figure 5. Cache la Poudre Watershed Roads Map

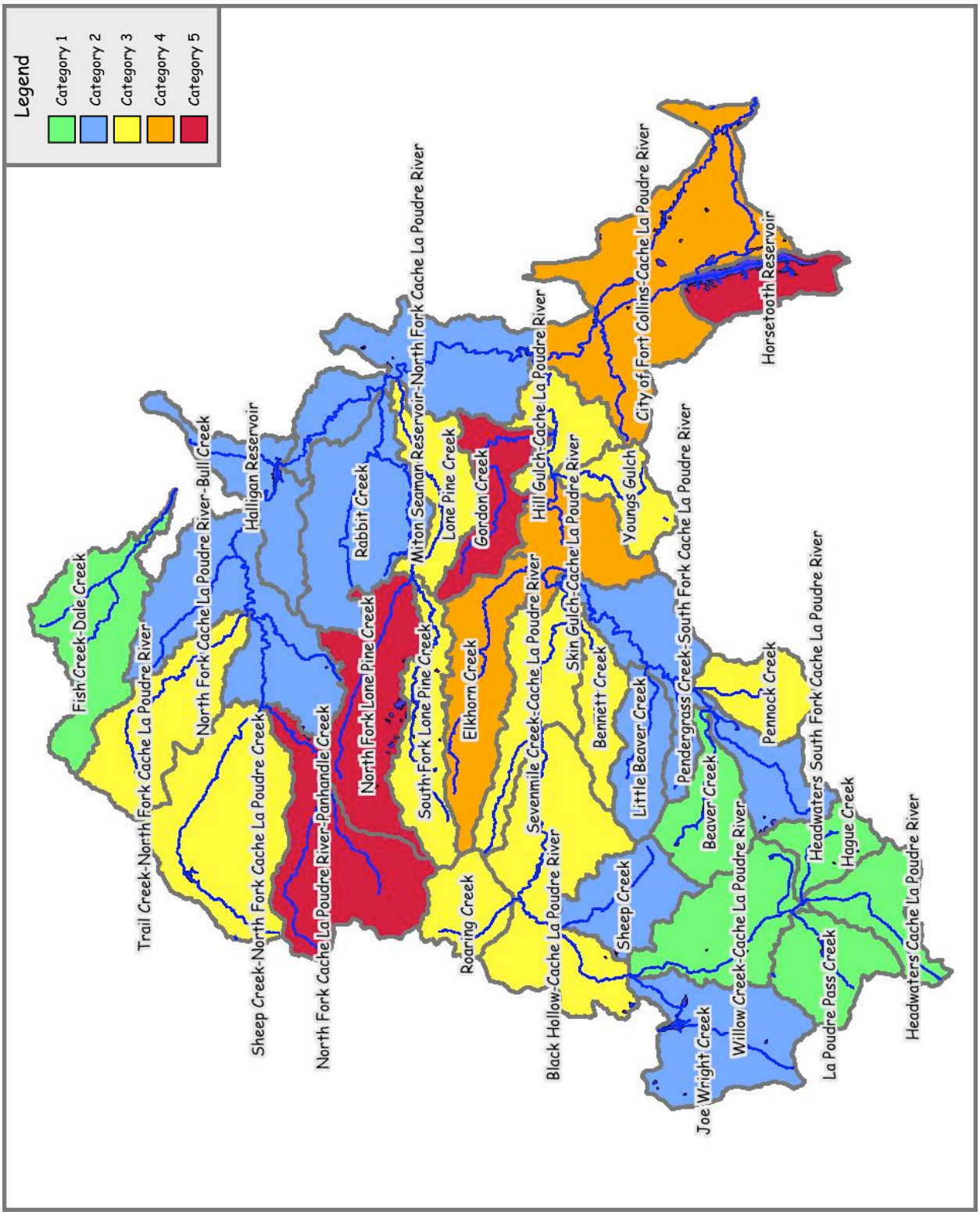

Figure 6. Cache la Poudre Watershed Road Density Ranking

Flooding or Debris Flow Hazard Ranking

The Flooding or Debris Flow Hazard is the combination of ruggedness and road density. The procedure from the Colorado Watershed Work Group (2009) assigned ruggedness a higher value than road density in this ranking. While ruggedness is the most important factor, an increase in road density will magnify the effects of ruggedness on the flooding/debris flow hazard. Accordingly, the analysis for flooding or debris flow hazard for the Cache la Poudre Watershed used the following formula. The results of this calculation were then re-categorized into five hazard rankings.

Flooding or Debris Flow Hazard Ranking = (Road Density Ranking + Ruggedness Ranking * 2)

Figure 7 shows that areas of the watershed with high road densities and high ruggedness rank high in this combined factor. The best way to look at this map is to look at a single watershed on the ruggedness and road density maps, noting the rankings on each. Then look at this map and see how they result in the final ranking for this component. The tabular results are presented in Table C-4 in Appendix C.

The highest ranked sixth-level watersheds are Sevenmile Creek-Cache La Poudre River, Skin Gulch-Cache La Poudre River, Headwaters South Fork Cache La Poudre River, Bennett Creek, Gordon Creek, Pendergrass Creek-South Fork Cache La Poudre River, and Pennock Creek.

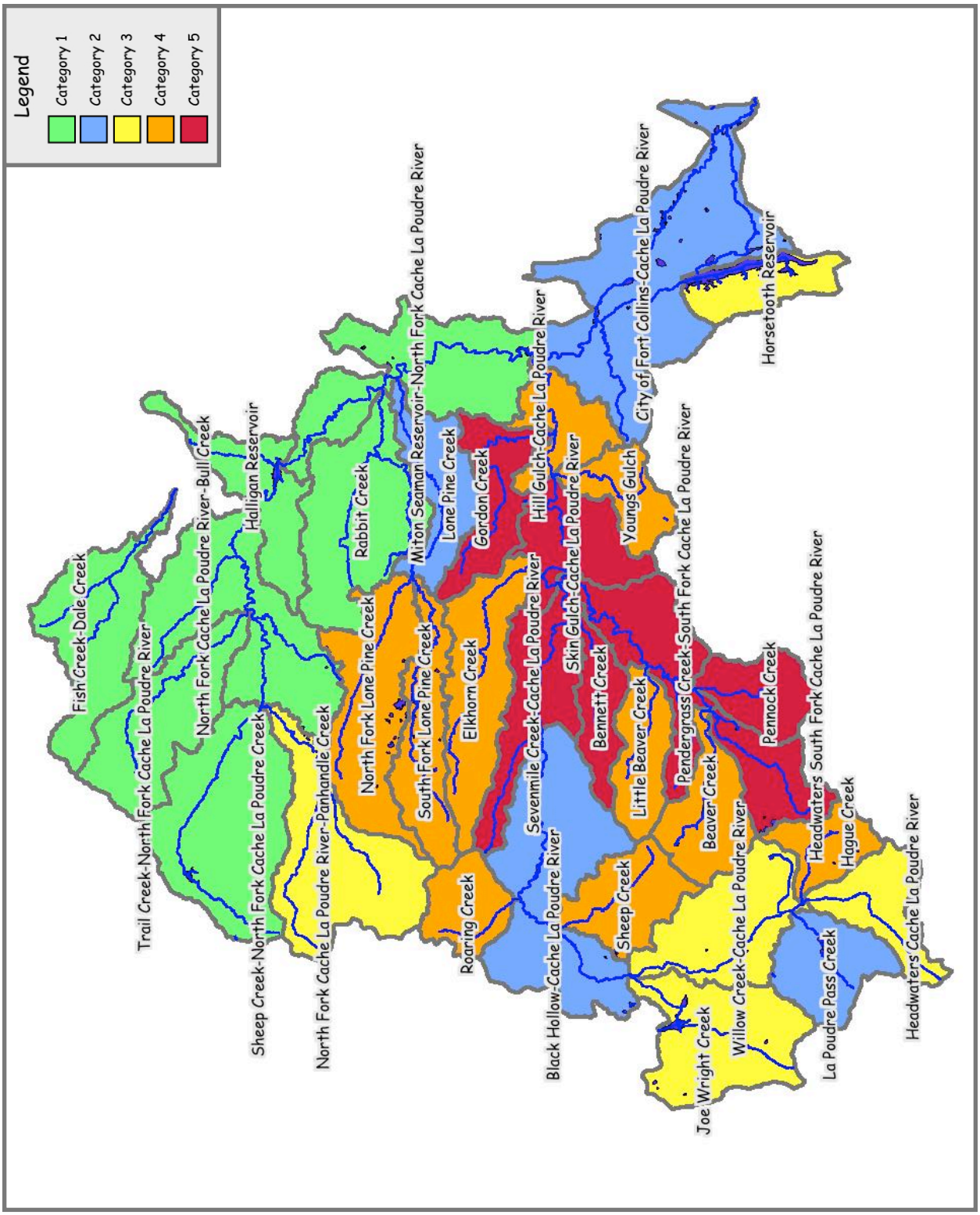

Figure 7. Cache la Poudre Watershed Flooding/Debris Flow Hazard Ranking

Component 3 - Soil Erodibility

High-severity fires can cause changes in watershed components that can dramatically change runoff and erosion processes in watersheds. Water and sediment yields may increase as more of the forest floor is consumed (Wells et al. 1979, Robichaud and Waldrop 1994, Soto et al. 1994, Neary et al. 2005, and Moody et al. 2008) and soil properties are altered by soil heating (Hungerford et al. 1991).

Two soils data sets were evaluated for use in this analysis. They were the U.S. Department of Agriculture - Natural Resources Conservation Service (NRCS) STATSGO and SSURGO soils data. STATSGO data are relatively coarse soils data, created at a scale of 1:250,000 and are available for the entire watershed assessment area. SSURGO soils data do not cover all the watershed assessment area, though efforts by the NRCS are currently under way to produce an updated soils data layer.

The data used in this analysis is the U.S. Department of Agriculture - Natural Resources Conservation Service (NRCS) SSURGO soils data combined with the U.S. Forest Service soils data. SSURGO data does not cover all the watershed but is available at a preferable scale (generally ranges from 1:12,000 to 1:63,360) than STATSGO data. The U.S. Forest Service soils data is comparable with the SSURGO data in scale and quality. Areas without SSURGO data were filled in with U.S. Forest Service soils data (Figure 8).

The soil erodibility analysis used a combination of two standard erodibility indicators: the inherent susceptibility of soil to erosion (K factor) and land slope derived from Unites States Geological Survey (USGS) 30-meter digital elevation models. The K factor data from the SSURGO spatial database was combined with a slope grid using NRCS (USDA NRCS 1997) slope-soil relationships (Table 2) to create a classification grid divided into slight, moderate, severe and very severe erosion hazard ratings.

Table 2. NRCS Criteria for Determining Potential Soil Erodibility

Percent Slope	K Factor <0.1	K Factor 0.1 to 0.19	K Factor 0.2 to 0.32	K Factor >0.32
0-14	Slight	Slight	Slight	Moderate
15-34	Slight	Slight	Moderate	Severe
35-50	Slight	Moderate	Severe	Very Severe
>50	Moderate	Severe	Very Severe	Very Severe

The potential soil erodibility hazard rankings are shown on Figure 9 and the tabular results are presented in Table C-5 in Appendix C. The map shows areas of high soil erodibility in the assessment area. The highest ranked sixth-level watersheds based on soil erodibility are Hague Creek, Black Hollow-Cache La Poudre River, and Headwaters South Fork Cache La Poudre River. The soil erodibility values for North Fork Lone Pine Creek and South Fork Lone Pine Creek were adjusted up due to the presence of granitic soils. Hague Creek and Black Hollow-Cache La Poudre River were skewing the categorization because of their high soil erodibility values and were manually given a score slightly higher than the next highest score (Appendix C).

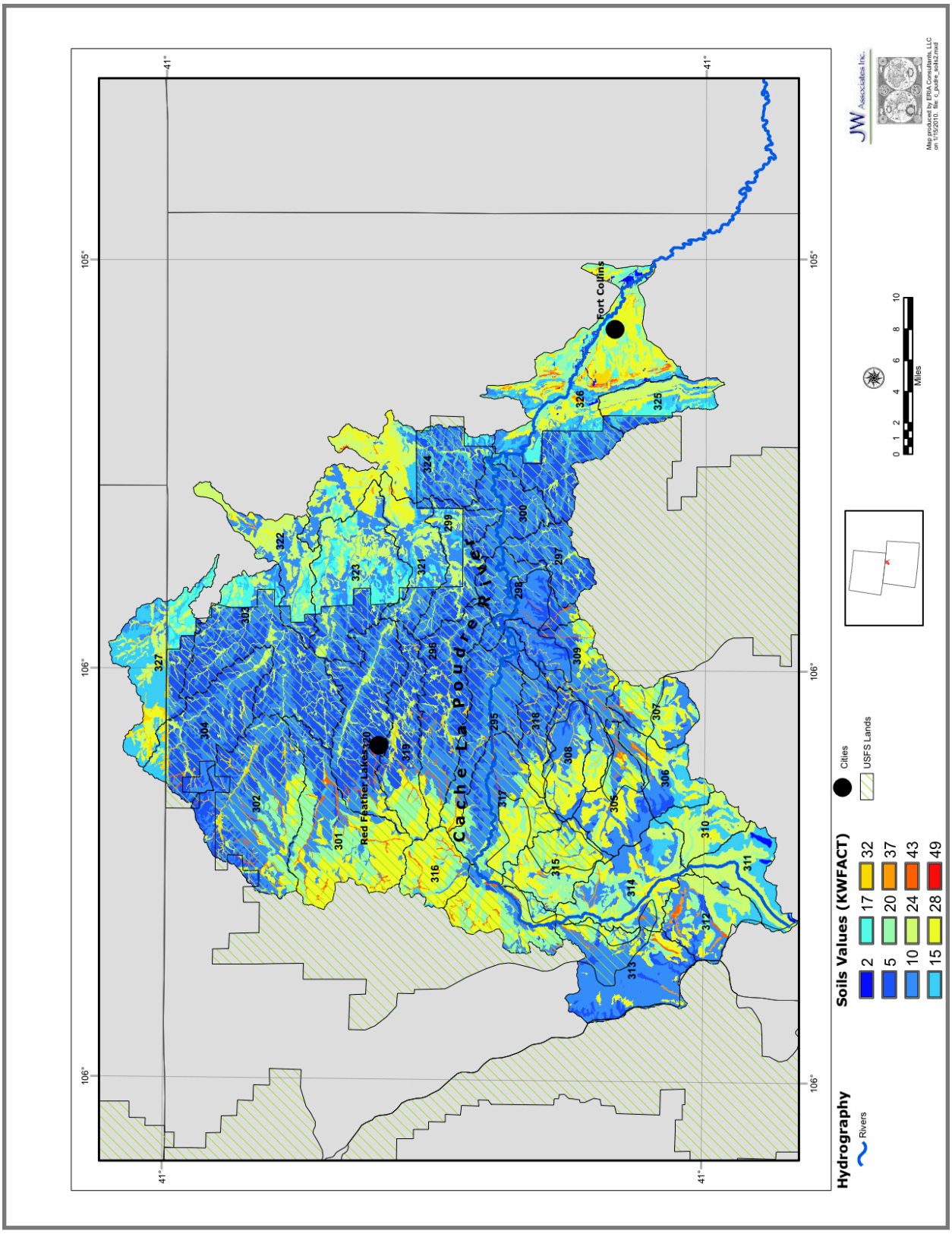

Figure 8. Cache la Poudre Watershed Soils K-Factor Map

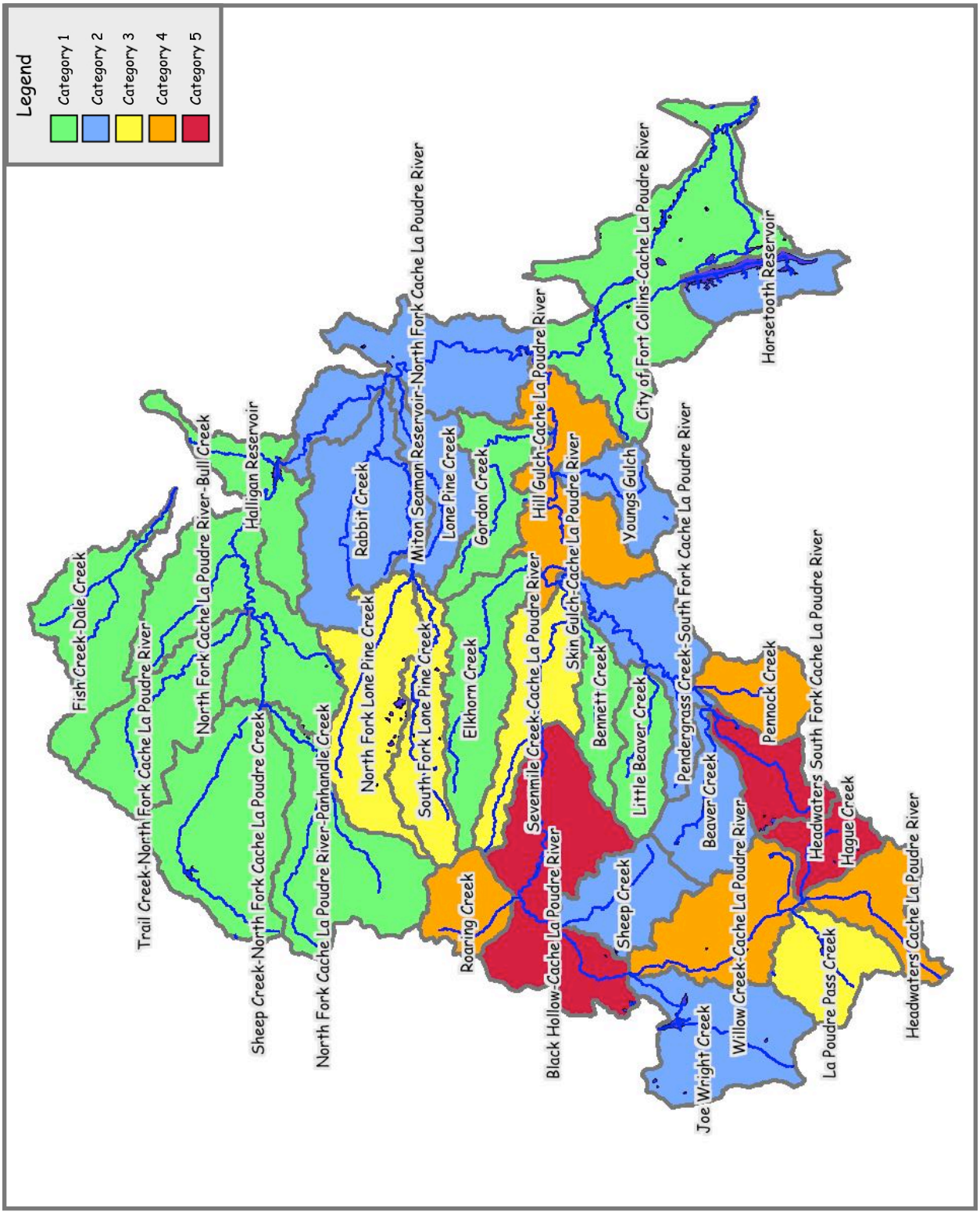

Figure 9. Cache la Poudre Watershed Potential Soil Erodibility Hazard Ranking

Composite Hazard Ranking

The Composite Hazard Ranking combines the first three components (Wildfire Hazard, Flooding/Debris Flow Hazard and Soil Erodibility) by numerically combining their rankings for each sixth-level watershed and then re-categorizing the results. The Composite Hazard Ranking map is useful in comparing relative watershed hazards based solely on environmental factors. Figure 10 shows the Composite Hazard Ranking for the Cache la Poudre Watershed. The tabular results that display the rankings for Wildfire Hazard, Flooding/Debris Flow Hazard and Soil Erodibility, as well as the composite rankings are presented in Table C-6 in Appendix C. The highest ranked sixth-level watersheds are Pennock Creek, Skin Gulch-Cache La Poudre River, Willow Creek-Cache La Poudre River, Headwaters Cache La Poudre River, Headwaters South Fork Cache La Poudre River, Hague Creek, Pendergrass Creek-South Fork Cache La Poudre River, Roaring Creek, and Black Hollow-Cache La Poudre River. Additionally, there are 10 watersheds in Category 4.

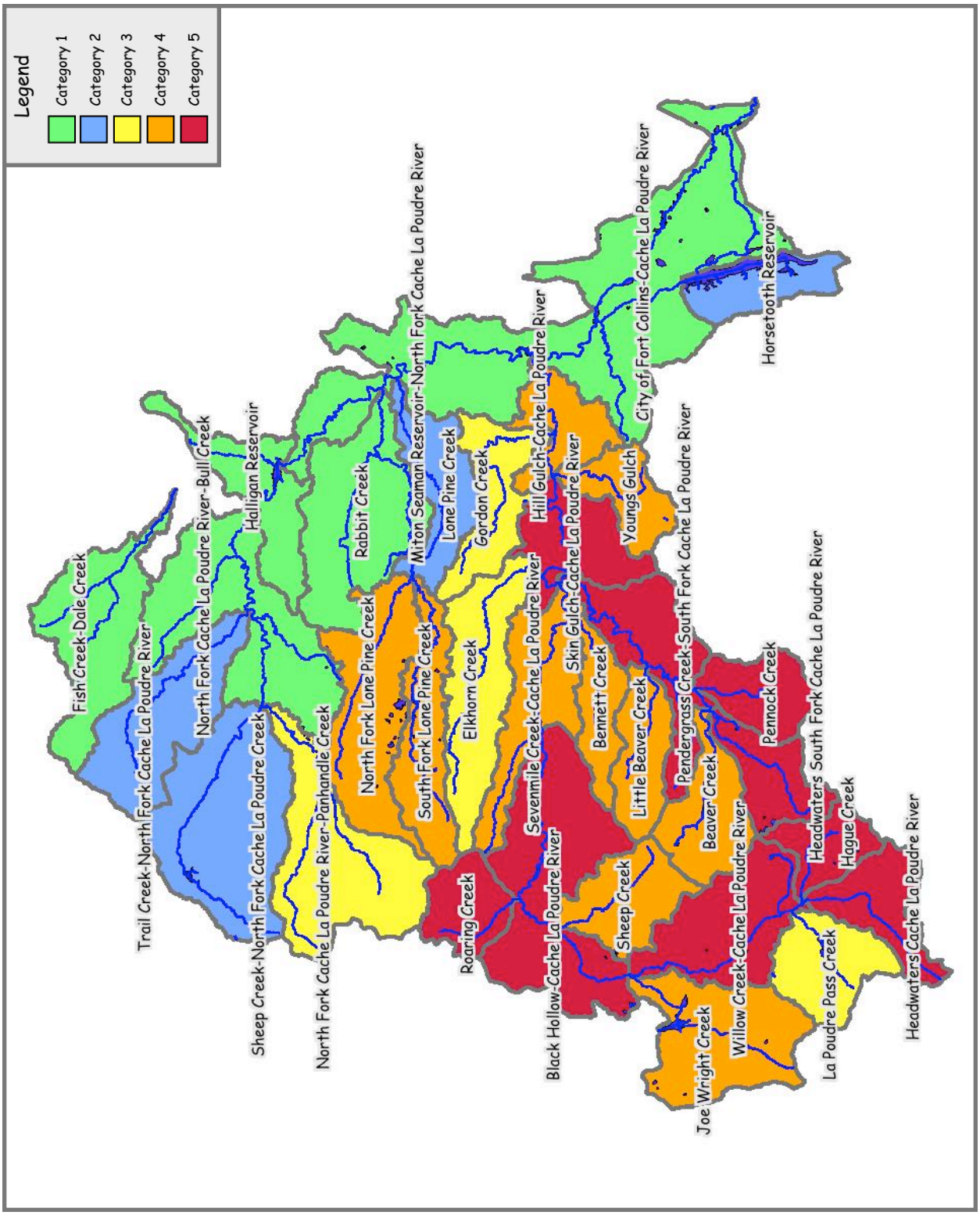

Figure 10. Cache la Poudre Watershed Composite Hazard Ranking

Component 4 - Water Supply Ranking

Surface water intakes, diversions, conveyance structures, storage reservoirs and streams are all susceptible to the effects of wildfires. The suggested approach from the procedure prescribed by the Colorado Watershed Protection Data Refinement Work Group (2009) is to first rank watersheds based upon the presence of water nodes.

Surface drinking water supply collection points from the Source Water Assessment and Protection (SWAP) Program (see http://www.cdphe.state.co.us/wq/sw/swaphom.html for basic information on the SWAP Program) were used to identify which sixth-level watersheds contain critical components of the public water supply infrastructure in Colorado. For this assessment, water nodes were defined as coordinate points corresponding to surface water intakes, upstream diversion points and classified drinking water reservoirs.

Water supply locations may not be identified in the state's database for some drinking water supply reservoirs that do not have associated direct surface water intakes. Also, some water supply reservoirs may not be identified in the SWAP database. The Water Supply map (Figure 11) was modified following the second stakeholder meeting to include several additional water supply sources.

Final Priority

Those watersheds that have a water supply feature (diversion, reservoir or other) were given higher priority in the ranking scheme by increasing their priorities from the Composite Hazard map by one category. Those results were then re-categorized into five categories. The final priority rankings are shown on the Final Priority map (Figure 12). The sixth-level watersheds that ranked highest on the Final Priority map are Skin Gulch-Cache La Poudre River, Willow Creek-Cache La Poudre River, Headwaters Cache La Poudre River, Headwaters South Fork Cache La Poudre River, Pendergrass Creek-South Fork Cache La Poudre River, Roaring Creek, Black Hollow-Cache La Poudre River, Pennock Creek, and Hill Gulch-Cache La Poudre River. In addition, there are six watersheds that were assigned a the second highest Final Priority ranking.

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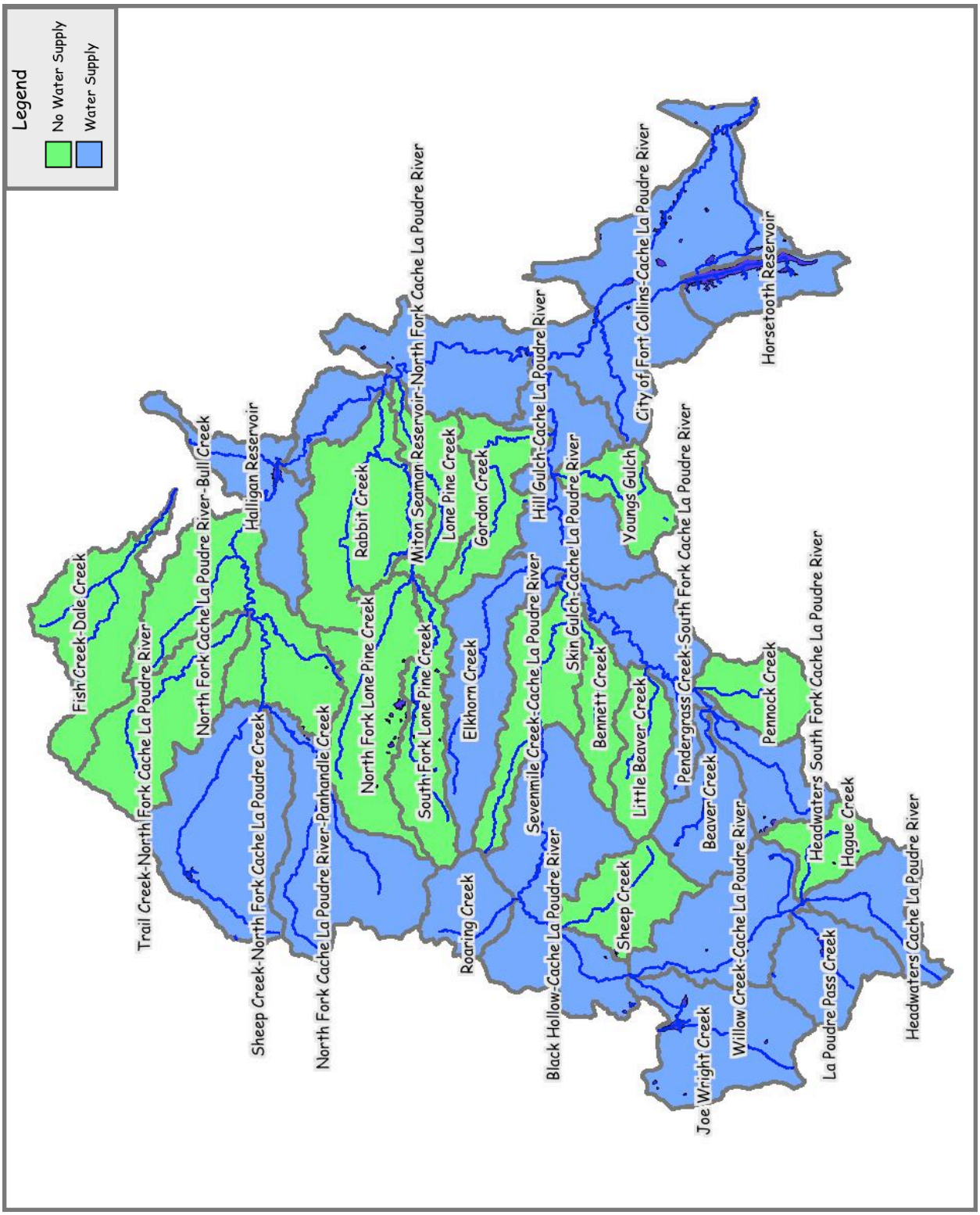

Figure 11. Cache la Poudre Watershed Water Supply

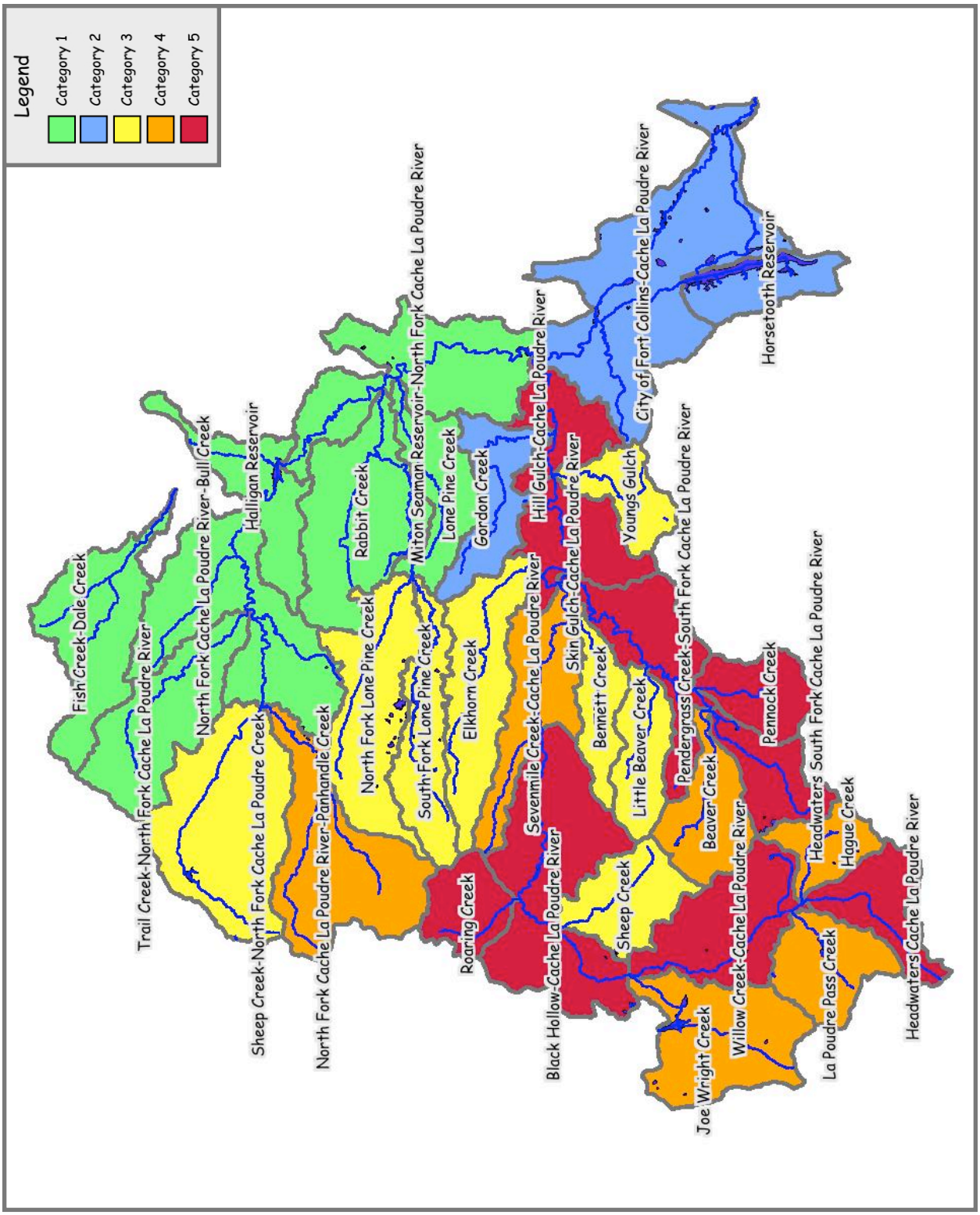

Figure 12. Cache la Poudre Watershed Final Priority

Zones of Concern

The Work Group identified an important hazard for water uses related to transport of debris and sediment from upstream source water areas. The source water areas (i.e. watershed areas) above important surface water intakes, upstream diversion points and drinking water supply reservoirs have a higher potential for contributing significant sediment or debris. These areas, called Zones of Concern (ZoC), can be used by stakeholders to further define project areas for protection actions.

There were several methods suggested by the Colorado Watershed Protection Data Refinement Work Group (2009) to define ZoC. The Cache la Poudre Watershed Stakeholders initially agreed to use the five-mile upstream distance. This approach is based on Colorado State Statute 31-15-707 which allows municipal water providers to enact an ordinance to protect their water intakes within five miles upstream of their intakes. This municipal statute has been in place since the late 1800's and has been tested in court several times and upheld.

Many of the ZoC stopped at a watershed divide before they reached the five mile upstream distance. There were several important diversions and reservoirs that are positioned lower in the watershed. During the third stakeholder meeting, the group suggested that the ZoC be extended to 11 miles upstream for Eaton Reservoir, Panhandle Reservoir and Poudre Main Stem. These ZoC were added as separate areas covering from five to 11 miles upstream.

Seventeen ZoC within five miles upstream of diversions and reservoirs were delineated in the Cache la Poudre Watershed (Figure 13 and Table 3) totaling more than 105,000 acres. Three of the ZoC were extended to 11 miles upstream increasing the area to more than 123,000 acres. The ZoC were overlaid on the Final Priority map (Figure 12). More detailed maps of the ZoC are presented in the *Opportunities & Constraints* section below. The water supply agencies for each ZoC have also been identified in Table 3. Some of the ZoC overlap with others, or in other areas, the ZoC are close to overlapping other ZoC. In those situations, ZoC can be combined or viewed as one, combining several stakeholders into a larger ZoC.

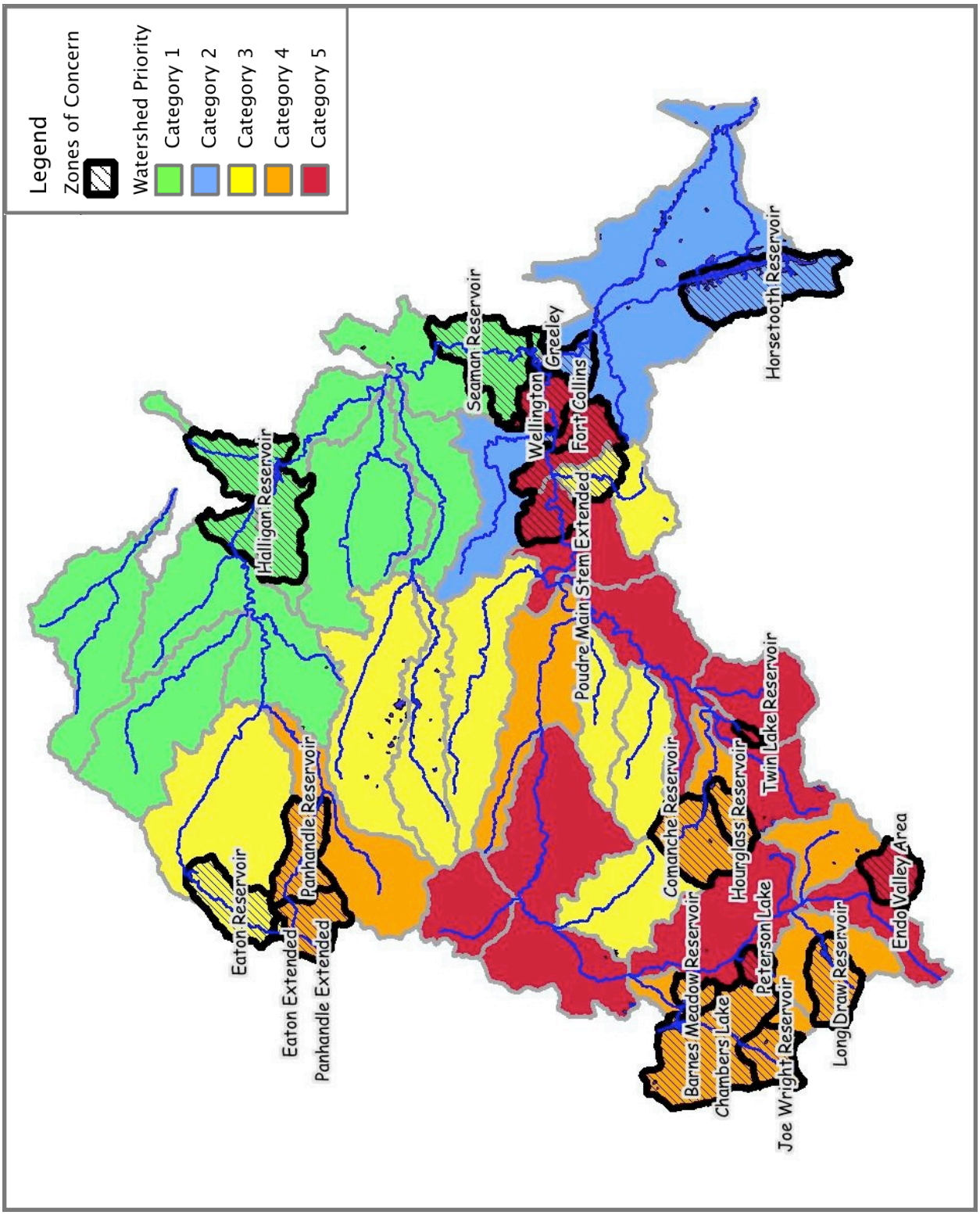

Figure 13. Cache la Poudre Watershed ZoC[4]

[4] The *Opportunities & Constraints* section below displays and identifies each ZoC at a better scale than Figure 11.

Table 3. Cache la Poudre Watershed Zones of Concern[5]

Water Supply Name	0-5 Mile ZoC	5-11 Mile ZoC	Total ZoC Area	Owner/Operator
Barnes Meadow Reservoir	1,812	0	1,812	City of Greeley
Chambers Lake	14,761	0	14,761	Water Supply and Storage Company
Comanche Reservoir	7,530	0	7,530	City of Greeley
Eaton Reservoir	6,382	0	6,382	Larimer and Weld Irrigation Company
Eaton Reservoir Extended	0	310	310	Larimer and Weld Irrigation Company
Endovalley Picnic Area	4,004	0	4,004	Rocky Mountain National Park
Halligan Reservoir	16,129	0	16,129	City of Fort Collins and North Poudre Irrigation Company
Horsetooth Reservoir	11,051	0	11,051	Northern Colorado Water Conservancy District and U.S. Bureau of Reclamation
Hourglass Reservoir	2,879	0	2,879	City of Greeley
Joe Wright Reservoir	4,083	0	4,083	City of Fort Collins
Long Draw Reservoir	5,421	0	5,421	Water Supply and Storage Company
Main Stem Poudre - Extended	0	13,115	13,115	City of Fort Collins, Greeley, Wellington, and Tri-Districts
Main Stem Poudre - Fort Collins	4,130	0	4,130	City of Fort Collins and Tri-Districts
Main Stem Poudre - Greeley	3,856	0	3,856	City of Greeley
Main Stem Poudre - Wellington	5,372	0	5,372	Town of Wellington
Panhandle Reservoir (Crystal Lake)	6,329	0	6,329	Crystal Lakes Water & Sewer Association
Panhandle Reservoir Extended	0	4,999	4,999	Crystal Lakes Water & Sewer Association
Peterson Lake Reservoir	1,508	0	1,508	City of Greeley
Seaman Reservoir	9,323	0	9,323	City of Greeley
Twin Lake Reservoir	527	0	527	City of Greeley
Totals	**105,097**	**18,424**	**123,521**	

[5] The areas of the ZoC are in acres. Some of the ZoCs in the Main Stem Poudre overlap, therefore some acres are double counted for that area.

RECOMMENDATIONS

This watershed assessment is a process that sets priorities, identifies stakeholders and ZoC. The next steps that are taken by stakeholders using the information presented in this report are essential to address the hazards identified through this process. Some potential opportunities are presented in the next section of this report. These recommendations are presented first to guide the reader through the *Opportunities & Constraints* section.

Hazard Reduction Strategies

Although there are other strategies that can be pursued, the reduction of wildfire severity is the main goal for minimizing adverse hydrologic responses following intense wildfires. Wildfire severity is the effect that the fire has on the ground. Vegetative forest treatments can be effective in reducing the threat of crown fire (Graham et al. 1999). Treatments that reduce density and change the composition of stands would reduce the probability of crown fire, decrease severity, and enhance fire-suppression effectiveness and safety (Oucalt and Wade 1999, and Pollet and Omi 2002). In forested stands that have developed without regular disturbance, combinations of mechanical harvest/thinning and prescribed fire are the most effective technique for altering the fuels matrix (Graham et al. 2004).

There are portions of watersheds that may not be available for vegetation treatments because they are economically or administratively inaccessible. Examples of economic inaccessibility include areas that are far from existing roads where it would be very costly to build new roads to provide access, or areas that are so steep that removal of logs by helicopter may be the only option. During follow-up planning efforts the costs of specific project alternatives should be carefully evaluated in light of fire probabilities and the potential costs of no action. An example of administrative inaccessibility would be areas designated by the US Forest Service as wilderness.

There are some prudent measures that can be taken in situations where critical watersheds are economically or administratively inaccessible including;

1. Managing wildland fires in certain places as a management tool that would allow wildfire to reduce wildland fuels under defined circumstances. The conditions would be monitored frequently to ensure that the fire stays within that management prescription or suppression efforts would be required.

2. Reduction of wildfire severity in surrounding areas within those watersheds to reduce the potential extent of high severity burn.

3. Pre-permitting sediment control structures downstream from high hazard watersheds. Following the Hayman Fire in 2002, Denver Water installed a sediment control structure in Turkey Creek above Cheesman Reservoir. It took more than one year to get all approvals and permits in place to construct that structure. The highest sediment yield from wildfires is usually in the first 2-3 years. Stakeholders can do much of the permitting work ahead of time, including planning with the appropriate government agencies and conceptual design.

4. Communicating with state and local leaders and other interested groups about the hazards that these watersheds pose. There may be other resources at risk below these watersheds that can be protected, such

as; houses in floodplains, important fisheries or riparian areas, and areas of mining tailings that could be a water quality risk if they are transported downstream.

Stakeholder Group Organization

The ZoC are natural project areas for stakeholders to start the next planning steps. In some cases several ZoC may be lumped together to form larger project areas. Stakeholder groups will, by definition, include the water providers and/or municipalities that own water rights and operate in those watersheds, but should also include the following;

1. U.S. Forest Service - Canyon Lakes Ranger District of the Arapaho & Roosevelt National Forests.
2. Colorado State Forest Service - Fort Collins District
3. Larimer County
4. Home owner associations
5. Other interested groups such as power companies

Stakeholders should review the *Opportunities & Constraints* section below to determine what watersheds/ZoC should be their priority. Some additional planning will be required to initiate watershed protection/hazard reduction projects within those ZoC. The discussion below presents some of the options.

There is a new planning process that is focused on watershed issues called Critical Community Watershed Wildfire Protection Plans (CWP)^2. The CWP^2 process (see http://www.jw-associates.org/Projects/Front_Range/Front_Range.html) is similar to the Community Wildfire Protection Plan (CWPP) process but expands to include watershed issues. Some existing CWPPs may cover portions of the watersheds/ZoC of interest. It may be more efficient to revise an existing CWPP by incorporating the watershed components from this assessment than to complete the CWP^2 process. Specific treatment areas and priorities identified in existing plans also should be reviewed for their contribution to the watershed protection efforts and incorporated into the expanded plan. Other efforts, such as source water protection plans, may also gain some efficiency and consistency by incorporating the results of this assessment.

National Environmental Policy Act (NEPA) planning efforts on federal lands may be able to be modified to incorporate watershed priorities. The NEPA analysis and decision-making process may also benefit from the technical support provided by this watershed assessment. Other existing land and vegetation management plans, fuels treatment plans, source water protection plans, watershed restoration plans or prescribed fire or fire-use plans may exist that cover portions of the critical watersheds.

This section of the assessment presents the first step in identifying opportunities and constraints within the ZoC. This analysis is intended to identify potential opportunities that will aid the stakeholders in deciding whether to pursue watershed protection/hazard reduction efforts, the overall scope that those efforts might involve, and identification of the key partners for those projects. This section is organized by general descriptions of the opportunities and constraints first and then presentation of potential opportunities for each ZoC that are shown on Figure 14.

General Opportunities & Constraints

The opportunities and constraints described below were applied to the ZoC as a series of filters and identifiers of potential opportunities.

Ownership

Major ownership classifications are Federal, State, Local Government and Private. Federal Lands include the NFS Lands, Bureau of Land Management (BLM), National Park Service, Department of Defense, and potentially other agencies and departments. State lands are typically those owned or managed by the State Land Board, the Colorado Division of Wildlife, or State Parks. However, there are other agencies or institutions, such as state universities, that also may own significant acreage.

Local Government lands typically include county, city or town-owned properties. County-owned lands are often managed as open space or park lands. City-owned lands are also often owned and managed for open space or parks, but also for watershed protection or other purposes.

Private land is basically a category that can include a myriad of other types of ownerships including special district lands, company or corporate-owned lands, privately owned properties and more. Privately owned parcels can be present in extremely complex patterns, particularly where they are composed of old mining claims.

Access

Access to and within a watershed or ZoC is a key factor in determining opportunities for mitigating wildfire hazards or the ability to install, operate and maintain erosion and sediment control structures following wildfires. The analysis often is limited by the data available in determining what roads exist within any given area. Normally, data layers available for the analysis usually show major roads and access routes, but often fail to include small, local roads and trails, particularly on non-federal lands. Such roads are very important for accessing backcountry areas for conducting mitigation activities. Experience has shown that old roads used for mining or logging that can be temporarily re-opened to conduct project work may not be shown on any maps. Another option is temporary roads that can be constructed and closed following treatment, but they add costs to projects and current policies on many federal lands make even use of temporary roads difficult.

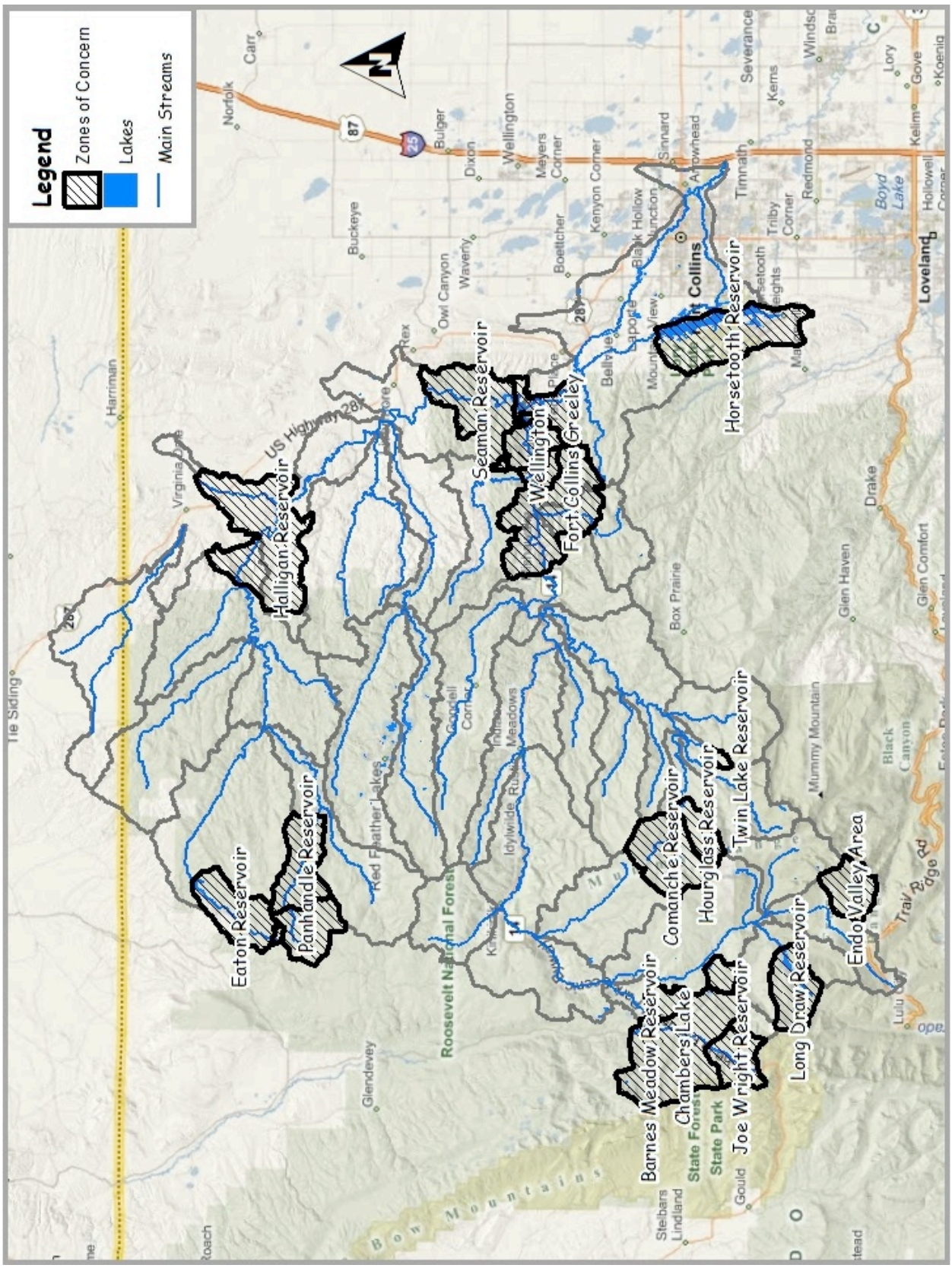

Figure 14. Cache la Poudre ZoC Base Map

When conducting traditional logging and thinning operations where products are removed from the forest, areas within ¼-mile of roads can be accessed. If products do not have to be removed to meet fuel loading requirements and alternate treatment methods such as "mastication" or mulching can be used, areas within ½-mile of roads can typically be considered.

Slopes

Land slope can be a major constraint when considering where and what treatments may be conducted to reduce wildfire hazards. Slope constraints are related directly to the typical harvesting or treatment systems and equipment employed and available within Colorado. Land management agency policies may also constrain the slopes upon which treatments may be conducted.

Slopes of 30 percent or less are the easiest to treat and the most traditional threshold for treatment given typical harvesting systems and equipment availability. Technological, power and other improvements now allow equipment to operate on slopes of 40 percent or perhaps even steeper ground. Experimental work conducted by the Colorado State Forest Service on Denver Water's lands in the Upper South Platte showed that tracked mastication equipment could work on slopes of up to 55 percent without causing erosion.

Quite recently in Colorado there have been several cable logging and even a few helicopter logging operations conducted. Slope is typically not an absolute constraint with these types of operations, but other factors such as the shape of the hillside (convex vs. concave), whether the project can be treated from above or below and others determine actual project feasibility.

The stakeholders decided to use a 40 percent slope as the upper limit of mechanical treatments. Potential opportunities were identified as greater on shallower slopes (less than 40 percent slope).

Wilderness Areas

Operations in designated wilderness areas are highly restricted by law and agency policies. Often the only treatments possible would be to plan for use of natural fire to reduce wildfire hazards.

Roadless Areas

Operations in designated roadless areas are restricted primarily by agency policies. Regulations allow construction of temporary roads, and their closure upon project completion, for the purpose of conducting harvests and wildfire hazard reduction treatments. Agency policy has caused treatments to focus on areas other than roadless whenever possible.

Colorado is one of two states that are attempting to develop rules for treatments within roadless areas. The Colorado Roadless Areas are currently under review by the US Secretary of Agriculture, but are operating under their proposed rules. This situation has resulted in roadless areas being divided into 2001 Roadless Rule (Federal) and Colorado Roadless Areas. Due to current legal actions, 2001 Roadless Rule areas are basically off limits to forest management. However, they should not be viewed as off limits to long-term watershed protection efforts.

The Colorado Roadless Areas have been reviewed and adjusted for actual conditions and therefore are likely more precise than the 2001 Roadless Rule areas. As currently proposed, treatments within Colorado Roadless Areas may be possible adjacent to at risk communities and for reducing wildfire hazards within watersheds. Areas within ½-mile of communities, and in some circumstances up to 1.5-miles from communities, may be treated to reduce wildfire hazards. Areas within watersheds may be treated if the USFS

Regional Forester determines a significant risk of wildfire exists. All decisions about specific projects within roadless areas will be made by the USFS Regional Forester.

Vegetation

Vegetation is what fuels a wildfire. The vegetation type and its arrangement, size, density, and moisture content; the slope of ground and the aspect it is found on; whether it is dead or alive; the weather and season of the year, and more all dictate if and how intensely fuels will burn.

The Colorado State Forest Service is developing a series of documents related to watersheds and their protection. The first document, tentatively titled, "*A Comprehensive Strategy for the Management and protection of Colorado's Watersheds*," will have a series of companion documents entitled, "*Management and Protection Techniques for Colorado's Watersheds*." The first companion document discusses management of ponderosa and lodgepole pines and uses numerous photographs to illustrate what these treatments might look like.

In general, ponderosa pine should most often be managed using forest restoration management techniques. Dense, homogenous stands of ponderosa pine can be thinned to a much more open state, and openings created and maintained across the landscape. This type of management makes a much more resilient ecosystem, one that reduces wildfire intensities is better able to absorb and recover from the impacts of wildfire (Colorado State Forest Service 2007).

In Colorado, lodgepole pine is also found in dense, continuous stands. Because lodgepole grows differently than ponderosa pine and has a different ecology, it is difficult, within a short time period, to thin it sufficiently to develop diversity significant enough to reduce wildfire hazards. This much needed diversity must be developed by creating diversity at the stand and landscape levels by clearcutting, patch cutting, creating permanent openings, converting areas to aspen. Once management has begun for watershed protection, in some situations it may be advisable to utilize less traditional management techniques, such as thinning in young lodgepole pine stands, for long-term management (Colorado State Forest Service 2009).

The stakeholders decided to use mixed conifer and ponderosa pine for vegetation targets at lower elevations, and lodgepole pine and mixed conifer at higher elevations as targets for vegetation treatments to reduce wildfire severity.

Past and Planned Treatments

Past and planned forest treatments were mapped to identify areas that may have reduced wildfire hazard. Data from the US Forest Service and the Colorado State Forest Service was used. The US Forest Service is currently planning and starting to implement hazard tree removal projects around trails, campground and roads that have been affected by mountain pine beetle caused mortality. There may be some additional opportunities to combine these hazard tree removal efforts with other wildfire hazard reduction efforts that would provide added benefit. Additionally, the current mountain pine beetle epidemic is causing landscape-level changes in wildfire hazard in the lodgepole pine forest and moving into the ponderosa pine forest. These changes will reduce the wildfire hazard after the needles fall off of the dead trees, essentially creating a very low wildfire hazard. However, as these dead trees fall down and new regeneration comes up, there may be a time when the wildfire hazard is substantially increased. These situations should be considered in site-specific planning.

Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake, & Peterson Lake ZoC

The maps and analysis for the Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC are combined. Figure 15 shows the general location of the Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

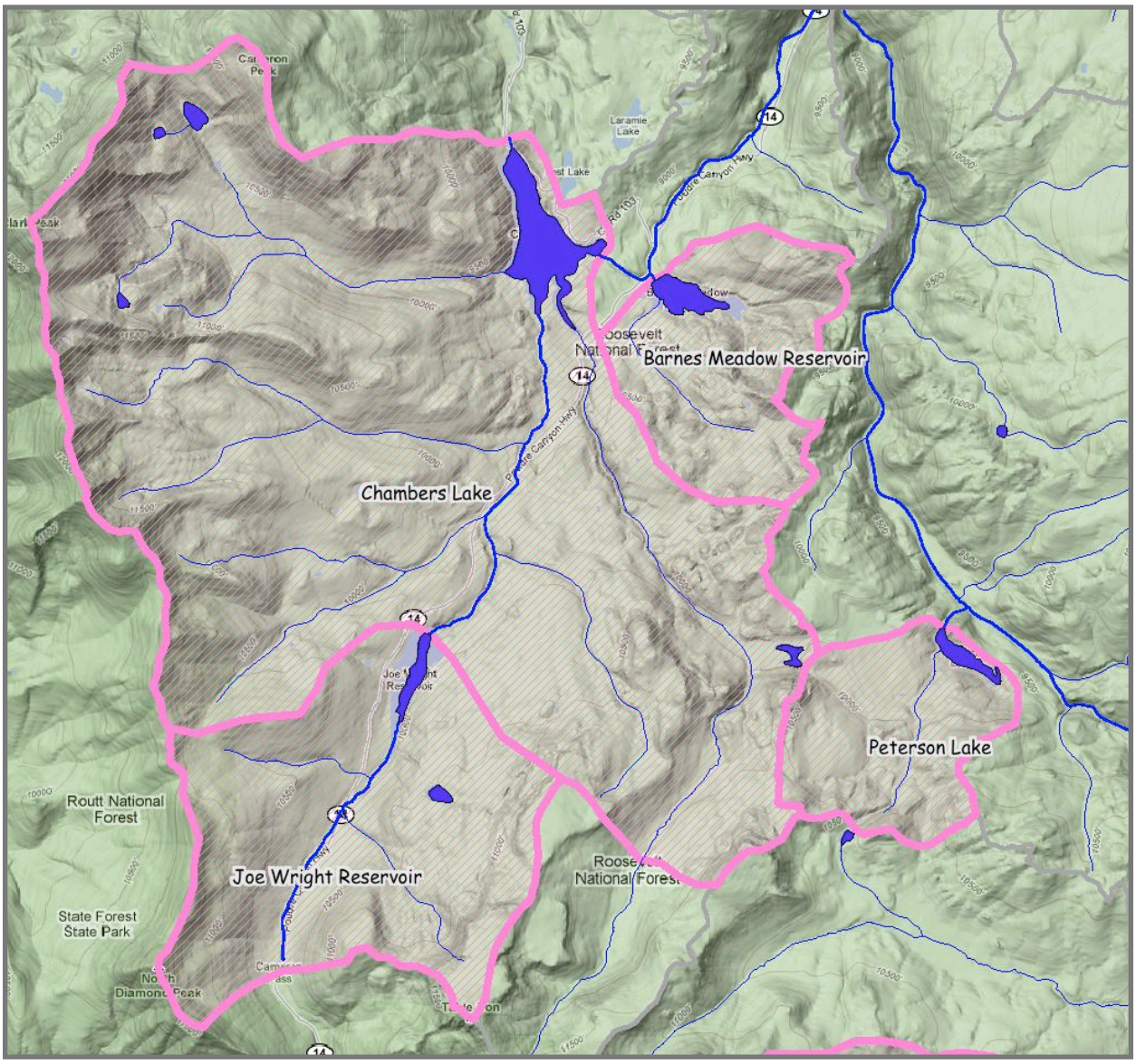

Figure 15. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Location

Chambers Lake Ownership

Land ownership is nearly all NFS lands. There is an area of the Colorado State Forest in the upper portions of the watershed. There is a small piece of private land east of the reservoir (Figure 16).

Joe Wright Reservoir Ownership

Land ownership is nearly all NFS lands. There is an area of state land that is part of the Colorado State Forest in the upper portions of the watershed (Figure 16).

Barnes Meadow Reservoir Ownership

Land ownership is mostly NFS lands. There is a small piece of private land around the reservoir (Figure 16).

Peterson Lake Ownership

Land ownership is all NFS lands (Figure 16).

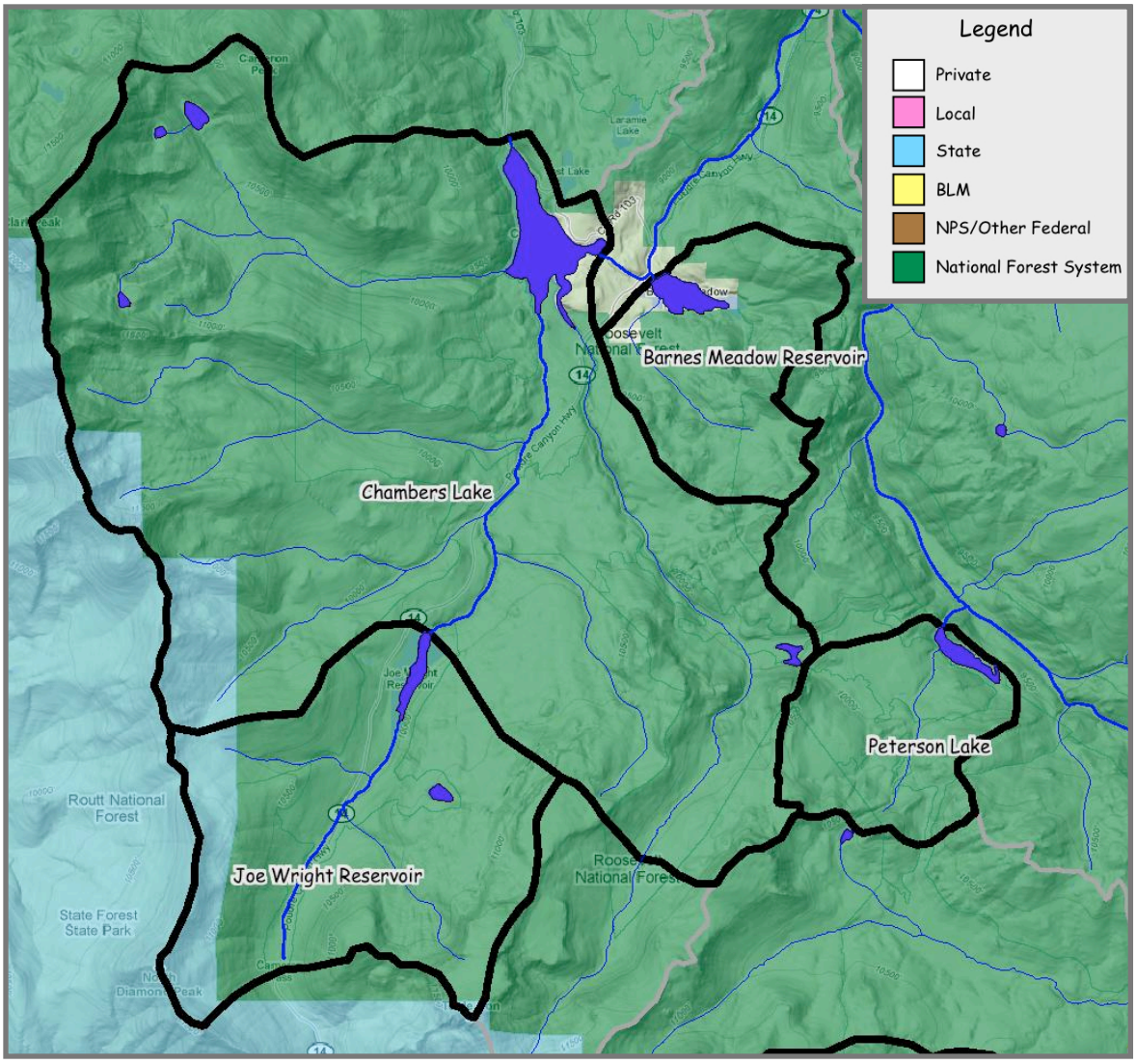

Figure 16. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Ownership

Chambers Lake Watershed Priority

Joe Wright watershed is Orange (Category 4) overall (Figure 17). Wildfire Hazard is Orange (Category 4).

Joe Wright Reservoir Watershed Priority

Joe Wright watershed is Orange (Category 4) overall (Figure 17). Wildfire Hazard is Orange (Category 4).

Barnes Meadow Reservoir Watershed Priority

Joe Wright watershed is Orange (Category 4) overall (Figure 17). Wildfire Hazard is Orange (Category 4).

Peterson Lake Watershed Priority

Willow Creek-Cache la Poudre River watershed is Red (Category 5) overall (Figure 17). Wildfire Hazard is also Red (Category 5) and Soil Erodibility is Orange (Category 4).

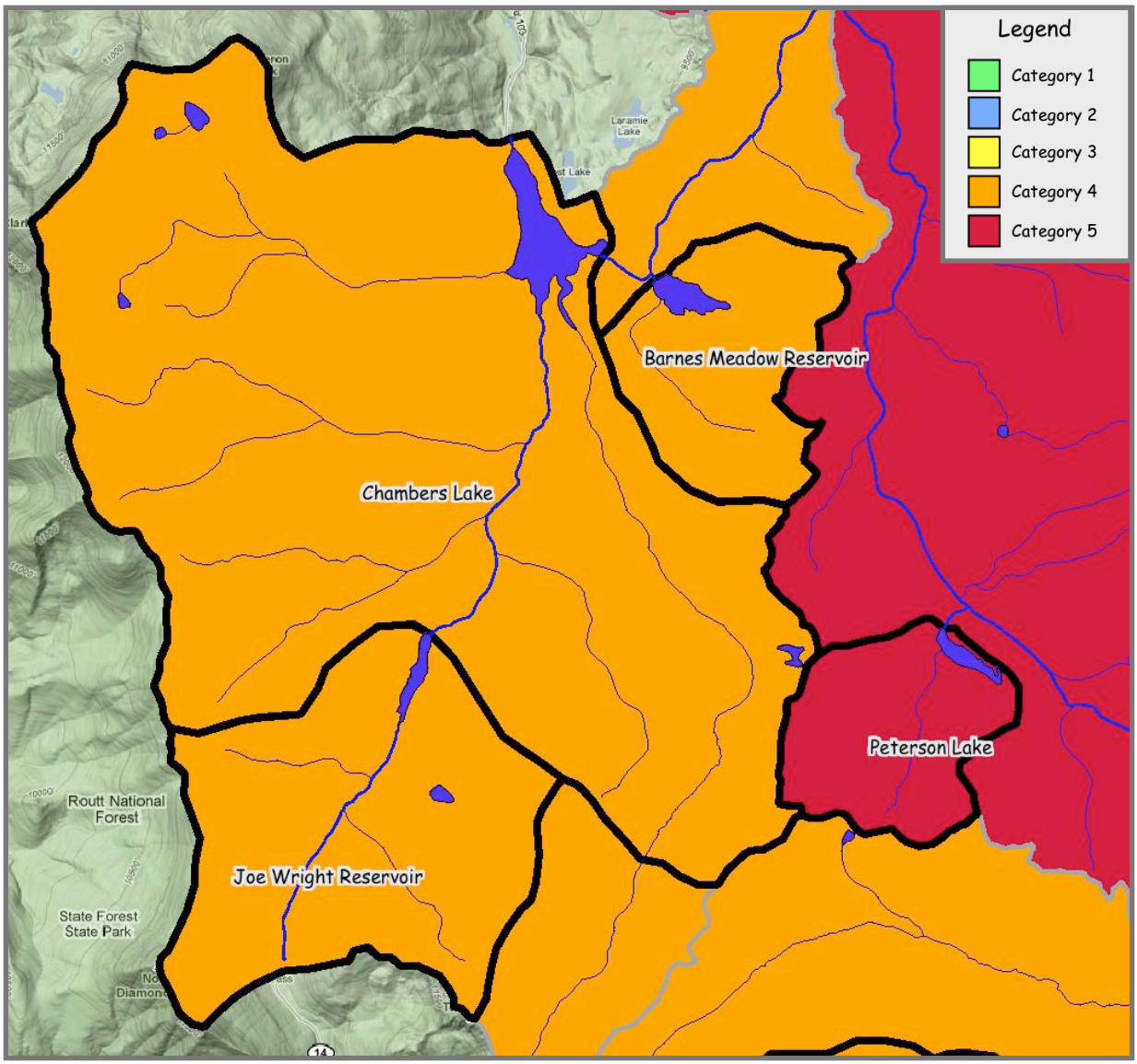

Figure 17. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Watershed Priority

Chambers Lake Slopes

Steep slopes cover a large portion of the upper watershed. The lower elevations are less steep (Figure 18).

Joe Wright Reservoir Slopes

Steep slopes cover a large portion of the upper watershed. The lower elevations are less steep (Figure 18).

Barnes Meadow Reservoir Slopes

Steep slopes cover a large portion of the upper watershed. The lower elevations are less steep (Figure 18).

Peterson Lake Slopes

Steep slopes are only present in the upper most portion of the ZoC (Figure 18).

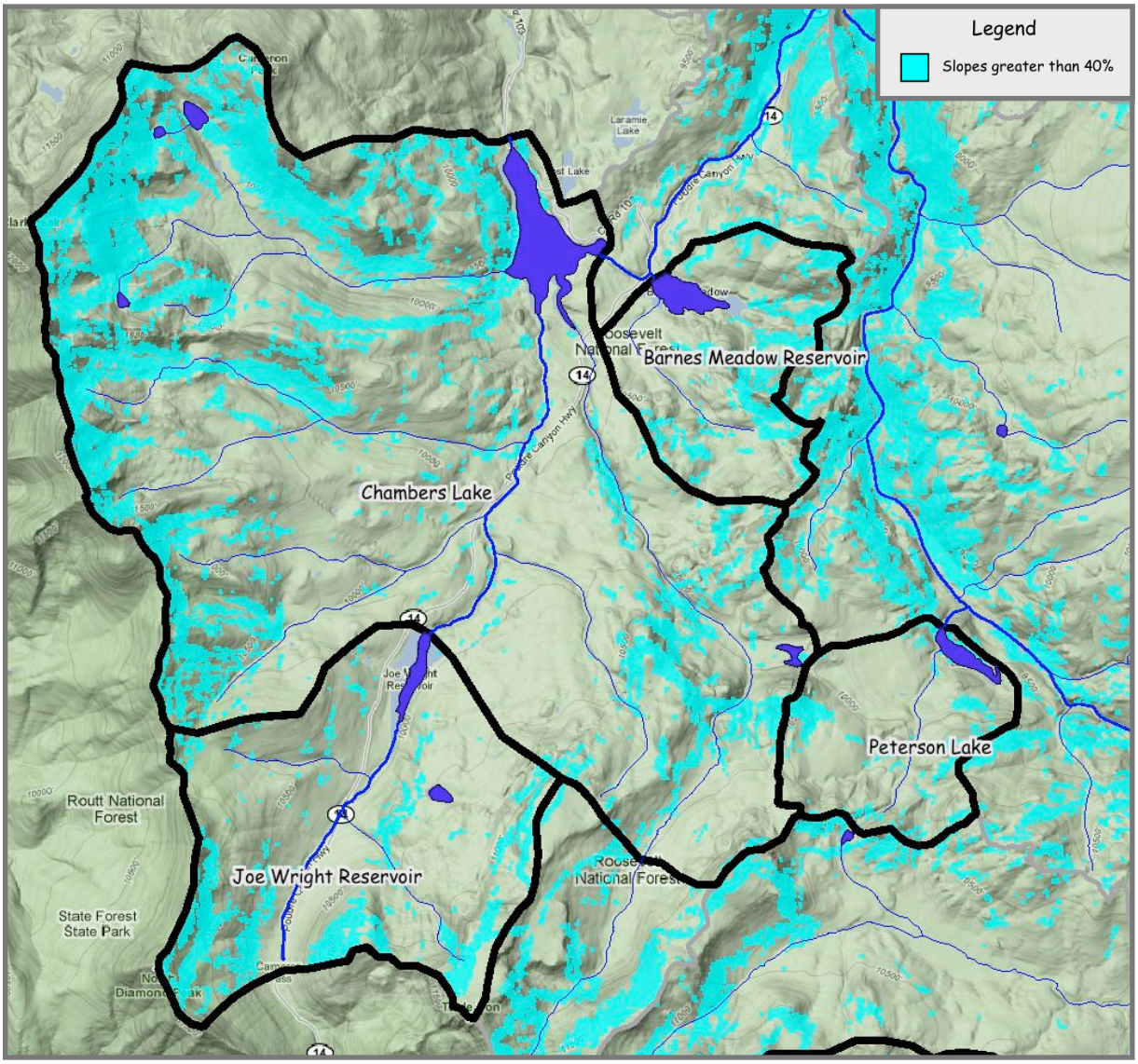

Figure 18. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Slope

Chambers Lake Special Management Areas

The western portion of the ZoC is in the Rawah Wilderness Area. The Rawah Adjacent Roadless Area occupies an area just southwest of the reservoir. The Neota Wilderness Area and Neota Adjacent Roadless Area occupies most of the headwaters in the Trap Creek area (Figure 19).

Joe Wright Reservoir Special Management Areas

The Rawah Wilderness Area and the Rawah Adjacent Roadless Area occupies most of the area west of the river. The Neota Wilderness Area occupies most of the area east of the river. There is an area around the reservoir and following the highway that has no special areas (Figure 19).

Barnes Meadow Reservoir Special Management Areas

Most of the ZoC is in the Comanche Peak Adjacent Roadless Area with a portion of the headwaters in the Comanche Peak Wilderness Area. There is an area around the reservoir that has no special management areas (Figure 19).

Peterson Lake Special Management Areas

The upper third of the ZoC is in the Neota Wilderness Area and Neota Adjacent Roadless Area. There is also a piece of the Comanche Peak Adjacent Roadless Area just south of the reservoir (Figure 19).

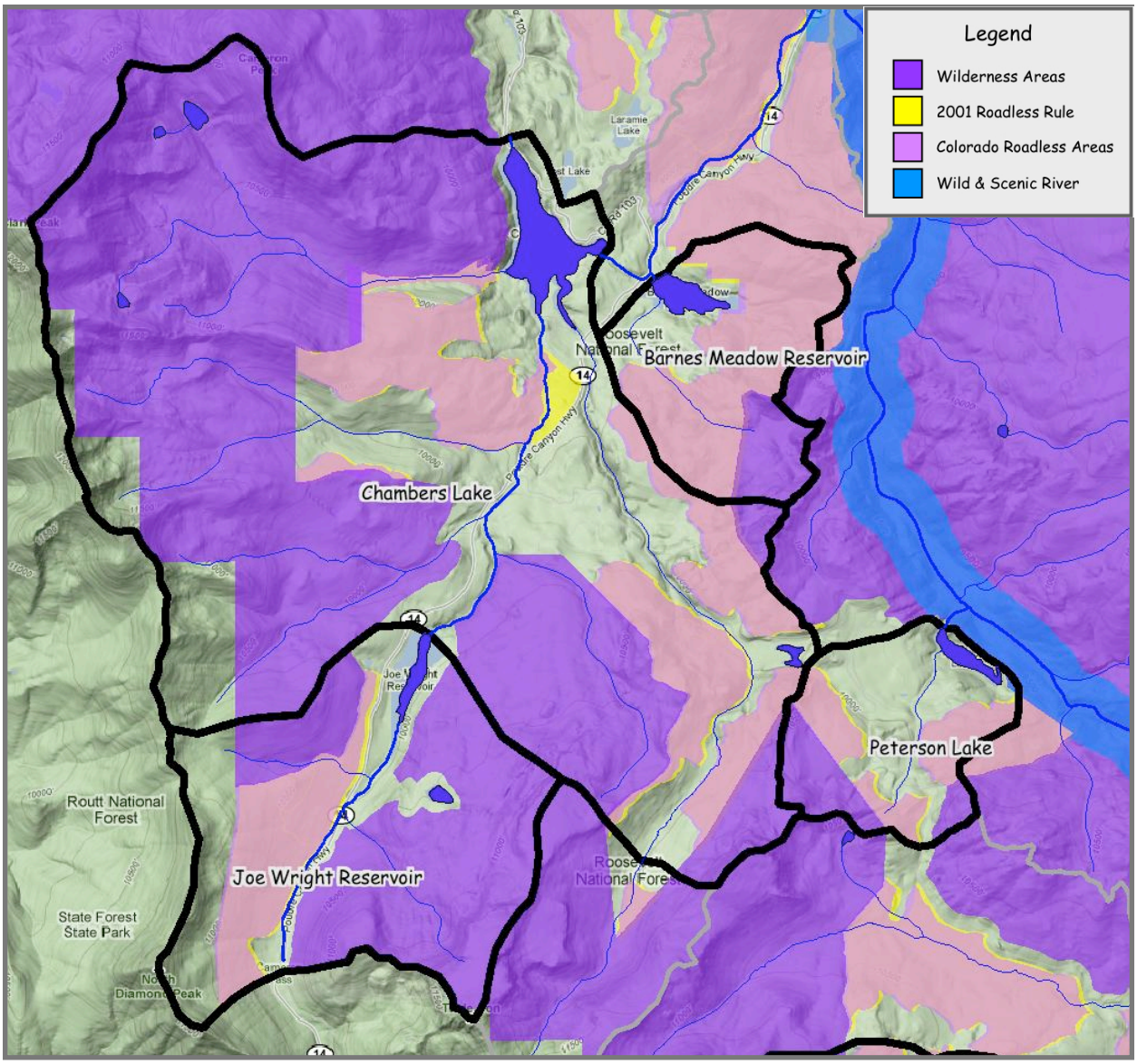

Figure 19. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Special Areas

Chambers Lake Vegetation

The area around the lake is dominated by lodgepole pine. There are large areas of spruce-fir at mid-elevations in the ZoC that transition to alpine at higher elevations. Fuels have been significantly modified west of the reservoir where extensive harvesting has occurred in the past (Figure 20).

Joe Wright Reservoir Vegetation

The ZoC is dominated by spruce-fir with a few small areas of lodgepole pine near the reservoir. The vegetation transitions to alpine at higher elevations (Figure 20).

Barnes Meadow Reservoir Vegetation

The ZoC is dominated by lodgepole pine with some spruce-fir mixed throughout. There is an area of sagebrush northeast of the reservoir (Figure 20).

Peterson Lake Vegetation

The ZoC is dominated by spruce-fir with some areas of lodgepole pine (Figure 20).

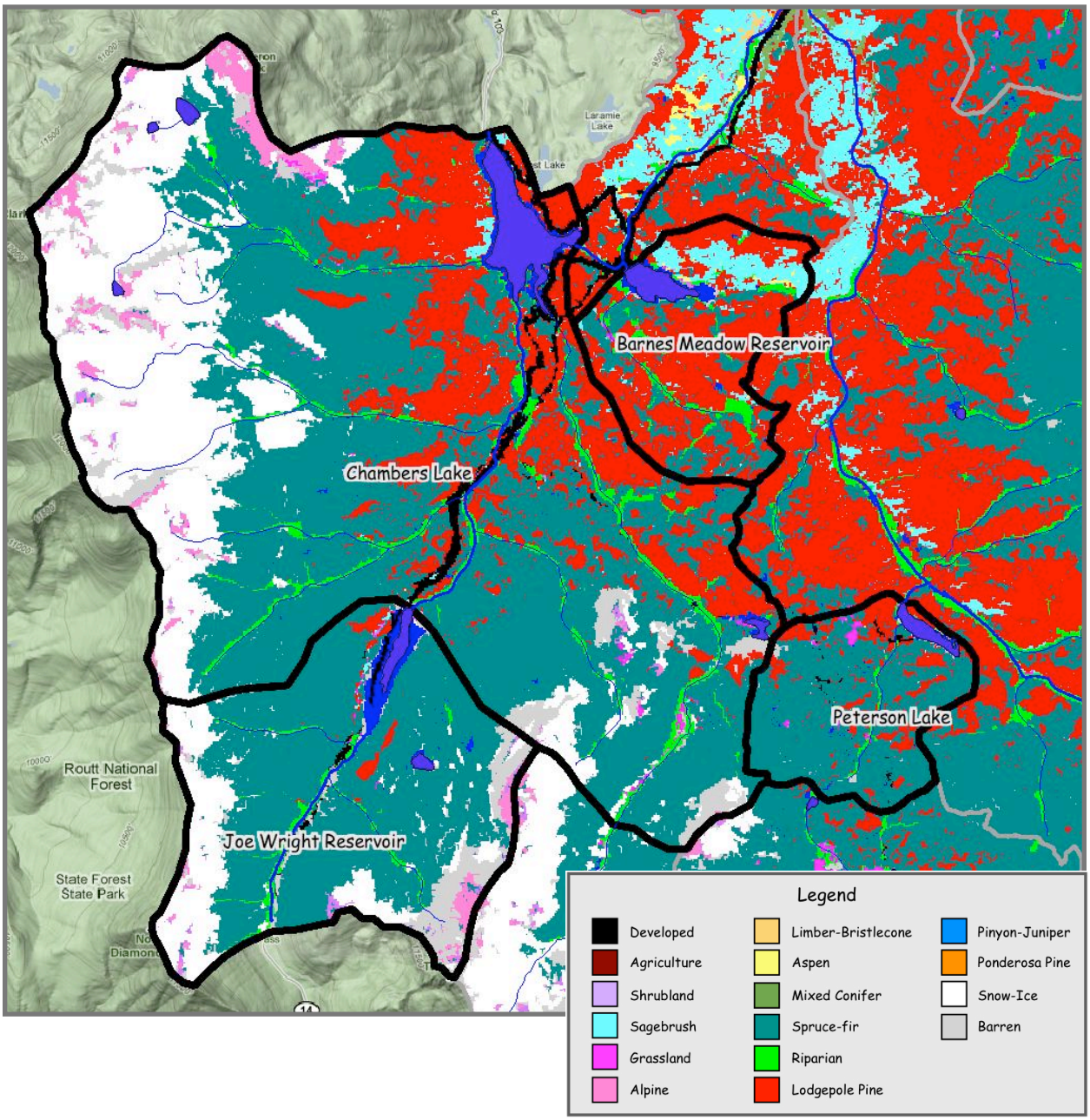

Figure 20. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Vegetation

Chambers Lake Opportunities

Existing road access is good in the lower portions of the ZoC, along the Highway 14 corridor and other road corridors within the ZoC. There is a good system of roads left from harvesting activities that occurred west of the reservoir (Figure 21). There are some opportunities around the reservoir and in the lower elevations between Trap Creek and the Cache la Poudre River. The area around the reservoir is where the majority of the human activity occurs and the risk of a fire starting is greatest. Treatments should incorporate all the non-federal lands and be focused around the reservoir to reduce the chance of a fire occurring here and moving upslope into the watershed. This treatment area should be combined and coordinated with those at Barnes Meadow Reservoir, including the areas just outside the ZoC. Part of this area is in the Spencer Heights CWPP, which should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District, agencies and area residents about this issue and to collaborate with them to update the CWPP as necessary, and possibly expand it to include a larger part of the ZoC.

Currently there are no planned treatments on any of the NFS lands. There has been a significant amount of previous forest treatments including; clearcuts, patch cuts and thinning. Methods of connecting some of these past treatments to create continuous fuelbreaks should be investigated. Selected areas could be kept as openings or in younger age-classes to help reduce fire spread. Follow-up thinning of regenerated stands and ongoing, periodic maintenance should be conducted. Consider also developing fuelbreaks along the road corridors that run through the ZoC. Approval of management of lands for watershed protection within the roadless area should be sought. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards.

Stakeholders include: Water Supply & Storage Company, US Forest Service, private landowners and Colorado State Forest Service.

Joe Wright Reservoir Opportunities

Existing road access is mostly limited to the highway corridor. However, there are some opportunities to the west of the reservoir and along road corridors (Figure 21). These areas are where the majority of the human activity occurs and the risk of a fire starting is greatest. Therefore, treatments should be focused here to reduce the chance of a fire occurring and moving higher into the watershed. Currently there are no planned treatments on any of the NFS lands. Stakeholders should consider developing fuel breaks along the road corridors that run through the ZoC. Approval of management of lands for watershed protection within the roadless area should be sought. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards.

Stakeholders include: City of Fort Collins, US Forest Service, and Colorado State Forest Service.

Barnes Meadow Reservoir Opportunities

Existing road access is very limited. However, there are some opportunities in this ZoC along the existing road on the north side of the reservoir (Figure 21). There may also be some opportunities to the south/southwest of the reservoir. Because the area around the reservoir is where the majority of the human activity occurs and the risk of fire is greatest, treatments should incorporate all the non-federal and adjacent federal

lands and be focused here to reduce the chance of a fire occurring and moving upslope into the watershed. This treatment area should be combined and coordinated with those at Chambers Lake, including the areas just outside the ZoC. Part of this area is in the Spencer Heights CWPP, which should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District, agencies and area residents about this issue and to collaborate with them to update the CWPP as necessary, and possibly expand it to include a larger part of the ZoC.

Currently there are no planned treatments on any of the NFS lands. Approval of management of lands for watershed protection within the roadless area should be sought. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards.

Stakeholders include: City of Greeley, US Forest Service, private landowners, and Colorado State Forest Service.

Peterson Lake Opportunities

There are some opportunities in this ZoC (Figure 21). Existing roads provide access to some of the lodgepole pine areas. The area around the reservoir is where the majority of the human activity occurs and the risk of a fire start is greatest. Treatments should be focused around the reservoir to reduce the chance of a fire occurring and moving upslope into the watershed. The majority of this watershed area is in the Spencer Heights CWPP, which should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District, agencies and area residents about this issue and to collaborate with them to update the CWPP as necessary, and possibly expand it to include the entire ZoC.

Currently there are no planned treatments on any of the NFS lands. However treatments have been completed in the past in the area west of the reservoir between Peterson Lake Road and Long Draw Road. Selected areas could be kept as openings or in younger age-classes to help reduce fire spread. Follow-up thinning of regenerated stands and ongoing, periodic maintenance should be conducted. Consider developing fuelbreaks along the road corridors that run through the ZoC. Approval of management of lands for watershed protection within the roadless area should be sought. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards.

Stakeholders include: City of Greeley and US Forest Service.

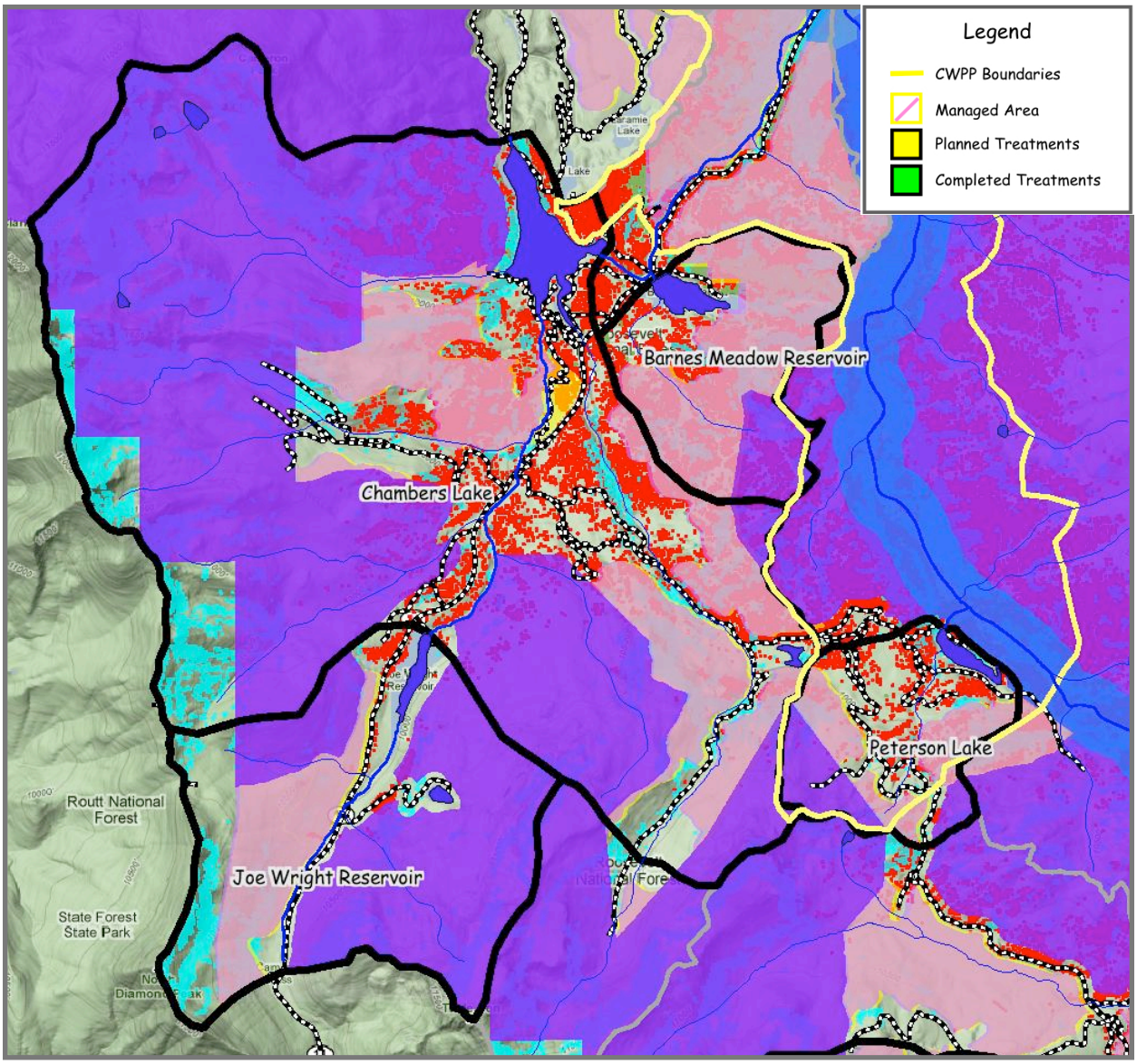

Figure 21. Chambers Lake, Joe Wright & Barnes Meadow Reservoirs, & Peterson Lake ZoC Opportunities

Long Draw Reservoir & Endo Valley ZoC

The maps and analysis for the Long Draw Reservoir & Endo Valley ZoC are combined. Figure 22 shows the general location of the Long Draw Reservoir & Endo Valley ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

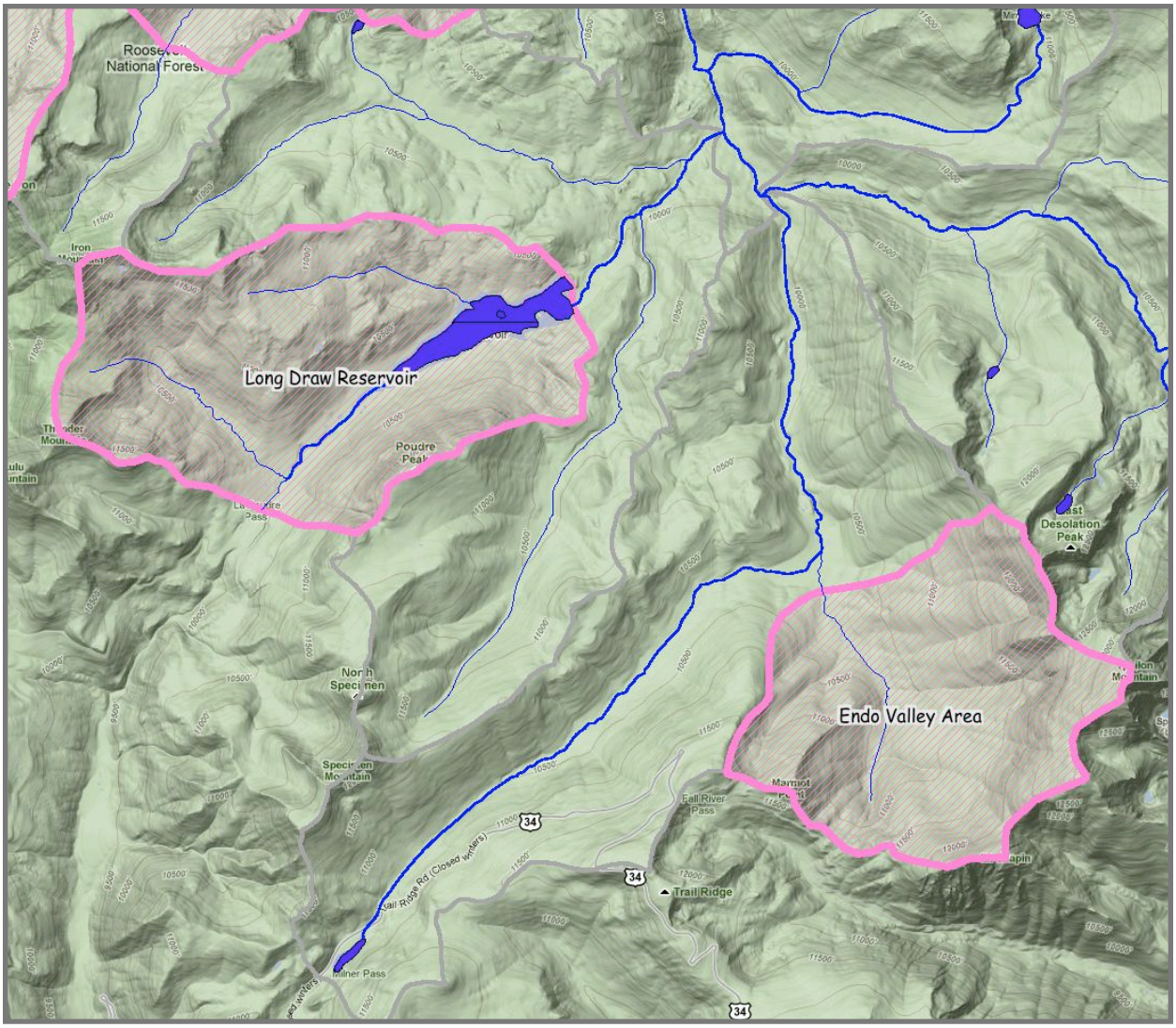

Figure 22. Long Draw Reservoir & Endo Valley ZoC Location

Long Draw Reservoir Ownership

Land ownership is all NFS lands west of La Poudre Pass Creek except for a small area of state land that is part of the Colorado State Forest in the upper portion of the watershed. Ownership is all National Park System lands east of La Poudre Pass Creek (Figure 23).

Endo Valley Ownership

All land within this ZoC are National Park Service lands (Figure 23).

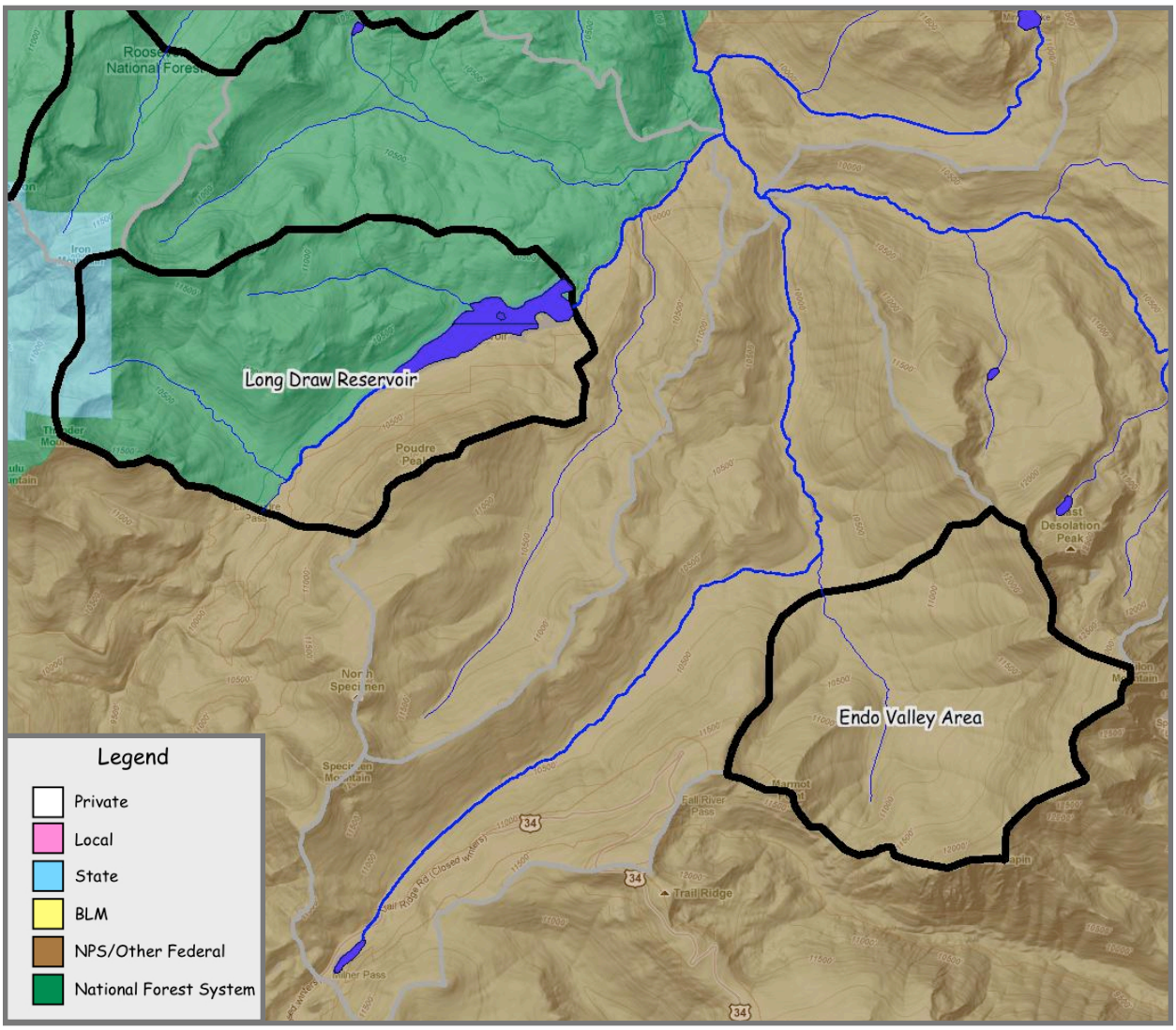

Figure 23. Long Draw Reservoir & Endo Valley ZoC Ownership

Long Draw Reservoir Watershed Priority

The La Poudre Pass Creek watershed (Figure 24) is Orange overall (Category 4). Wildfire Hazard is Red (Category 5).

Endo Valley Watershed Priority

The Headwaters Cache la Poudre River watershed (Figure 24) is Red overall (Category 5). Wildfire Hazard is also Red (Category 5) and Soil Erodibility is Orange (Category 4).

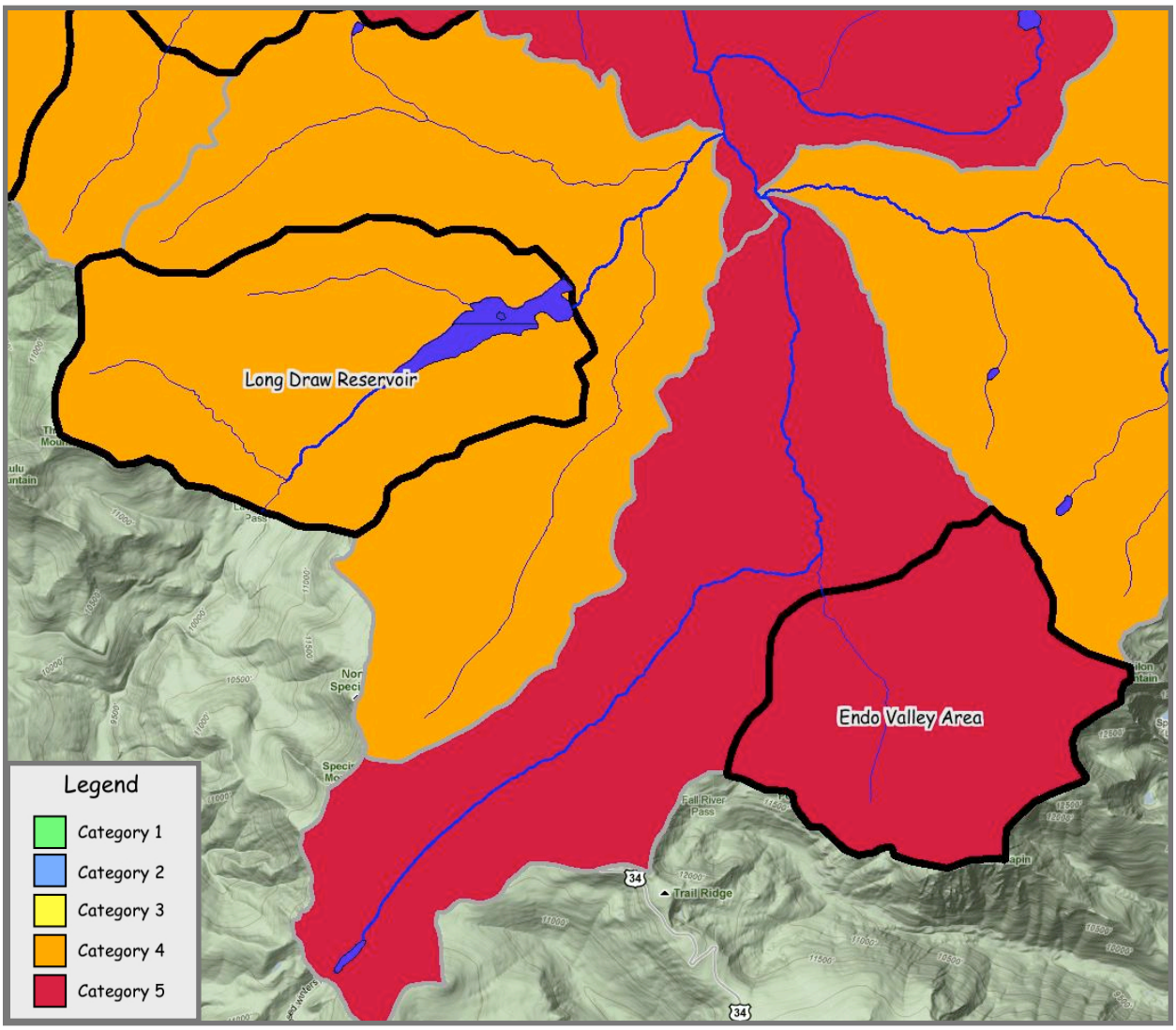

Figure 24. Long Draw Reservoir & Endo Valley ZoC Watershed Priority

Long Draw Reservoir Slopes

Steep slopes are present in the upper portions of the ZoC and along some streams (Figure 25).

Endo Valley Slopes

Steep slopes are present in the upper portions of the ZoC (Figure 25).

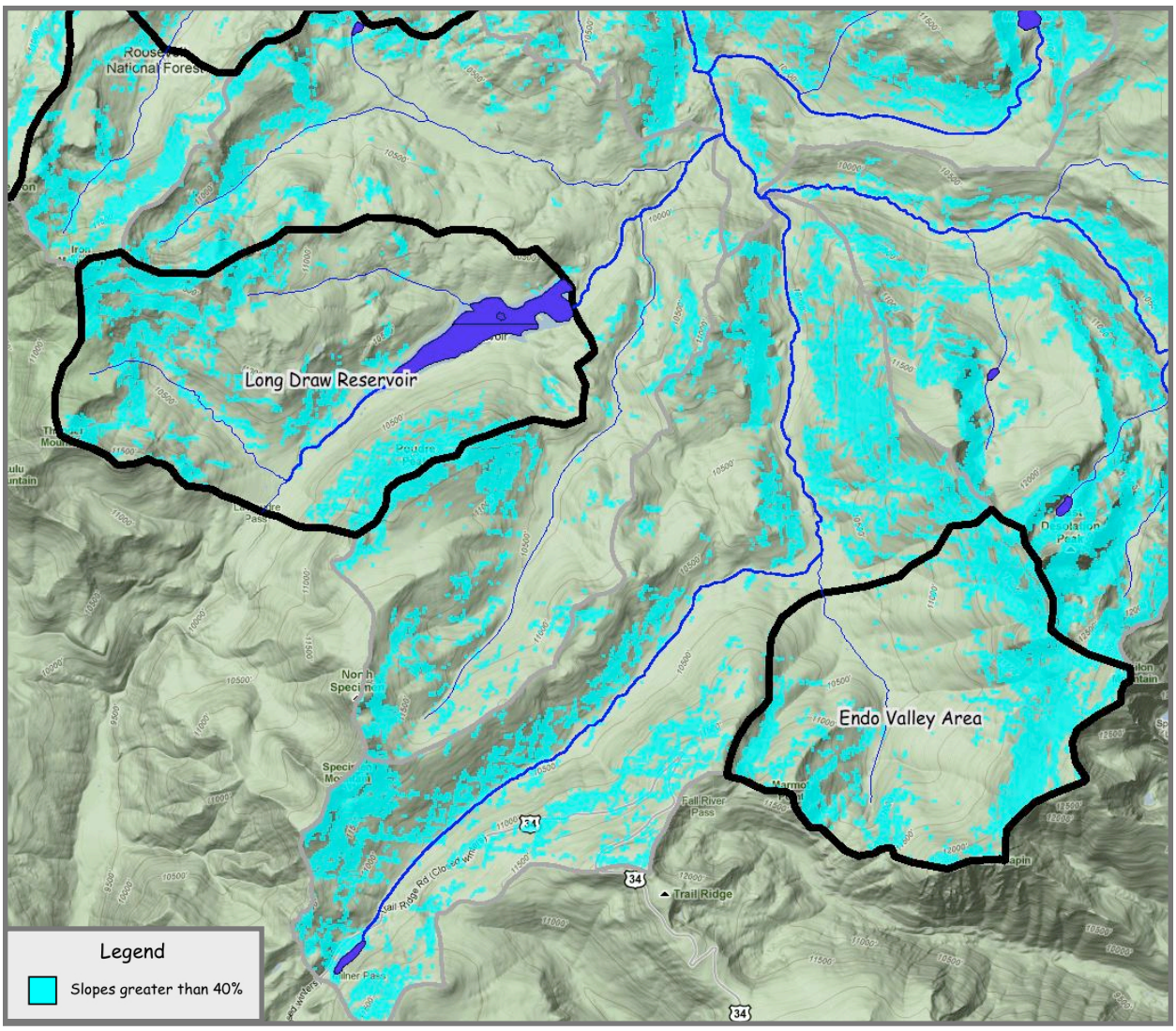

Figure 25. Long Draw Reservoir & Endo Valley ZoC Slope

Long Draw Reservoir Special Management Areas

West of La Poudre Pass Creek is the Neota Wilderness Area and Neota Adjacent Roadless Area except for a small area north of the reservoir. East of La Poudre Pass Creek the ZoC is within Rocky Mountain National Park (Figure 26).

Endo Valley Special Management Areas

The ZoC is part of Rocky Mountain National Park (Figure 26).

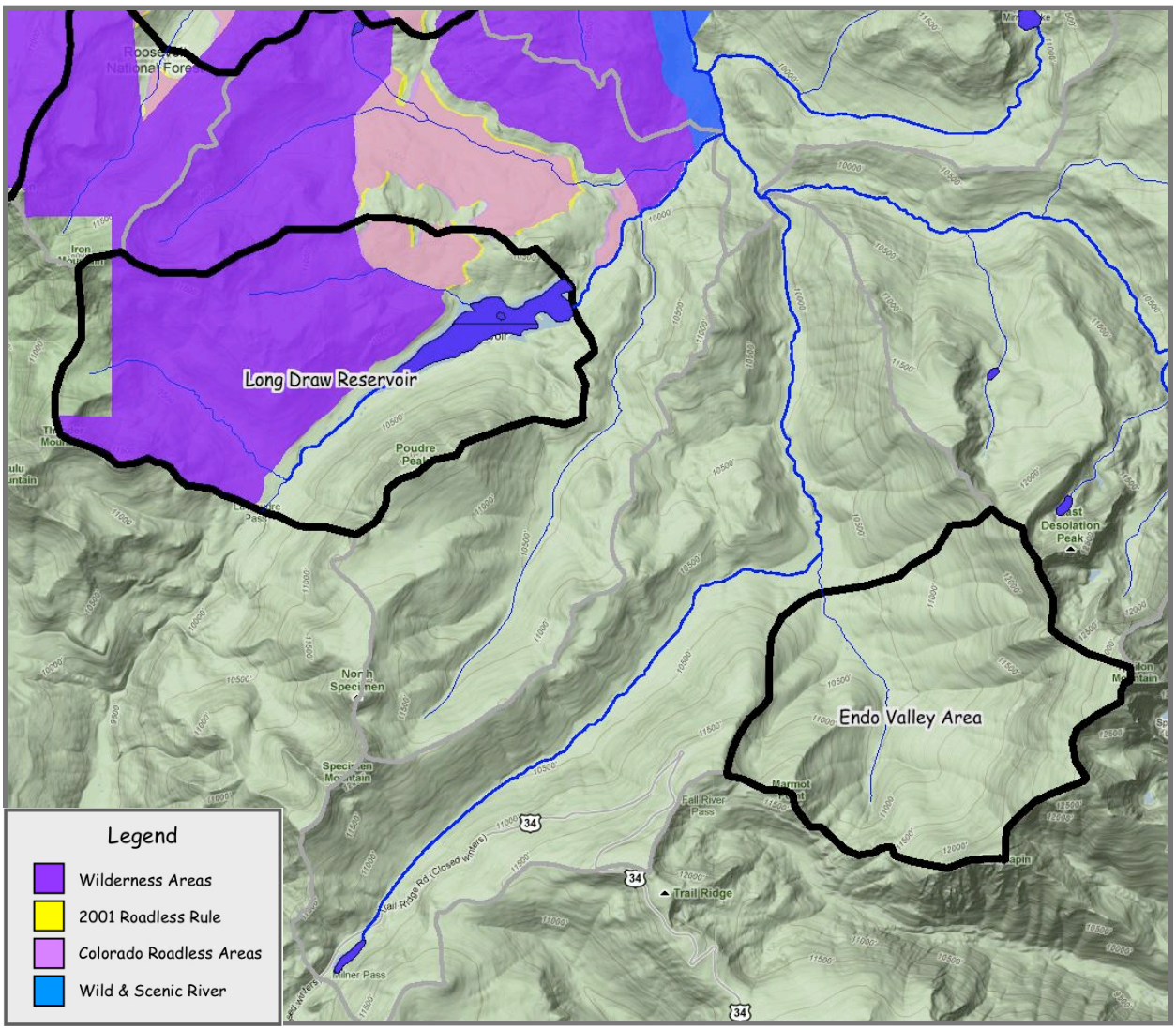

Figure 26. Long Draw Reservoir & Endo Valley ZoC Special Areas

Long Draw Reservoir Vegetation

The ZoC is dominated by spruce-fir with some areas of lodgepole pine. It transitions to alpine at higher elevations (Figure 27).

Endo Valley Vegetation

The ZoC is dominated by spruce-fir with few areas of lodgepole pine. It transitions to alpine at higher elevations (Figure 27).

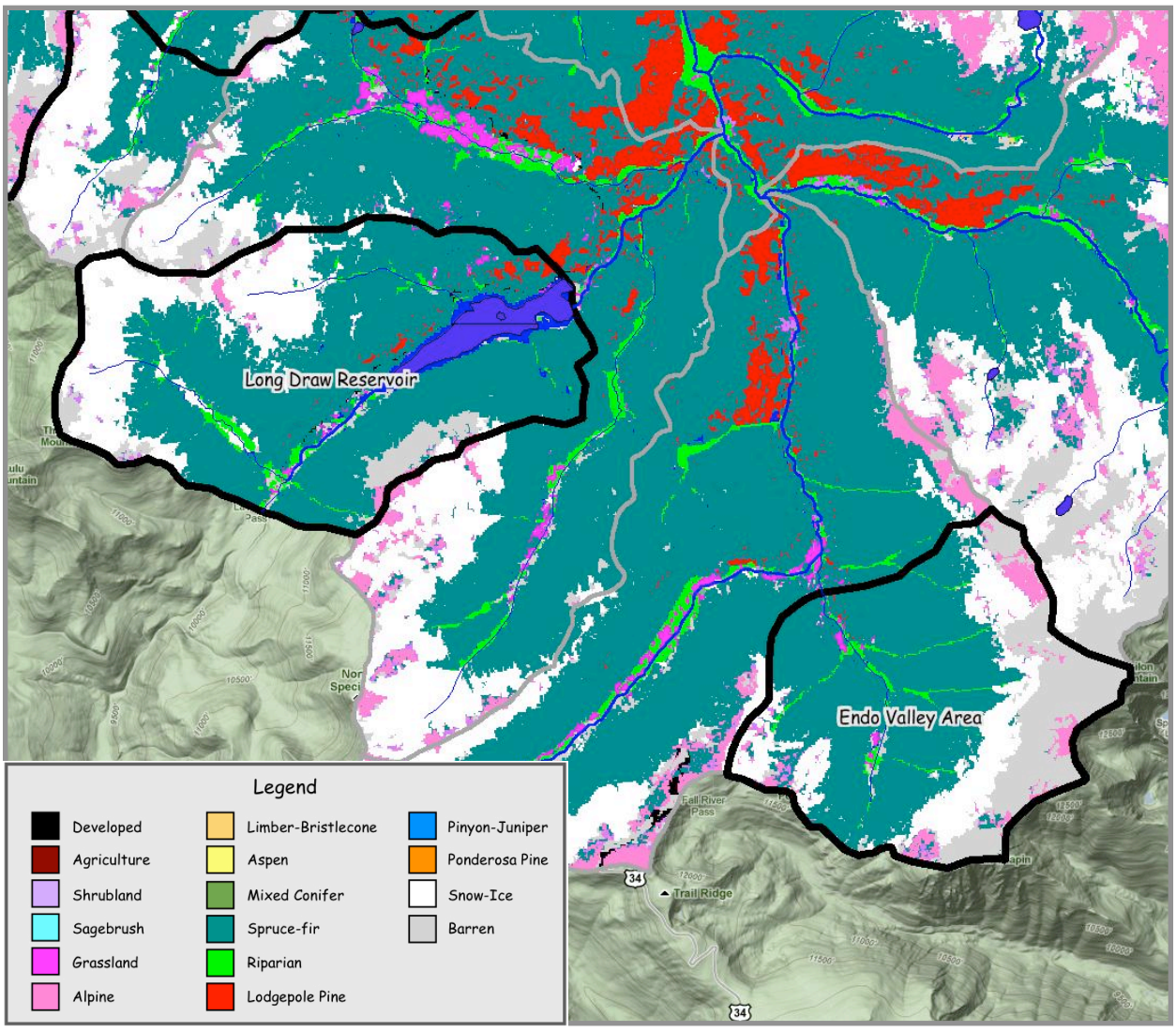

Figure 27. Long Draw Reservoir & Endo Valley ZoC Vegetation

Long Draw Reservoir Opportunities

There are some opportunities in this ZoC (Figure 28). Existing roads provide access to some lodgepole pine areas just north of the reservoir. The area around the reservoir and along the roads are where the majority of human activity occurs and the risk of a fire start is greatest. Therefore, treatments should be focused there to reduce the chance of a fire occurring and moving upslope into the watershed. Stakeholders should consider developing fuelbreaks along the road corridors that run through the ZoC. Currently there are no planned treatments on any NFS lands. Opportunities to manage lands for watershed protection within roadless areas should be explored. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards. Discuss with the National Park Service to explore what, if any, treatments might occur on their lands.

Stakeholders include: Water Supply & Storage Company, US Forest Service, and National Park Service.

Endo Valley Opportunities

There are few opportunities in this ZoC (Figure 28). Existing roads just touch the ZoC along the southwest boundary, but temporary access could be developed from those roads in areas where slopes allow. High elevation grasslands exist along the ridgelines of mountains in this area, creating natural fuelbreaks. It appears that there are some ridgelines connecting to these grasslands where fuelbreaks could be developed. Currently there are no treatments planned for this area and it is not covered by any CWPP. If no other treatments can be found, the best approach would be to manage this area for the use of natural fire.

Stakeholders include: National Park Service

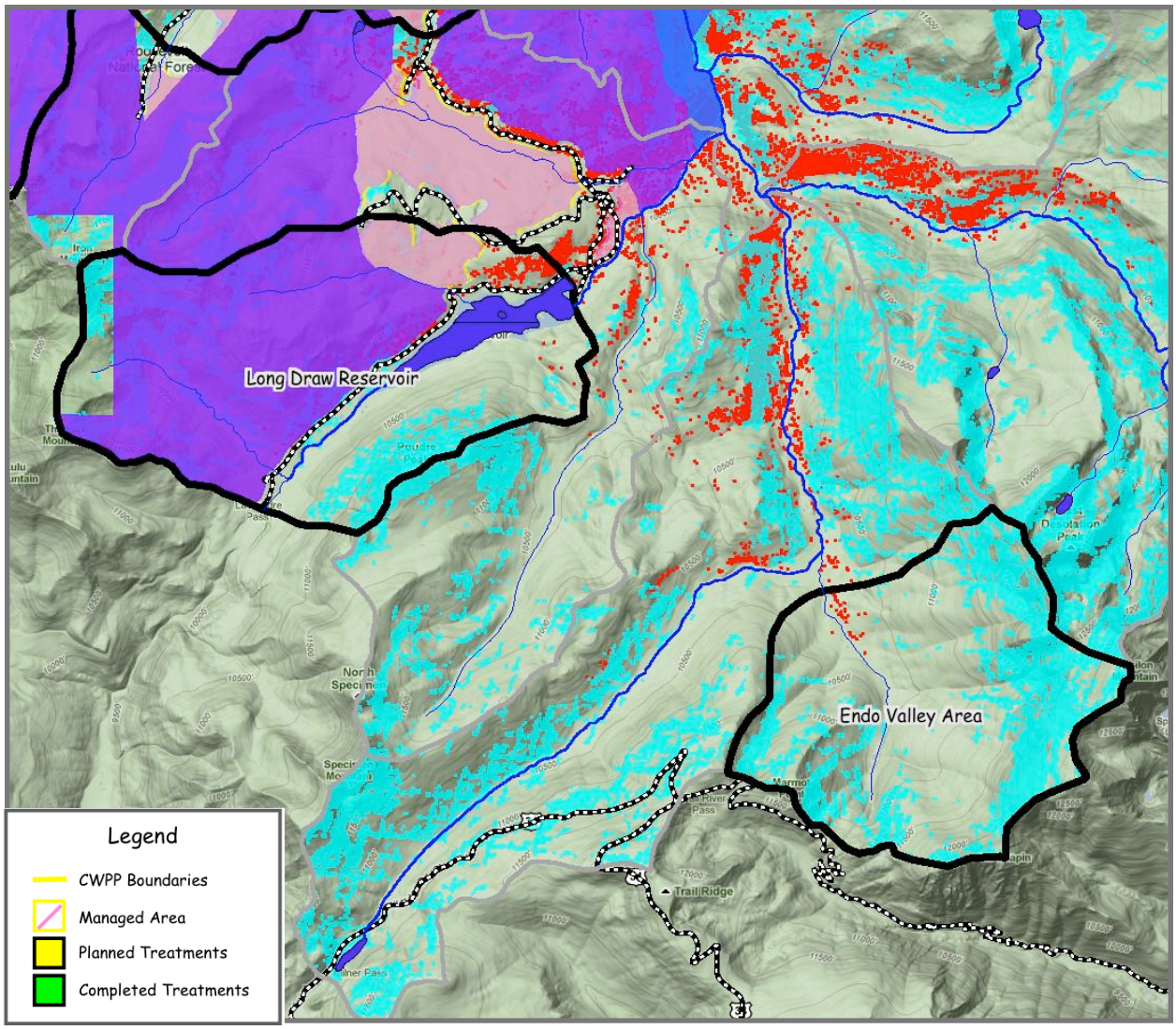

Figure 28. Long Draw Reservoir & Endo Valley ZoC Opportunities

Comanche, Hourglass & Twin Lake Reservoirs ZoC

The maps and analysis for the Comanche, Hourglass & Twin Lake Reservoirs ZoC are combined. Figure 29 shows the general location of the Comanche, Hourglass & Twin Lake Reservoirs ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

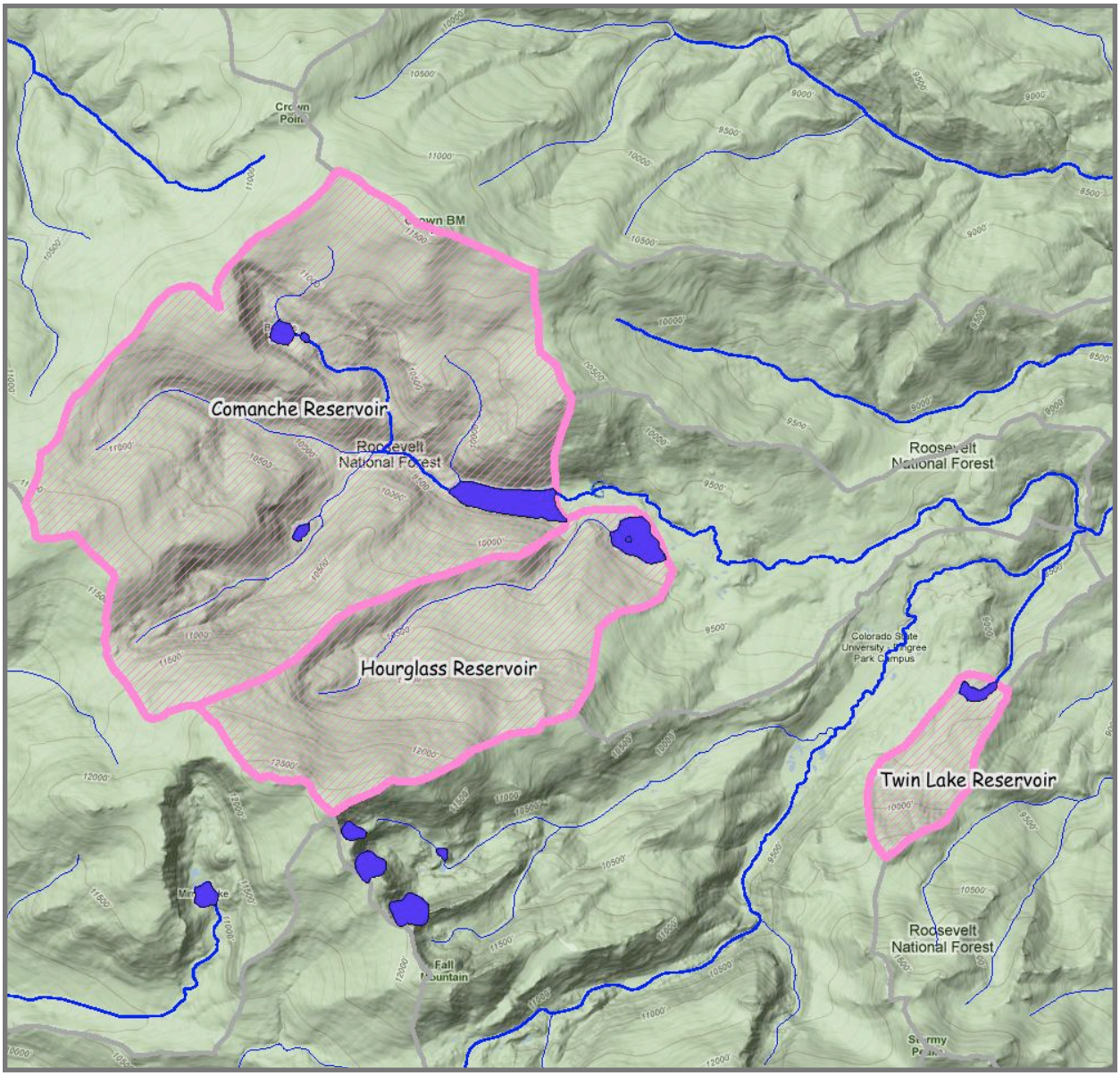

Figure 29. Comanche, Hourglass & Twin Lake Reservoirs ZoC Location

Comanche Reservoir Ownership

Land ownership is entirely NFS lands (Figure 30).

Hourglass Reservoir Ownership

Land ownership is nearly all NFS lands within this ZoC (Figure 30). There is a small area of private land around the reservoir.

Twin Lake Reservoir Ownership

Land ownership is nearly all NFS lands within this ZoC (Figure 30). There is an area of state land that is part of the Pingree Park Campus of Colorado State University.

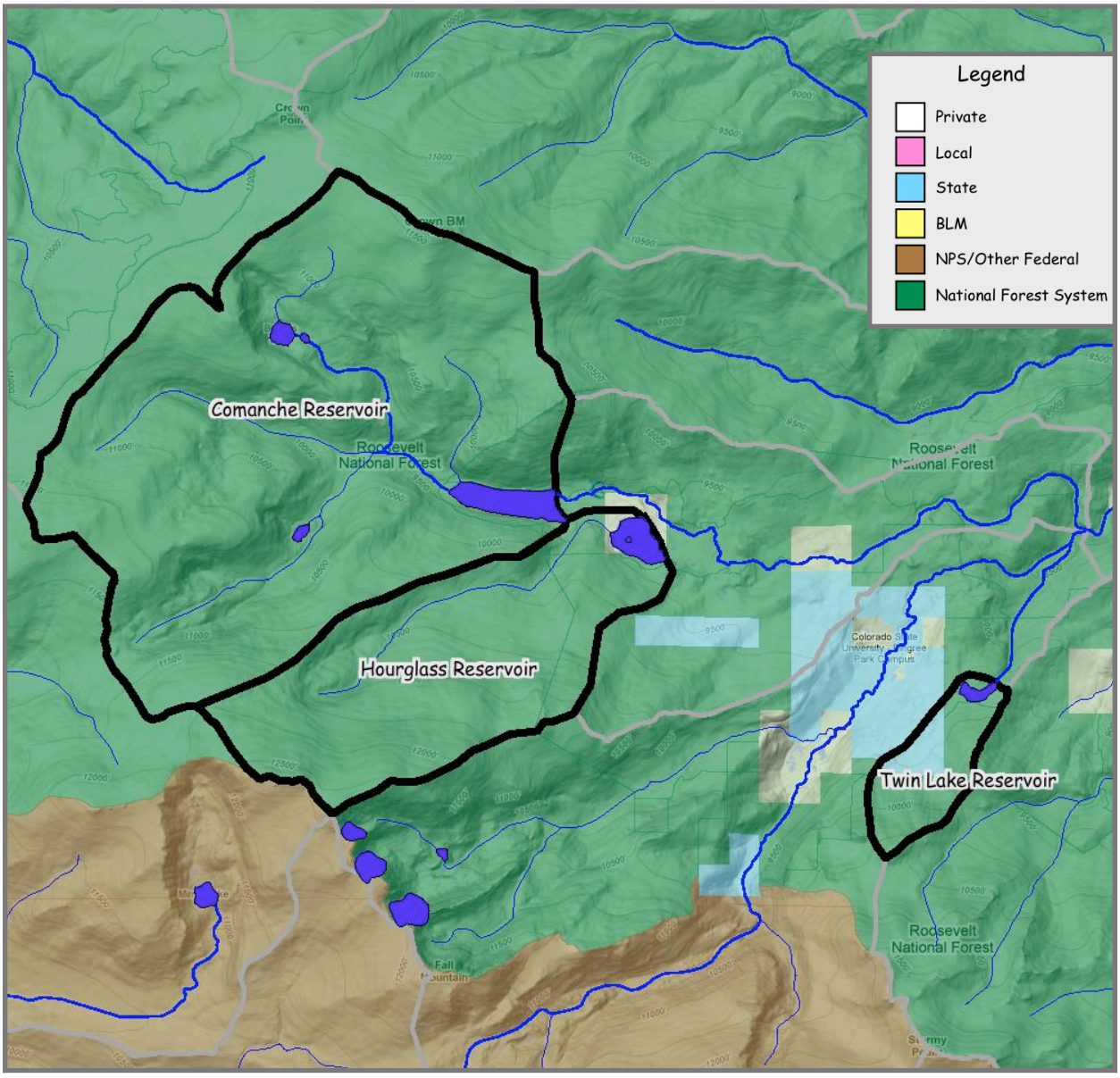

Figure 30. Comanche, Hourglass & Twin Lake Reservoirs ZoC Ownership

Comanche Reservoir Watershed Priority

The Beaver Creek watershed (Figure 31) is Orange overall (Category 4). Rankings for Wildfire Hazard and Flooding/Debris Flow are also Orange (Category 4).

Hourglass Reservoir Watershed Priority

The Beaver Creek watershed (Figure 31) is Orange overall (Category 4). Rankings for Wildfire Hazard and Flooding/Debris Flow are also Orange (Category 4).

Twin Lake Reservoir Watershed Priority

The Headwaters South Fork Cache la Poudre River watershed (Figure 31) is Red overall (Category 5). Rankings for Flooding/Debris Flow and Soil Erodibility are also Red (Category 5).

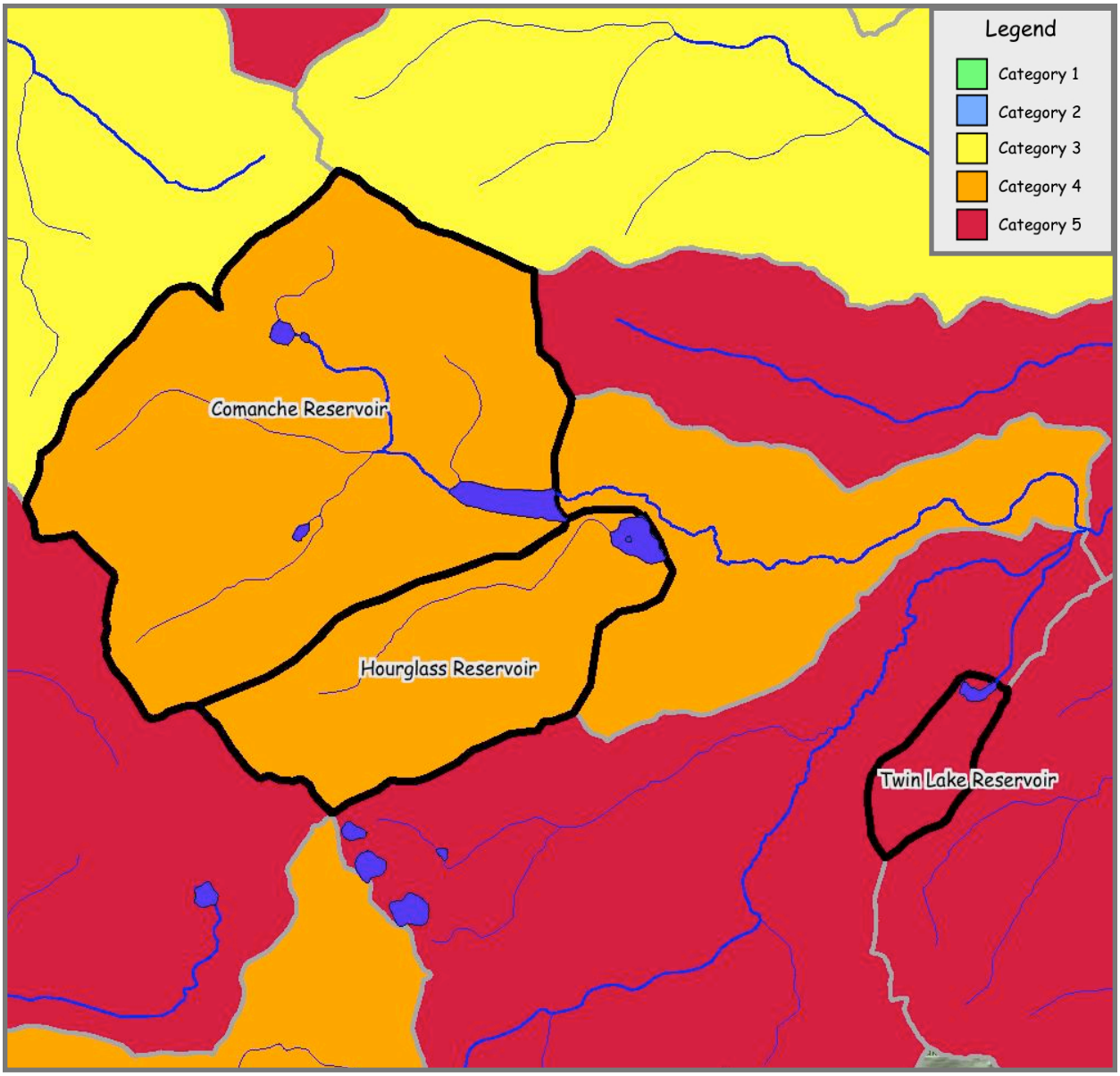

Figure 31. Comanche, Hourglass & Twin Lake Reservoirs ZoC Watershed Priority

Comanche Reservoir Slopes

There are some areas of steep slopes that follow the drainages and some side slopes (Figure 32).

Hourglass Reservoir Slopes

There are some areas of steep slopes that follow the drainages and some side slopes (Figure 32).

Twin Lake Reservoir Slopes

Steep slopes are only present in the upper most portion of the ZoC (Figure 32).

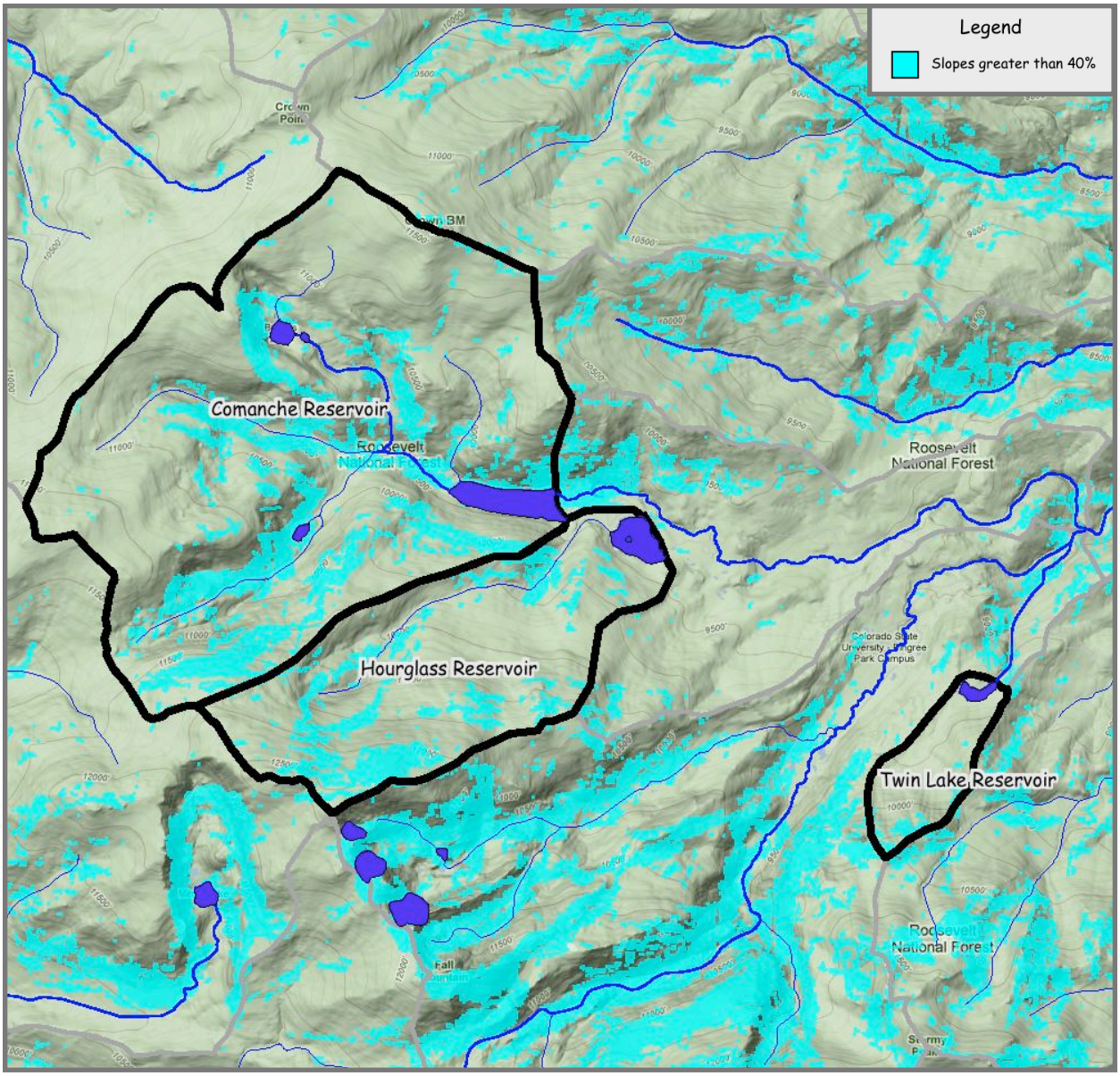

Figure 32. Comanche, Hourglass & Twin Lake Reservoirs ZoC Slope

Comanche Reservoir Special Management Areas

Most of the ZoC is in the Comanche Peak Wilderness Area. The Comanche Peak Adjacent Roadless Area is north of the reservoir. Land around the reservoir is outside of wilderness or roadless (Figure 33).

Hourglass Reservoir Special Management Areas

Most of the ZoC is in the Comanche Peak Wilderness Area. The Comanche Peak Adjacent Roadless Area is just south and west of the reservoir. There is a band around the reservoir that is outside of wilderness or roadless including a piece that connects west to Comanche Reservoir (Figure 33).

Twin Lake Reservoir Special Management Areas

The southern third of the ZoC is in the Comanche Peak Wilderness Area. The Comanche Peak Adjacent Roadless Area occupies a small area just south of the reservoir. The Cache la Poudre Wild & Scenic River occupies a small piece of the ZoC (Figure 33).

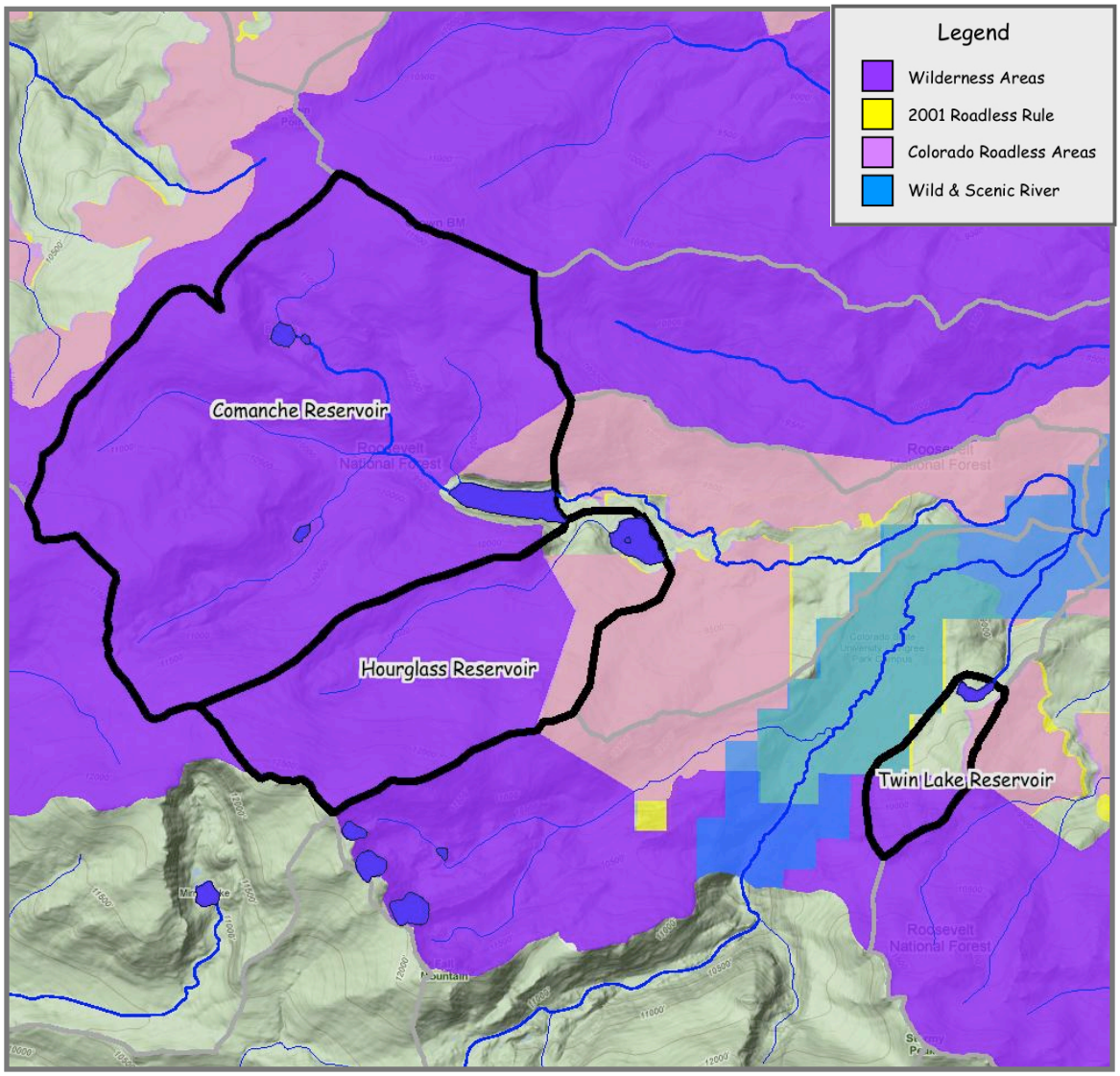

Figure 33. Comanche, Hourglass & Twin Lake Reservoirs ZoC Special Areas

Comanche Reservoir Vegetation

The ZoC is dominated by spruce-fir. There are some large areas of lodgepole pine just north of the reservoir, with some aspen and sagebrush. At the top of the watershed it transitions to alpine (Figure 34).

Hourglass Reservoir Vegetation

The ZoC has distinct bands of vegetation based on elevation. The area around the reservoir is lodgepole pine, which, as elevation increases, transitions to spruce-fir and then to alpine (Figure 34).

Twin Lake Reservoir Vegetation

The ZoC is dominated by lodgepole pine (Figure 34). At the top of the watershed it transitions to Spruce-fir. There is a large fire scar (1,275 acres) to the west/southwest/south of the reservoir from the Hourglass/Pingree Fire of July 1994.

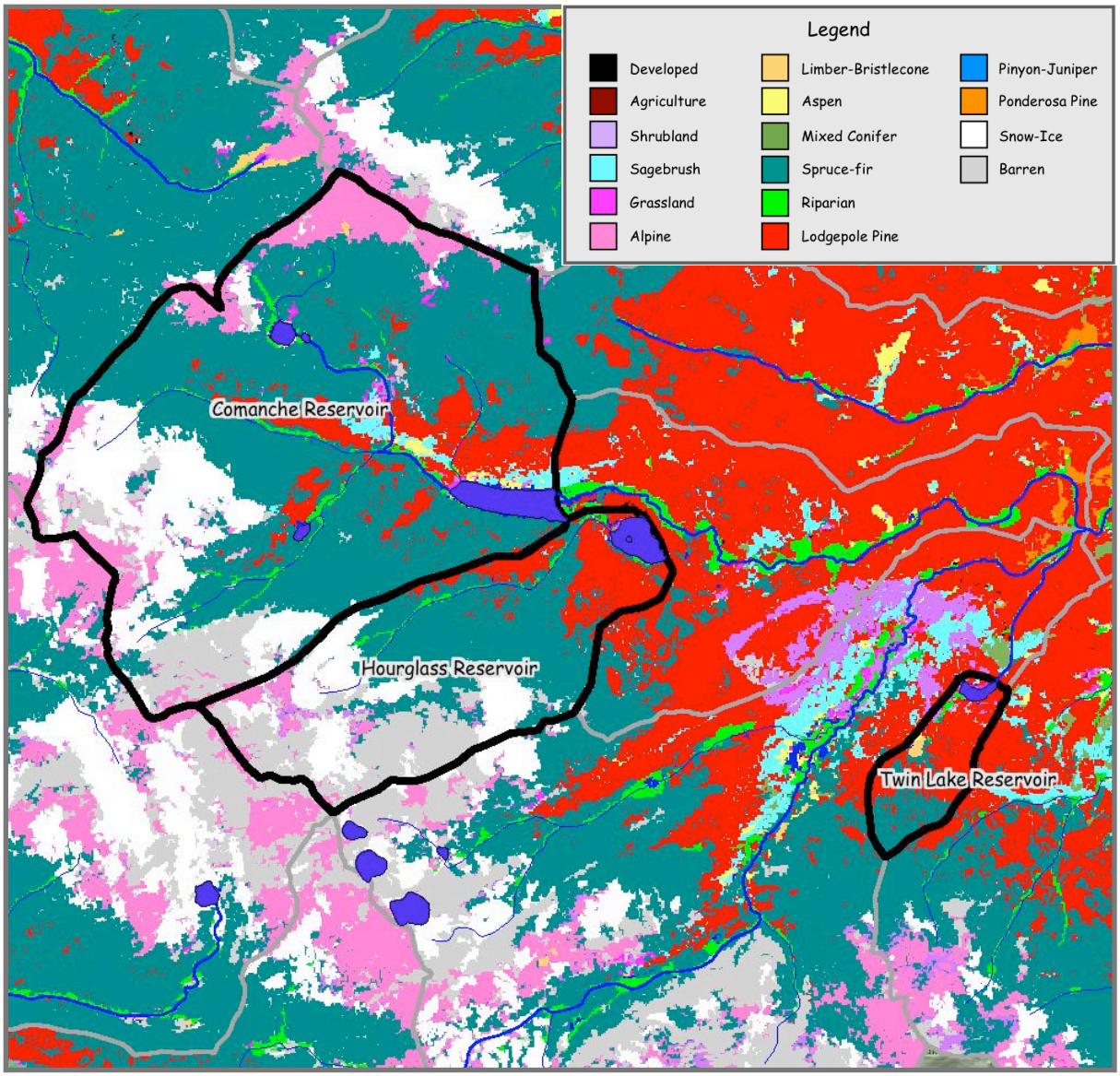

Figure 34. Comanche, Hourglass & Twin Lake Reservoirs ZoC Vegetation

Comanche Reservoir Opportunities

Currently there are no treatments planned on any of the NFS lands within the ZoC. Other than using natural fire within the wilderness area, the only areas of opportunity appear to be around the reservoir (Figure 35). Steep slopes and lack of access would likely only allow hand treatments. These treatments should be combined and coordinated with those at Hourglass Reservoir. Opportunities to manage lands for watershed protection within roadless areas should be explored.

Stakeholders include: City of Greeley and US Forest Service.

Hourglass Reservoir Opportunities

There are some opportunities around the reservoir in areas that have good access, shallower slopes and the presence of lodgepole pine (Figure 35). The majority of human activity occurs near the reservoir and the risk of a fire starting is greatest there. Therefore, treatments should incorporate all the non-federal lands and be focused around the reservoir to reduce the chance of a fire starting and moving upslope into the watershed. This treatment area should be combined and coordinated with those at Comanche Reservoir. Part of this area is in the Pingree Park CWPP, which should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District, agencies and area residents about this issue and to collaborate with them to update the CWPP as necessary. Currently there are no planned treatments on any of the NFS lands. Opportunities to manage lands for watershed protection within roadless areas should be explored. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards.

Stakeholders include: City of Greeley, US Forest Service, and private landowners.

Twin Lake Reservoir Opportunities

The Hourglass/Pingree Fire of 1994 significantly modified fuels to the west, southwest, and south of the reservoir. There are some treatment opportunities to the north and northwest of the reservoir (Figure 35) where the fire did not burn (or did not burn as intensely). That area has good access, shallower slopes and lodgepole pine present. This area is also where the majority of the human activity occurs and the risk of a fire start is greatest. Treatments should incorporate all the non-federal lands and be focused on reducing the risk of a fire occurring here and moving upslope into the watershed.

Part of this ZoC is in the Pingree Park CWPP and there has been some treatments completed within the Pingree Park area. The CWPP and the Pingree Park management plan should be reviewed for additional proposed treatments that would contribute to watershed protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District and Colorado State University about this issue and to collaborate with them to update the CWPP as necessary. Currently there are no planned treatments on any of the NFS lands. Opportunities to manage lands for watershed protection within roadless areas should be explored. In wilderness areas, create and implement plans that would use natural fire to reduce wildfire hazards.

Stakeholders include: City of Greeley, US Forest Service, Colorado State University, and Colorado State Forest Service.

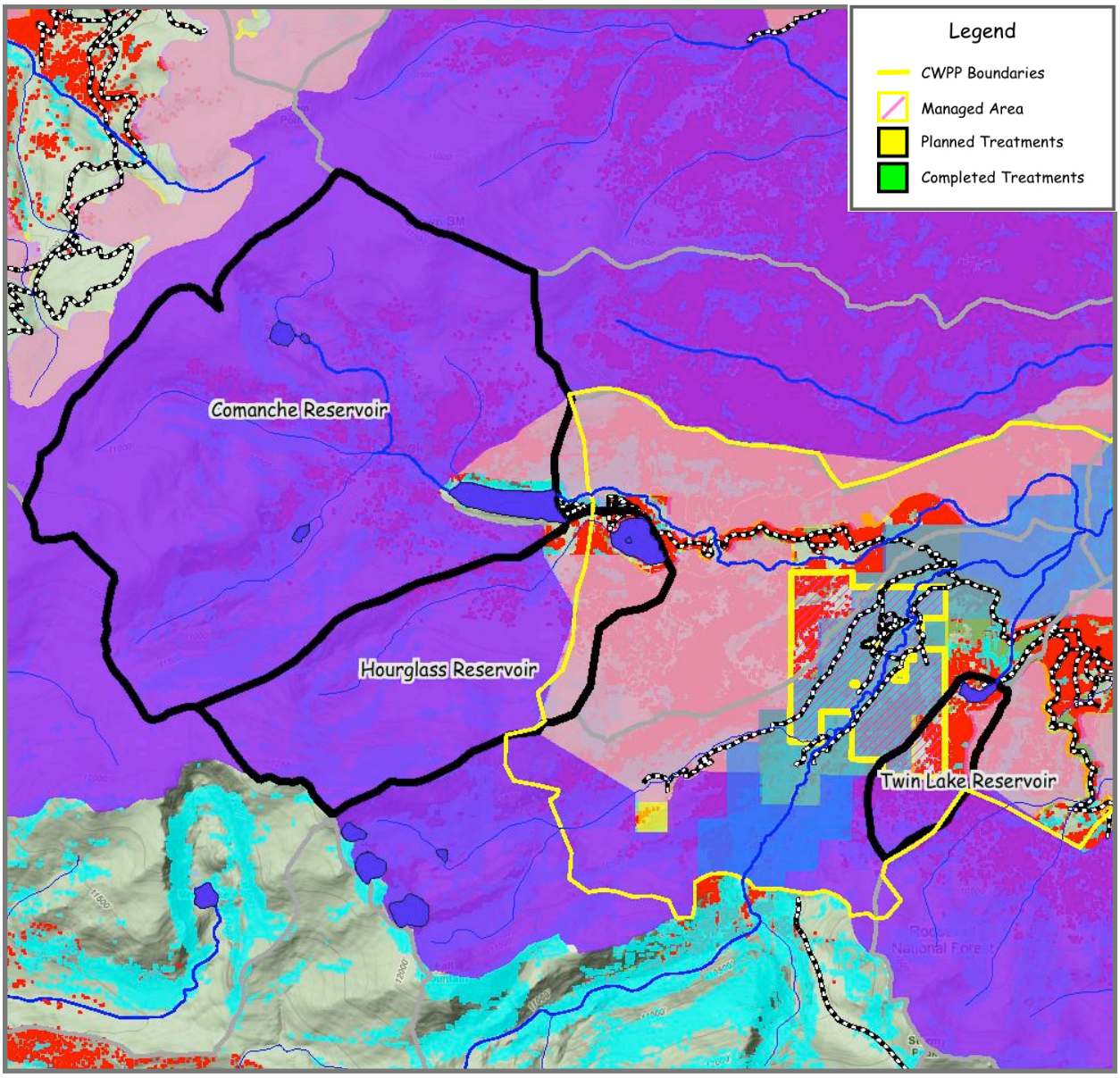

Figure 35. Comanche, Hourglass & Twin Lake Reservoirs ZoC Opportunities

Eaton & Panhandle Reservoirs ZoC

The maps and analysis for the Eaton & Panhandle Reservoirs ZoC are combined. Figure 36 shows the general location of the Eaton & Panhandle Reservoirs ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

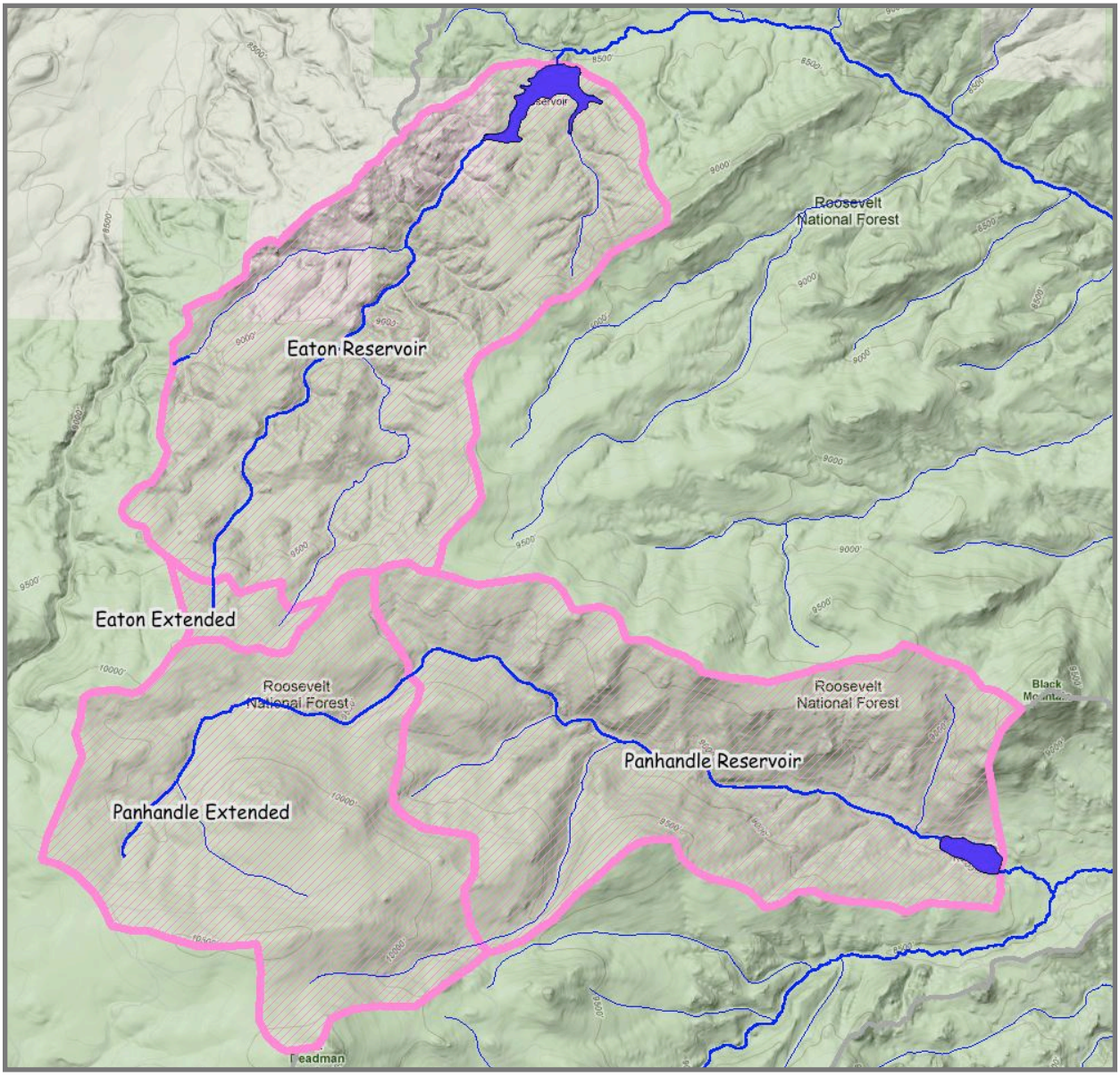

Figure 36. Eaton & Panhandle Reservoirs ZoC Location

Eaton Reservoirs Ownership

Land ownership is mostly NFS lands (Figure 37). There is a small area of private land around the reservoir. There is also a small piece of BLM land.

Panhandle Reservoirs Ownership

Land ownership is mostly by NFS lands (Figure 37). However, there are some significant areas of private lands. Surrounding Panhandle Reservoir is an area of private development that has a relatively high density of cabins and summer homes.

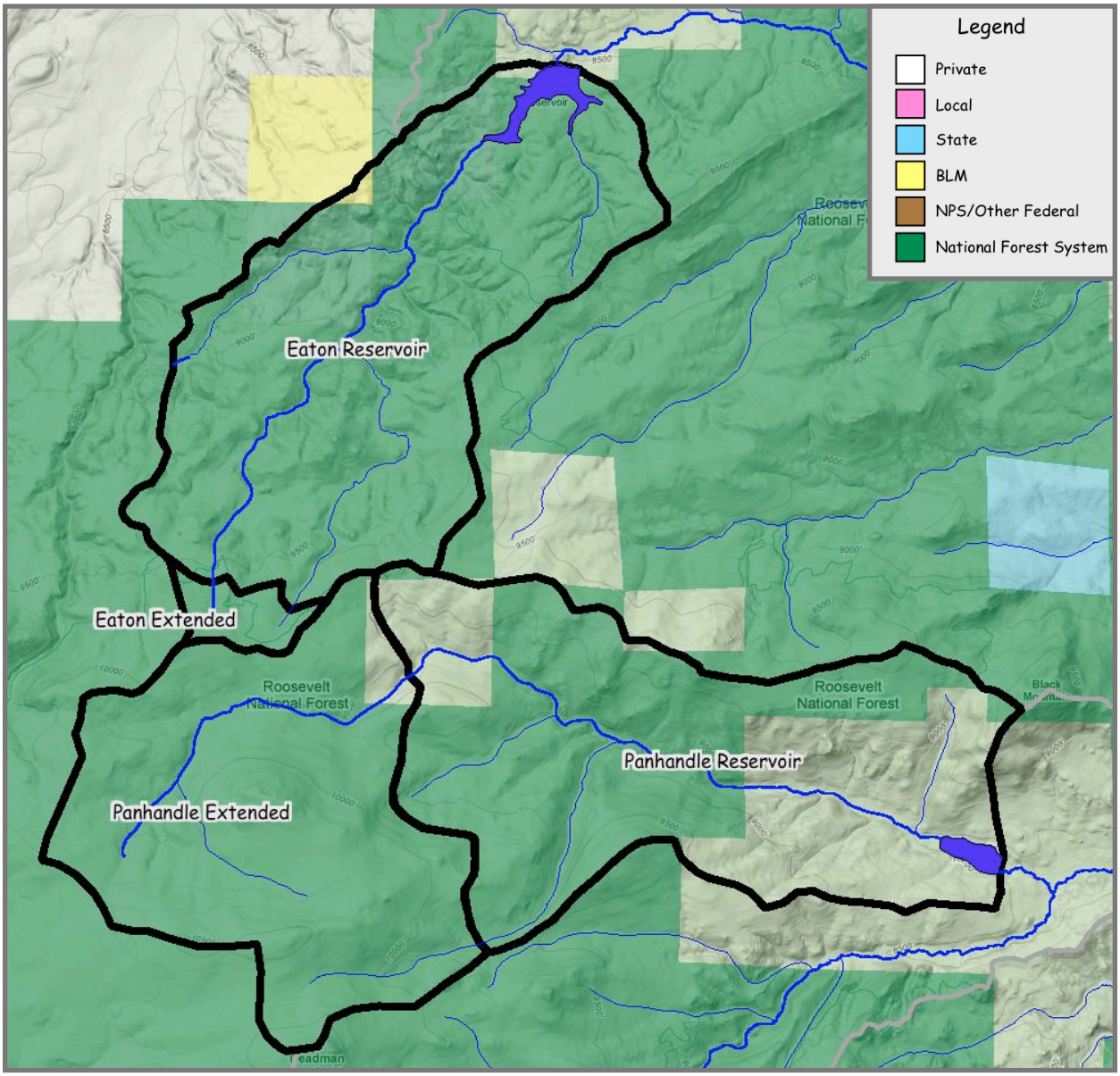

Figure 37. Eaton & Panhandle Reservoirs ZoC Ownership

Eaton Reservoirs Watershed Priority

The Sheep Creek-North Fork Cache la Poudre Creek watershed (Figure 38) is Yellow overall (Category 3). The ranking for Wildfire Hazard is Orange (Category 4).

Panhandle Reservoirs Watershed Priority

The North Fork Cache la Poudre River-Panhandle Creek watershed (Figure 38) is Orange overall (Category 4). The ranking for Wildfire Hazard is also Orange (Category 4).

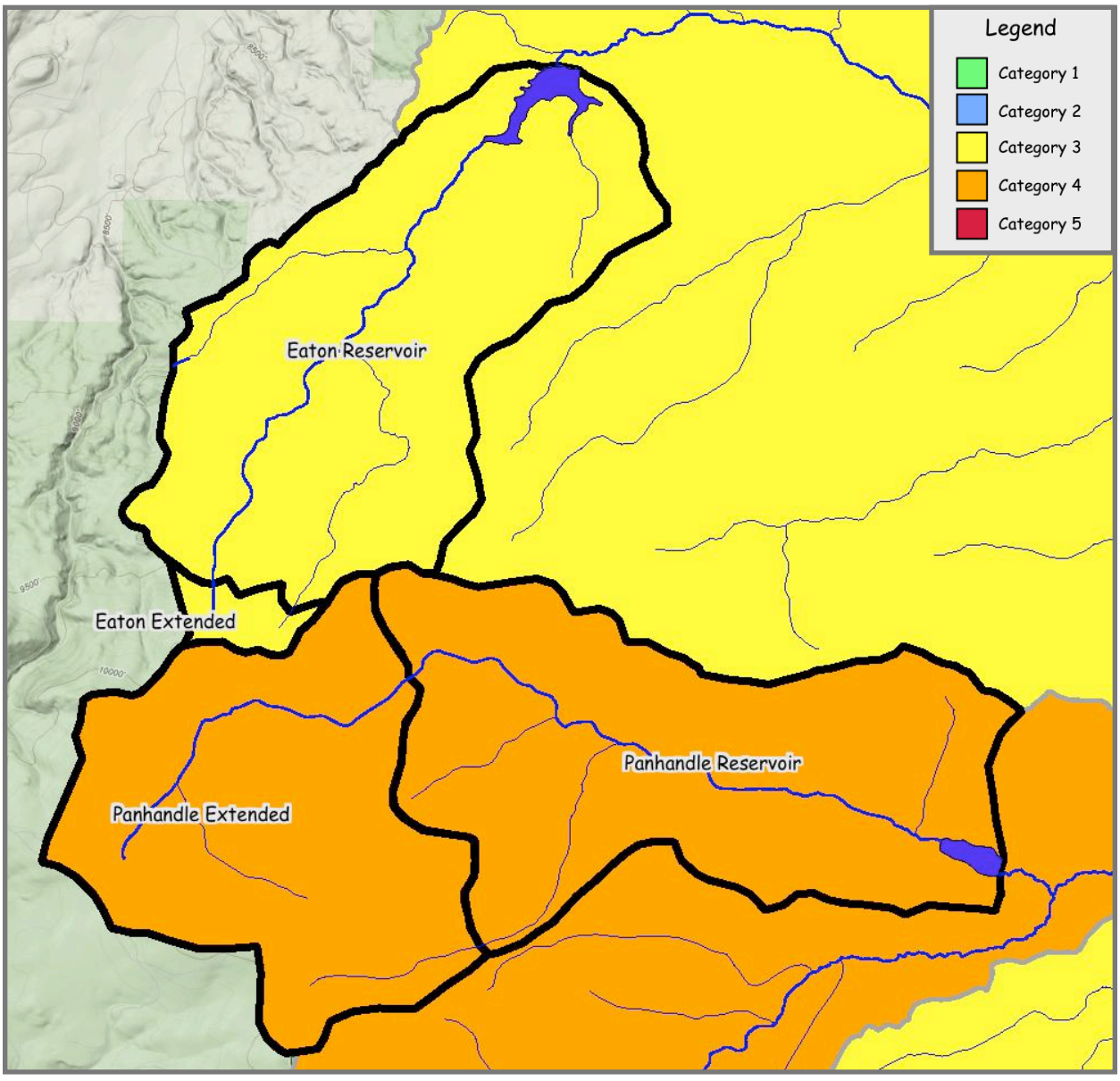

Figure 38. Eaton & Panhandle Reservoirs ZoC Watershed Priority

Eaton Reservoirs Slopes

There are some steep slopes scattered throughout the watershed (Figure 39).

Panhandle Reservoirs Slopes

There are some steep slopes scattered throughout the lower watershed (Figure 39).

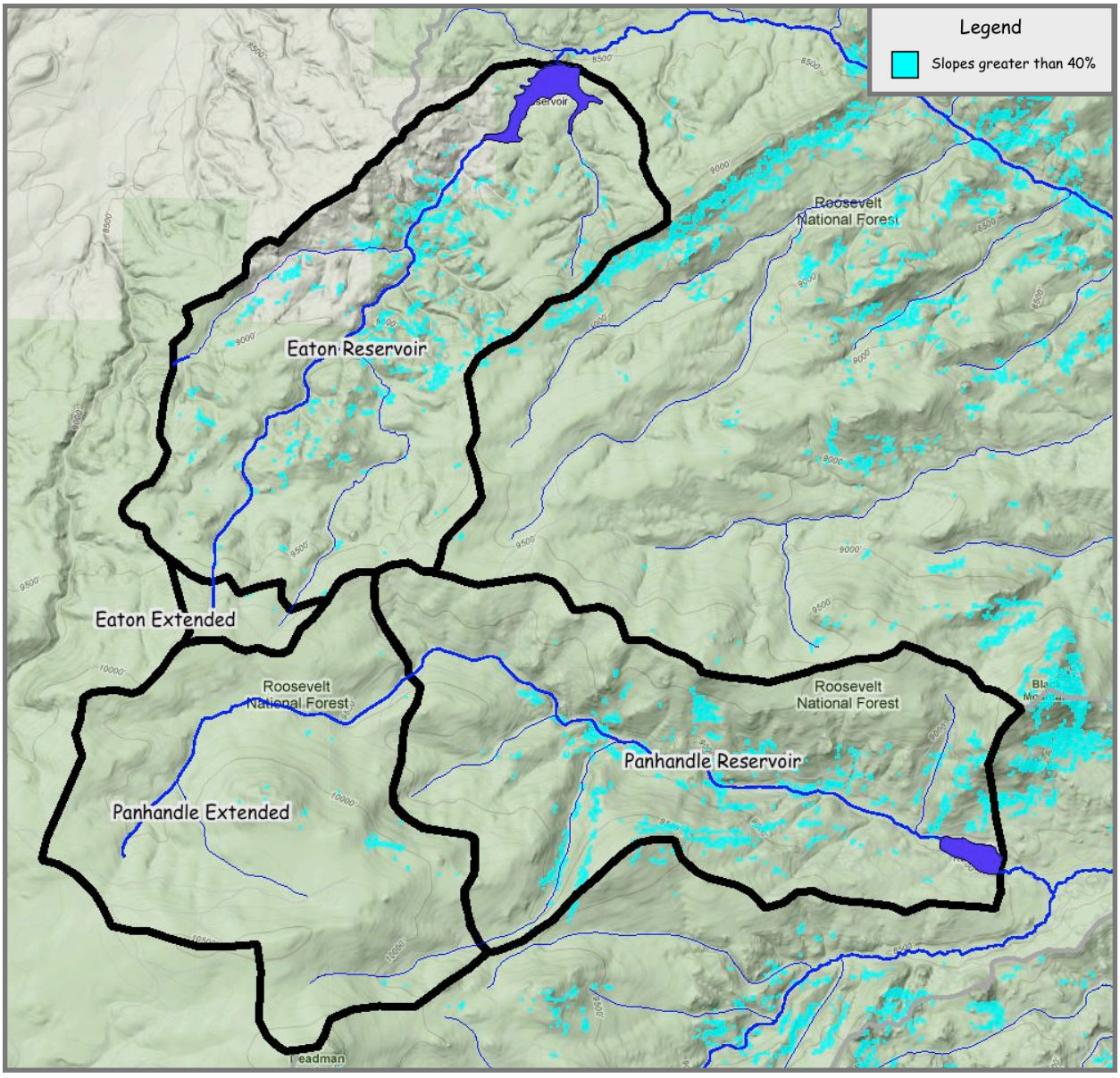

Figure 39. Eaton & Panhandle Reservoirs ZoC Slope

Eaton Reservoirs Special Management Areas

There are no wilderness areas. The Cherokee Park Roadless Area covers nearly the entire ZoC (Figure 40).

Panhandle Reservoirs Special Management Areas

There are no wilderness or roadless areas (Figure 40).

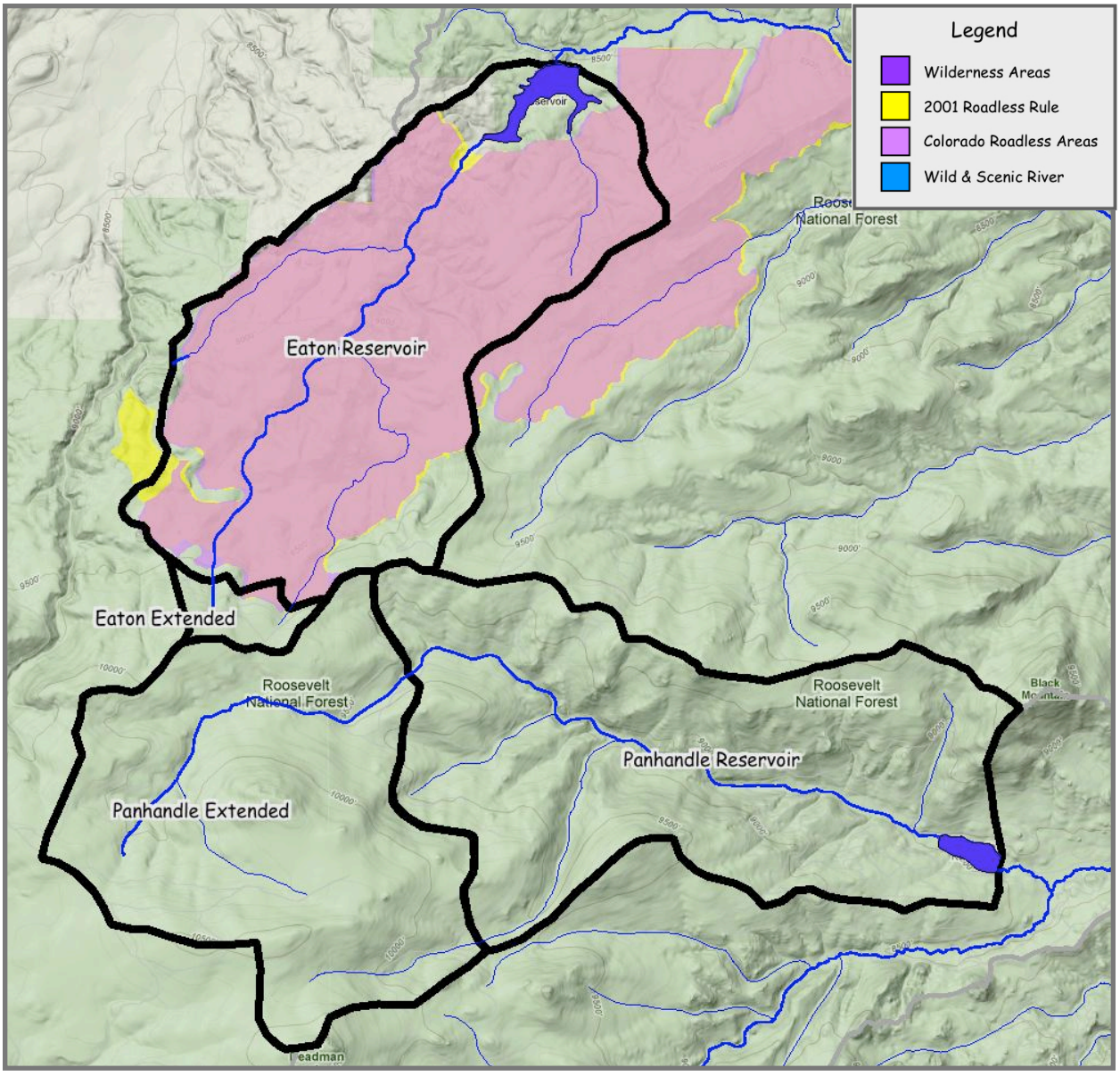

Figure 40. Eaton & Panhandle Reservoirs ZoC Special Areas

Eaton Reservoirs Vegetation

The ZoC is dominated by lodgepole pine. At the top of the watershed there are some areas of Spruce-fir (Figure 41).

Panhandle Reservoirs Vegetation

The ZoC is dominated by lodgepole pine. At the top of the watershed it transitions to Spruce-fir (Figure 41).

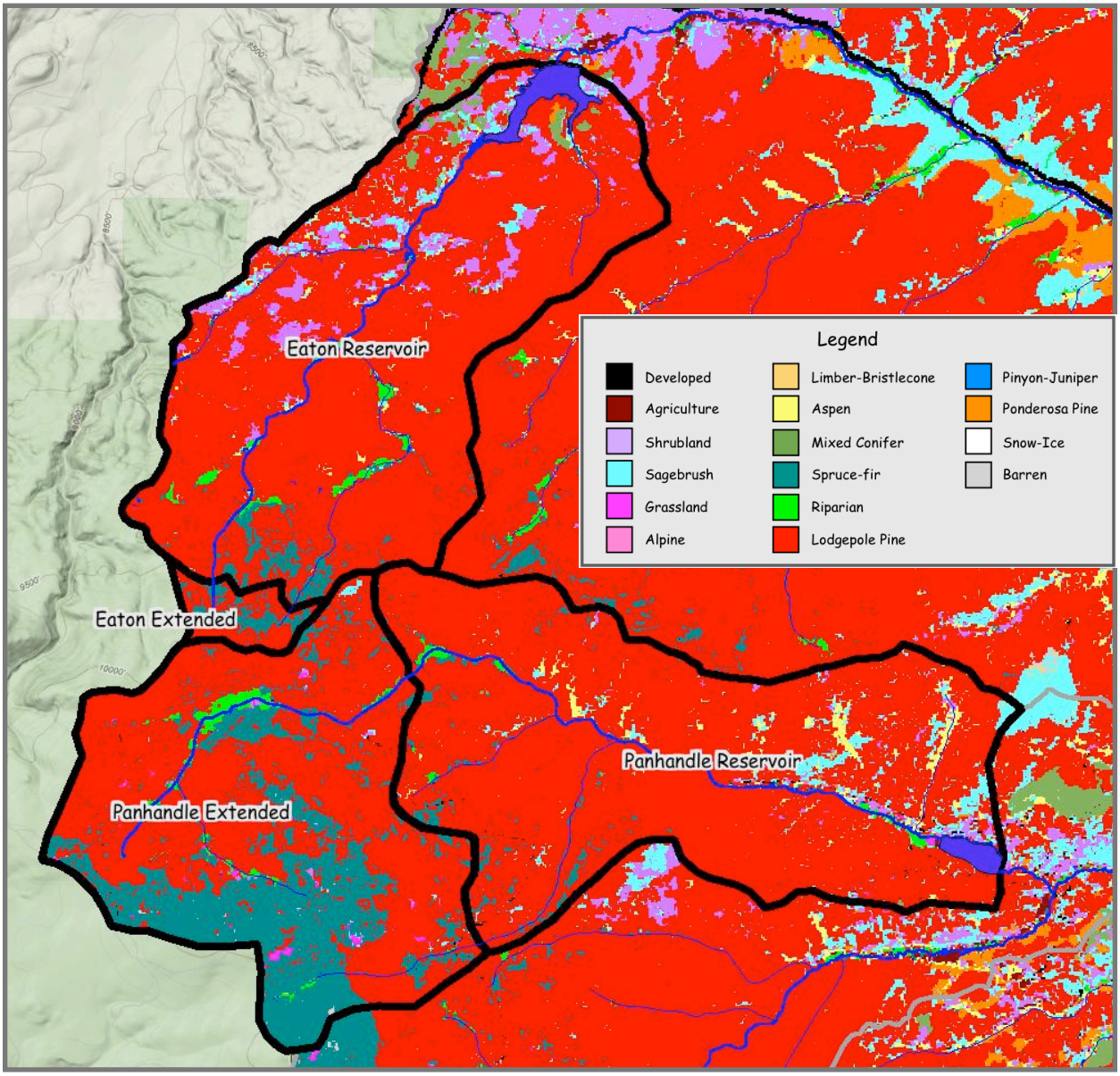

Figure 41. Eaton & Panhandle Reservoirs ZoC Vegetation

Eaton Reservoirs Opportunities

There are management and fuel hazard reduction opportunities in lodgepole pine and spruce outside of roadless areas on slopes less than 40 percent, on all ownerships with good road access. Some vegetation management has been completed on NFS lands. If localized areas of shrublands are problematic, hazards can be mitigated relatively easily. The alpine areas are generally of lower wildfire hazard concern. It appears that within the extended ZoC, considerable thinning and harvesting have occurred on the NFS lands outside of roadless areas. Thinned and regenerated areas may be due for another entry to further thin, or to complete non-commercial thinnings. Mountain pine beetles are beginning to appear in scattered locations in lodgepole pine. There is an area of lodgepole in the north end of the subdivision where thinning could occur.

In areas of aspen, removal of encroaching conifers would help maintain aspen. Aspen is generally a good species to favor from a wildfire hazard standpoint. Some aspen stands in this area are old and suffering from Sudden Aspen Decline (SAD). These areas should be considered for regeneration to maintain this vegetation type (Figure 42).

Treatments within the roadless areas would need a fuels treatment plan specifically addressing watershed protection and would require approval from the US Forest Service's Regional Forester. There are roadless areas where conditions are favorable for management. Treatment plans for these locations should be designed to develop greater stand and landscape diversity.

Stakeholders include: Larimer & Weld Irrigation Company, US Forest Service, Bureau of Land Management, and private landowners.

Panhandle Reservoirs Opportunities

There are many opportunities in this ZoC because of the lack of steep slopes, good access and large areas of lodgepole pine (Figure 42). Much of the lower ZoC is covered by the Crystal Lakes CWPP and some treatments within that CWPP have been completed. The CWPP should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District, agencies and area residents about this issue and to collaborate with them to update the CWPP as necessary.

West of the private lands, there has been a substantial amount of forest treatments including; clearcuts, patch cuts and thinning. Approaches that would connect some of these past treatments to create continuous fuelbreaks should be investigated. Selected areas could be kept as openings or in younger age-classes to help reduce fire spread. Follow-up thinning of regenerated stands and ongoing, periodic maintenance should be planned and conducted. Above the CWPP boundary the US Forest Service has already planned a number of treatments.

Stakeholders include: US Forest Service and private landowners.

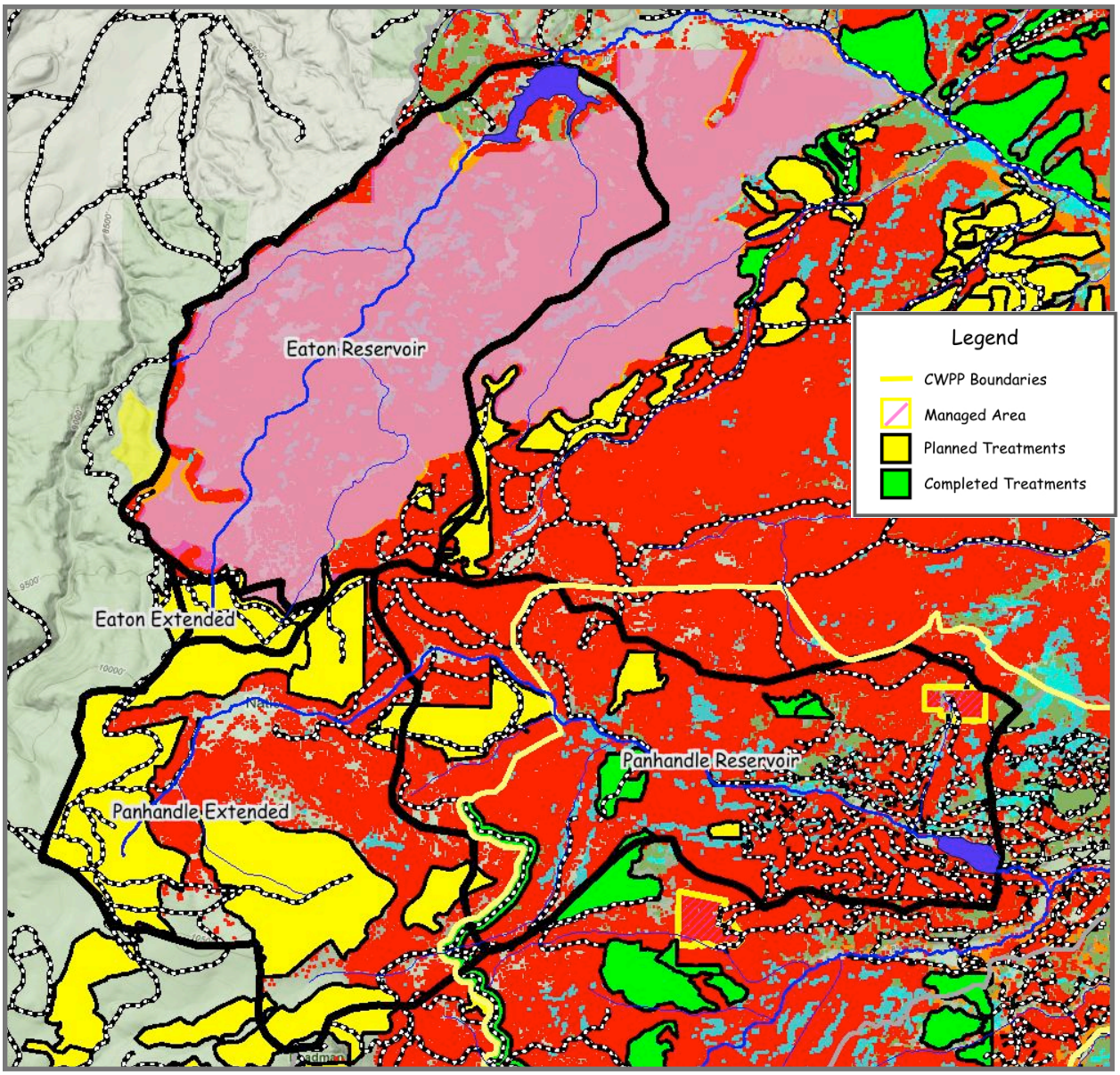

Figure 42. Eaton & Panhandle Reservoirs ZoC Opportunities

Halligan Reservoir ZoC

Figure 43 shows the general location of the Halligan Reservoir ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

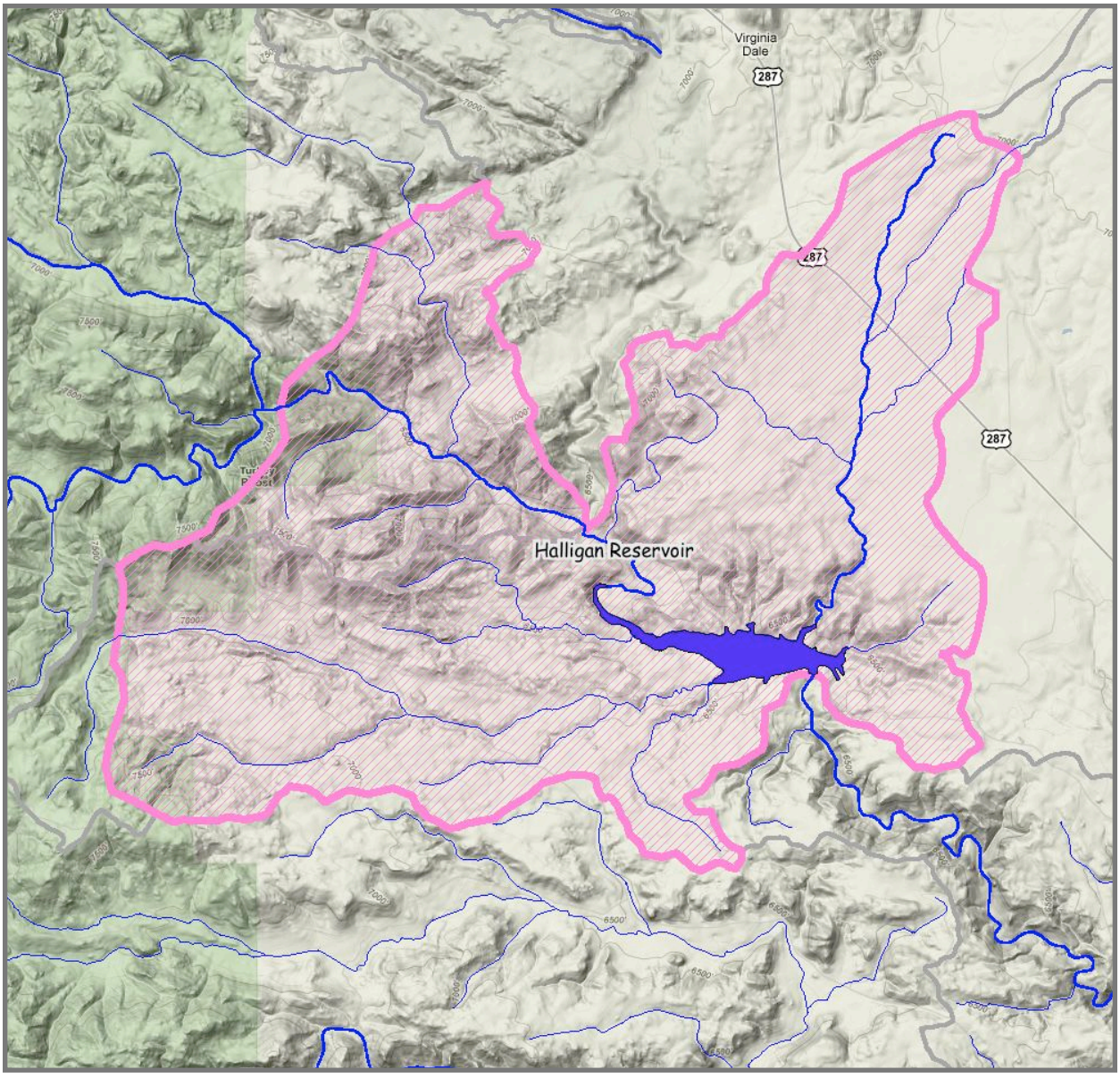

Figure 43. Halligan Reservoir ZoC Location

Halligan Reservoir Ownership

Land ownership is mostly private but there is a very mixed ownership in the remainder of the ZoC (Figure 44). The Colorado Division of Wildlife's Cherokee Special Wildlife Area (SWA) is just west of Halligan Reservoir. There is also a section owned by the Colorado State Land Board. There are some BLM and North Poudre Irrigation lands surrounding the reservoir. NFS lands are present in the western portion in a checkerboard pattern with the Division of Wildlife lands.

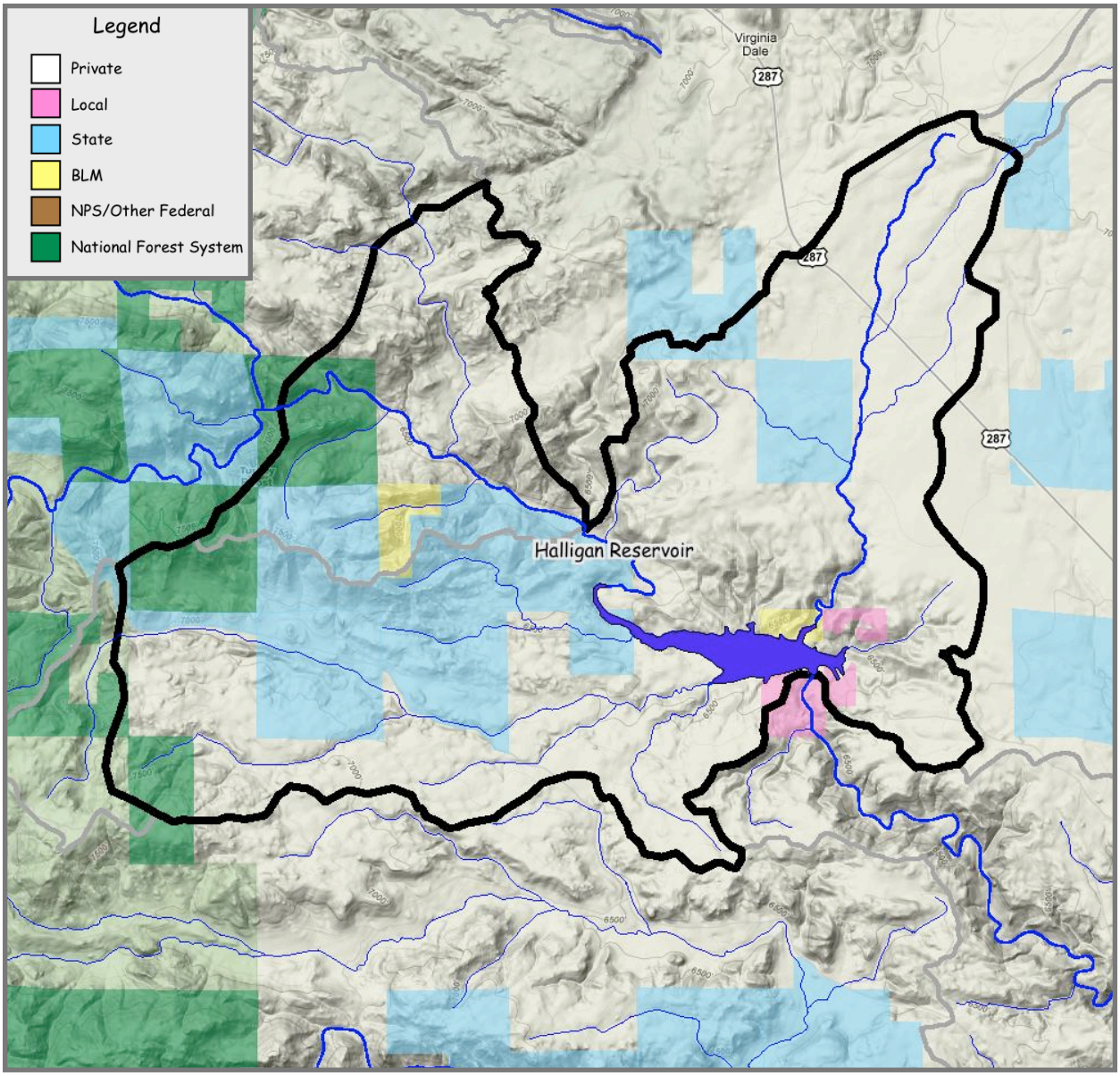

Figure 44. Halligan Reservoir ZoC Ownership

Halligan Reservoir Watershed Priority

The North Fork Cache La Poudre River-Bull Creek and Halligan Reservoir watersheds are both ranked Green (Category 1) overall (Figure 45).

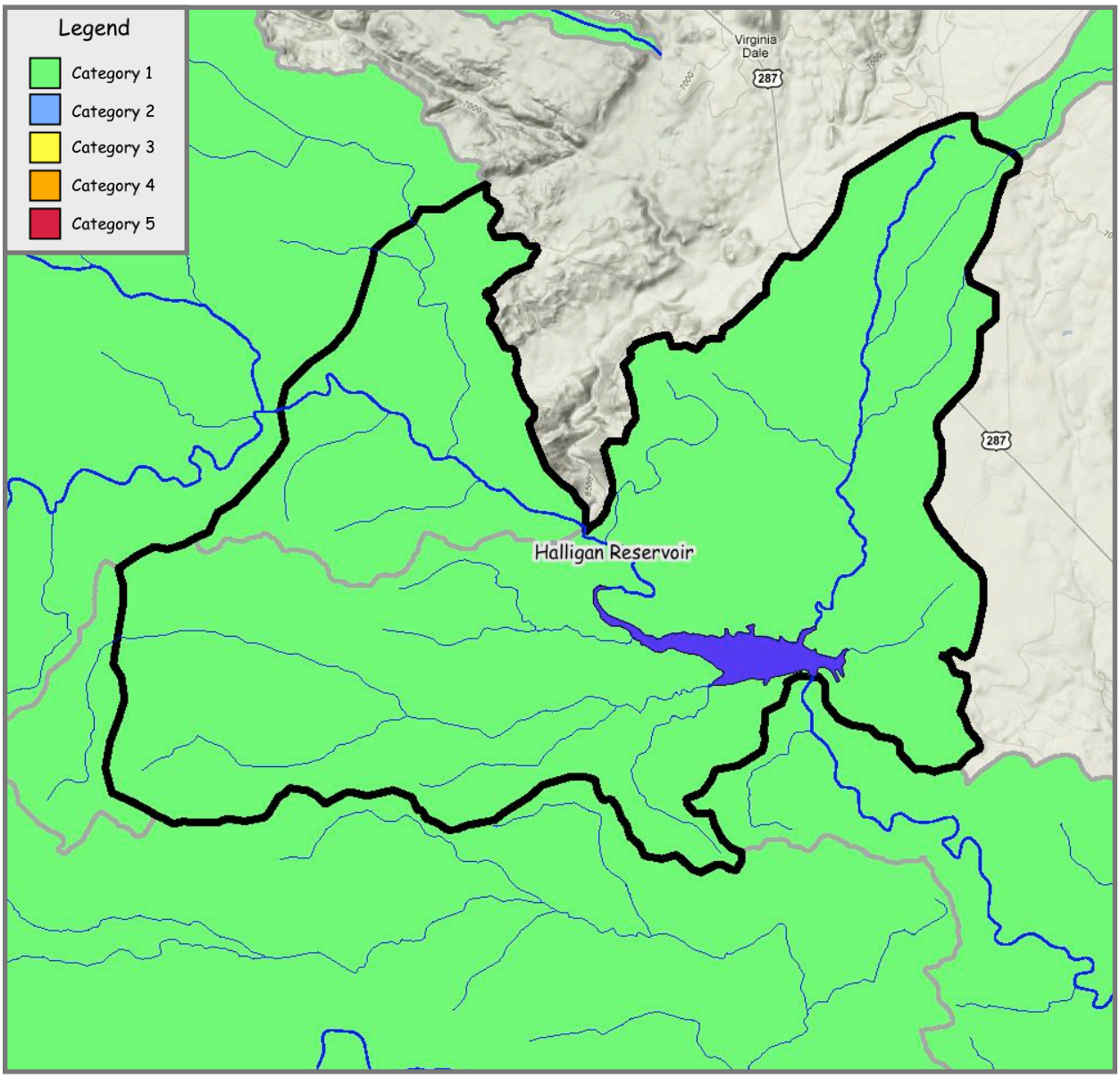

Figure 45. Halligan Reservoir ZoC Watershed Priority

Halligan Reservoir Slopes

There are steep slopes surrounding the North Fork Cache la Poudre River and north of the reservoir. The other areas are less steep (Figure 46).

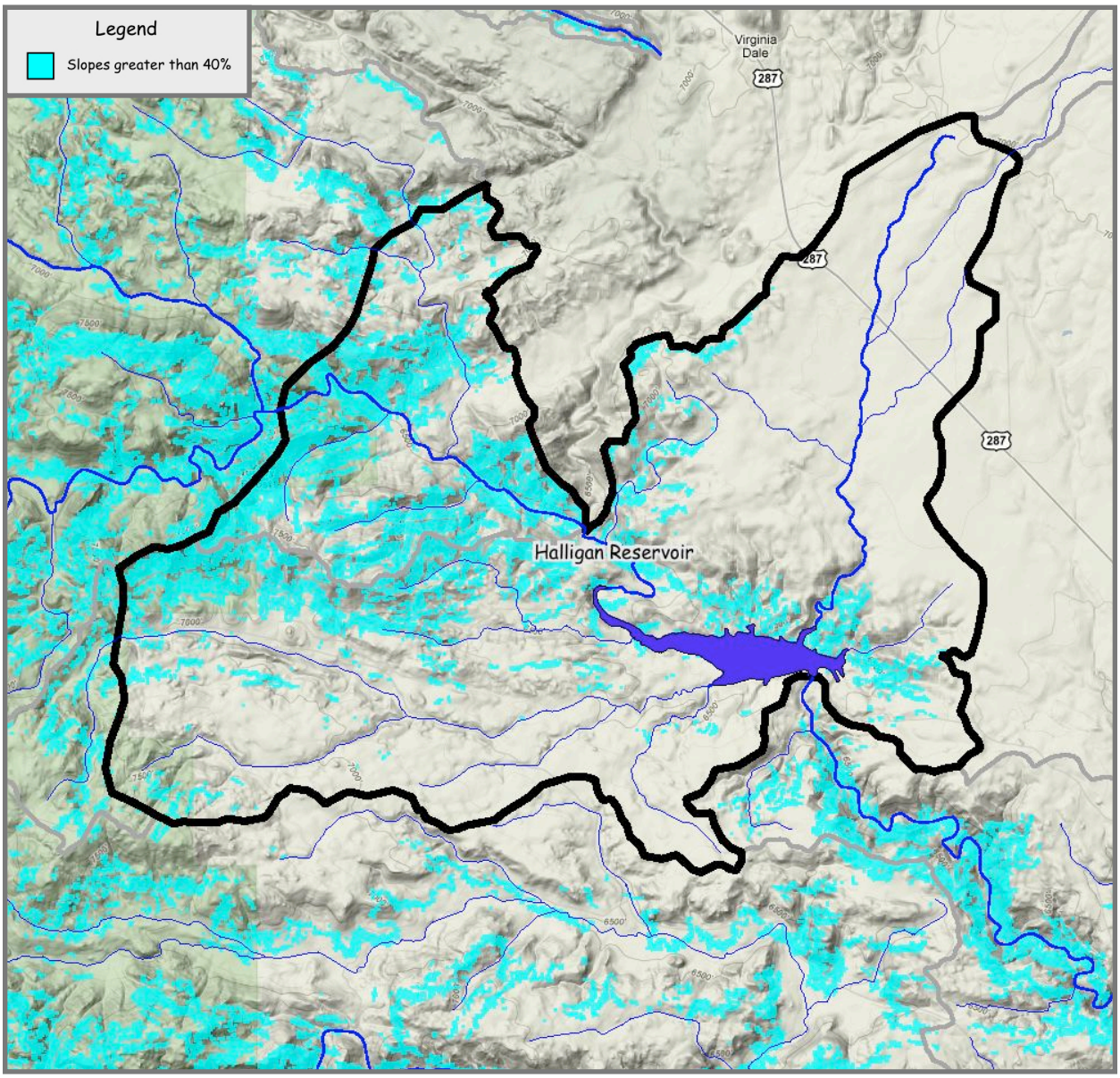

Figure 46. Halligan Reservoir ZoC Slope

Halligan Reservoir Special Management Areas

There are no wilderness or roadless areas (Figure 47).

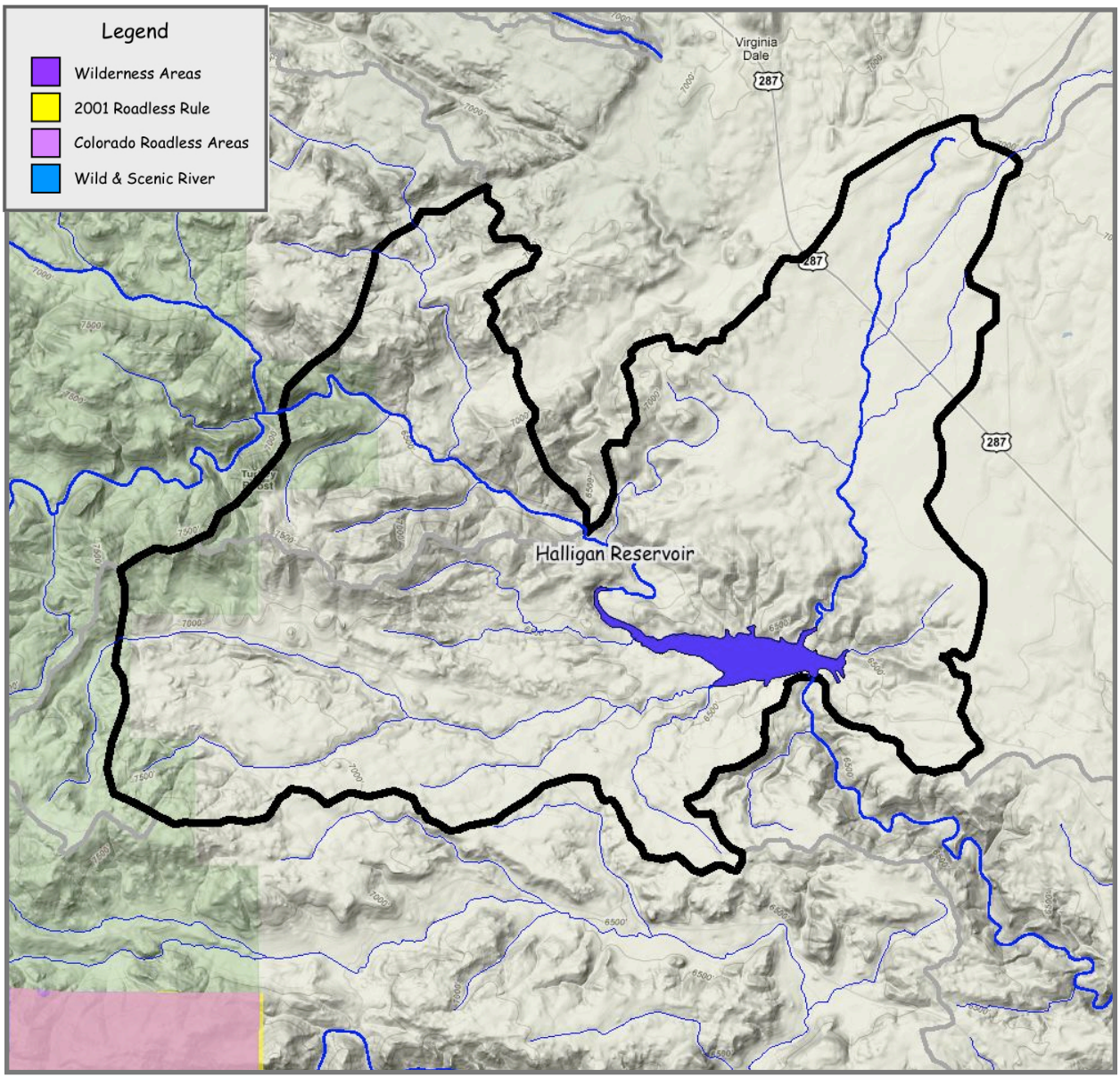

Figure 47. Halligan Reservoir ZoC Special Areas

Halligan Reservoir Vegetation

The ZoC is mostly sagebrush and grasslands (Figure 48). Forested areas are present in two locations. In the upper portions of the North Fork Poudre River there is a mixture of ponderosa pine and mixed conifer. South of Meadow Creek there is an area of mostly ponderosa pine. Forested stands are generally open and scattered. Where more dense, stand densities are slope- and aspect-determined, where the more dense stands are found on the steeper, northerly-facing slopes.

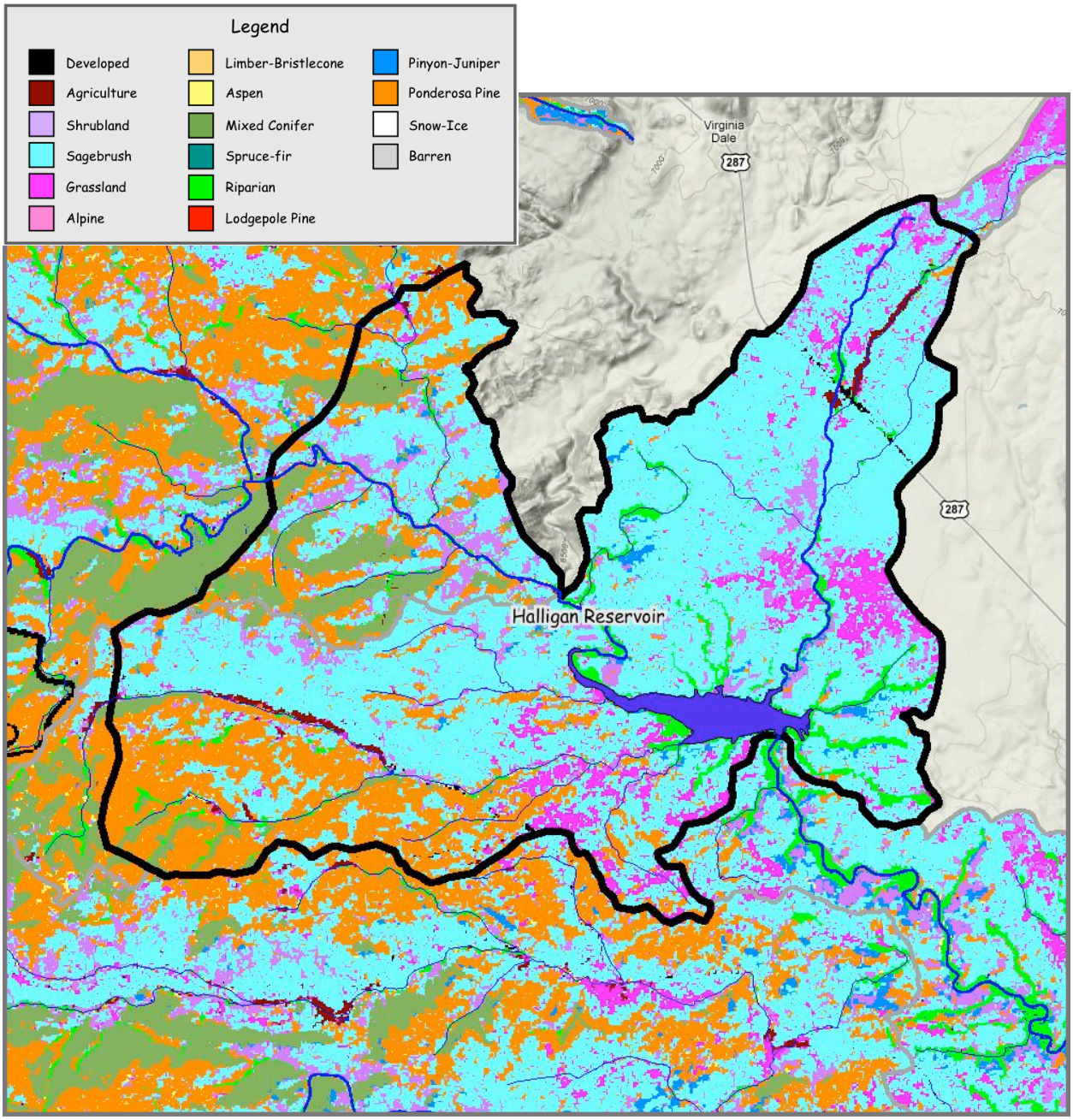

Figure 48. Halligan Reservoir ZoC Vegetation

Halligan Reservoir Opportunities

The Livermore Fire District CWPP covers this area and should be reviewed for proposed treatments that would contribute to watershed-level protection. If the CWPP does not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection District, agencies and area residents about this issue and to collaborate with them to update the CWPP as necessary.

The steep slopes in the North Fork Cache la Poudre River area and lack of access limit the opportunities to only one area on the north end of the ZoC (Figure 49). In the forested area south of Meadow Creek there are some opportunities. Some activities have taken place or are planned on the Colorado State Land Board and NFS lands. The Colorado Division of Wildlife should be encouraged to begin management of their numerous lands within the ZoC. In this area, treatments for watershed protection would generally be favorable for wildlife. Given the open nature of most of the forested lands, light thinning from below with low-limbing, followed by the periodic use of prescribed fire might be a relatively inexpensive treatment regime.

Stakeholders include: City of Fort Collins, North Poudre Irrigation Company, Colorado Division of Wildlife, private landowners, and US Forest Service.

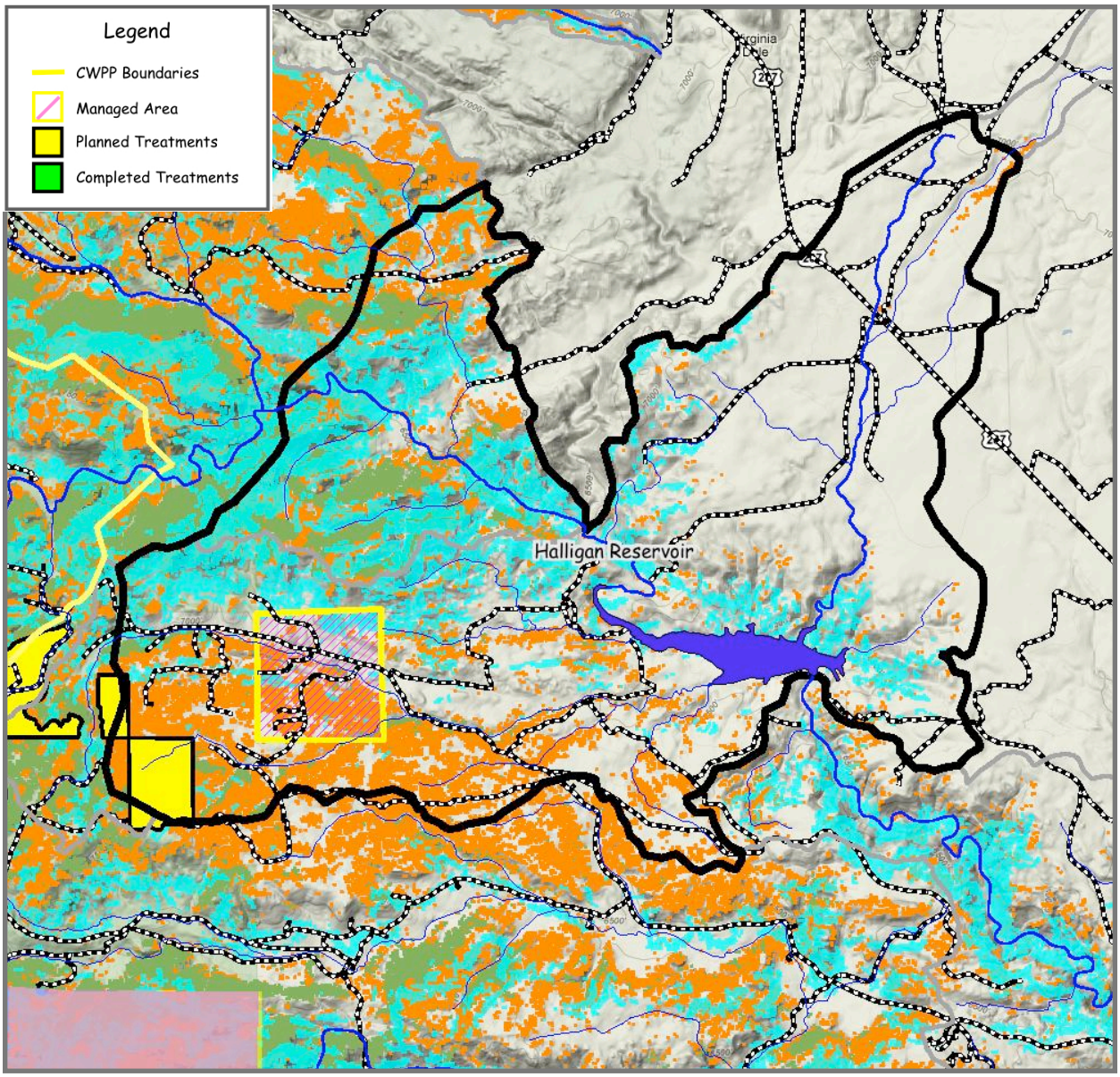

Figure 49. Halligan Reservoir ZoC Opportunities

Seaman Reservoir ZoC

Figure 50 shows the general location of the Seaman Reservoir ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

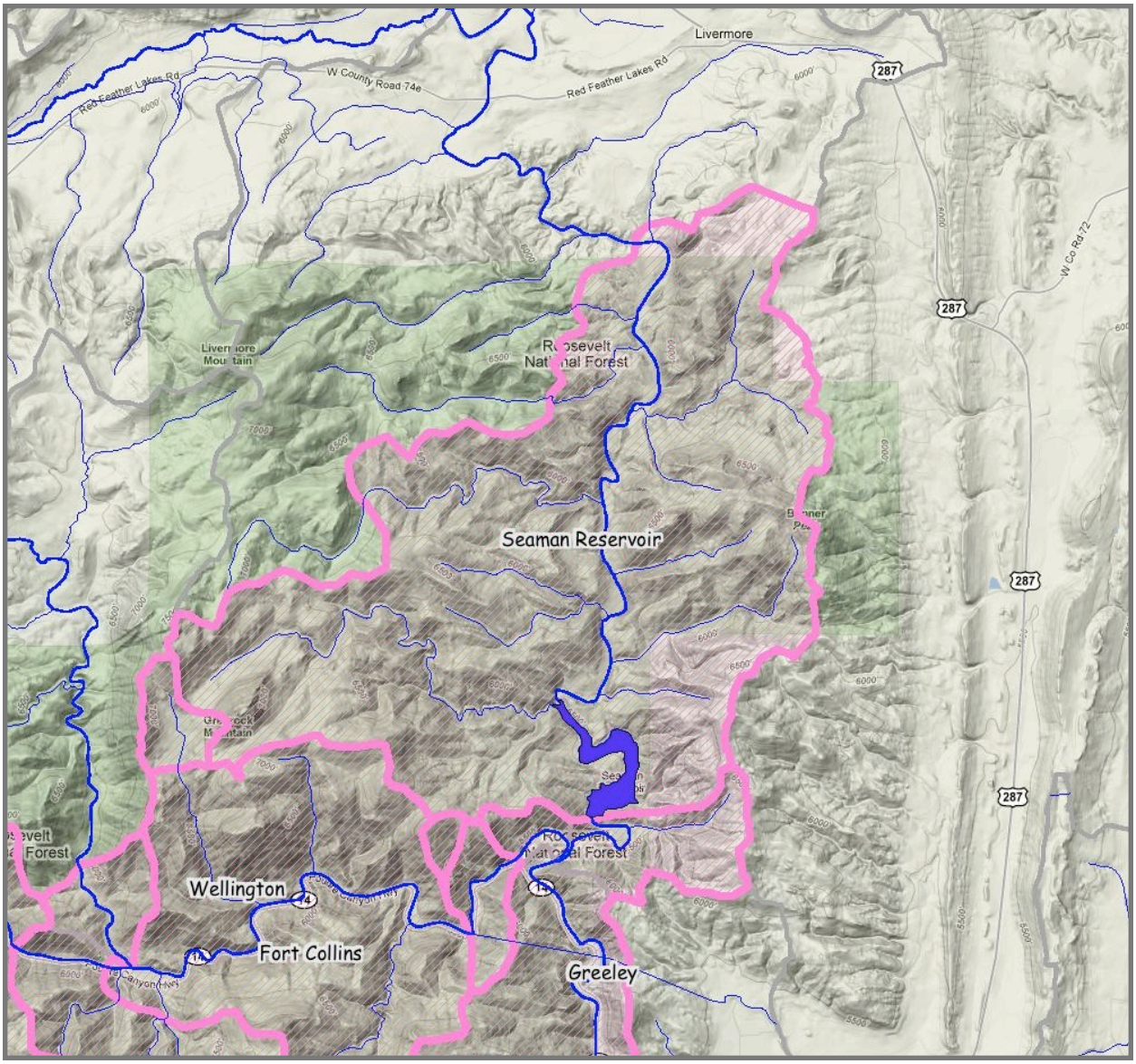

Figure 50. Seaman Reservoir ZoC Location

Seaman Reservoir Ownership

The ZoC is mostly NFS lands with some large areas of private lands (Figure 51). Surrounding the reservoir is Colorado State Land Board and City of Greeley Water Department property. There is some Larimer County open space in the north portion of the ZoC.

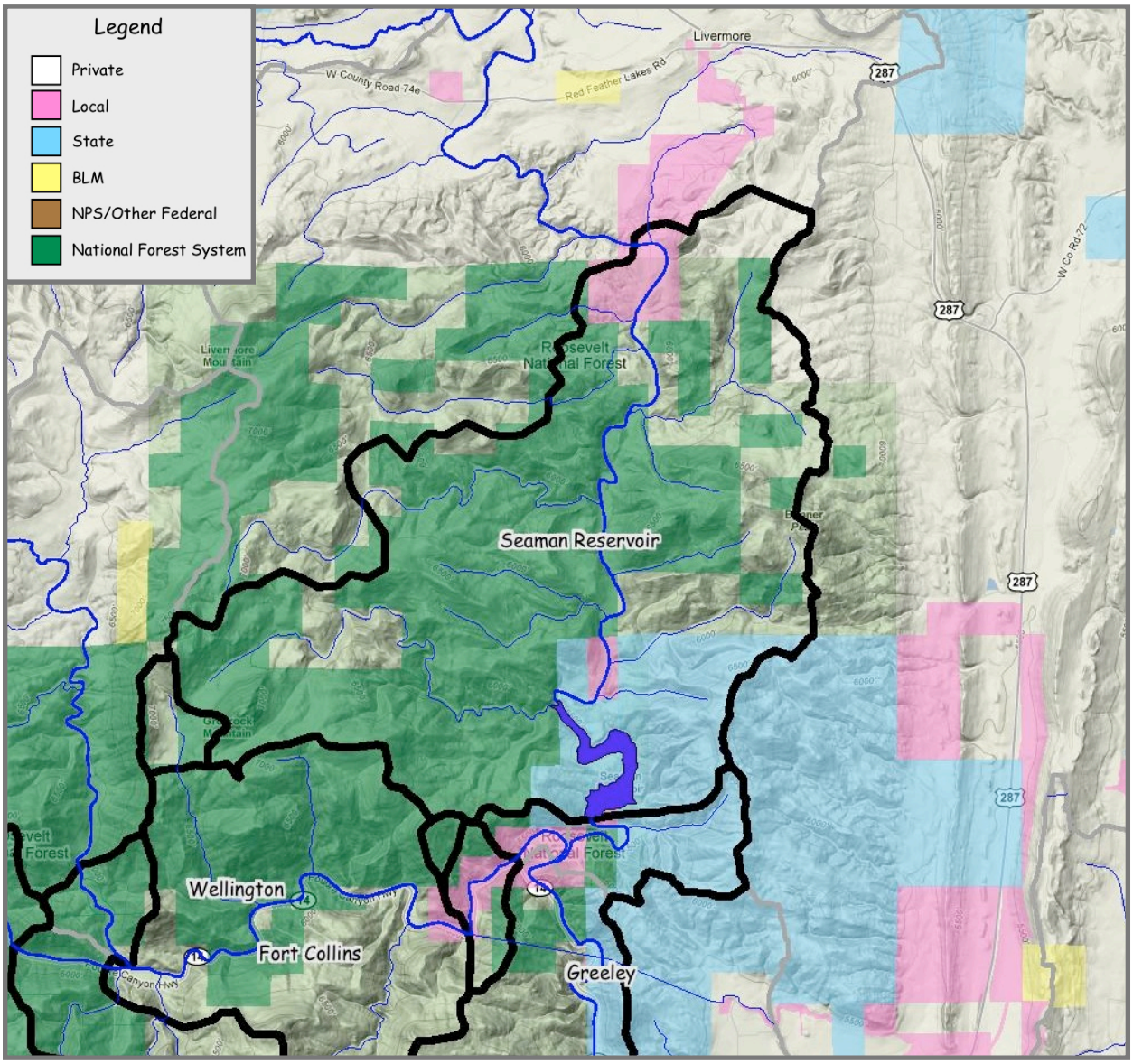

Figure 51. Seaman Reservoir ZoC Ownership

Seaman Reservoir Watershed Priority

The Milton Seaman Reservoir-North Fork Cache la Poudre River watershed is Green overall (Category 1) (Figure 52).

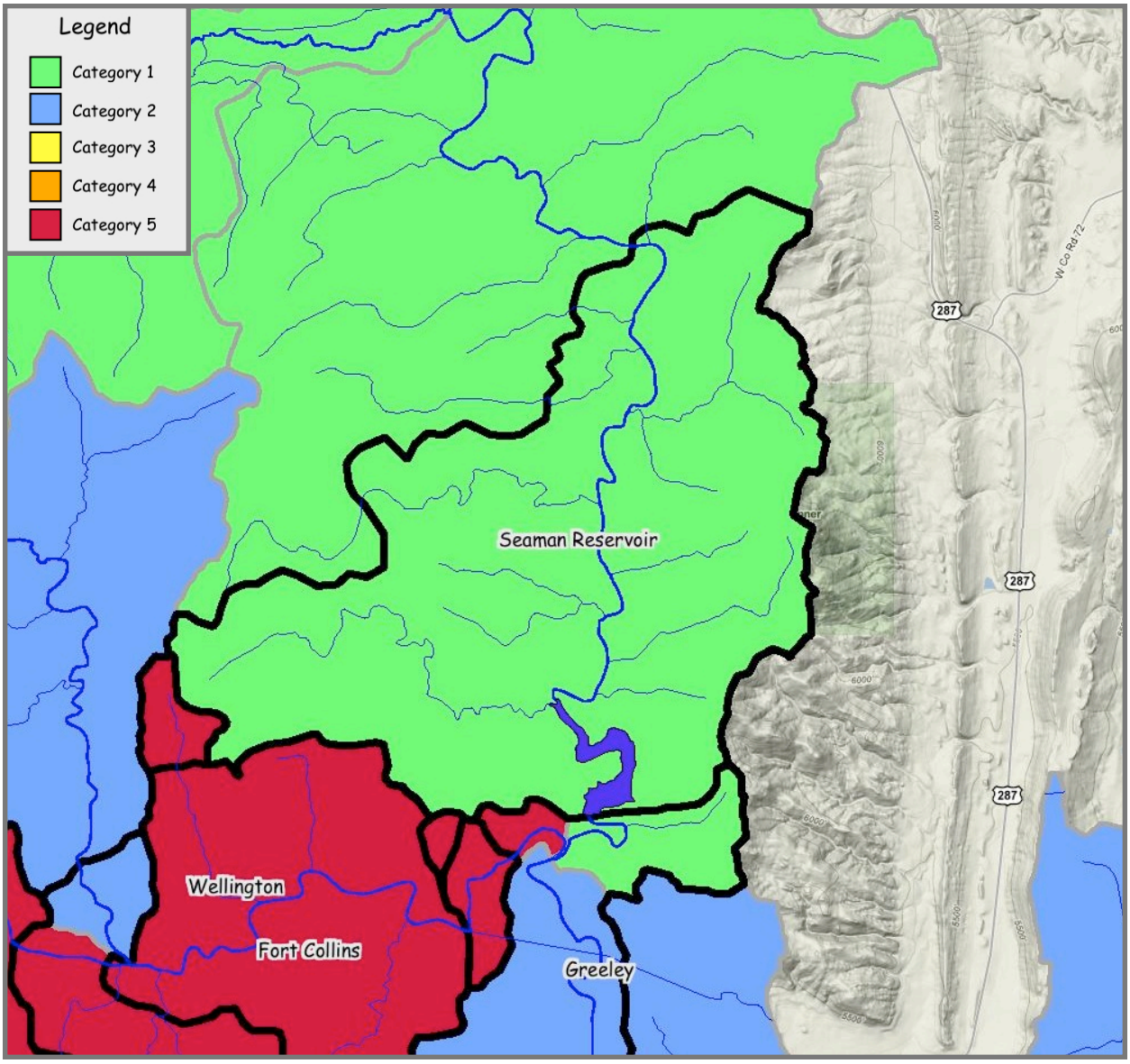

Figure 52. Seaman Reservoir ZoC Watershed Priority

Seaman Reservoir Slopes

Steep slopes are present throughout much of the ZoC (Figure 53).

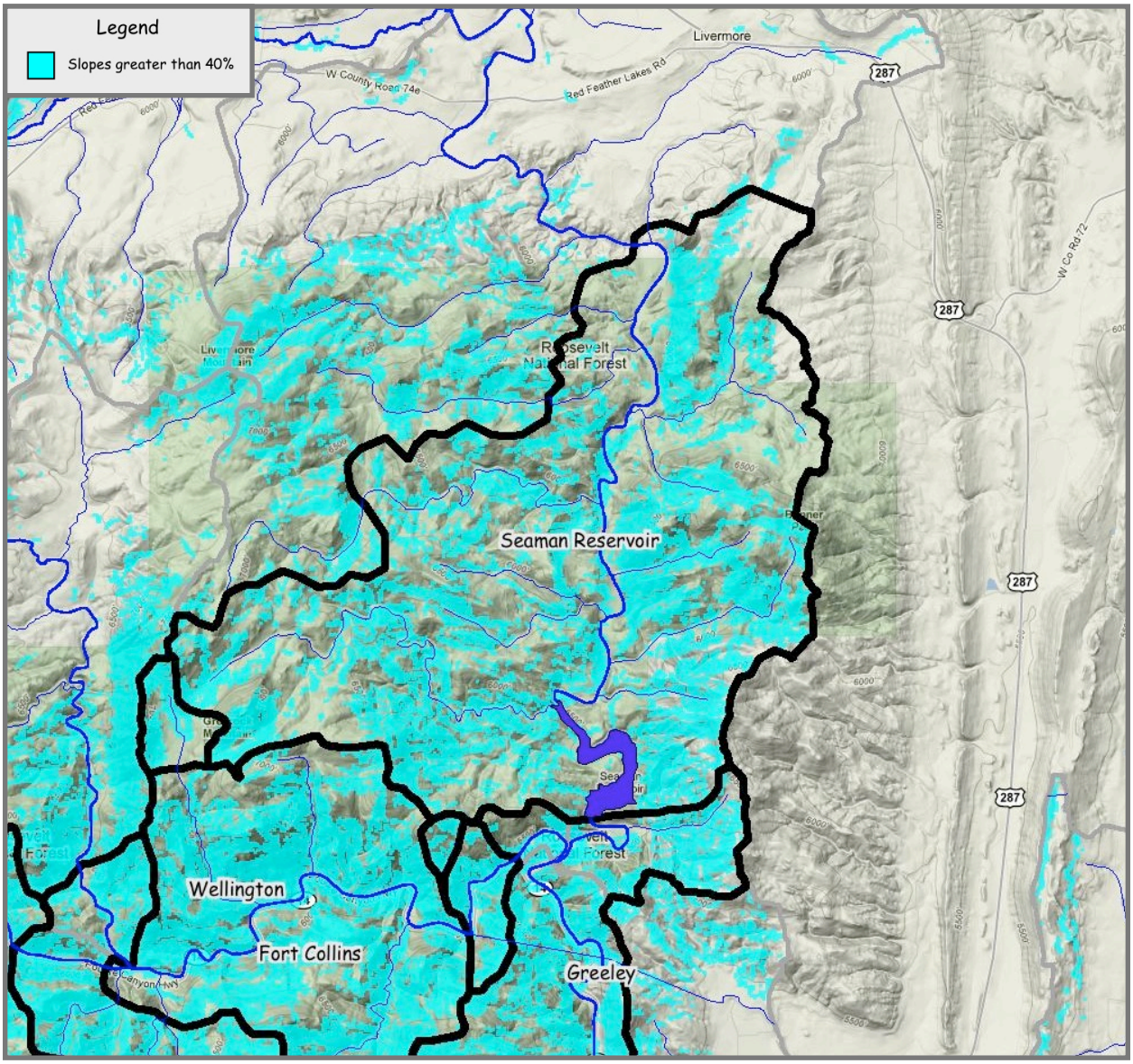

Figure 53. Seaman Reservoir ZoC Slope

Seaman Reservoir Special Management Areas

A large portion of the ZoC is within the Grey Rock Roadless Area (Figure 54).

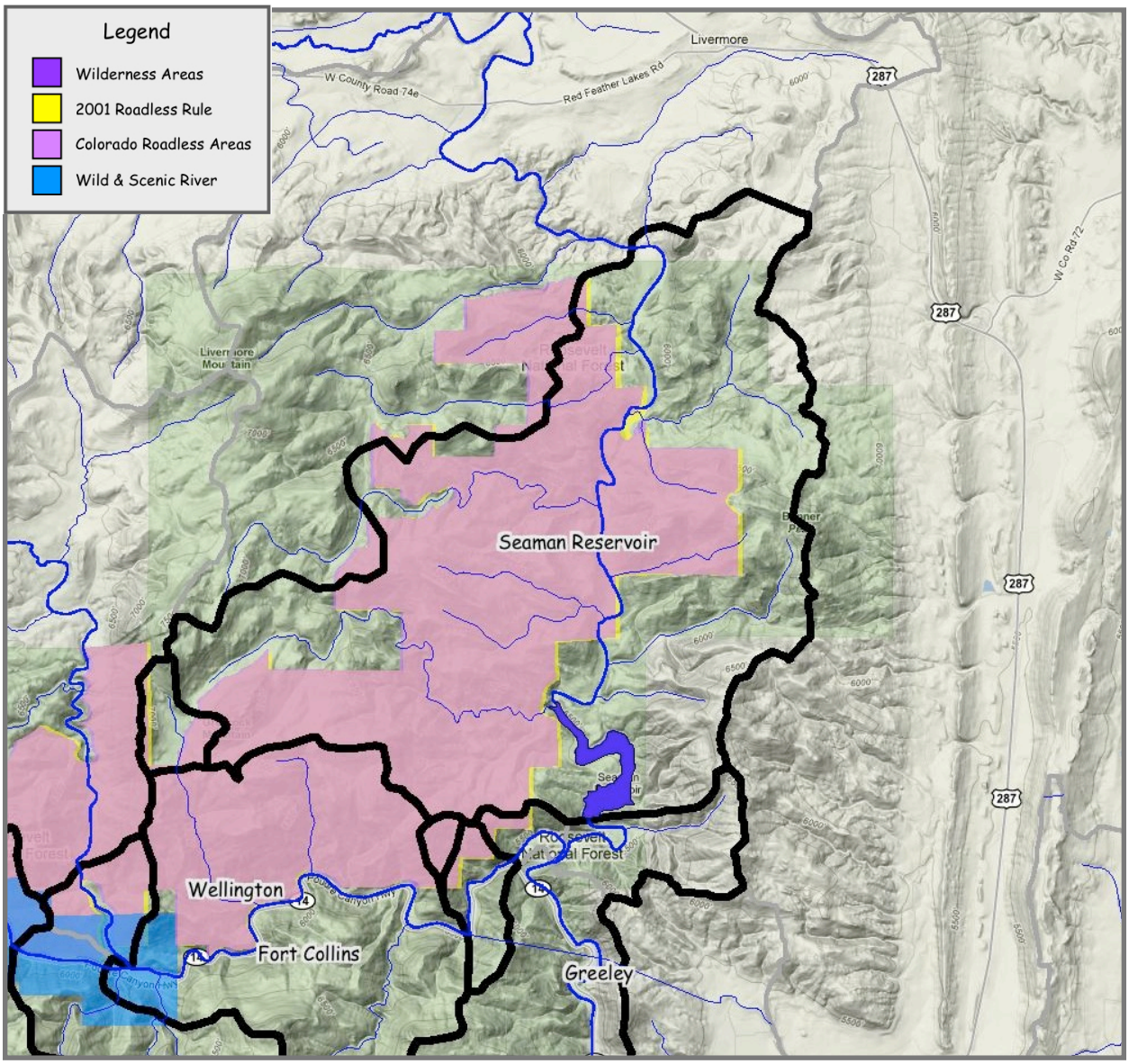

Figure 54. Seaman Reservoir ZoC Special Areas

Seaman Reservoir Vegetation

Vegetation around the reservoir and on the west side of the North Fork Cache la Poudre River is dominated by shrubland, grassland and some sagebrush. The vegetation transitions to ponderosa pine and mixed conifer to the east and west of the North Fork Cache la Poudre River at higher elevations. Forested areas are highly elevation and aspect-determined (Figure 55).

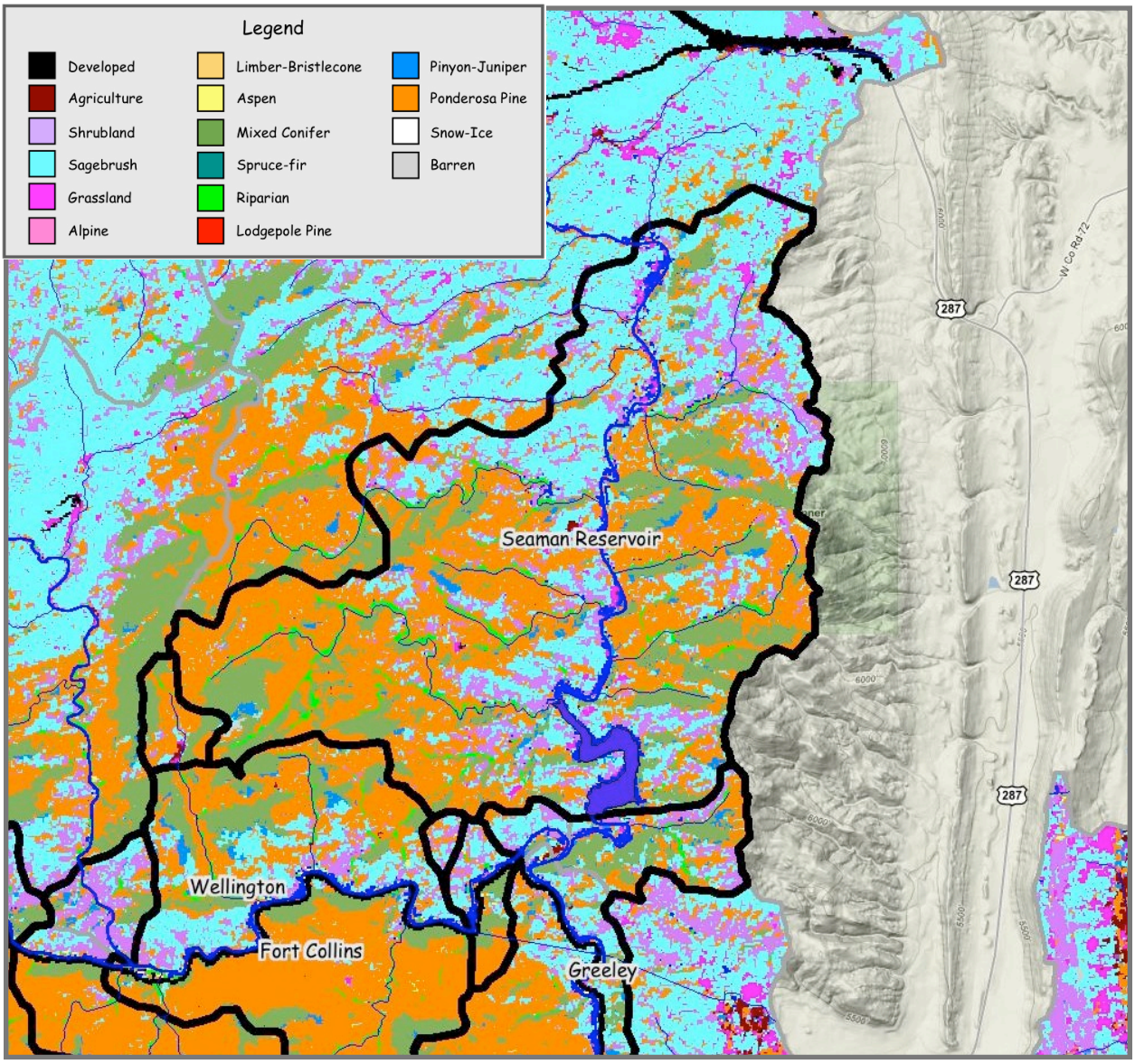

Figure 55. Seaman Reservoir ZoC Vegetation

Seaman Reservoir Opportunities

There are some opportunities in this ZoC (Figure 56). Existing roads provide access to some ponderosa and mixed conifer areas. The Poudre Park CWPP covers the area around the reservoir. The Livermore Fire District CWPP covers the entire ZoC. The CWPPs should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPPs do not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection Districts, agencies and area residents about this issue and to collaborate with them to update the CWPPs as necessary.

Consider fuelbreaks along the road corridors that run through the ZoC. Currently there are no planned treatments on any of the NFS lands. Opportunities to manage lands for watershed protection within roadless areas should be explored. Management using natural fire within the entire ZoC might be an opportunity. Given the open nature of most of the forested lands, light thinning from below with low-limbing, followed by the periodic use of prescribed fire might be a relatively inexpensive treatment.

Stakeholders include: City of Greeley, US Forest Service, private landowners, Colorado State Land Board, Larimer County, and Colorado State Forest Service.

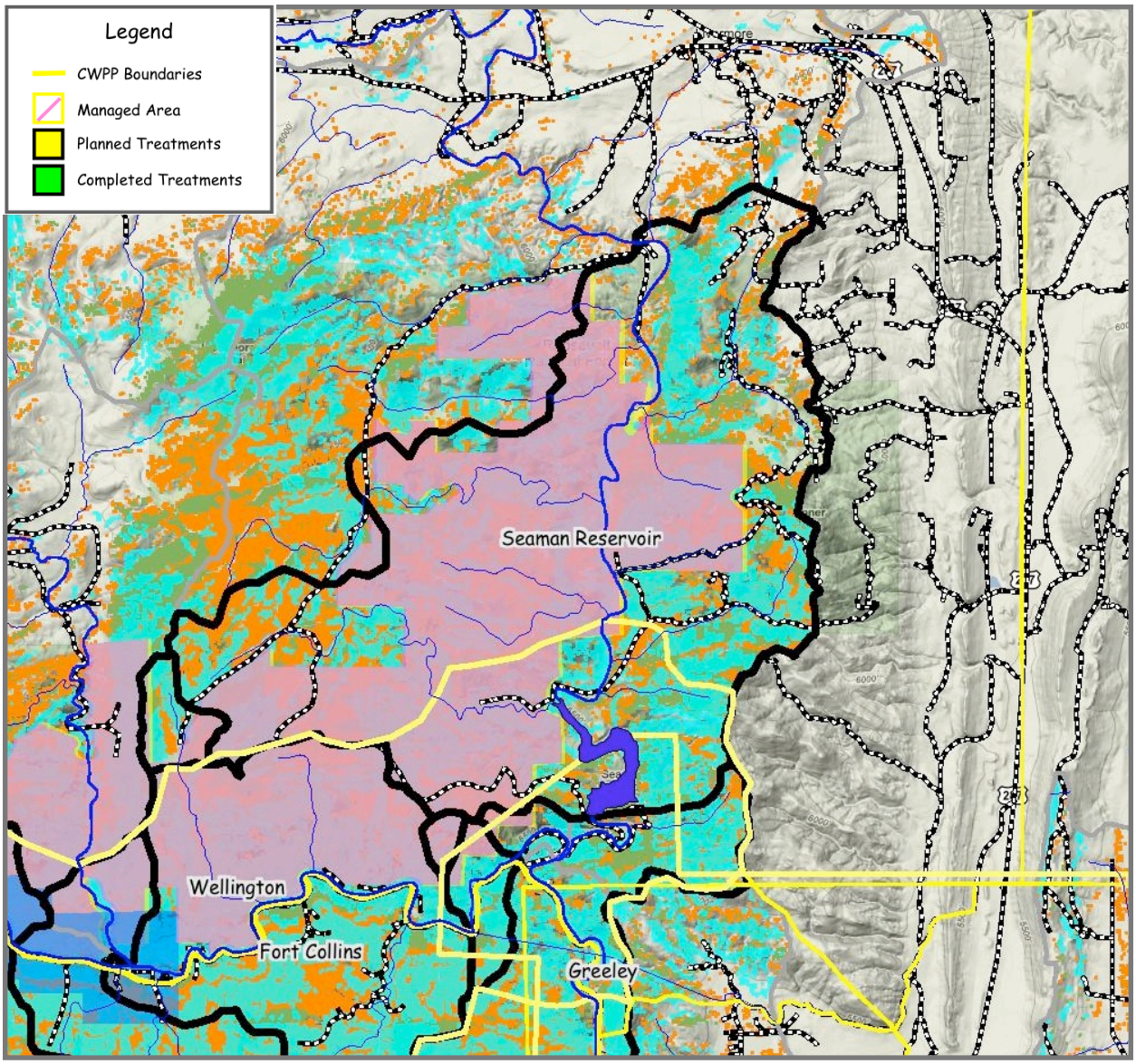

Figure 56. Seaman Reservoir ZoC Opportunities

Poudre Main Stem ZoC

Figure 57 shows the general location of the Poudre Main Stem ZoC. The Greeley, Fort Collins and Wellington ZoC overlap substantially. An extended ZoC (6-11 miles upstream was added after the third stakeholder meeting. The overlap of these ZoC makes them functionally one ZoC, therefore they are combined and discussed together as the Poudre Main Stem ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

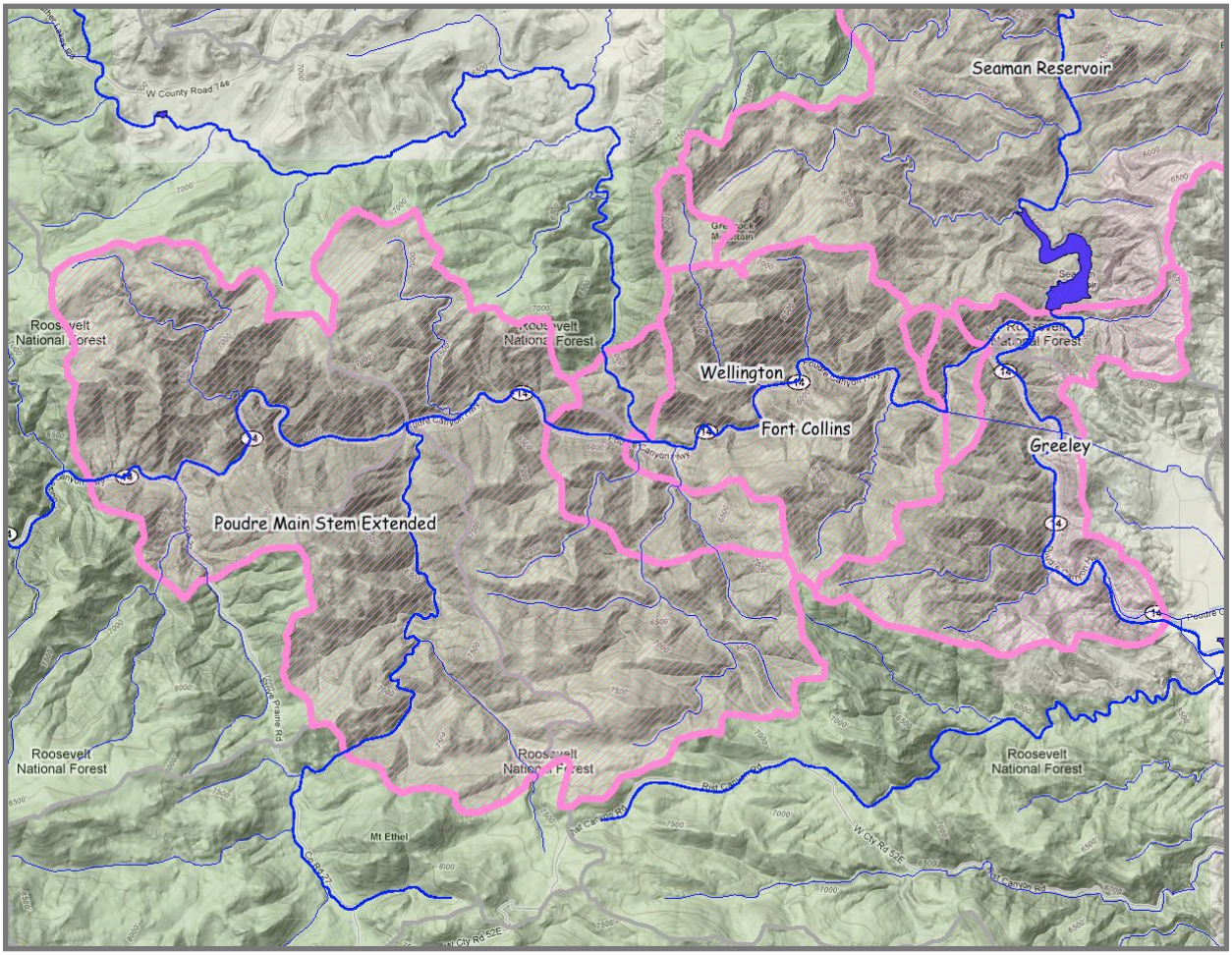

Figure 57. Poudre Main Stem ZoC Location

Poudre Main Stem Ownership

Land ownership is mostly NFS lands with some large areas of private lands (Figure 58). At the lowest end of the ZoC there are some pieces of State Land Board and Colorado Division of Wildlife properties. There is also a piece of land owned by the City of Fort Collins. Another State Land Board property is located in upper portion of the ZoC on the south side of the Poudre.

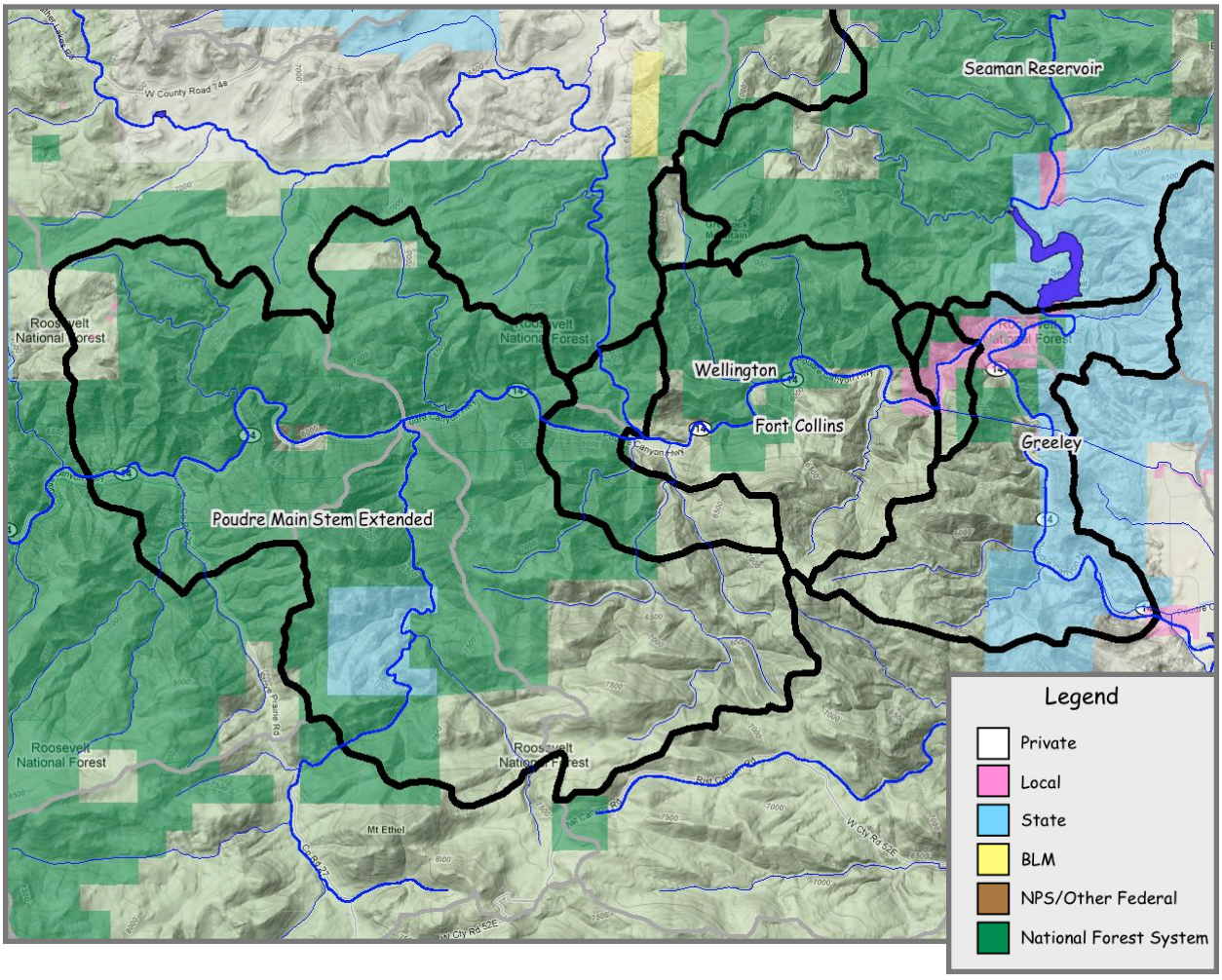

Figure 58. Poudre Main Stem ZoC Ownership

Poudre Main Stem Watershed Priority

The Hill Gulch-Cache la Poudre River watershed (Figure 59) is Red overall (Category 5), with ratings of Orange (Category 4) for Flooding/Debris Flow and Soils Erodibility. The Youngs Gulch watershed is Yellow overall (Category 3), with a ranking of Orange (Category 4) for Flooding/Debris Flow. The Skin Gulch-Cache la Poudre River watershed is Red overall (Category 5), with ratings of Orange (Category 4) for Wildfire Hazard and Soil Erodibility and Red (Category 5) for Flooding/Debris Flow.

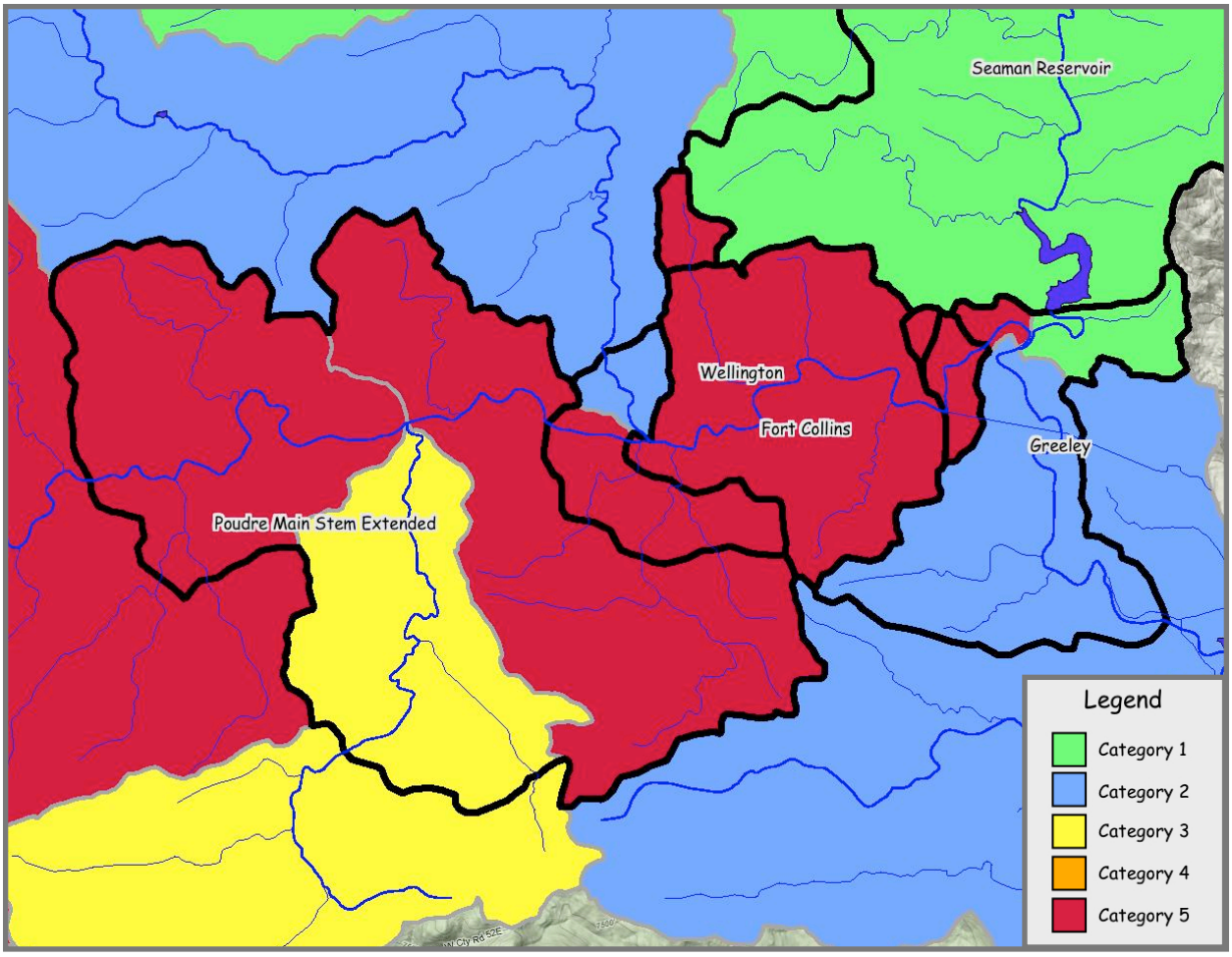

Figure 59. Poudre Main Stem ZoC Watershed Priority

Poudre Main Stem Slopes

Steep slopes dominate most of the ZoC (Figure 60).

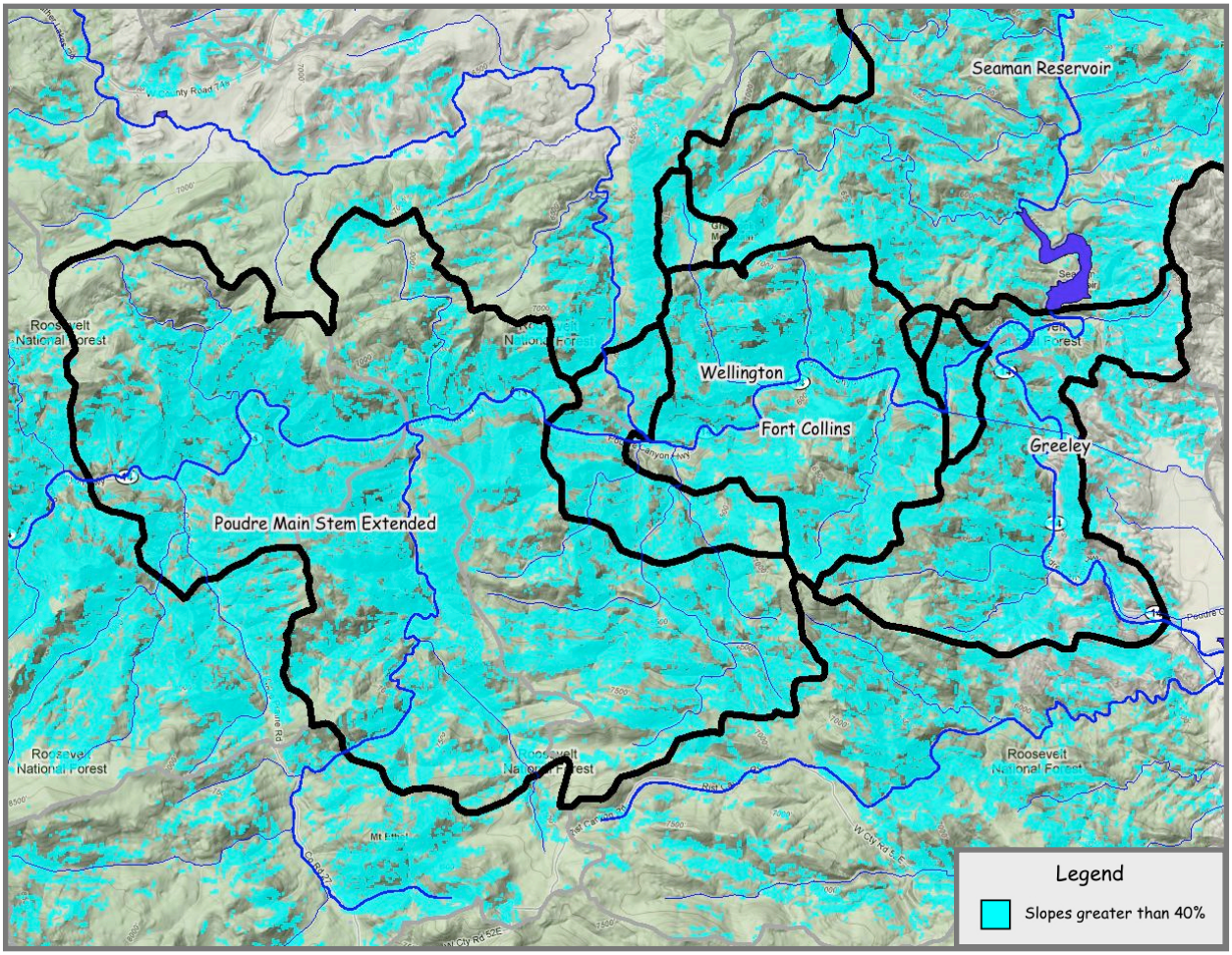

Figure 60. Poudre Main Stem ZoC Slope

Poudre Main Stem Special Management Areas

The Grey Rock Roadless Area covers most of the ZoC north of the Poudre. The Cache la Poudre Wild & Scenic River covers about half the river corridor (Figure 61).

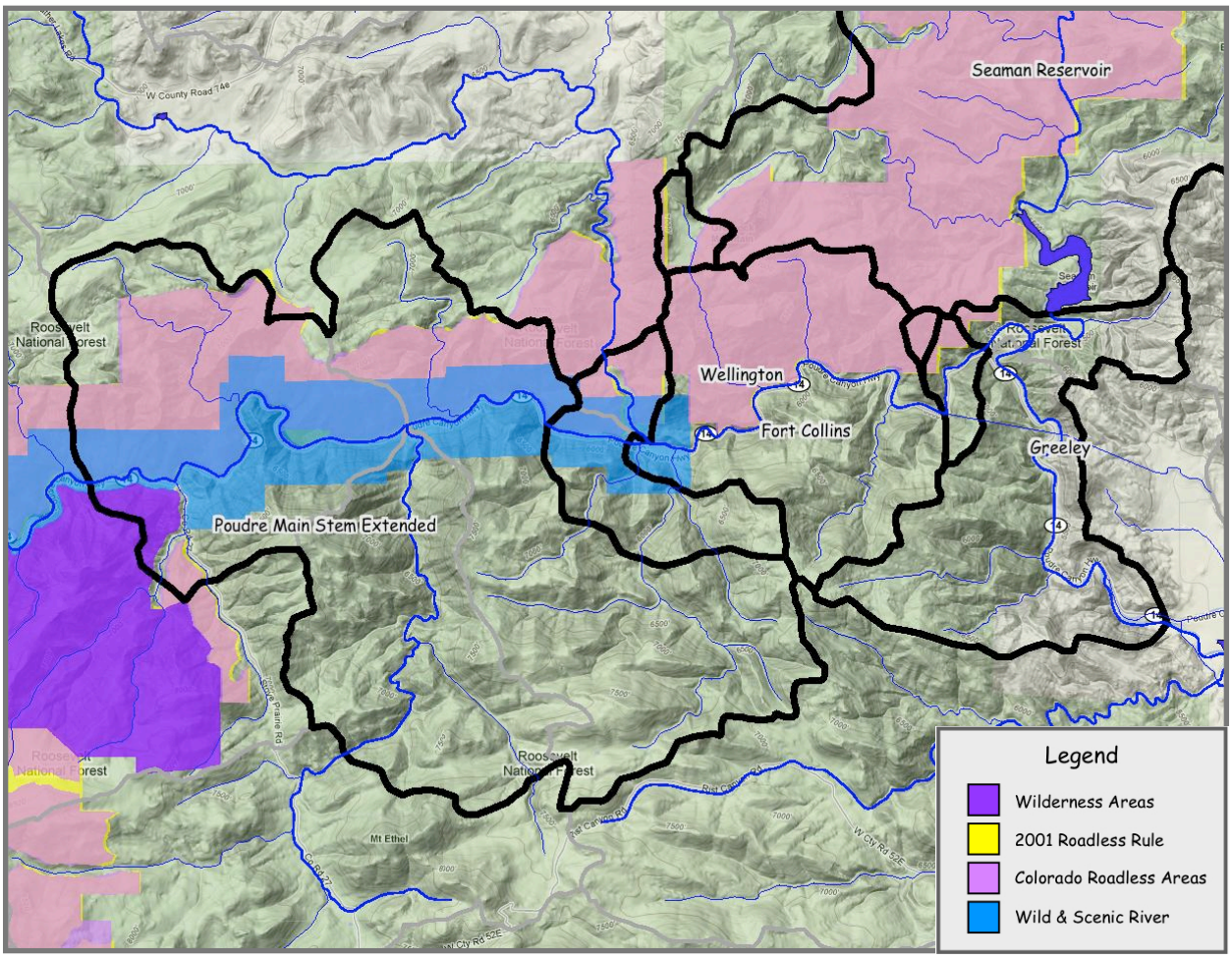

Figure 61. Poudre Main Stem ZoC Special Areas

Poudre Main Stem Vegetation

Vegetation south of the Poudre is mostly ponderosa pine and mixed conifer (Figure 62). North of the Poudre the lower slopes are composed of sagebrush and shrublands. These south-facing slopes transition to ponderosa pine and mixed conifer but still have some areas of sagebrush.

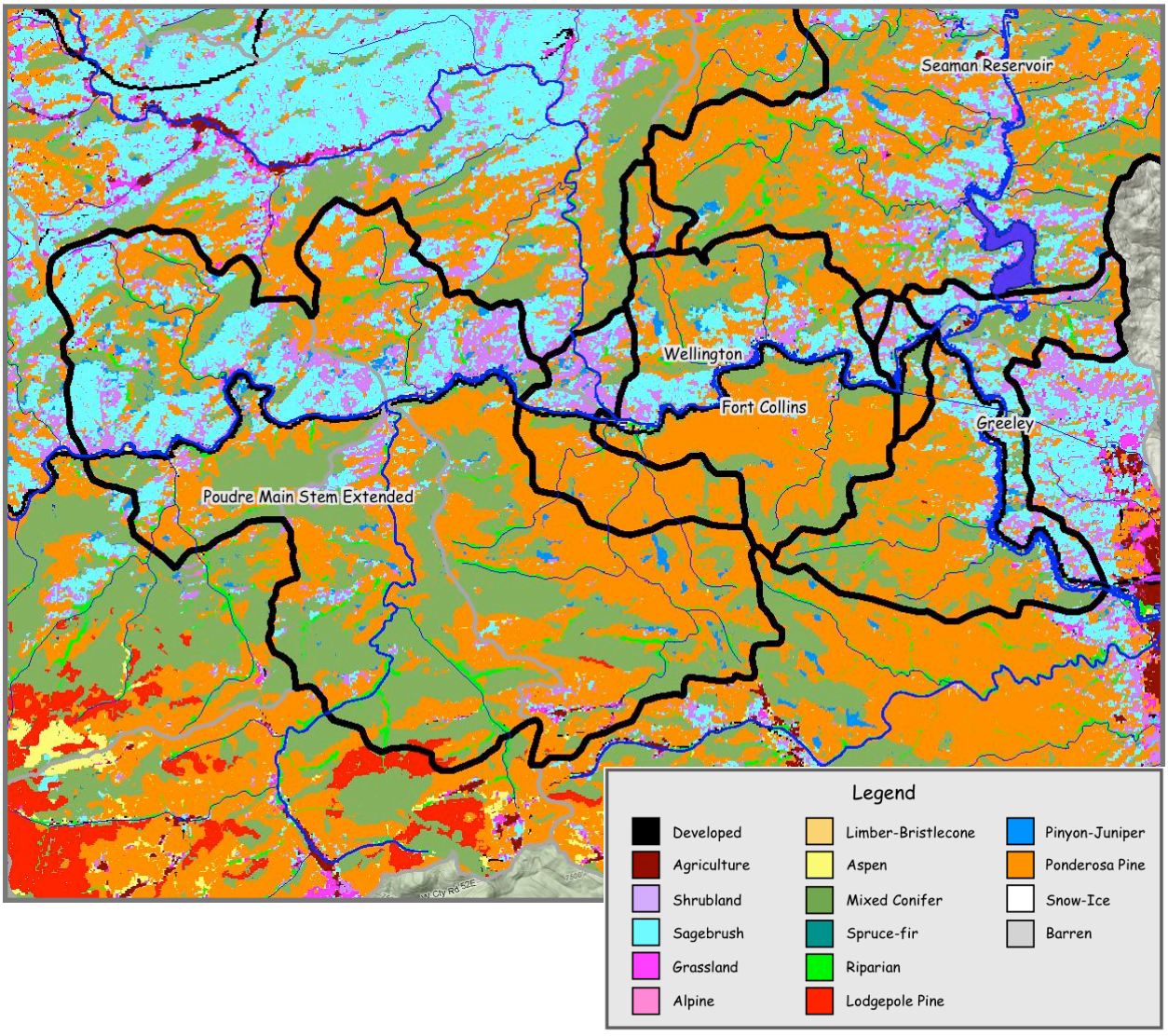

Figure 62. Poudre Main Stem ZoC Vegetation

Poudre Main Stem Opportunities

There are some opportunities in this ZoC (Figure 63). Existing roads provide access to some ponderosa and mixed conifer areas on shallower slopes. The Poudre Park CWPP covers most of the ZoC. The Poudre Fire Authority, Rist Canyon, Livermore Fire District and Glacier View CWPPs all cover portions of the ZoC. The CWPPs should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPPs do not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection Districts, agencies and area residents about this issue and to collaborate with them to update the CWPPs as necessary. A first step would be to do a thorough inventory of all completed and planned treatments on non-federal lands and see where these might be expanded.

Currently there are no planned treatments on any of the NFS lands. Opportunities to manage lands for watershed protection within roadless areas should be explored. Consider if management using natural fire within this ZoC might be beneficial given the limited access available. Consider developing fuelbreaks along ridgelines throughout the ZoC to provide areas for attacking wildfires and breaking the ZoC into smaller units. Much of the watershed may require handwork, but elsewhere creating fuelbreaks along steep ridgelines has been accomplished using Timbcos (or similar) equipped with mulching heads on slopes up to 55 percent.

Stakeholders include: City of Fort Collins, City of Greeley, Town of Wellington, Colorado State Land Board, US Forest Service, private landowners, and Colorado State Forest Service.

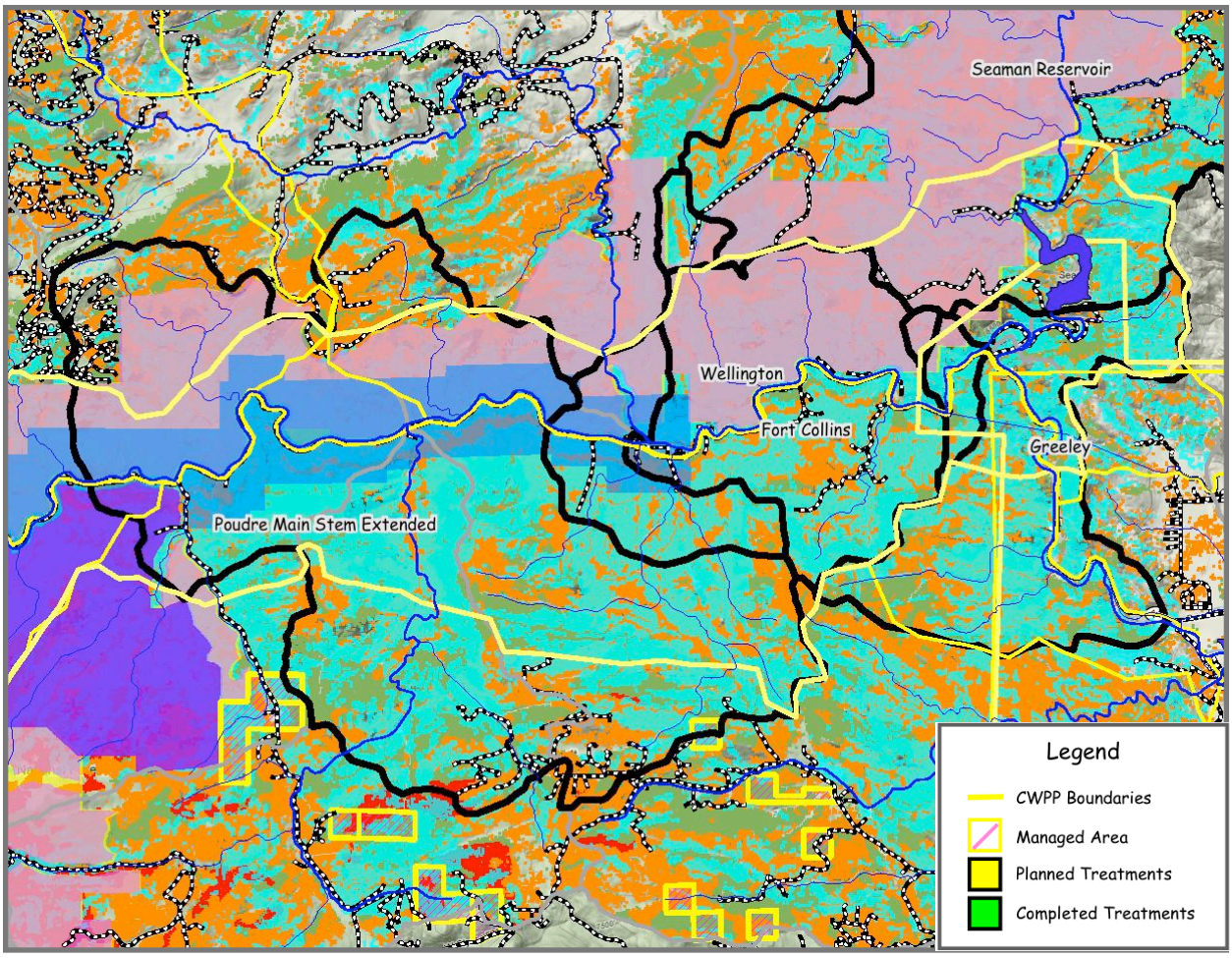

Figure 63. Poudre Main Stem ZoC Opportunities

Horsetooth Reservoir ZoC

Figure 64 shows the general location of the Horsetooth Reservoir ZoC. Note that the ZoC are shown here in pink with crosshatching, but in the remaining figures the outlines appear as bold black lines with no crosshatching.

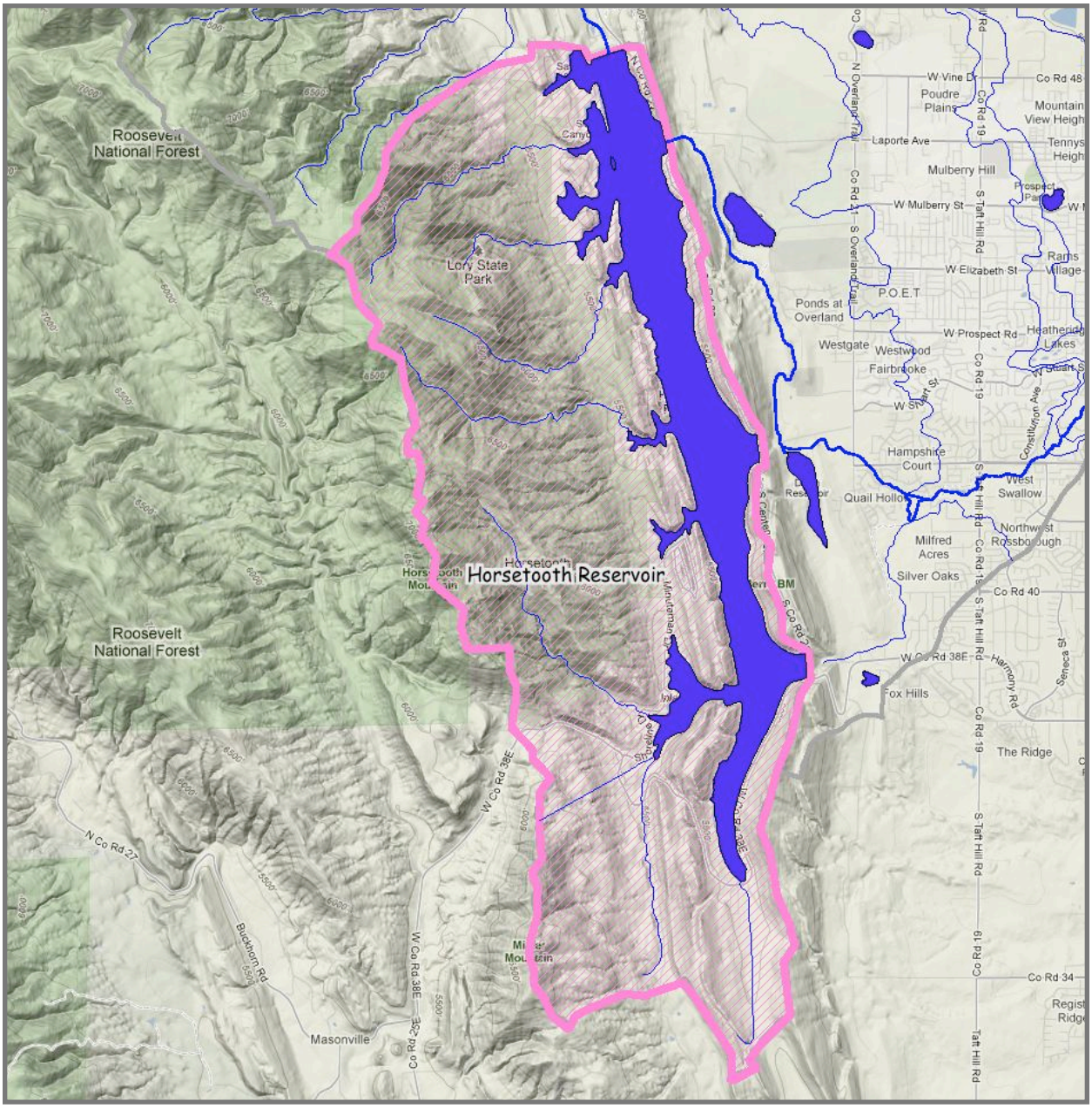

Figure 64. Horsetooth Reservoir ZoC Location

Horsetooth Reservoir Ownership

Land ownership in this ZoC is dominated by Lory State Park and Larimer County Park and Open Land (Figure 65). The remainder of the ZoC is private land.

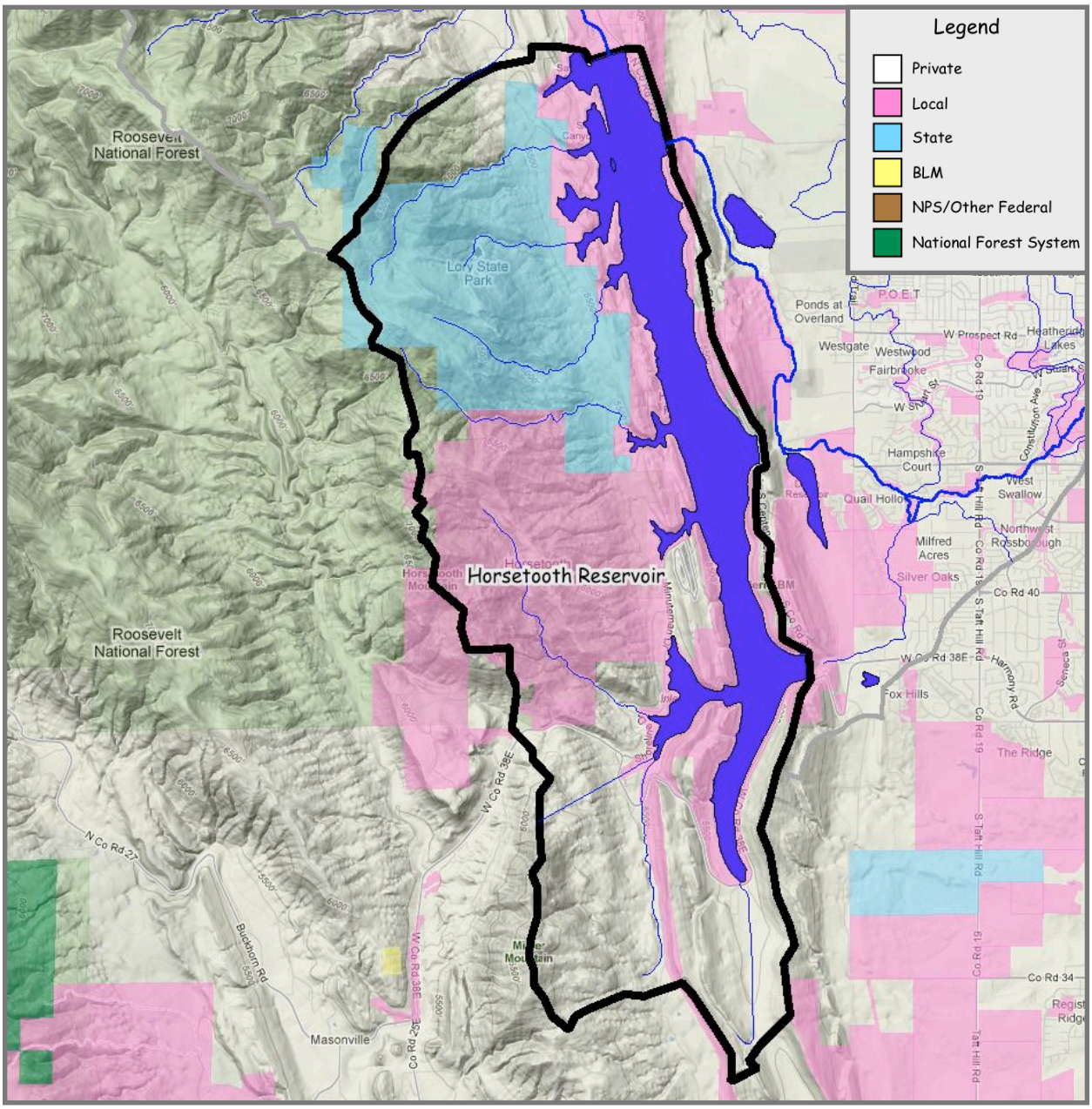

Figure 65. Horsetooth Reservoir ZoC Ownership

Horsetooth Reservoir Watershed Priority

The Horsetooth Reservoir watershed (Figure 66) is ranked Blue overall (Category 2).

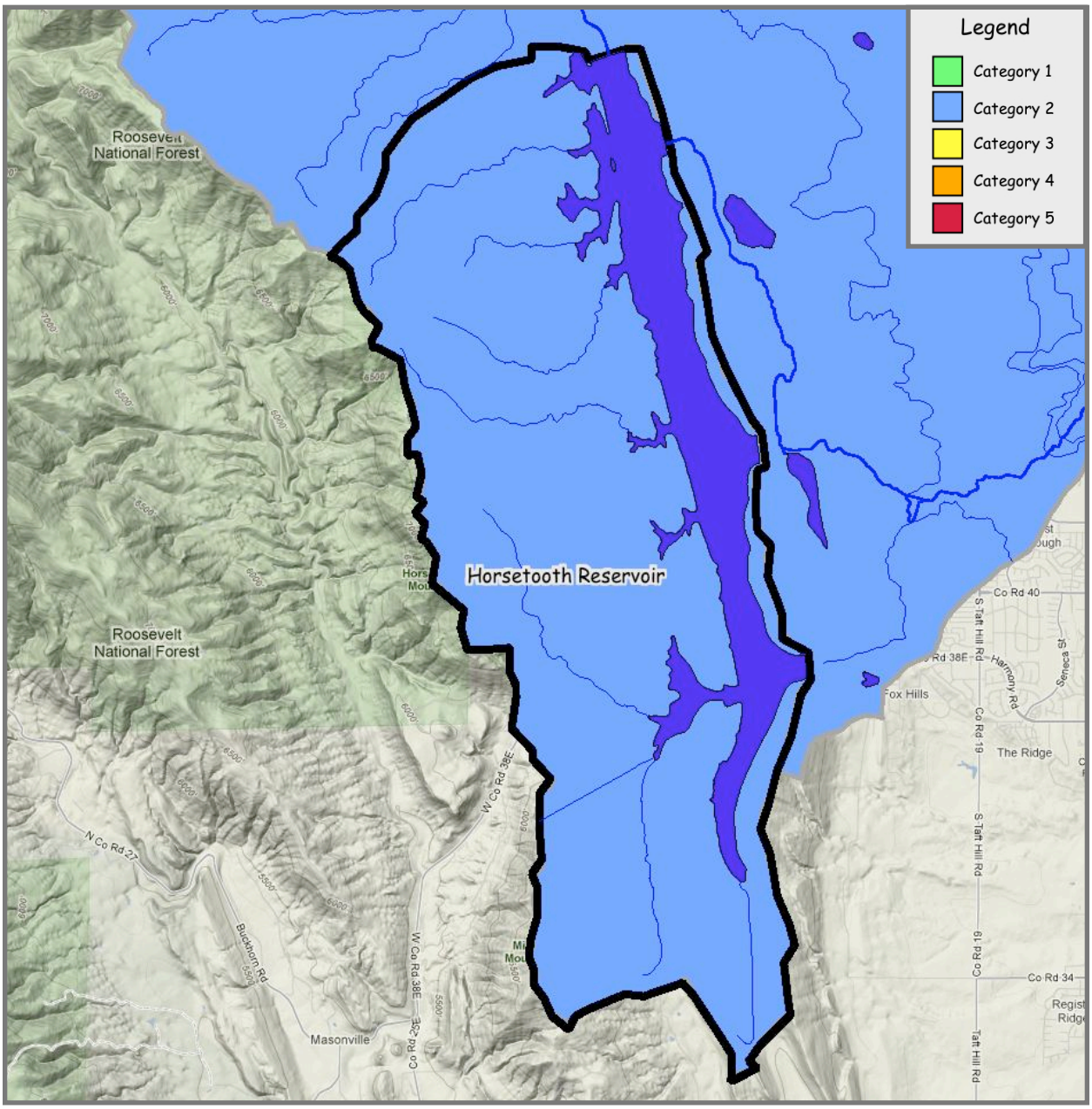

Figure 66. Horsetooth Reservoir ZoC Watershed Priority

Horsetooth Reservoir Slopes

There are some large areas of steep slopes that are present in the upper portions of the ZoC (Figure 67).

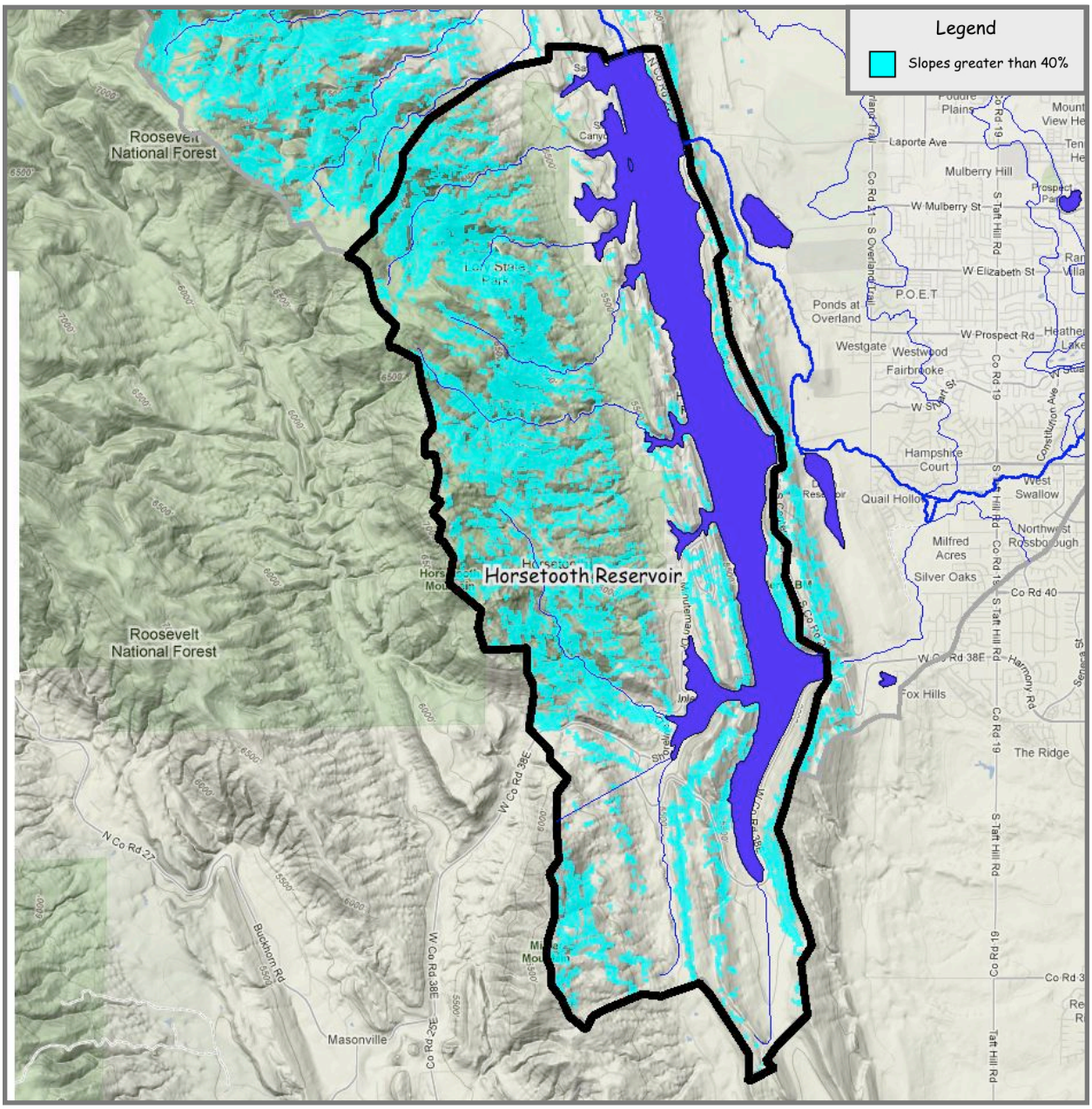

Figure 67. Horsetooth Reservoir ZoC Slope

Horsetooth Reservoir Special Management Areas

Lory State Park is the only special area (Figure 68) and is shown on the land ownership map (Figure 65). There are no wilderness or roadless areas.

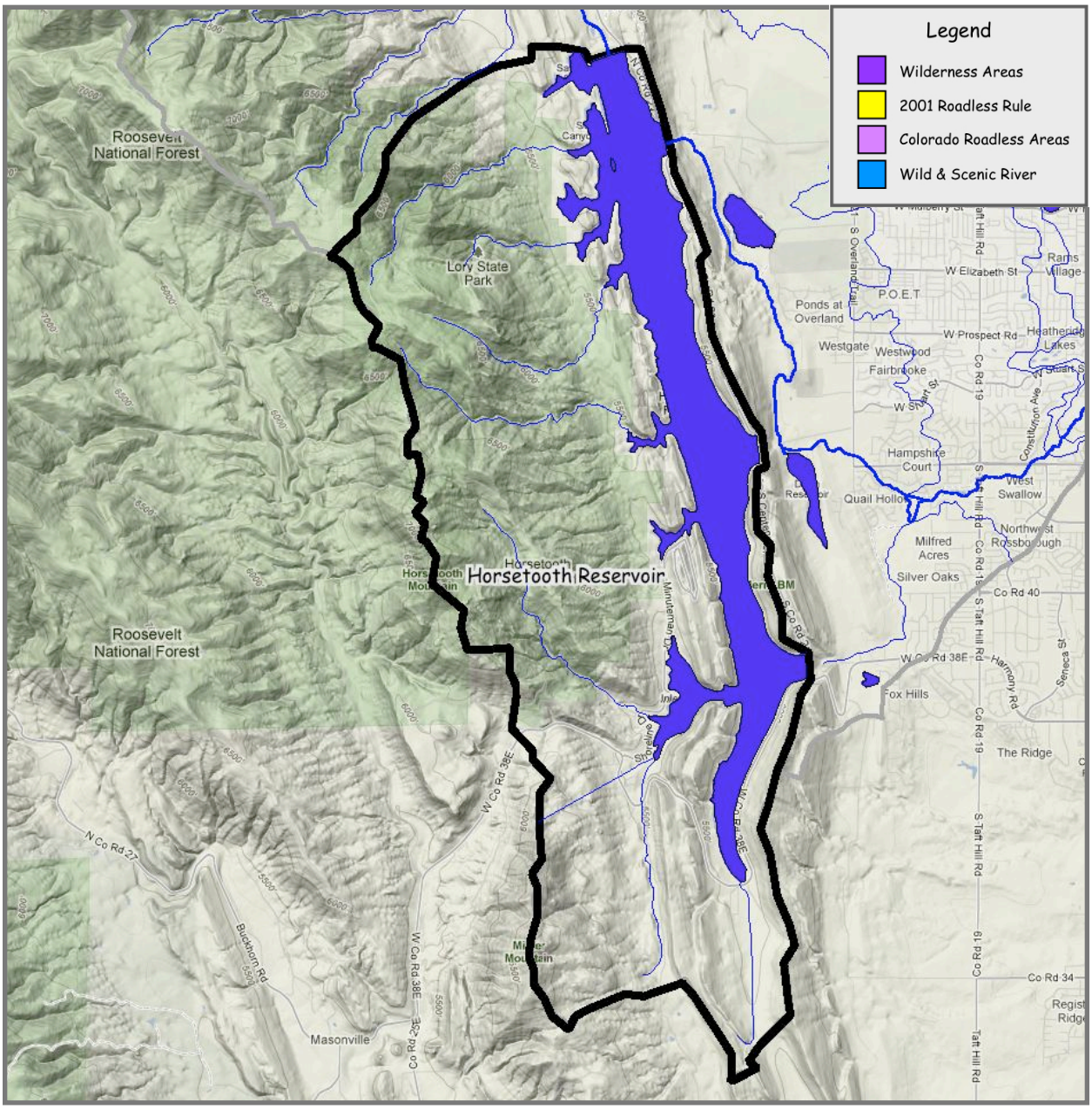

Figure 68. Horsetooth Reservoir ZoC Special Areas

Horsetooth Reservoir Vegetation

Vegetation around the reservoir is dominated by shrubland, grassland and some sagebrush (Figure 69). The vegetation transitions to ponderosa pine and then to mixed conifer at higher elevations.

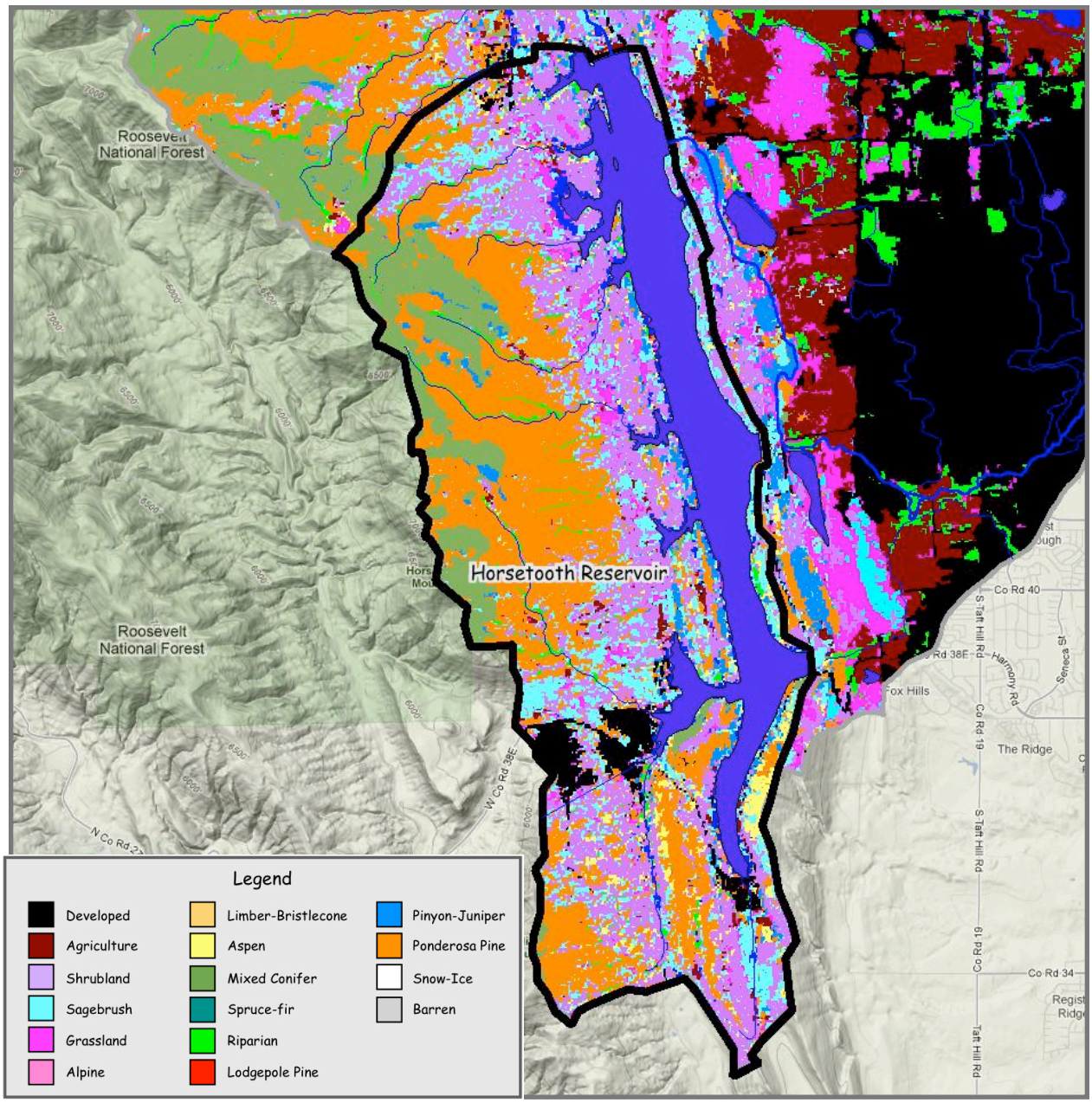

Figure 69. Horsetooth Reservoir ZoC Vegetation

Horsetooth Reservoir Opportunities

There are some opportunities in this ZoC (Figure 70). Existing roads provide access to some ponderosa and mixed conifer areas. The Poudre Fire Authority CWPP covers the entire ZoC. The Loveland CWPP covers the southern portion of the ZoC. The CWPPs should be reviewed for additional proposed treatments that would contribute to watershed-level protection. If the CWPPs do not address watershed issues and protection, there would be a good opportunity to inform the Fire Protection Districts, agencies and area residents about this issue and to collaborate with them to update the CWPPs as necessary.

Some existing treatments have been completed in Lory State Park and on Larimer County lands. There is good opportunity to partner with these agencies on future, and possibly, expanded treatments. Follow-up thinning of regenerated stands and ongoing, periodic maintenance should be conducted. Consider also developing fuelbreaks along the road corridors that run through the ZoC.

Stakeholders include: Spring Canyon W&SD, City of Fort Collins, City of Greeley, Northern Colorado Water Conservancy District, U.S. Bureau of Reclamation, Tri-Districts Soldier Canyon Filter Plant, Larimer County, Colorado State Parks, private landowners, and Colorado State Forest Service.

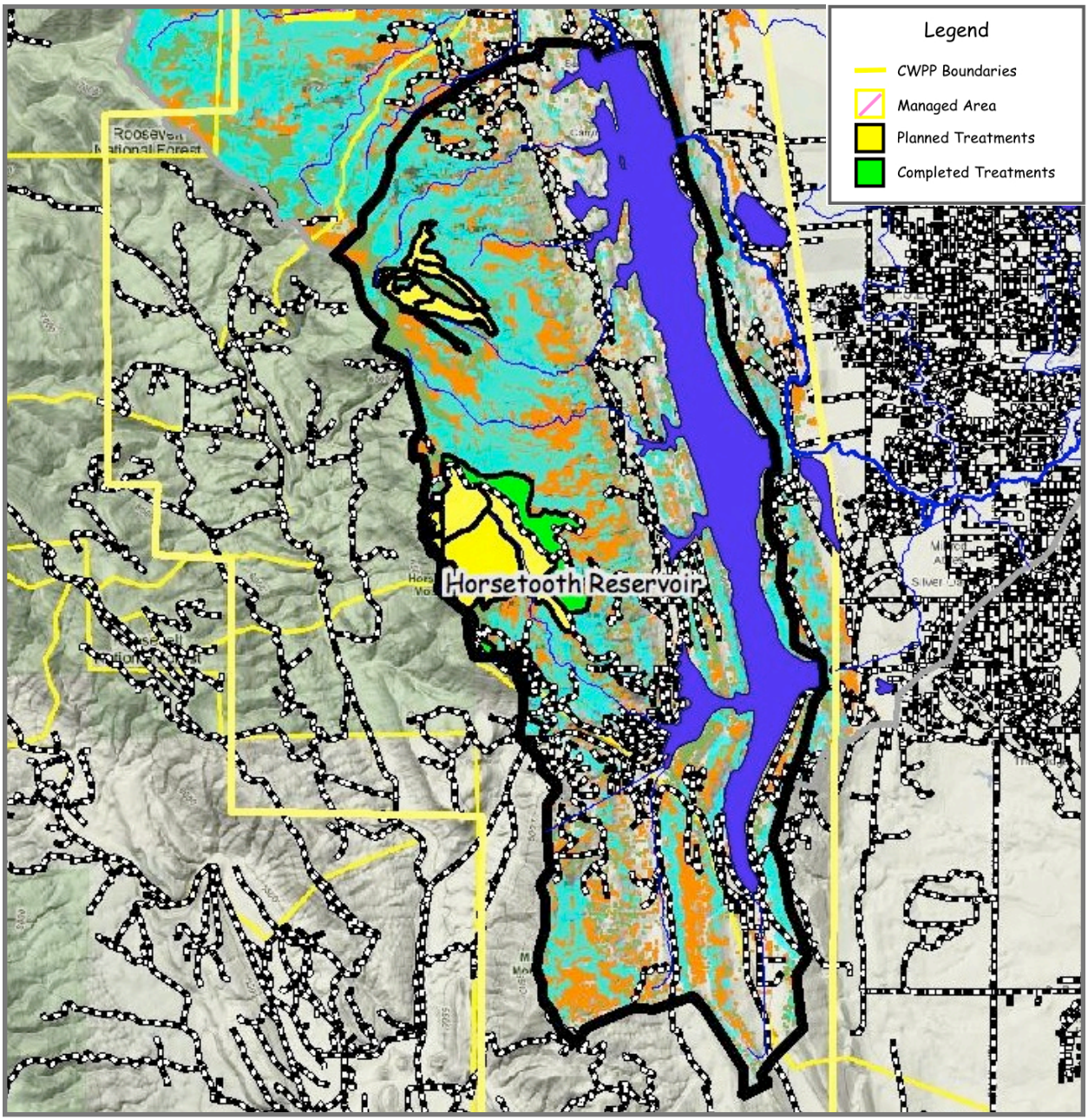

Figure 70. Horsetooth Reservoir ZoC Opportunities

Cache la Poudre Watershed ZoC Summary

Finally, a summary of the opportunities is presented in Table 4 for each ZoC. The overlapping and extended ZoC are combined in the following table.

Table 4. Summary of Cache la Poudre Watershed ZoC Opportunities

Zone of Concern Name	ZoC Area (acres)	Watershed Priority	Potential Hazard Reduction Opportunities	Stakeholders	CWPP
Barnes Meadow Reservoir	1,812	Category 4 (Orange)	Potential treatments around reservoir and between here and Chambers Lake	City of Greeley, US Forest Service, private landowners, and Colorado State Forest Service	Portions in Spencer Heights CWPP
Chambers Lake	14,761	Category 4 (Orange)	Potential treatments around reservoir and between here and Barnes Meadow and Joe Wright. Try to create fuel breaks by connecting past treatments.	Water Supply & Storage Company, US Forest Service, private landowners and Colorado State Forest Service	Portions in Spencer Heights CWPP
Comanche Reservoir	7,530	Category 4 (Orange)	Limited opportunities around reservoir but some between here and Hourglass.	City of Greeley and US Forest Service	None
Eaton Reservoir	6,692	Category 3 (Yellow)	Few opportunities outside roadless areas. More opportunities inside roadless areas.	Larimer & Weld Irrigation Company, US Forest Service, Bureau of Land Management, and private landowners	None
Endovalley Picnic Area	4,004	Category 5 (Red)	Few opportunities, would need temporary roads.	National Park Service	None
Halligan Reservoir	16,129	Category 1 (Green)	Opportunities limited to one area on the north end of the ZoC.	City of Fort Collins, North Poudre Irrigation Company, Colorado Division of Wildlife, private landowners, and US Forest Service	Livermore Fire District CWPP
Horsetooth Reservoir	11,051	Category 2 (Blue)	Some opportunities to coordinate with existing and planned treatments.	Spring Canyon W&SD, City of Fort Collins, City of Greeley, Northern Colorado Water Conservancy District, U.S. Bureau of Reclamation, Tri-Districts Soldier Canyon Filter Plant, Larimer County, Colorado State Parks, private landowners, and Colorado State Forest Service	Poudre Fire Authority and Loveland CWPPs

Table 4. Summary of Cache la Poudre Watershed ZoC Opportunities

Zone of Concern Name	ZoC Area (acres)	Watershed Priority	Potential Hazard Reduction Opportunities	Stakeholders	CWPP
Hourglass Reservoir	2,879	Category 4 (Orange)	Some opportunities around reservoir and between here and Comanche	City of Greeley, US Forest Service, and private landowners	Pingree Park CWPP
Joe Wright Reservoir	4,083	Category 4 (Orange)	Some opportunities west of reservoir and along highway.	City of Fort Collins, US Forest Service, and Colorado State Forest Service	None
Long Draw Reservoir	5,421	Category 4 (Orange)	Some opportunities north of reservoir.	Water Supply & Storage Company, US Forest Service, and National Park Service	None
Main Stem Poudre	26,473	Categories 2, 3 and 5 (Blue, Yellow and Red)	Some opportunities along existing roads south of the Poudre. Opportunities to the north of the Poudre are mostly in roadless areas	City of Fort Collins, City of Greeley, Town of Wellington, Colorado State Land Board, US Forest Service, private landowners, and Colorado State Forest Service	Poudre Park CWPP, Poudre Fire Authority, Rist Canyon, Livermore Fire District and Glacier View CWPPs
Panhandle Reservoir (Crystal Lake)	11,328	Category 4 (Orange)	Many opportunities to connect existing and planned treatments into larger fuel breaks.	US Forest Service and private landowners	Crystal Lakes CWPP
Peterson Lake Reservoir	1,508	Category 5 (Red)	Some opportunities above reservoir with good existing road access.	City of Greeley and US Forest Service	Spencer Heights CWPP
Seaman Reservoir	9,323	Category 1 (Green)	Some opportunities for fuel breaks around existing roads.	City of Greeley, US Forest Service, private landowners, Colorado State Land Board, Larimer County, and Colorado State Forest Service	Poudre Park and Livermore Fire District CWPPs
Twin Lake Reservoir	527	Category 5 (Red)	Some opportunities to the north and northwest of the reservoir.	City of Greeley, US Forest Service, Colorado State University, and Colorado State Forest Service	Pingree Park CWPP
Totals	**123,521**				

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APPENDIX A

LIST OF CACHE LA POUDRE WATERSHED STAKEHOLDERS

Table A-1. Cache la Poudre Watershed Stakeholders List

Cache la Poudre Watershed Stakeholders

Company	Last	First	Phone	email
City of Fort Collins	Billica	Judy	970.221.6690	jbillica@fcgov.com
City of Fort Collins	Oropeza	Jill	970.221.6690	joropeza@fcgov.com
City of Fort Collins	Greenwood	Clyde	970.221.6690	cgreenwood@fcgov.com
City of Fort Collins	Voytko	Lisa	970.221.6690	lvoytko@fcgov.com
City of Greeley	McCutchan	John	970.482.2446	John.McCutchan@GreeleyGov.com
Colorado Department of Health and Environment	Duggan	John	303.692.3534	john.duggan@state.co.us
Colorado State Forest Service	Lebeda	Boyd	970.491.8445	Boyd.Lebeda@Colostate.edu
Larimer County	Flenniken	Meegan	970.679.4562	mflenniken@larimer.org
Larimer County	Lentz	Dave		dlentz@larimer.org
Northern Colorado Water Conservancy District	Vincent	Esther	970.622.2356	evincent@ncwcd.org
Northern Colorado Water Conservancy District	Drager	Jeff	970.622.2333	jdrager@ncwcd.org
NRCS	Feinstein	Jonas	720.544.2839	jonas.feinstein@co.usda.gov
Tri-Districts	Roberts	Bill		broberts@soldiercanyon.com
Tri-Districts	Pindilli	Rosie	970.482.3143	rpindilli@soldiercanyon.com
US Forest Service	Chambers	Carl	970.295.6633	cchambers@fs.fed.us
US Forest Service	Gibbs	Hal	970.295.6630	hdgibbs@fs.fed.us
US Forest Service - Arapaho-Roosevelt NF	Atchley	Kevin	970.295.6711	katchley@fs.fed.us
US Forest Service - Arapaho-Roosevelt NF	Entwistle	Deb	970.295.6763	dentwistle@fs.fed.us

Wednesday, October 6, 2010

APPENDIX B

CACHE LA POUDRE WILDFIRE HAZARD MODELING METHODOLOGY

The forest conditions that are of concern for the assessments are the wildfire hazard based on existing forest conditions. The wildfire hazard (Flame Length) was determined using the Fire Behavior Assessment Tool (FBAT) (http://www.fire.org) which is an interface between ArcMap and FlamMap. The input spatial data were collected from LANDFIRE project (http://www.landfire.gov/).

After a mountain pine beetle outbreak there are substantial increases in the amount of fine dead fuels in the canopy. The majority of these fuels remain in the canopy for 2-3 years post outbreak (Knight 1987, Schmid and Amman 1992). Therefore, certain input spatial data sets were updated reflecting Mountain Pine Beetle (MPB) mortality conditions using USDA Forest Service, Rocky Mountain Region Aerial Detection Survey (ADS) Data from the years 2002 - 2007 (http://www.fs.fed.us/r2/resources/fhm/aerialsurvey/). The following modeling settings and spatial data modification were used:

Modeling Setting

1. Scott and Burgan (2005) Fire Behavior Model (Fuel Moisture is shown in Table A-1)
2. Uphill wind direction
3. Scott & Reinhardt (2001) crown fire calculation
4. Foliar Moisture at 100%

Spatial Data Modifications

1. Canopy Cover was assigned a value of 10% when coincident with MPB mortality from ADS for years 2002-2007.
2. Canopy Base Height (CBH) was reduced by 25% for MPB mortality derived from ADS for the years 2002-2006.
3. CBH was reassigned a value of 0 for MPB mortality from ADS for the year 2007.
4. Canopy Bulk Density (CBD) was reduced by 50% for MPB mortality derived from ADS for the years 2002-2006

Table B-1. Fuel Moisture (percent) used in FBAT Model Runs

Scott and Burgan (2005) fuel model	1-Hour Fuel	10-Hour Fuel	100-Hour Fuel	Live Herbaceous	Live Woody
1	4	5	8	200	95
2	4	5	8	150	95
3	4	5	8	85	95
4	4	5	8	85	95
5	4	5	8	85	150
6	4	5	8	85	95
7	4	5	8	85	95
8	4	5	8	85	95
9	4	5	8	85	95
10	4	5	8	85	95
11	4	5	8	85	95
12	4	5	8	85	95
13	4	5	8	85	95
14	3	4	8	85	95
15	3	4	8	85	95
16	3	4	8	85	95
17	3	4	8	85	95
18	3	4	8	85	95
19	3	4	8	85	95
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21	3	4	8	85	95
22	3	4	8	85	95
23	3	4	8	85	95
24	3	4	8	85	95
25	3	4	8	85	95
26	3	4	8	85	95
27	3	4	8	85	95
28	3	4	8	85	95
29	3	4	8	85	95
30	3	4	8	85	95
31	3	4	8	85	95
32	3	4	8	85	95
33	3	4	8	85	95
34	3	4	8	85	95
35	3	4	8	85	95
36	3	4	8	85	95
37	3	4	8	85	95
38	3	4	8	85	95
39	3	4	8	85	95
40	3	4	8	85	95
41	3	4	8	85	95
42	3	4	8	85	95
43	3	4	8	85	95
44	3	4	8	85	95
45	3	4	8	85	95
46	3	4	8	85	95
47	3	4	8	85	95
48	3	4	8	85	95
49	3	4	8	85	95
50	3	4	8	85	95

Weather Data

The weather data used comes from the Colorado Wildfire Risk Assessment Statewide (CRA) dataset prepared by Sandborn under contract to the Colorado State Forest Service. For the Colorado Fire Risk Assessment nine weather influence zones (WIZ) were developed for analysis purposes. A WIZ is an area where for analysis purposes the weather on any given day is uniform. Within each WIZ, daily weather data was gathered for the years 1980-2006. Where not available, the weather data was gathered from the earliest year through 2006. Several weather stations were analyzed within each WIZ. From this analysis, one representative weather station was selected for each WIZ. From this data set, percentile weather was developed for each WIZ using the Fire Family Plus software package.

For this watershed assessment the percentile weather for WIZ CO 02 (Dowd 1986-2006) was used for all watersheds on the west side of the continental divide and WIZ CO 03 (Coral Creek 1980-2006) was used for all watersheds on the east side of the continental divide. The 20-foot wind speeds for the "High" case was used in the modeling runs (Table B-2).

In addition the wind direction was assumed to be uphill (parallel with slope) in all instances. This setting encourages crown fire initiation and establishes a common baseline for the evaluation of areas within the landscape based upon the fuels hazard represented by vegetation conditions.

Table B-2. Wind Speed (Miles per Hour) used in FBAT Model Runs

Watershed Name	Wind Speed (mph)	Probable Momentary Gust Speed (mph)
North Platte	15	29
Upper North Platte	15	29
Crow/Medicine Bow/Upper Laramie/Upper Lodgepole	12	25
Clear/Bear Creek	12	25
Big Thompson	12	25
Cache la Poudre	12	25
Blue River	15	29
Eagle River	15	29
Upper Yampa	15	29
Little Snake	15	29
Upper White	15	29
Lower Colorado	15	29
Upper Colorado	15	29
Saint Vrain	12	25
Roaring Fork	15	29

Categorization of Results

The FBAT model results were divided into five categories of flame length. These values range from lowest (Category 0) to highest (Category 4) based upon flame length. The flame length categories that were used are:

Flame Length Category 0 - 0 meters

Flame Length Category 1 - 1 to 10 meters

Flame Length Category 2 - 11 to 25 meters

Flame Length Category 3 - 26 to 40 meters

Flame Length Category 4 - >40 meters

APPENDIX C

DETAILED CACHE LA POUDRE WATERSHED ASSESSMENT RESULTS

Table C-1. Cache la Poudre Watershed Wildfire Hazard Ranking

Sixth-level Watershed Name	Watershed Area (acres)	Wildfire Hazard Calculation	Wildfire Hazard Rank
Willow Creek-Cache La Poudre River	21,936	63.3%	*5.5*
Headwaters Cache La Poudre River	12,709	62.6%	*5.4*
Little Beaver Creek	11,562	60.7%	*5.3*
Pendergrass Creek-South Fork Cache La Poudre River	18,639	59.2%	*5.2*
Pennock Creek	11,068	59.2%	*5.2*
Sheep Creek	13,966	56.6%	*5.0*
La Poudre Pass Creek	14,066	53.1%	*4.7*
Joe Wright Creek	24,468	50.9%	*4.5*
Roaring Creek	9,938	50.7%	*4.5*
Black Hollow-Cache La Poudre River	37,738	50.5%	*4.5*
Sheep Creek-North Fork Cache La Poudre Creek	35,586	49.2%	*4.3*
Beaver Creek	14,135	46.2%	*4.1*
Bennett Creek	9,210	45.8%	*4.1*
North Fork Cache La Poudre River-Panhandle Creek	29,786	45.6%	*4.1*
Skin Gulch-Cache La Poudre River	14,920	40.0%	*3.6*
Trail Creek-North Fork Cache La Poudre River	23,034	38.5%	*3.5*
Youngs Gulch	9,823	38.4%	*3.5*
Sevenmile Creek-Cache La Poudre River	18,640	33.9%	*3.1*
South Fork Lone Pine Creek	16,305	33.6%	*3.1*
Hague Creek	8,685	32.4%	*3.0*
Elkhorn Creek	22,259	26.9%	*2.5*
Headwaters South Fork Cache La Poudre River	11,094	25.4%	*2.4*
Hill Gulch-Cache La Poudre River	11,161	25.3%	*2.4*
North Fork Lone Pine Creek	25,269	24.6%	*2.3*
North Fork Cache La Poudre River-Bull Creek	34,294	18.1%	*1.8*
Gordon Creek	13,908	11.7%	*1.3*
Fish Creek-Dale Creek	23,097	11.4%	*1.3*
Rabbit Creek	28,860	10.9%	*1.2*
City of Fort Collins-Cache La Poudre River	51,119	10.1%	*1.2*
Lone Pine Creek	14,153	8.0%	*1.0*
Horsetooth Reservoir	10,974	6.9%	*0.9*
Miton Seaman Res.-North Fork Cache La Poudre River	30,516	2.4%	*0.5*
Halligan Reservoir	15,127	2.1%	*0.5*

Table C-2. Cache la Poudre Watershed Ruggedness Ranking[1, 2, 3]

Sixth-level Watershed Name	Maximum Elevation	Minimum Elevation	Difference Elevation	Ruggedness	Ruggedness Rank
Headwaters South Fork Cache La Poudre River	13,212	8,308	4,904	0.2000	*5.5*
Sevenmile Creek-Cache La Poudre River	10,883	6,524	4,359	0.1874	*5.1*
Pendergrass Creek-South Fork Cache La Poudre River	11,208	6,537	4,671	0.1833	*4.9*
Hague Creek	13,304	9,742	3,562	0.1831	*4.9*
Skin Gulch-Cache La Poudre River	9,558	5,819	3,739	0.1796	*4.8*
Bennett Creek	10,296	6,701	3,595	0.1795	*4.8*
Pennock Creek	11,801	8,144	3,657	0.1666	*4.3*
Beaver Creek	12,471	8,394	4,077	0.1643	*4.2*
Little Beaver Creek	11,490	7,934	3,556	0.1584	*4.0*
South Fork Lone Pine Creek	10,985	6,786	4,198	0.1575	*4.0*
Hill Gulch-Cache La Poudre River	7,800	5,369	2,430	0.1559	*3.9*
Roaring Creek	10,998	7,856	3,142	0.1510	*3.8*
Headwaters Cache La Poudre River	13,268	9,735	3,533	0.1501	*3.7*
Sheep Creek	11,454	7,787	3,667	0.1487	*3.7*
Youngs Gulch	8,856	5,789	3,067	0.1483	*3.7*
Willow Creek-Cache La Poudre River	12,687	8,374	4,313	0.1395	*3.4*
Gordon Creek	8,115	5,707	2,408	0.1383	*3.3*
Elkhorn Creek	10,840	6,540	4,300	0.1381	*3.3*
Joe Wright Creek	12,851	8,377	4,474	0.1370	*3.3*
North Fork Lone Pine Creek	10,653	6,816	3,838	0.1157	*2.5*
La Poudre Pass Creek	12,290	9,676	2,614	0.1056	*2.2*
Black Hollow-Cache La Poudre River	11,221	7,134	4,087	0.1008	*2.0*
North Fork Cache La Poudre River-Panhandle Creek	10,840	7,537	3,303	0.0917	*1.7*
Lone Pine Creek	8,006	5,792	2,214	0.0892	*1.6*
Horsetooth Reservoir	7,167	5,284	1,883	0.0861	*1.5*
Trail Creek-North Fork Cache La Poudre River	9,161	7,006	2,155	0.0680	*0.8*
Rabbit Creek	8,088	5,806	2,283	0.0644	*0.7*
Miton Seaman Res.-North Fork Cache La Poudre River	7,682	5,353	2,329	0.0639	*0.7*
City of Fort Collins-Cache La Poudre River	7,770	4,861	2,909	0.0617	*0.6*
Fish Creek-Dale Creek	8,767	6,832	1,935	0.0610	*0.6*
North Fork Cache La Poudre River-Bull Creek	8,695	6,406	2,289	0.0592	*0.5*
Halligan Reservoir	7,852	6,350	1,502	0.0585	*0.5*
Sheep Creek-North Fork Cache La Poudre Creek	9,870	7,567	2,303	0.0585	*0.5*

[1] Ruggedness is based on Melton (1957)

[2] These watersheds were manually adjusted because they do not accurately reflect the ruggedness in those watersheds. The original values were; Sevenmile Creek-Cache La Poudre River (0.1530), Pendergrass Creek-South Fork Cache La Poudre River (0.1639), Skin Gulch-Cache La Poudre River (0.1467), Hill Gulch-Cache La Poudre River (0.1102), and Elkhorn Creek (0.0978).

[3] Headwaters South Fork Cache La Poudre River (original value 0.2231) was skewing the categorization because of its high ruggedness value and was manually given a score slightly higher than the next highest score.

Table C-3. Cache la Poudre Watershed Road Density Ranking[4]

Sixth-level Watershed Name	Roads (miles)	Roads Adjusted (miles)	Watershed Area (sq. mi.)	Road density (miles per sq. mi.)	Road Density Rank
North Fork Cache La Poudre River-Panhandle Creek	127.3	101.8	46.54	2.19	*5.5*
Gordon Creek	59.4	47.5	21.73	2.19	*5.5*
North Fork Lone Pine Creek	82.9	82.9	39.48	2.10	*5.3*
Horsetooth Reservoir	42.4	31.8	17.15	1.85	*4.7*
Elkhorn Creek	53.1	53.1	34.78	1.53	*4.0*
Skin Gulch-Cache La Poudre River	32.5	32.5	23.31	1.39	*3.7*
City of Fort Collins-Cache La Poudre River	421.0	105.3	79.87	1.32	*3.5*
Sevenmile Creek-Cache La Poudre River	36.5	36.5	29.13	1.25	*3.4*
Bennett Creek	17.7	17.7	14.39	1.23	*3.3*
Sheep Creek-North Fork Cache La Poudre Creek	68.0	68.0	55.60	1.22	*3.3*
South Fork Lone Pine Creek	29.2	29.2	25.48	1.15	*3.1*
Pennock Creek	18.8	18.8	17.29	1.09	*3.0*
Trail Creek-North Fork Cache La Poudre River	36.0	36.0	35.99	1.00	*2.8*
Roaring Creek	15.4	15.4	15.53	0.99	*2.8*
Youngs Gulch	14.4	14.4	15.35	0.94	*2.6*
Hill Gulch-Cache La Poudre River	16.2	16.2	17.44	0.93	*2.6*
Black Hollow-Cache La Poudre River	53.5	53.5	58.97	0.91	*2.6*
Lone Pine Creek	19.4	19.4	22.11	0.88	*2.5*
North Fork Cache La Poudre River-Bull Creek	44.8	44.8	53.58	0.84	*2.4*
Miton Seaman Res.-North Fork Cache La Poudre River	38.6	38.6	47.68	0.81	*2.4*
Pendergrass Creek-South Fork Cache La Poudre River	21.9	21.9	29.12	0.75	*2.2*
Headwaters South Fork Cache La Poudre River	11.7	11.7	17.33	0.68	*2.0*
Halligan Reservoir	14.5	14.5	23.64	0.61	*1.9*
Little Beaver Creek	10.9	10.9	18.07	0.60	*1.9*
Joe Wright Creek	22.8	22.8	38.23	0.60	*1.9*
Sheep Creek	12.2	12.2	21.82	0.56	*1.8*
Rabbit Creek	24.9	24.9	45.09	0.55	*1.8*
Fish Creek-Dale Creek	13.1	13.1	36.09	0.36	*1.3*
La Poudre Pass Creek	7.9	7.9	21.98	0.36	*1.3*
Headwaters Cache La Poudre River	5.5	5.5	19.86	0.28	*1.1*
Beaver Creek	5.8	5.8	22.09	0.26	*1.1*
Willow Creek-Cache La Poudre River	7.3	7.3	34.28	0.21	*1.0*
Hague Creek	0.0	0.0	13.57	0.00	*0.5*
Totals	1,385	1,022	1,012.6	1.01	

[4] The road density was adjusted based upon the procedure discussed in the report (p. 12). The original road density values were; North Fork Cache La Poudre River-Panhandle Creek (2.74), Gordon Creek (2.73), Horsetooth Reservoir (2.47), and City of Fort Collins-Cache La Poudre River (5.27).

Table C-4. Cache la Poudre Watershed Flooding/Debris Flow Hazard Ranking

Sixth-level Watershed Name	Ruggedness Ranking	Road Density Ranking	Combined Numeric Rank	Combined Ranking
Sevenmile Creek-Cache La Poudre River	5.1	3.4	13.47	5.5
Skin Gulch-Cache La Poudre River	4.8	3.7	13.25	5.4
Headwaters South Fork Cache La Poudre River	5.5	2.0	13.05	5.3
Bennett Creek	4.8	3.3	12.86	5.2
Gordon Creek	3.3	5.5	12.14	4.9
Pendergrass Creek-South Fork Cache La Poudre River	4.9	2.2	12.03	4.8
Pennock Creek	4.3	3.0	11.62	4.7
South Fork Lone Pine Creek	4.0	3.1	11.12	4.4
Elkhorn Creek	3.3	4.0	10.62	4.2
Hill Gulch-Cache La Poudre River	3.9	2.6	10.50	4.1
North Fork Lone Pine Creek	2.5	5.3	10.34	4.1
Hague Creek	4.9	0.5	10.31	4.1
Roaring Creek	3.8	2.8	10.30	4.1
Youngs Gulch	3.7	2.6	9.99	3.9
Little Beaver Creek	4.0	1.9	9.94	3.9
Beaver Creek	4.2	1.1	9.57	3.7
Sheep Creek	3.7	1.8	9.15	3.5
North Fork Cache La Poudre River-Panhandle Creek	1.7	5.5	8.85	3.4
Headwaters Cache La Poudre River	3.7	1.1	8.61	3.3
Joe Wright Creek	3.3	1.9	8.42	3.2
Willow Creek-Cache La Poudre River	3.4	1.0	7.71	2.9
Horsetooth Reservoir	1.5	4.7	7.69	2.9
Black Hollow-Cache La Poudre River	2.0	2.6	6.56	2.3
Lone Pine Creek	1.6	2.5	5.67	1.9
La Poudre Pass Creek	2.2	1.3	5.65	1.9
City of Fort Collins-Cache La Poudre River	0.6	3.5	4.74	1.5
Trail Creek-North Fork Cache La Poudre River	0.8	2.8	4.46	1.4
Sheep Creek-North Fork Cache La Poudre Creek	0.5	3.3	4.29	1.3
Miton Seaman Res.-North Fork Cache La Poudre River	0.7	2.4	3.73	1.1
North Fork Cache La Poudre River-Bull Creek	0.5	2.4	3.46	0.9
Rabbit Creek	0.7	1.8	3.18	0.8
Halligan Reservoir	0.5	1.9	2.91	0.7
Fish Creek-Dale Creek	0.6	1.3	2.51	0.5

Table C-5. Cache la Poudre Watershed Soil Erodibility Ranking[5, 6, 7]

Sixth-level Watershed Name	Severe (%)	Very Severe (%)	Soil Erodibility Value	Soil Erodibility Rank
Hague Creek	19.0%	13.3%	0.370	*5.5*
Black Hollow-Cache La Poudre River	22.2%	10.2%	0.360	*5.4*
Headwaters South Fork Cache La Poudre River	17.2%	7.8%	0.328	*4.9*
Willow Creek-Cache La Poudre River	12.8%	8.4%	0.297	*4.4*
Hill Gulch-Cache La Poudre River	25.1%	2.2%	0.295	*4.4*
Pennock Creek	19.4%	5.0%	0.294	*4.4*
Skin Gulch-Cache La Poudre River	23.5%	2.3%	0.281	*4.2*
Headwaters Cache La Poudre River	19.9%	3.7%	0.272	*4.1*
Roaring Creek	15.0%	4.8%	0.246	*3.7*
North Fork Lone Pine Creek	6.0%	1.7%	0.230	*3.4*
Sevenmile Creek-Cache La Poudre River	16.6%	2.2%	0.210	*3.1*
La Poudre Pass Creek	13.2%	2.1%	0.173	*2.6*
South Fork Lone Pine Creek	2.9%	0.4%	0.173	*2.6*
Pendergrass Creek-South Fork Cache La Poudre River	13.5%	1.4%	0.164	*2.5*
Youngs Gulch	14.4%	1.0%	0.163	*2.5*
Joe Wright Creek	11.6%	2.3%	0.163	*2.5*
Lone Pine Creek	11.2%	2.2%	0.156	*2.4*
Beaver Creek	10.5%	2.2%	0.148	*2.2*
Horsetooth Reservoir	10.7%	1.3%	0.134	*2.0*
Rabbit Creek	8.6%	1.8%	0.122	*1.9*
Sheep Creek	6.6%	2.7%	0.120	*1.8*
Miton Seaman Res.-North Fork Cache La Poudre River	8.4%	1.6%	0.117	*1.8*
North Fork Cache La Poudre River-Bull Creek	7.0%	1.2%	0.095	*1.5*
Little Beaver Creek	7.7%	0.7%	0.090	*1.4*
Bennett Creek	7.2%	0.6%	0.084	*1.3*
Gordon Creek	6.4%	0.8%	0.081	*1.3*
North Fork Cache La Poudre River-Panhandle Creek	6.5%	0.7%	0.079	*1.2*
Halligan Reservoir	5.2%	0.7%	0.067	*1.1*
City of Fort Collins-Cache La Poudre River	5.3%	0.6%	0.065	*1.0*
Sheep Creek-North Fork Cache La Poudre Creek	4.5%	0.5%	0.054	*0.9*
Elkhorn Creek	3.7%	0.7%	0.050	*0.8*
Trail Creek-North Fork Cache La Poudre River	2.8%	0.3%	0.034	*0.6*
Fish Creek-Dale Creek	1.9%	0.5%	0.029	*0.5*

[5] Soil Erodibility Value is percentage of Severe plus 2 times the percentage of Very Severe.

[6] The soil erodibility values for North Fork Lone Pine Creek and South Fork Lone Pine Creek were adjusted up (original values of 0.094 and 0.037, respectively) due to the presence of granitic soils.

[7] Hague Creek and Black Hollow-Cache La Poudre River watersheds were skewing the categorization because of their high soil erodibility values (originally 0.456 and 0.425 respectively) and were manually given a score slightly higher than the next highest score.

Table C-6. Cache la Poudre Watershed Composite Hazard Ranking

Sixth-level Watershed Name	Wildfire Hazard Rank	Flooding/ Debris Flow Rank	Soil Erodibility Rank	Composite Hazard Rank
Pennock Creek	5.2	4.7	4.4	5.5
Skin Gulch-Cache La Poudre River	3.6	5.4	4.2	5.1
Willow Creek-Cache La Poudre River	5.5	2.9	4.4	4.9
Headwaters Cache La Poudre River	5.4	3.3	4.1	4.9
Headwaters South Fork Cache La Poudre River	2.4	5.3	4.9	4.8
Hague Creek	3.0	4.1	5.5	4.8
Pendergrass Creek-South Fork Cache La Poudre River	5.2	4.8	2.5	4.8
Roaring Creek	4.5	4.1	3.7	4.7
Black Hollow-Cache La Poudre River	4.5	2.3	5.4	4.6
Sevenmile Creek-Cache La Poudre River	3.1	5.5	3.1	4.5
Hill Gulch-Cache La Poudre River	2.4	4.1	4.4	4.1
Bennett Creek	4.1	5.2	1.3	4.0
Little Beaver Creek	5.3	3.9	1.4	4.0
Sheep Creek	5.0	3.5	1.8	3.9
Joe Wright Creek	4.5	3.2	2.5	3.8
South Fork Lone Pine Creek	3.1	4.4	2.6	3.8
Beaver Creek	4.1	3.7	2.2	3.8
North Fork Lone Pine Creek	2.3	4.1	3.4	3.7
Youngs Gulch	3.5	3.9	2.5	3.7
La Poudre Pass Creek	4.7	1.9	2.6	3.4
North Fork Cache La Poudre River-Panhandle Creek	4.1	3.4	1.2	3.2
Elkhorn Creek	2.5	4.2	0.8	2.7
Gordon Creek	1.3	4.9	1.3	2.7
Sheep Creek-North Fork Cache La Poudre Creek	4.3	1.3	0.9	2.3
Horsetooth Reservoir	0.9	2.9	2.0	2.0
Trail Creek-North Fork Cache La Poudre River	3.5	1.4	0.6	1.8
Lone Pine Creek	1.0	1.9	2.4	1.8
North Fork Cache La Poudre River-Bull Creek	1.8	0.9	1.5	1.3
Rabbit Creek	1.2	0.8	1.9	1.2
City of Fort Collins-Cache La Poudre River	1.2	1.5	1.0	1.1
Miton Seaman Res.-North Fork Cache La Poudre River	0.5	1.1	1.8	1.0
Fish Creek-Dale Creek	1.3	0.5	0.5	0.5
Halligan Reservoir	0.5	0.7	1.1	0.5

Table C-7. Cache la Poudre Watershed Water Supply Ranking

Sixth-level Watershed Name	State Data	Reservoirs	Water Rank
Beaver Creek		1	*1*
Headwaters South Fork Cache La Poudre River		1	*1*
Pendergrass Creek-South Fork Cache La Poudre River		1	*1*
Headwaters Cache La Poudre River	1		*1*
La Poudre Pass Creek		1	*1*
Joe Wright Creek		1	*1*
Willow Creek-Cache La Poudre River		1	*1*
Roaring Creek		1	*1*
Black Hollow-Cache La Poudre River		1	*1*
Elkhorn Creek	1		*1*
Skin Gulch-Cache La Poudre River		1	*1*
Hill Gulch-Cache La Poudre River	1		*1*
North Fork Cache La Poudre River-Panhandle Creek		1	*1*
Sheep Creek-North Fork Cache La Poudre Creek		1	*1*
Halligan Reservoir		1	*1*
Miton Seaman Res.-North Fork Cache La Poudre River		1	*1*
Horsetooth Reservoir	1	1	*1*
City of Fort Collins-Cache La Poudre River	1		*1*
Pennock Creek			*0*
Little Beaver Creek			*0*
Hague Creek			*0*
Sheep Creek			*0*
Bennett Creek			*0*
Sevenmile Creek-Cache La Poudre River			*0*
Youngs Gulch			*0*
Gordon Creek			*0*
North Fork Cache La Poudre River-Bull Creek			*0*
Trail Creek-North Fork Cache La Poudre River			*0*
Fish Creek-Dale Creek			*0*
South Fork Lone Pine Creek			*0*
North Fork Lone Pine Creek			*0*
Lone Pine Creek			*0*
Rabbit Creek			*0*

Table C-8. Cache la Poudre Final Watershed Ranking

Sixth-level Watershed Name	Wildfire Hazard Rank	Flooding /Debris Flow Rank	Soil Erod. Rank	Composite Hazard Rank	Water Supply Rank	Final Rank
Skin Gulch-Cache La Poudre River	3.6	5.4	4.2	5.1	1	5.5
Willow Creek-Cache La Poudre River	5.5	2.9	4.4	4.9	1	5.3
Headwaters Cache La Poudre River	5.4	3.3	4.1	4.9	1	5.3
Headwaters South Fork Cache La Poudre River	2.4	5.3	4.9	4.8	1	5.3
Pendergrass Creek-South Fork Cache La Poudre River	5.2	4.8	2.5	4.8	1	5.2
Roaring Creek	4.5	4.1	3.7	4.7	1	5.1
Black Hollow-Cache La Poudre River	4.5	2.3	5.4	4.6	1	5.1
Pennock Creek	5.2	4.7	4.4	5.5	0	4.9
Hill Gulch-Cache La Poudre River	2.4	4.1	4.4	4.1	1	4.6
Joe Wright Creek	4.5	3.2	2.5	3.8	1	4.2
Hague Creek	3.0	4.1	5.5	4.8	0	4.2
Beaver Creek	4.1	3.7	2.2	3.8	1	4.2
Sevenmile Creek-Cache La Poudre River	3.1	5.5	3.1	4.5	0	3.9
La Poudre Pass Creek	4.7	1.9	2.6	3.4	1	3.9
North Fork Cache La Poudre River-Panhandle Creek	4.1	3.4	1.2	3.2	1	3.6
Bennett Creek	4.1	5.2	1.3	4.0	0	3.4
Little Beaver Creek	5.3	3.9	1.4	4.0	0	3.4
Sheep Creek	5.0	3.5	1.8	3.9	0	3.3
South Fork Lone Pine Creek	3.1	4.4	2.6	3.8	0	3.2
Elkhorn Creek	2.5	4.2	0.8	2.7	1	3.2
North Fork Lone Pine Creek	2.3	4.1	3.4	3.7	0	3.1
Youngs Gulch	3.5	3.9	2.5	3.7	0	3.1
Sheep Creek-North Fork Cache La Poudre Creek	4.3	1.3	0.9	2.3	1	2.8
Horsetooth Reservoir	0.9	2.9	2.0	2.0	1	2.5
Gordon Creek	1.3	4.9	1.3	2.7	0	2.1
City of Fort Collins-Cache La Poudre River	1.2	1.5	1.0	1.1	1	1.6
Miton Seaman Res.-North Fork Cache La Poudre River	0.5	1.1	1.8	1.0	1	1.5
Trail Creek-North Fork Cache La Poudre River	3.5	1.4	0.6	1.8	0	1.3
Lone Pine Creek	1.0	1.9	2.4	1.8	0	1.3
Halligan Reservoir	0.5	0.7	1.1	0.5	1	1.0
North Fork Cache La Poudre River-Bull Creek	1.8	0.9	1.5	1.3	0	0.8
Rabbit Creek	1.2	0.8	1.9	1.2	0	0.7
Fish Creek-Dale Creek	1.3	0.5	0.5	0.5	0	0.5