Ashley National Forest Assessment

Aquatic Ecosystems Report

Prepared by:
Chris Plunkett
Hydrologist

for:
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Introduction

The following is an assessment of aquatic ecosystems on the Ashley National Forest. This assessment is drawn from draft riparian and wetland assessments for the Ashley National Forest (Dwire and Smith 2016, Smith et al. 2017), the Air, Soil, Water and Watershed Assessment (Bevenger 2017), the Ashley National Forest Ecosystem Diversity Evaluation Report (USDA FS, 2009), the 2011 Watershed Condition Framework, the draft Intermountain Adaptation Partnership Vulnerability Assessment Summary (IAP 2016), the Chapter 4 draft of Effects of Climate Change on Hydrology and Water Resources in the Intermountain Region (Halofsky et al. 2017) and the draft Assessment of Watershed Vulnerability to Climate Change for the Uinta-Wasatch-Cache and Ashley National Forests (Rice et al. 2015).

Following guidance from chapter 10 of Forest Service Handbook 1909.12 – Land Management Planning Handbook, this assessment will identify key ecosystem characteristics, drivers; and stressors; current status and trends; and determinations of natural range of variation to assess conditions of aquatic ecosystems within the plan area. In making natural range of variation determinations, current conditions were compared to the era prior to settlement by Euro-Americans. If a stressors had notable and widespread impacts on the long-term integrity of a key ecosystem characteristic, the characteristic was considered to be **outside** its natural range of variation. If effects were present but were either localized or being managed, the key ecosystem characteristic was considered to be **trending towards** the natural range of variation. A key ecosystem characteristic was considered **within** the natural range of variation if natural processes were the primary drivers of current conditions.

Information Sources

Key information sources considered in this assessment of aquatic ecosystems on the Ashley National Forest:

- A forestwide land system inventory and a forestwide Ecosystem Diversity Evaluation Report (USDA Forest Service 2009) characterizing conditions trends, stressors, and processes based on the scale of land type association units from the land system inventory.
- National Hydrography Dataset (U.S. Geological Survey 2014) map data depicting distribution of waterbodies and springs
- National Wetland Inventory Dataset (U.S. Fish and Wildlife Service 2016) depicting wetland areas across the Ashley National Forest. This categorizes aquatic habitat by multiple wetland types. Information is largely based on aerial photo interpretation of wetland areas under tree cover; wetlands of smaller size are likely underrepresented in the dataset.
- The 2011 Watershed Condition Framework, which characterizes the health and condition of National Forest System lands with results depicted on the scale of subwatersheds (U.S. Geological Survey 6^{th}-level hydrologic units)
- Stream classification inventories (1990s to 2000s) depicting valley bottom type, stream type, particle size distribution, channel and bank measures, and photographs of representative reaches
- Repeat photography studies inventory (1880s to current) maintained on the Ashley National Forest containing over 17,000 sites; some sites occurring in riparian areas, stream reaches, and at groundwater-dependent ecosystems (springs, seeps, fens). Accompanying some photo studies are groundcover, nested frequency, and Winward greenline inventories of the stream channel-riparian interface

- Aquatic macroinvertebrate[1] inventory and fish population surveys (1980s to current)
- A forestwide aquatic organism passage assessment completed in 2005, following protocols developed by the USDA Forest Service-San Dimas Technology Center
- Multiple indicator monitoring sites for 12 locations on the Vernal and Flaming Gorge Ranger Districts (2006-2013)
- 165 groundwater-dependent ecosystem level 1 inventories of springs and fens throughout the Ashley National Forest (2010 to 2013)
- A Weber State University study on a pair of fens in the Reader Creek and Dry Fork drainages (2014). The study characterizes wetland form, water chemistry, vegetation type, and employed remote sensing to map wetland extent in the two drainages.
- The Riparian Condition Assessment Tool (R-CAT) developed by MacFarlane and others (2016), a remote sensing mapping tool that includes a riparian vegetation departure classification based on the LANDFIRE vegetation mapping project. The Riparian Condition Assessment Tool is one of the measures used to determine natural range of variation in Smith and others (2017).

Spatial Scale and Data Gaps

For this assessment, the Ashley National Forest was divided into three major units: the Tavaputs Plateau, the Uinta Mountains, and the Flaming Gorge National Recreation Area. Where sufficient data exists, analysis of riparian and wetland ecosystems associated with streams lakes and meadows is made at the scale of land type associations, which the Ashley National Forest uses for ecosystem evaluation and planning. Each land type association is a collection of smaller land types, each distinguished by processes of geology, geomorphology, soils, and climate. These processes influence the structure and composition of vegetation types, including riparian and wetland communities (Padgett et al. 1989), which vary among the land type associations (USDA Forest Service 2009).

There are 3 land type associations in the Tavaputs Plateau area, 6 in the Flaming Gorge National Recreation Area, and 15 in the Uinta Mountains unit. In the draft riparian and wetland assessments for the Ashley National Forest (Dwire and Smith 2016, Smith et al. 2017), most key ecosystem characteristics analyzed were made at an land type association scale. The 2009 ecosystem diversity evaluation also analyzes conditions and trends for hydrology, geomorphology, water quality, and riparian areas based on these land type associations. This summary assessment draws from these documents and the other sources mentioned for a determination of natural range of variation. Land type associations not included in aquatic ecosystem assessment are the Dry Moraine, Moenkopi Hills, Strawberry Highlands, Structural Grain, and Wolf Plateau (Dwire and Smith, 2016, Smith et al. 2017). Natural range of variation determinations were not made in these areas due to a lack of documented wetland and aquatic habitat. These land type associations represent roughly 4 percent of the total extent of the Ashley National Forest.

For the aquatic habitat connectivity key ecosystem characteristics, a forestwide scale is used when discussing results of an aquatic organism passage survey of selected road-stream crossings across the Ashley National Forest. Aquatic habitat connectivity is described on a subwatershed scale when citing attribute ratings for aquatic habitat fragmentation from the 2011 Watershed Condition Framework and for describing natural range of variation.

[1] A macroinvertebrate is an invertebrate organism large enough to be seen with the naked eye.

In the case of groundwater-dependent ecosystems (springs and fens), a coverage of 165 level 1 groundwater-dependent ecosystems surveys were considered from Dwire and Smith (2016). As these 165 survey sites are unevenly distributed across the Ashley National Forest and considered a small representation of the total number of groundwater-dependent ecosystems present, this assessment will consider the natural range of variation for individual sites, tally their percentages across the Ashley, and map their locations to depict general patterns.

Key Ecosystem Characteristics.

Five key ecosystem characteristics reflect current standards and guidelines, conservation goals, and objectives relevant for monitoring adaptive management. For each characteristic, a description of natural drivers and anthropogenic stressors are provided, as well as descriptions of status and trend and a determination of whether current conditions are within the natural range of variation. The five key ecosystem characteristics are listed below and discussed in detail in the following sections.

- Distribution, timing, and quantity of water across the plan area
- Channel, floodplain, and sediment dynamics
- Composition and condition of riparian and wetland vegetation and soils
- Invasive and encroaching species
- Habitat connectivity – the ability of aquatic species to move through the plan area and into adjacent areas to use habitat that fulfills their life cycle needs

Distribution, Timing, and Quantity of Water across the Plan Area

Description Including Rationale

The availability and distribution of water are key factors in the distribution of surface water aquatic ecosystems and associated riparian wetland community types. The depth to groundwater, the volume of surface water, and the timing and magnitude of their fluctuations influence the survival, growth, and composition of riparian and wetland plant communities (Stromberg et al. 1997, Horton et al. 2001, Auchincloss et al. 2013). Distribution of water bodies across the Ashley National Forest is largely driven by natural climatic and geomorphic factors. Management can influence water availability and in turn affect distribution of aquatic ecosystems. Examples of human alterations include reservoirs, diversions (canals, pipelines) and spring developments. Natural and anthropogenic patterns of water availability have considerable influence on the composition, structure, and function of riparian and wetland systems (Smith et al. 2017).

The timing, duration, and magnitude of groundwater flow is critical for sustaining springs, fens, and the unique plant and animal species and communities found in these groundwater-dependent ecosystems. Groundwater-dependent ecosystems are complex biogeochemical systems where water, nutrients, sediments, microclimate, and biota interact as part of natural processes (Dwire and Smith 2016).

Influence of Drivers and Stressors

Natural **drivers** of water distribution, timing, and quantity on the Ashley National Forest are climate, geology, topography, and geomorphology. Natural disturbances such as floods, landslides, drought, wildfire, and beaver activity also have short-term, localized effects.

The Ashley National Forest has a snow-dominated hydroclimate regime. Annual precipitation across the Ashley National Forest varies from eight inches at lower elevations on the Flaming Gorge National Recreation area to more than 60 inches in the highest elevations of the Uinta Mountains (Bevenger 2017). Snowfall typically begins in October and extends into May. The snowpack builds through this period, acting as a water storage reservoir that begins to melt in April. Streamflow is heavily influenced by annual snowmelt, with peak flows occurring in May through June. There can be increases in flow for short periods due to summer thunderstorm activity, particularly in lower-elevation catchments of the Uinta Mountains and on the South Unit (Ibid.).

Geology (parent material, contact zones), topography (slope, aspect, elevation), and geomorphology (past histories of uplift, faulting, glaciation) influence the location and characteristics of streams, lakes, springs, and groundwater-dependent habitats across the Ashley National Forest. Periodic disturbance events (flood, drought, wildfire, landslides) can affect wetland and riparian areas by modifying water and sediment supply and through physical alteration of the vegetation and morphology of these zones. Beaver activity also has a marked geomorphic role for meadows and unconfined riparian zones in several land type associations on the Ashley (USDA Forest Service 2009).

Dams, diversions, and water withdrawals are **stressors** to water distribution, timing, and quantity on the Ashley National Forest. They can alter the timing and the quantity of flow in waterbodies compared to conditions in which the stream channels and wetlands originally developed. Streams across the Ashley National Forest transport water and sediment delivered to them from the surrounding watershed, meaning the streams are self-formed and self-maintained by annual peak flows. Significant changes in either the amount of water or the sediment load transported can result in instability, such as channel widening or down-cutting, which in turn can negatively affect stream and riparian area health (Bevenger 2017).

Dams and diversion systems, depending on their design and operation, can alter the hydrologic regimes in which these streams were formed. Dams displace riparian areas in the reservoir pool and can result in changes to the active stream channel, floodplain, and adjacent riparian zones downstream (Stamp and Schmidt 2000). Canals and diversions have the capacity to dewater portions of perennial channels which they intercept, exporting the water to other locations. The affected downstream distance of dewatered channels depends on the design of the canal, the period of operation, the stream network, and availability of groundwater (seeps and springs) to recharge the channel. Canals passing over unconsolidated material or fractured geology can have significant infiltration to groundwater and leakage, resulting in limited return flow to stream channels. An example is a canal site on Beaver Creek on the Flaming Gorge District (USDA Forest Service 2009). In some cases, leakage and piping can result in canal failure and overland flood events. Breaches have occurred in the past on the Oaks Park Canal, the Carter Creek arm of the Sheep Creek Canal, and the Mosby Canal (Ibid.). Figure 1 shows the active dams and canals in, and adjacent to, the Ashley National Forest.

Climate change is considered an additional stressor. Potential changes in weather patterns could further affect the distribution, timing, and quantity of water in the plan area. These changes include the timing of precipitation, temperature, and increases in wildfire size and intensity brought by warming temperatures, drought, and extreme weather events.

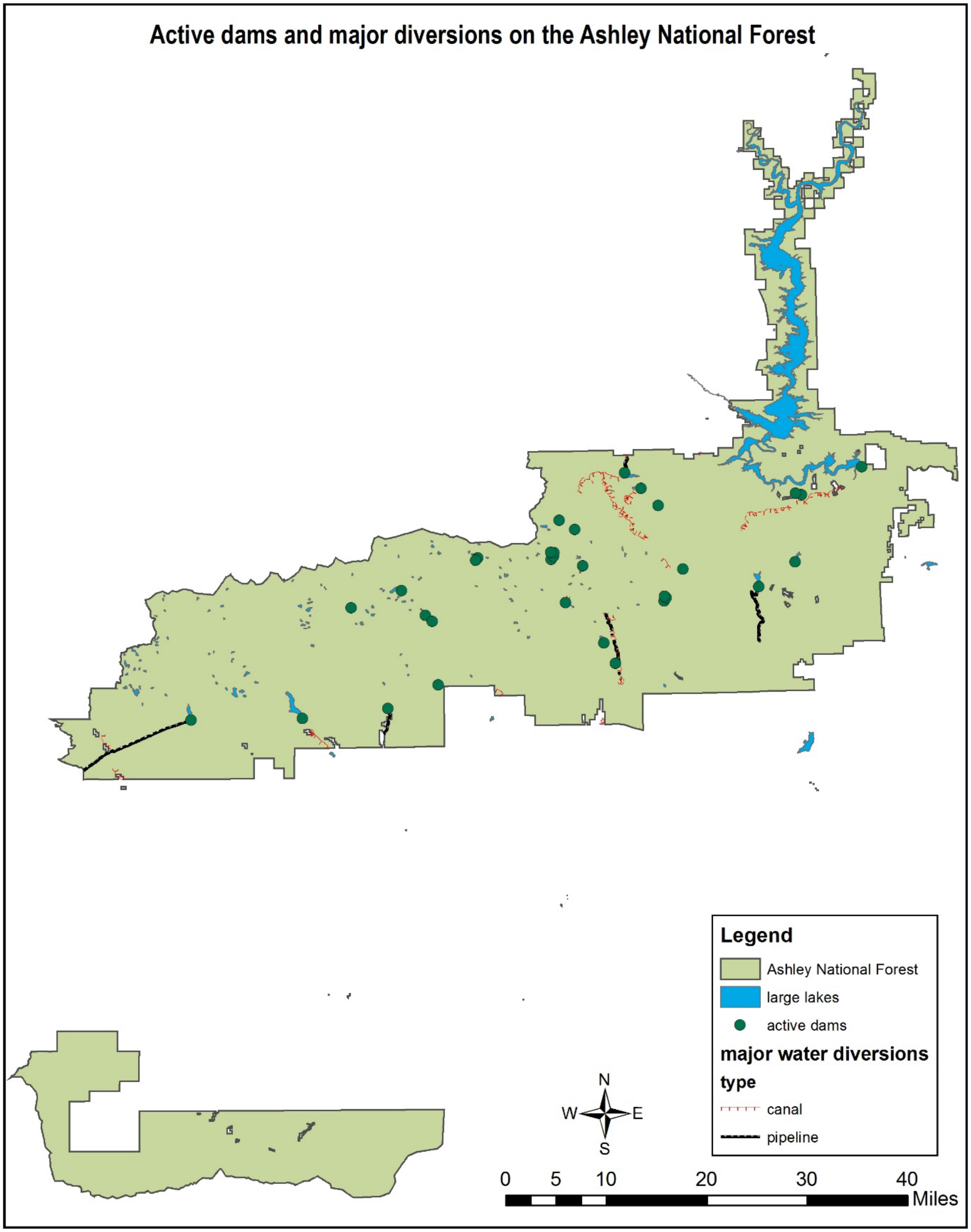

Figure 1. Map of dams and canal systems in, and adjacent to, the plan area

Status and Trends

Currently 32 actively operating dams on the Ashley National Forest are of a size that requires engineer inspection. The largest of these is the Flaming Gorge Dam, with a total reservoir capacity of over 3.7 million acre-feet. Other large reservoirs on the Ashley National Forest are Moon Lake (total capacity of more than 35,000 acre-feet) and Upper Stillwater Reservoir (total capacity of more than 32,000 acre-feet). Since 2007, thirteen dams were decommissioned in the High Uintas Wilderness as part a project that transferred water rights to downstream reservoirs and allowed the dams to be breached. This work resolved the logistical challenge of maintaining the aging dams in a wilderness setting. The work also provided an ecological benefit for stabilizing lake levels and returning flow patterns of drainages closer to pre-dam conditions. An additional dam at Milk Lake is planned for decommissioning.

There are 31 irrigation pipelines and canals in operation under special use permit. One pipeline is a trans-basin diversion, which routes water from Lower Stillwater Reservoir on the Rock Creek drainage to Strawberry Reservoir for use on the Wasatch Front. On the Ashley National Forest, there are 13 pipelines under permit for domestic uses and two pipelines under permit for hydroelectric power generation (Reese 2016). Some segments of irrigation canal on the Ashley National Forest have been converted to pipeline: the Sols Canyon and Mosby Canals in the 1990s and the Oaks Park Canal in 2007. This has reduced flood risk from canal breaching and returned natural flow patterns to previously affected areas. However, canals and dams remain a prominent hydrologic feature in many locations in the plan area.

Downscaled climate modeling for the Ashley National Forest predicts warming winter and summer temperatures (IAP 2016, Rice et al. 2015). Predictions for precipitation in the Ashley area vary between models. Increased annual precipitation is predicted for areas north of the Ashley National Forest, while further south, decreases are predicted in areas such as the Four Corners region (Halofsky et al. 2017). With increasing winter temperatures, some decreases are expected in snowpack accumulation and extent in mid and lower elevations, with earlier snowpack melt-off, earlier peak flows and reduced stream flows during the summer, a time when human, agricultural and ecologic needs are highest (Halofsky et al. 2017, Rice et al 2015). Predictions of reduced summer flows would include shorter flow periods for intermittent and ephemeral channels. Small perennial streams at mid and lower elevations, with low average flows, may experience summer periods when surface flows cease (Rice et al. 2015).

Climate change may have less influence on supply to groundwater-dependent ecosystems compared to surface-water-dependent wetlands. Groundwater-dependent areas potentially affected by timing and supply of water would be those fed by shallow, small-sized recharge areas and geology, such as karst, with rapid infiltration and a relatively short travel time in the aquifer (Ibid. Halofsky et al. 2017).

Modeling for the Intermountain West predicts precipitation events occurring with greater intensity and longer dry periods between events, increasing the numbers of consecutive dry days (Halofsky et al. 2017). Fewer storms, with more precipitation per event, have been occurring in Utah since the mid-20th century (Gillies et al. 2012). Extreme precipitation and extreme heat episodes are projected to increase for the region by the end of the 21st century (Kunkel et al. 2013, Wuebbles et al. 2014).

With growing population and rising temperatures projected for the region, increased demands for developed water uses are expected (diversions, dams, wells, and spring developments for irrigation, livestock, municipal and industrial uses) with demands exceeding renewable water supplies in more basins of the West (Rice et al. 2015, Utah Foundation 2014, USDA Forest Service 2016).

Description of Natural Range of Variation

Riparian and Wetland Areas Associated with Streams, Lakes, and Meadows

For the key ecosystem characteristics of distribution, timing, and quantity of water, all land type associations in the Flaming Gorge National Recreation Area (Antelope Flat, Green River, Greendale Plateau, North Flank, and Red Canyon) were determined to be **outside** the natural range of variation. This was due to the widespread influence of the Flaming Gorge Reservoir and other canals and diversions in these areas. The Glacial Bottom land type association on the south slope of the Uinta Mountains was also determined to be outside the natural range of variation due to the influence of large reservoirs in the Lake Fork and Rock Creek drainages and the transbasin diversion of water from Rock Creek to the Wasatch Front. A comparison between upstream and downstream locations of these two reservoirs shows reductions in annual runoff and changes in the timing and magnitude of surface water flows (Stamp and Schmidt 2000).

Isolated riparian areas in the Alpine Moraine, Limestone Hills, Parks Plateau, Stream Canyon, South Flank, and Trout Slope land type associations were identified with some alteration in the distribution and timing of water. This is largely due to the presence of reservoirs, diversions, canals, and past timber harvest activity in the Parks Plateau and Trout Slope land type associations. These land types were designated as **trending towards** the natural range of variation because effects were limited and localized relative to the majority of aquatic habitat present in these land type associations.

Land type associations determined to be **within** the natural range of variation were Round Park, Stream Pediment, Uinta Bollie, Anthro Plateau, and Anthro Canyon. Land type associations not analyzed in the assessment, due to a lack of riparian and wetland habitat were Dry Moraine, Moenkopi Hills, Strawberry Highlands, Structural Grain, and Wolf Plateau (Dwire and Smith 2016, Smith et al. 2017). See figure 2 for depictions of natural range of variation classes for distribution, timing, and quantity of water across the plan area.

Springs and Groundwater-dependent Ecosystems

A majority of spring developments on the Ashley National Forest are range improvements; pipeline and trough systems to improve livestock distribution in grazing allotments. Other spring developments include domestic and drinking water systems for summer homes, campgrounds, recreation facilities, and larger systems for public drinking water use.

Of the 165 level 1 groundwater-dependent ecosystems survey sites considered in this assessment, the majority did not show signs of dewatering or flow alteration beyond natural ranges of variability. On a forestwide scale, 9 percent of the 165 sites showed diversion and flow regulation effects **outside** the natural range of variation. All of these were spring sites, 16 percent were designated as **trending towards** the natural range of variation and 75 percent of were **within** the natural range of variation. No distinct pattern was apparent, though general incidence of sites outside the natural range of variation were more frequent at developed springs where alternate surface water sources occur less common in the landscape. Figure 2 shows the surveyed groundwater-dependent ecosystems sites (displayed as small circles) and natural range of variation calls based on this key ecosystem characteristic.

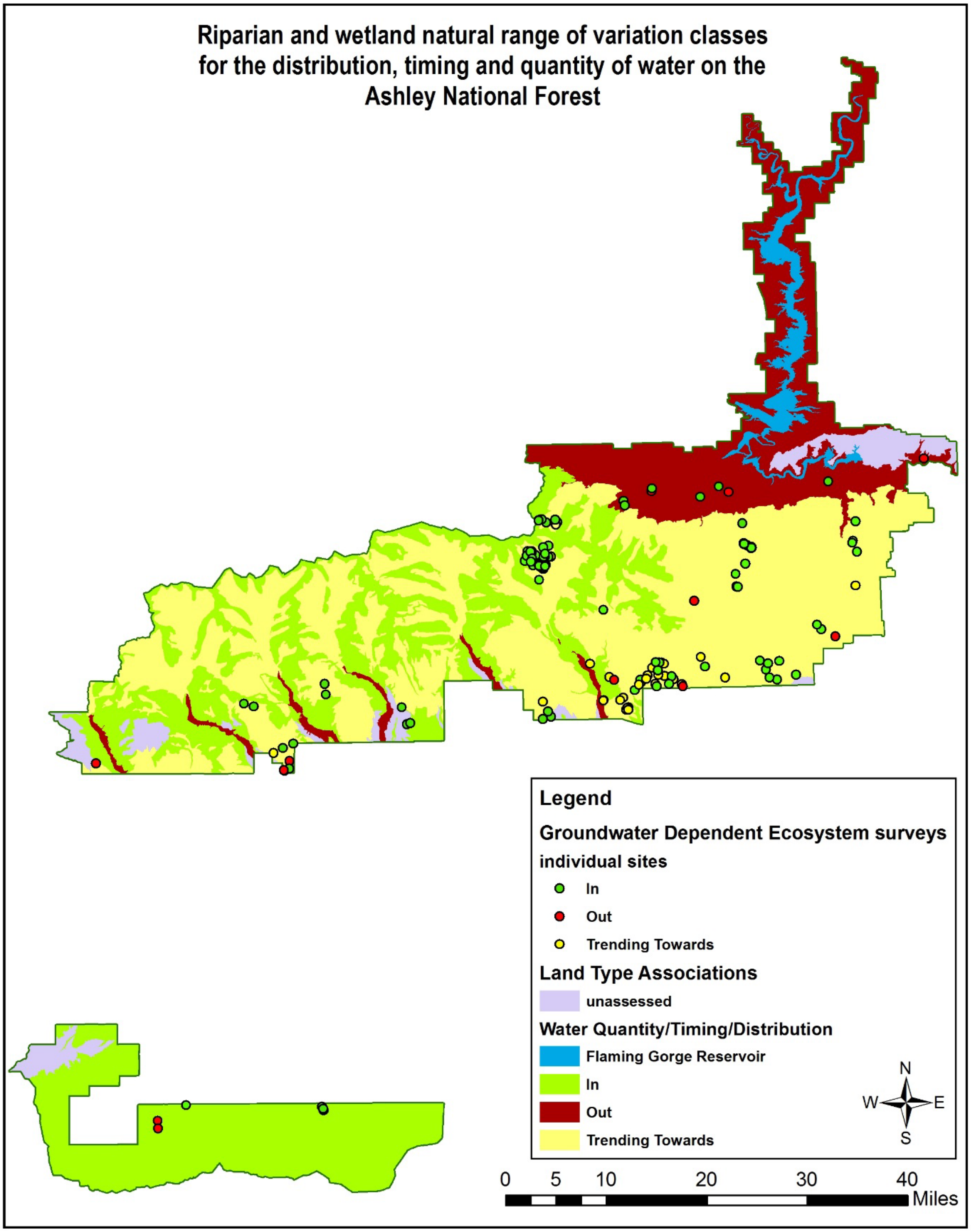

Figure 2. Land type association scale depiction of riparian and wetland natural range of variation classes for distribution, timing, and quantity of water. Surveyed groundwater-dependent ecosystems sites are also shown.

Channel, Floodplain, and Sediment Dynamics

Description Including Rationale

Patterns and processes such as flooding, channel migration, and abandonment determine the spatial extent, composition, and structure of floodplain plant and animal communities (Stanford et al. 1993). Natural rates of these processes vary among geomorphic settings and are influenced by a variety of factors. These factors include:

- climate;
- geology;
- slope;
- depth to bedrock;
- substrate size;
- upland vegetative cover; and
- availability of instream wood.

Connectivity between waterbodies and their surrounding floodplains sustains adjacent riparian zones and wetlands. Floodplain riparian zones, in turn, provide important ecological functions including:

- short term storage of surface water;
- maintenance of a high water table;
- maintenance of streambank stability and channel function; and
- filtration and detention of sediment, nutrients, and pollutants originating from the uplands.

These areas create microclimates to buffer water temperature, provide organic inputs for aquatic and terrestrial food webs, sequester carbon in riparian soil, and contribute to overall biodiversity in a landscape (Dwire et al. 2010). Floodplains and their associated riparian areas are an important regulator for water quality and how water is distributed over time (Bevenger 2017). Healthy stream and riparian systems dissipate flood energy and recharge alluvial aquifers. Water is then slowly released from aquifers back to the channel during drier periods of the year.

Sedimentation is a key component of floodplain and wetland dynamics in the Ashley National Forest. The upland slopes are natural sources of sediment, particularly in the marine geology and climate of the Tavaputs Plateau. Rates of sedimentation can also be influenced by recreation and forest management practices.

Where present at springs and fens, runout channels are groundwater-fed streams that emerge from springs or within groundwater-fed wetlands (USDA Forest Service 2012a). Spring brooks (spring runout channels) provide special flowing water habitat due to relatively uniform, cold temperatures and relatively low oxygen concentrations (Springer and Stevens 2009). The condition of the runout channel is important to assess because the downstream portion of the spring or wetland can support unusual aquatic and wetland biota. Such areas are frequently compromised when springs are developed.

Influence of Drivers and Stressors

Natural **drivers** of channel, floodplain, and sediment dynamics on the Ashley National Forest include:

- climate;
- geology;

- drainage size;
- location in the drainage;
- topography;
- valley confinement;
- channel gradient;
- substrate size;
- presence of instream woody debris; and
- presence of stabilizing vegetation in the uplands and riparian zone.

In some settings, natural disturbances such as wildfire, landslides, avalanche, floods, and beaver activity also influence channel and floodplain characteristics. Channel morphology drivers in spring-dominated and runoff-dominated streams differ in their discharge regimes and sediment loads (Griffiths et al. 2008). Spring-dominated channels have more stable flow characteristics and inputs of sediment, due to the influence of groundwater, and the longer transit times and greater potential source areas associated with groundwater flow.

Anthropogenic **stressors** of channel, floodplain, and sediment dynamics can include:

- diversions;
- dam and reservoir fluctuations;
- herbivory from livestock and wild ungulates;
- road networks; and
- transport-related recreation in, or adjacent to, floodplains.

Dams and diversions, depending on their design and operation, can alter the hydrologic flushing regimes in which mountain streams are formed. Dams displace riparian areas in the reservoir pool. This displacement can result in changes to the active stream channel, floodplain, and adjacent riparian zones downstream (Stamp and Schmidt 2000, Schmidt et al. 2008). Canals and diversions have the capacity to dewater portions of perennial channels they intercept, exporting the water to other locations with flow intervals that may not support aquatic organisms and wetland vegetation characteristic of their natural channels. Roads and other disturbed sites can act as storm channels that augment sediment loads to stream networks. Streams on the Ashley National Forest transport water and sediment delivered to them from the surrounding watersheds. The streams are formed and maintained by the flow regimes and sediment loads under which they developed. If vegetative groundcover in a floodplain or watershed is markedly reduced through stressors (such as uncharacteristically intense wildfire, poor management practices, or other disturbance), an increases in peak flow or sediment delivered to streams can result in channel widening or downcutting, leading to a host of negative effects on stream and riparian health (Bevenger 2017).

Climate change is considered an additional stressor. Potential changes in the pattern and timing of precipitation and temperature can augment other stressors already occurring. Warming temperatures, prolonged drought, and extreme weather events have the potential to affect channel, floodplain and sediment dynamics by increased water stress on riparian and upland vegetation, increased wildfire intensity and frequency, and increased peak flow and sediment impacts to area streams (IAP 2016, Rice et al. 2015).

Status and Trends

In some locations of the Ashley National Forest, channel, floodplain, and sediment dynamics have been altered since European settlements. Roads, dams, water diversions, mining, and timber activity have occurred on the Ashley with some effects to this key ecosystem characteristic. Stream reaches in the Green River and Avintaquin Plateau land type associations and, to a lesser degree, in wet meadow locations in the Parks Plateau and Trout Slope have downcut with some reduction in floodplain capacity (USDA Forest Service 2009). Adaptive improvements in grazing management since the early 20th century have increased vegetation cover in uplands and riparian areas of allotments. In the 1980s, a series of channel structures were installed in gullied streams of the Avintaquin Canyon and Avintaquin Plateau with localized success at arresting headcuts, raising water tables, and increasing floodplain width. (Dwire and Smith 2016, Smith et al. 2017, USDA Forest Service 2009). Increased beaver activity in Timber Canyon since the 1980s has benefitted floodplains and gullied stream reaches. Restoration projects are currently planned at four meadow stream sites in the Vernal and Flaming Gorge Ranger Districts.

Travel system management and unauthorized off-road use continues to be a challenge in wet meadows and riparian areas, particularly in the eastern Uintas in the Trout Slope, Greendale Plateau, and Parks Plateau land type associations. In recent years, there have been projects on the Vernal and Flaming Gorge district to improve and relocate segments of National Forest System roads and motorized trails away from wet meadows. Yearly targeted closures of nonsystem routes on the Ashley National Forest are also being made. In the Anthro Plateau land type association, oil and gas development has increased in the past decade, with a growing number of oil well pads and access routes. Operating requirements have been established for the siting and design of well pads and access routes. The requirements include buffer distances from channels and erosion and spill controls to reduce potential impacts from development (USDA Forest Service 2012b).

Downscaled climate modeling for the Ashley National Forest predicts warming winter and summer temperatures (IAP 2016, Rice et al. 2015). Predictions for precipitation in the area vary between models. Increased annual precipitation is predicted for areas north of the Ashley National Forest. Decreases are predicted for areas further south in the Four Corners region (Halofsky et al. 2017). With increasing winter temperatures, some reduction is predicted in snowpack accumulation and extent for mid and lower elevations of the Ashley National Forest. Earlier snowpack melt-off, earlier peak flows, and reduced streamflows during the summer are also predicted (IAP 2016a, Rice et al. 2015). Potential effects from increased temperatures, reduced summer streamflows, increased vegetative stress, and increased wildfire intensity and frequency may have an additive effect on current stressors.

Description of Natural Range of Variation

Riparian and wetland areas associated with streams, lakes, and meadows

For channel, floodplain, and sediment dynamics, there are no land type associations on the Ashley National Forest determined to be **outside** the natural range of variation (Dwire and Smith 2016, Smith 2017). Land type associations determined to be **trending towards** natural range of variation are listed below and displayed in figure 3:

- South Unit
    - ♦ Anthro Plateau land type association
- Uinta Mountains
    - ♦ Glacial Bottom
    - ♦ Parks Plateau

  - ♦ South Flank
  - ♦ Stream Pediment
  - ♦ Trout Slope land type associations
- Flaming Gorge National Recreation Area
  - ♦ Antelope Flat
  - ♦ Green River
  - ♦ North Flank
  - ♦ Red Canyon land type associations

Land type associations determined to be **within** natural range of variation are:

- South Unit
  - ♦ Anthro Canyon
  - ♦ Alpine Moraine
  - ♦ Glacial Canyon
  - ♦ Limestone Hills
  - ♦ Round Park
  - ♦ Stream Canyon
- Uinta Mountains
  - ♦ Uinta Bollies
- Flaming Gorge National Recreation Area
  - ♦ Greendale Plateau

Land type associations within natural range of variation tend to be higher elevations and canyon portions of the Ashley National Forest. These associations tend to have less influence from roads, motorized recreation, and other management activities.

Springs and Groundwater-dependent Ecosystems

Of the 165 level 1 groundwater-dependent ecosystems survey sites considered in this assessment, 148 are documented with spring runout channels. Seventy five percent of the 148 sites have runout channels determined **within** the natural range of variation. Ten percent of these sites have channels designated as **trending towards** the natural range of variation and 17 percent of channels are **outside** the natural range of variation. General incidence of surveyed runout channels outside the natural range of variation tend to occur at lower elevations, where surface water is less prevalent in the landscape. Two sites outside of natural range of variation, Dry Ridge Mine Spring and Bull Moose Spring, are at elevations greater than 10,000 feet, but in settings where little surface water is available. Figure 3 shows the surveyed groundwater-dependent ecosystems sites (displayed as small circles) and natural range of variation calls based on this key ecosystem characteristic.

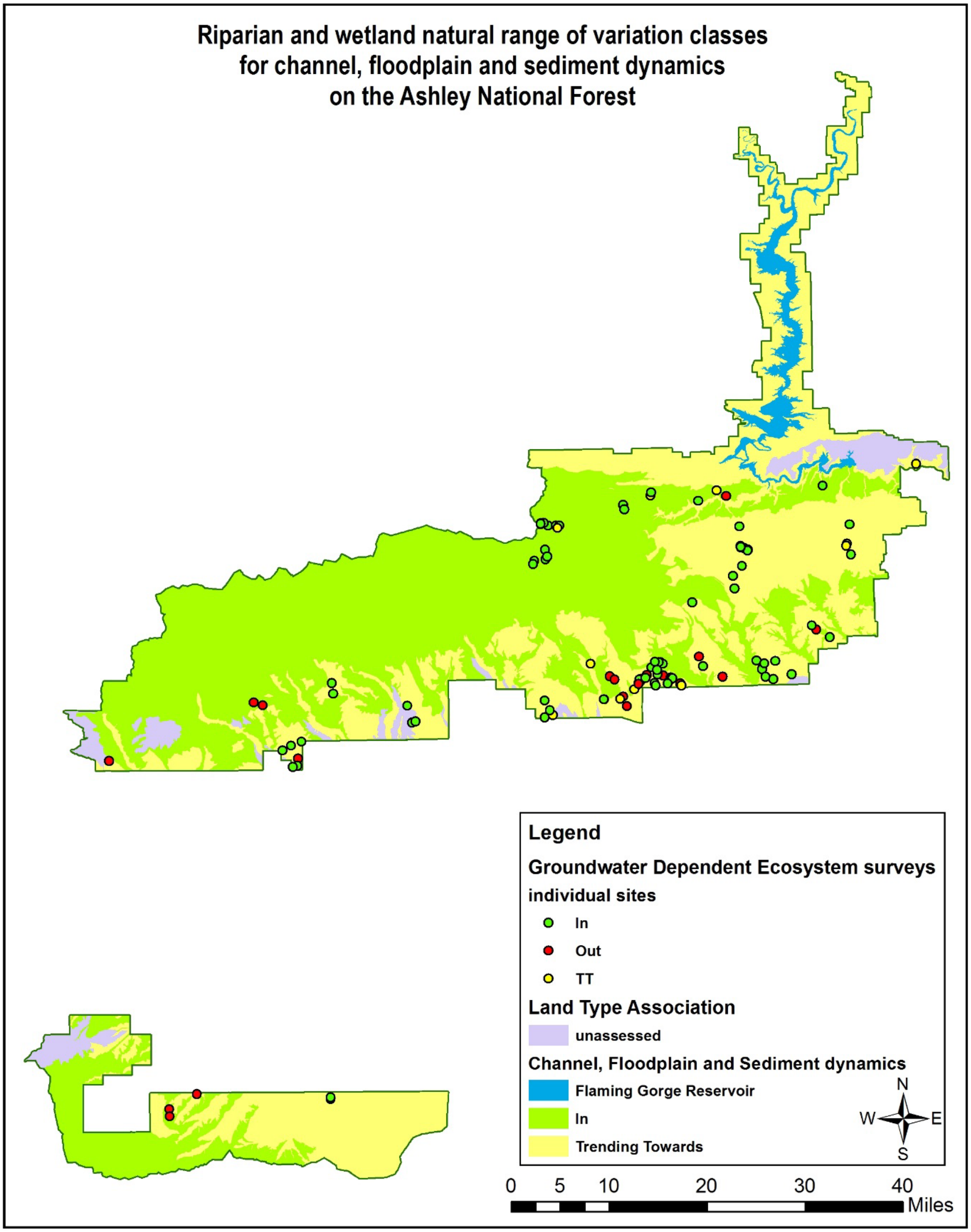

Figure 3. Land type association scale depiction of riparian and wetland natural range of variation classes for channel floodplain and sediment dynamics. Surveyed groundwater-dependent ecosystems sites are also shown.

Composition and Condition of Riparian and Wetland Vegetation and Soils

Description Including Rationale

Riparian and wetland vegetation provides physical, hydrological, and biotic services. Among other functions, riparian and wetland vegetation can reduce damage from floods by stabilizing soil, dissipating stream energy, and trapping sediment (Hubert 2004). Riparian and wetland ecosystems also contribute to critical habitat for species of concern and species of interest in the Ashley National Forest. Large trees and snags in riparian areas are used as nesting sites and perches by northern goshawks (*Accipiter gentilis*), Lewis's woodpeckers (*Melanerpes lewis*), and other birds (Graham et al. 1999, Saab and Vierling 2001, Hollenbeck and Ripple 2008). Fallen logs at streams and wetlands provide cover, thermoregulation, and foraging sites for terrestrial and aquatic wildlife (Brown 2002). Woody and herbaceous vegetation are also used as forage by greater sage-grouse (*Centrocercus urophasinaus*), elk (*Cervus canadensis*), and other herbivores (Collins 1977, Atamian et al. 2010). By stabilizing undercut banks and shading water, riparian and wetland plants help maintain conditions required for the persistence of Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) and other coldwater fish (Horan et al. 2000). By harvesting woody vegetation and constructing dams and ponds, beaver (*Castor canadensis*) increase biodiversity and stability of riparian and wetland ecosystems (Parker et al. 1985, Pollock et al. 1995).

For groundwater-dependent ecosystems, management activities can alter both the soil and the hydrologic conditions that affect the soil at a site (USDA Forest Service 2012a). In wetlands, intact hydric soils, including histosols (peat profiles), are useful indicators of site hydrology and wetland function. Features of a hydric soil profile can reveal evidence of duration and frequency of saturation, and indicate if water table levels sufficiently maintain soil characteristics and wetland plant communities (Mitsch and Gosselink 2007). In fens, disturbance of peat soils can lead to their drying out, resulting in oxidation and degradation of the peat and accelerated release of carbon dioxide (Chimner and Cooper 2003). The thickness of the peat body in fens (peat depth) can be used to estimate site-level carbon storage. Soil disturbance, such as erosion and compaction, can be detrimental to both fens and springs.

Influence of Drivers and Stressors

Natural **drivers** of the composition and condition of wetland vegetation and soils are:

- climate (temperature and precipitation);
- geologic setting;
- regular access to a water source (by inundation or shallow groundwater);
- unique soil properties (water saturation and chemical properties) to support wetland and riparian vegetation; and
- a stabilizing cover of vegetation to support and build wetland soils.

In some settings, natural disturbances can also have an influence on the composition and condition of wetland vegetation and soils. Types of disturbances can include flooding, beaver activity, debris flows, landslides, wild ungulate herbivory, wildfire, and insect activity.

Potential management-related **stressors** include:

- herbivory from livestock;
- dams and water diversions;
- road and trail networks;
- construction;
- dispersed camping; and
- motorized off-road travel in, or adjacent to, wetlands.

Climate change is considered an additional stressor. Changes in the pattern and timing of precipitation, temperature, and wildfire frequency and intensity have the potential to increase water stress on vegetation, displace cold-adapted species and augment other management related stressors already occurring (IAP 2016, Halofsky et al. 2017, Rice et al. 2015). Examples include:

- further reductions in water availability below diversions;
- increased demand for developing new water diversions;
- increased herbivory in wetland and riparian zones when upland forage is reduced by drought; and
- potential shifts in alpine zone aquatic and riparian species currently experiencing increased atmospheric deposition of nitrogen (Porter et al. 2013, Hundey et al. 2016).

Status and Trends

The composition and condition of wetland and riparian vegetation and soils has changed to varying degrees over the plan area since the time of European settlement. In some headwater locations, little change in wetland vegetation and soil condition has likely occurred since presettlement times. In other areas, anthropogenic activity (roads, dams, water diversions, timber and grazing activity, the introduction of invasive plants) has occurred with varying effects to wetland vegetation and soils.

Adaptive improvements in grazing management since the early 20th century have increased vegetation cover in uplands and riparian areas of allotments compared to conditions documented previously. Adjustments to allotments continue to be made. Dams on the Ashley National Forest have altered hydrologic flow patterns. These dams have displaced riparian vegetation with their reservoir pools and influenced some changes to riparian zones downstream (Stamp and Schmidt 2000). As previously mentioned in this report, 13 small reservoirs in the High Uintas Wilderness were decommissioned when their storage rights were transferred to a lower-elevation reservoir in the Uinta basin. A small dam at Milk Lake is planned for decommissioning in the future. Since 2006, the Bureau of Reclamation manages spring releases from Flaming Gorge Dam to simulate natural high flows in support of endangered fish species in the Green River (BOR 2006). Simulated high flows also assist maintenance and recruitment of riparian species such as cottonwood (BOR 2005).

Travel system management and unauthorized off-road use remain a challenge in wet meadows and riparian areas, particularly in the eastern Uintas in the Trout Slope, Greendale Plateau, and Parks Plateau land type associations. In recent years, there have been projects on the Vernal and Flaming Gorge Ranger Districts to improve and relocate segments of system roads and motorized trails away from wet meadows. Yearly targeted closures of non-system routes on the Ashley National Forest are also being made.

Downscaled climate modeling for the Ashley National Forest predicts warming winter and summer temperatures (IAP 2016, Rice et al. 2015). Precipitation predictions for the Ashley area vary between models. Increased annual precipitation is predicted for areas north of the Ashley National Forest while further south, decreases are predicted in the Four Corners region (Halofsky et al. 2017). With increasing winter temperatures, some reduction is predicted in snowpack accumulation and extent for mid and lower elevations of the Ashley National Forest. Earlier snowpack melt-off, earlier peak flows and reduced stream flows during the summer are also predicted (IAP 2016a, Rice et al 2015). Future warming and drying has the potential to inhibit the survival and growth of riparian and wetland plants, the extent varying by elevation. In the Uinta Mountains, most of the land is at elevations greater than 9,000 feet. Wetland and riparian vegetation in upper elevations would likely have lower vulnerability to potential climatic changes. Wetland and riparian zones at mid to lower elevations of the Ashley National Forest (especially those fed by seasonal and intermittent water sources) would have greater vulnerability to a warming and drying climate.

Predicted changes in precipitation and streamflow may also have some influence on the distribution of groundwater-dependent vegetation. This could come via changes in local hydrologic regimes, especially if summer base flows decrease (Halofsky et al. 2017). Groundwater-dependent areas with higher potential for effects would be those fed by shallow, small-sized recharge areas and those underlain by karst and unconsolidated sediments, with rapid infiltration and a relatively short travel time in the aquifer. Increased herbivory pressure on groundwater-dependent ecosystems from livestock and wild ungulates may result from warmer and drier summer conditions as upland forage sources are diminished.

Description of Natural Range of Variation

Riparian and Wetland Areas Associated with Streams, Lakes, and Meadows

On the land type association scale for composition and condition of wetland vegetation and soils, the only area determined to be **outside** the natural range of variation is the Green River land type association. This determination is attributed to displacement of riparian habitat from operation of the Flaming Gorge Reservoir, widespread presence of invasive weeds, off-road vehicle use, and grazing pressure primarily at springs (USDA Forest Service 2009, Dwire and Smith 2016). Land type associations determined to be **trending towards** the natural range of variation are:

- South Unit
  - Anthro Plateau
- Uinta Mountains and Flaming Gorge National Recreation Area
  - Limestone Hills
  - Parks Plateau
  - Trout Slope Round Park
  - South Face
  - North Flank
  - Antelope Flat

Land type associations determined to be **within** the natural range of variation are:

- Alpine Moraine
- Glacial Bottom
- Stream Canyon
- Uinta Bollie
- Anthro Canyon
- Greendale Plateau
- Red Canyon

See figure 4 for depictions of natural range of variation classes based on this key ecosystem characteristic.

Springs and Groundwater-dependent Ecosystems

Of the 165 level 1 groundwater-dependent ecosystems surveys considered in this assessment, 55 percent have vegetation and soil conditions determined to be **within** the natural range of variation. Thirty two percent of 165 surveyed sites were designated as **trending towards** the natural range of variation and 13 percent were **outside**. In the surveys sources of disturbance affecting the composition and condition of wetland vegetation and soil at the sites included: trampling and herbivory from livestock and wild ungulates, de-watering/diversions, and vehicle traffic. For groundwater-dependent ecosystems, this key ecosystem characteristic represents the lowest percentage of surveyed sites within the natural range of variation. The general distribution of site conditions is similar to the other key ecosystem characteristics, where lower elevation sites and sites in drier landscapes tend to show more impacts than sites where surface water is plentiful. Figure 4 shows the surveyed groundwater-dependent ecosystems sites (displayed as small circles) and natural range of variation calls based on this key ecosystem characteristic.

Invasive and Encroaching Species

Description Including Rationale

Due to their dynamic nature and high productivity relative to upland ecosystems, riparian areas and wetlands are vulnerable to colonization by invasive plants (Richardson et al. 2007). Invasive plants can damage wildlife habitat, alter disturbance dynamics, and degrade soil and water quality in riparian and wetland settings (Vitousek et al. 1996, Smith and Finch 2014). Soil plant interactions are strong and the establishment of invasive plants can impact physical, biological, and chemical properties of soil (Jordan et al. 2008). Invasive plants can reduce the biodiversity of plant communities and reduce canopy cover, leaf litter, and root size and density, leaving soils more prone to erosion. Invasive plants may also result in an enhanced fire regime, as with cheatgrass (*Bromus tectorum*). Invasive plants change the amount and nature of organic additions to soil that derive from leaf litter, chemical and organic contributions from roots, and soil organisms. Litter from halogeton (*Halogeton glomeratus*) markedly increases soil pH and salts, particularly exchangeable sodium, making it more difficult for native species to exist (Smith 2015, Eckert and Kinsinger 1960). Soil organic matter, soil biota, and soil microorganisms can be altered by invasive species. These changes, in turn, alter soil structure and nutrient cycling (Wiedenhamer 2010). Invasive species can continue their dominance and prevent seed establishment by changing soil properties and outcompeting native plants for soil moisture (Young and Clements 2005).

Nonnative woody and herbaceous plants have been introduced to the Ashley National Forest or have spread through natural pathways. Harmful invasive plants are treated aggressively by managers, but beneficial species, such as forage grasses, are managed for livestock and wildlife use.

Aquatic invasive species can alter the productivity, species diversity, water chemistry, and habitat value of water bodies. They can alter habitat by:

- outcompeting the native flora and fauna (examples: nonnative sportfish and crayfish);
- changing the nutrient content of the water (quagga and zebra mussels); and
- impairing habitat structure (quagga and zebra mussels and didymo, an invasive algae) affecting the survivability and life cycles of desired organisms (whirling disease effects to fish, chytrid fungus effects to amphibians).

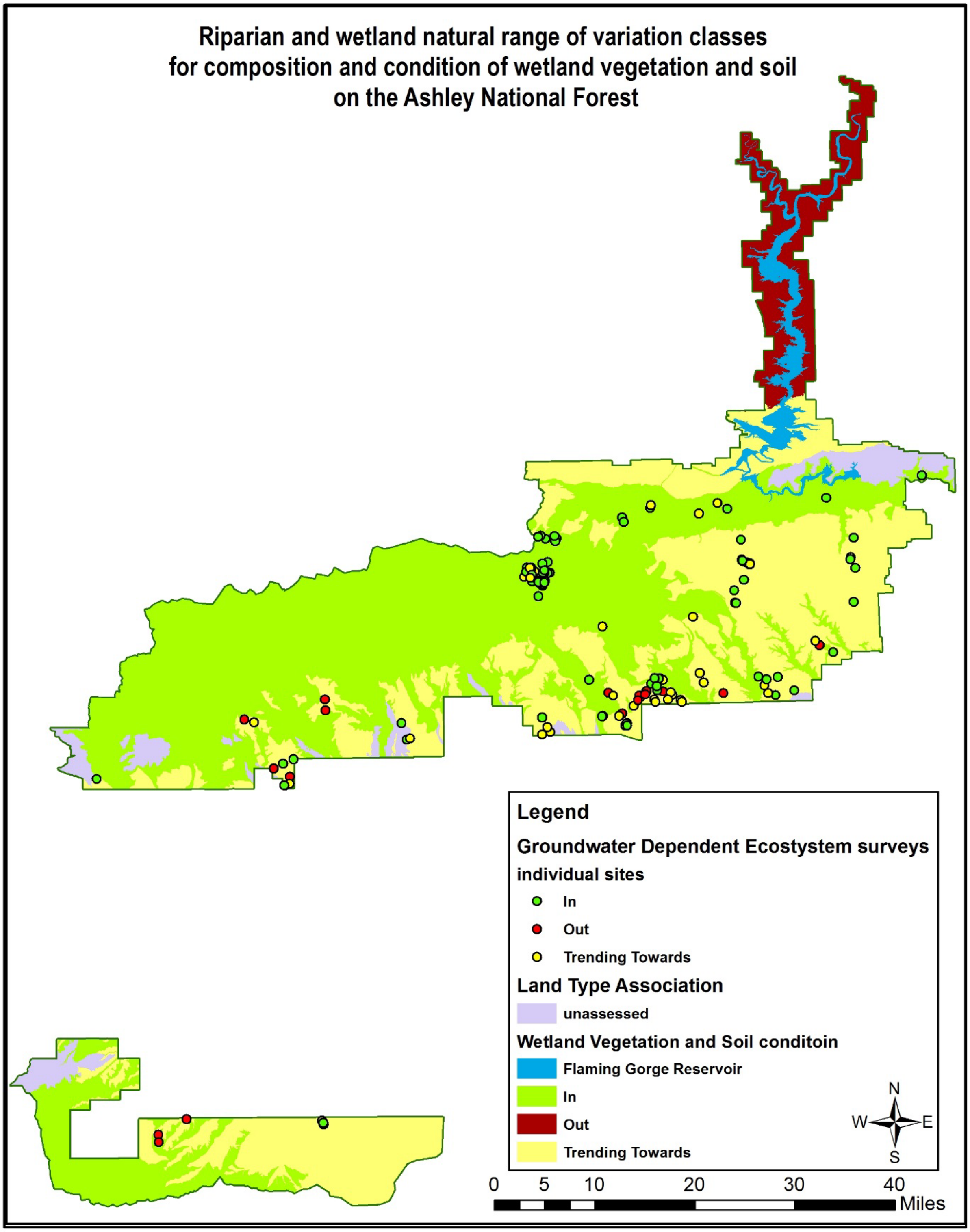

Figure 4. Land type association scale depiction of riparian and wetland natural range of variation classes for composition and condition of wetland vegetation and soil. Surveyed groundwater-dependent ecosystems sites are also shown.

Portions of the Ashley National Forest contain aquatic nuisance species including whirling disease, New Zealand mud snail, chytrid fungus, didymo, and curly leaf pondweed (USDA Forest Service 2013, Utah Division of Wildlife Resources 2012 and 2016)

Encroaching species (typically coniferous trees and shrubs) are native to the Ashley National Forest. However, in recent decades, these species have increased in cover and abundance along the mesic fringes of wetland meadows. These increases have the potential to displace riparian plants and animals that specialize in grassland or deciduous tree-dominated vegetation types (Marlow et al. 2006).

Influence of drivers and stressors

Drivers and stressors of invasive species include:

- temperature and precipitation patterns;
- atmospheric carbon dioxide concentration;
- evolutionary adjustments;
- human trade activities causing direct and indirect introductions; and
- indirect effects from altered wildfire regimes (IAP 2016).

Terrestrial invasive species often establish after soil disturbance. Natural disturbances that expose bare soil due to wildfire, prolonged drought, and changes in the timing of precipitation can benefit advancement of invasive species. Human-caused soil disturbance can be a pathway for establishment of invasive species. Examples of human-caused disturbances include livestock grazing, burning slash piles, road construction, vehicle traffic, and reservoir operations that produce fluctuating water levels and a shoreline zone of exposed soil, lacking stable vegetative cover (Zobell 2013, USDA Forest Service 2009, Rice et al. 2015)

Predicted effects from climate change include increasing temperature, decreasing summer streamflow, increased vegetative stress, and increases in wildfire intensity and frequency. Added effects from these stresses would help establish and spread invasive species (IAP 2016, Rice et al. 2016).

Drivers of **aquatic invasive species** include the presence of suitable aquatic conditions for the species (temperature, water chemistry, seasonality of flow, channel properties) and modes of introduction and spread between water bodies, often related to human transit and aquatic recreation. Examples include:

- intentional or unintentional introductions through fisheries management;
- transfer of contaminated boats and gear (fishing tackle, waders, dive equipment, hunting equipment);
- releases of live bait used in sport fishing or contents of home aquariums
- transbasin diversion of water via canals and pipelines; and
- water drafting for use in wildland fire suppression (USDA 2007).
- transfer of bilge water from recreational boats; and
- contamination from construction and survey equipment.

Status of and Trends

Since the 2009 Ecosystem Diversity Evaluation Report and the 2011 Watershed Condition Framework, there has been a marked expansion of terrestrial invasive species in lower elevations of the Ashley National Forest. This expansion has occurred subsequent to drought years in 2012 and 2013 (Goodrich and Huber 2015).

Whirling disease has been documented in portions of the North Fork Duchesne River, South Fork Rock Creek Beaver Creek, Carter Creek and Sheep Creek drainages, as well as the Flaming Gorge Reservoir (Utah Division of Wildlife Resources 2012 and 2016, USDA Forest Service 2013). New Zealand mud snail is present in the Green River below the Flaming Gorge Reservoir. Curly leaf and clasping leaf pondweed are present in the Flaming Gorge Reservoir, Sheep Creek Lake, and Browne Lake. Chytrid fungus has been documented in the Grandaddy Lakes Basin (Rock Creek Drainage). Didymo has been documented in the Rock Creek and Carter Creek drainages.

Repeat photography in mid- and high-elevation meadows on the Ashley National Forest has documented an increase in young conifer species. The encroachment of conifer is primarily on the wet and dry periphery of these meadows. In some areas, the conversion is significant and may require management actions if these dry meadow areas are to be maintained.

Description of Natural Range of Variation

Riparian and wetland areas associated with streams, lakes, and meadows

There is localized incidence of aquatic and terrestrial invasive and encroaching species at many portions of the Ashley National Forest. A majority of land type associations were determined as **trending towards** the natural range of variation, because invasions were either being treated or did not have a dominant influence on the riparian areas (Dwire and Smith 2016).

Trending towards:

- Glacial Bottom
- Glacial Canyon Parks Plateau
- Round Park
- Stream Pediment Trout Slope
- Anthro Plateau
- Anthro Canyon
- Greendale Plateau
- North Flank

Land type associations with riparian areas **outside** the natural range of variation for invasive species are:

- Green River
- Antelope Flat
- North Flank and Red Canyon land type associations on the Flaming Gorge National Recreation Area
- South Face land type association on the south slope of the Uinta Mountains

These land type associations in the Flaming Gorge natural range of variation were determined to have widespread presence of terrestrial and aquatic invasive species along Flaming Gorge Reservoir and the Green River below the Flaming Gorge Dam. The South Face land type association has a growing presence of annual invasive species (cheatgrass). Alpine Moraine, Uinta Bollie, Limestone Hills, and the Stream Canyon land type associations were determined to be **within** the natural range of variation for a relative absence of invasive species affecting riparian areas. See figure 5 for land type depictions of natural range of variation classes for invasive and encroaching species.

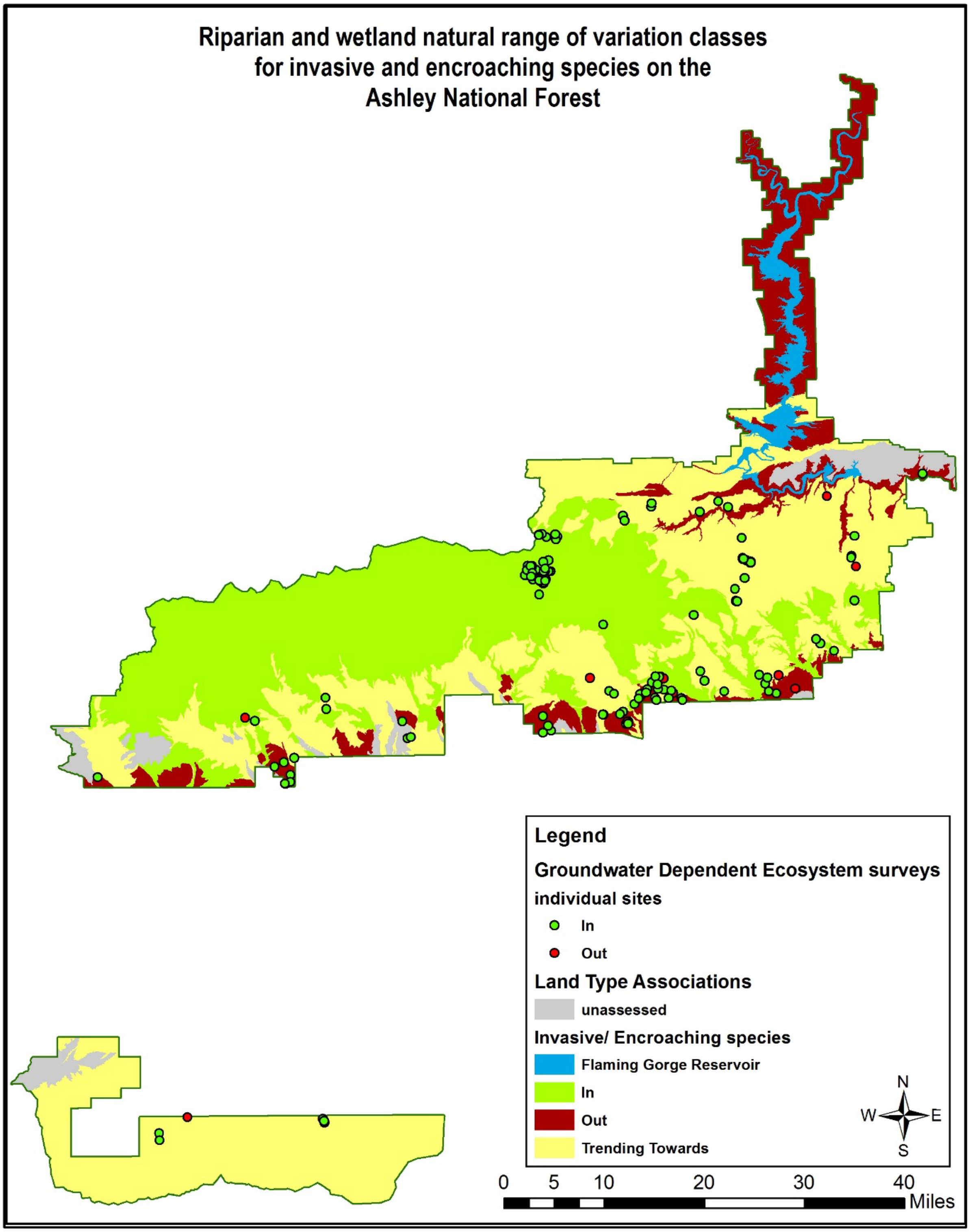

Figure 5. Land type association scale depiction of riparian and wetland natural range of variation classes for invasive and encroaching species. Surveyed groundwater-dependent ecosystems sites are also shown.

Springs and Groundwater-dependent Ecosystems

Of the 165 level 1 groundwater-dependent ecosystems surveys considered in this assessment, 92 percent of sites were within the natural range of variation with no invasive species documented. Of the remaining sites with invasive species documented, all were springs, and all but two were at elevations below 8,400 feet. The highest elevation site, Bull Moose Spring, was at 10,710 feet on Dry Ridge. Dry Ridge is a high-elevation plateau with surface water limited to isolated spring sites and use by livestock and wildlife is concentrated (USDA Forest Service 2012c). Figure 5 shows the surveyed groundwater-dependent ecosystems sites (displayed as small circles) and natural range of variation calls based on this key ecosystem characteristic.

Habitat Connectivity

Description Including Rationale

Habitat connectivity is the ability of aquatic species to move through the plan area and into adjacent areas to use habitat that fulfills their life cycle needs. Historic ranges of native aquatic species can be altered by fishing pressures, introduction of exotics, and construction of barriers such as dams, hanging culverts, and diversions (Bevenger 2017, Ward and Stanford 1982). With added barriers to migration, populations of fish and other aquatic species can become isolated, limiting gene flow and potentially impacting population viability. Fragmented aquatic populations can have reduced access to suitable food sources and habitat for life cycle needs. Fragmented populations can also become more vulnerable to extirpation (localized extinction of a species or population), by their inability to migrate after large disturbance events or other detrimental changes in habitat.

Two assessments apply to the current condition of aquatic habitat connectivity on the Ashley National Forest. One is the forestwide aquatic organism passage assessment completed in 2005. This assessment followed the protocol developed by the USDA Forest Service-San Dimas Technology Center. The second is the watershed condition framework assessment, completed for the Ashley National Forest in 2011.

Influence of Drivers and Stressors

Most of the stressors for this ecosystem characteristic are brought through management needs. Existing water diversions, weirs, dams, hanging culverts, and artificially dewatered streams can affect the ability of aquatic organisms to freely move through a watershed. While man-made stressors tend to have a greater influence on connectivity on the Ashley National Forest, other natural processes or drivers play a role for this key ecosystem characteristic. Naturally occurring barriers include bedrock nicks, waterfalls, and cascading stream reaches with slopes greater than 15 percent. Some locations contain steep slopes, narrow canyons, and highly erosive soils. These drivers, coupled with heavy summer monsoonal rains, can lead to intense debris flows which could potentially affect connectivity through the creation of large debris jams consisting of woody vegetation, rock, and soil. One of these areas is the South Unit of the Roosevelt/Duchesne Ranger District on the Ashley National Forest. The soil in this area is highly erosive and the area is more susceptible to these types of events. The threat exists for other drivers such as intense, large-scale wildfire; major winds; and severe flooding. However, these drivers seem to be less common and are therefore less likely to affect connectivity.

Changes in climate can place additional stress on aquatic connectivity. Modeled predictions of reduced summer flows and increased water temperatures have the potential to alter habitat connectivity of streams at lower and mid elevations of the Ashley National Forest. Small perennial streams which currently pass flows year-round, may have reaches that go dry for portions of the year or summer water temperatures that rise above what is suitable for coldwater-adapted species (Rice et al. 2015, Halofsky et al. 2017).

Status and Trends

During the 2005 aquatic organism passage assessment, forest staff surveyed 26 stream crossings for passage information. Fifteen stream crossings (57 percent) had some sort of passage barrier for adult life stage salmonids (Brunson 2005). Typically, a culvert was set too high or down cutting created a perch to prevent aquatic organisms from getting into the culvert. In other cases, the culvert was placed at an angle too steep for aquatic organisms to pass through. Since 2005, five of the 26 (19 percent) streams surveyed have had replacement culverts installed. These newly installed culverts consist of baffled bottoms, which retain natural channel material, primarily cobble and large gravel. The bottoms have restored aquatic organism passage for both juvenile and adult life stages for salmonids. This information from the aquatic organism passage surveys is summarized in the following tables.

Table 1. Stream crossings assessed including crossing type and barrier triggers for adult and juvenile salmonids in the Carter Creek 5th-code watershed

Stream Crossing	Crossing Type	Adult	Juvenile
Burnt Creek	Circular	Slope > 2%	Slope > 1%
Elk Creek	Circular	Slope > 2%	Outlet drop > 0.34 feet
Lake Creek	Circular	Slope > 2%	Slope > 1%
Cub Creek	Circular	Slope > 2%	Outlet drop > 0 .34 feet

Table 2. Stream crossings assessed including crossing type and barrier triggers for adult and juvenile salmonids in the Whiterocks 5th-code watershed

Stream Crossing	Crossing Type	Adult	Juvenile
Lily Lake Creek	Circular	Outlet drop > 0.8 feet	Outlet drop >0 .34 feet
Reader Creek	Pipe Arch	Outlet drop > 0.8 feet	Outlet drop > 0.34 feet
Lynn Creek	Pipe Arch	Outlet drop >0 .8 feet	Outlet drop >0 .34 feet

Table 3. Stream crossings assessed including crossing type and barrier triggers for adult and juvenile salmonids in the Dry Fork 5th-code watershed

Stream Crossing	Crossing Type	Adult	Juvenile
North Fork of Dry Fork	Pipe Arch	Slope > 2%	Slope > 1%
North Brownie Creek	Circular	Slope > 2%	Slope > 1%

Table 4. Stream crossings assessed including crossing type and barrier triggers for adult and juvenile salmonids in the Upper Ashley Creek 5th-code watershed

Stream Crossing	Crossing Type	Adult	Juvenile
Trout Creek	Open Bottom	BFW ratio < 0.5	BFW ratio < 0.5
Center Creek	Pipe Arch	Outlet drop > 0.8 feet	Outlet drop > 0.34 feet

Table 5. Stream crossings assessed including crossing type and barrier triggers for adult and juvenile salmonids in the Big Brush Creek 5th-code watershed

Stream Crossing	Crossing Type	Adult	Juvenile
Government Creek	Pipe Arch	BFW ratio < 0.5	Outlet drop > 0.34 feet
Windy Park Tributary	Pipe Arch	NA	Outlet drop > 0.34 feet

Table 6. Stream crossings assessed including crossing type and barrier triggers for adult and juvenile salmonids in the Little Brush Creek, Rock Creek, and Middle Strawberry 5th-code watersheds

Watershed	Stream Crossing	Crossing Type	Adult	Juvenile
Little Brush Creek	West Fork Little Brush Creek	Circular	Slope > 2%	Slope > 1%
Rock Creek	South Fork Rock Creek	Circular	Outlet drop > 0.8 feet	Outlet drop > 0.34 feet
Middle Strawberry	Shotgun Creek	Circular	Slope > 2%	Outlet drop > 0.34 feet

Interestingly, the 2011 Watershed Condition Framework assessment found 78 of the 107 watersheds assessed (73 percent) had been rated in good condition for aquatic organism passage, with the other 29 watersheds assessed (27 percent) to be in fair condition. This assessment was determined to be a larger-scale assessment than the site-specific, on-the-ground aquatic organism passage survey.

There are 32 large and medium sized dams (for example, Flaming Gorge, Upper Stillwater, Moon Lake, East Park, and Oaks Park) on the planning unit that prevent upstream movement of aquatic organisms. However, suitable habitat to support a complete life cycle exists above and below these dams. In summary, it appears the overall aquatic habitat connectivity is in good condition, with some site-specific areas spread across the Ashley National Forest that need attention.

Since 2007, 13 dams in the High Uintas Wilderness have been decommissioned as part a project which transferred water rights to downstream reservoirs and allowed the wilderness dams to be breached. This work resolved the logistical challenge of maintaining the aging dams in a wilderness setting. The work also provided an ecological benefit by stabilizing lake levels and returning connectivity patterns to pre-dam conditions. An additional dam at Milk Lake in the High Uintas Wilderness is planned to be decommissioned in the future.

The Ashley National Forest has been replacing problem culverts as resources become available. To date, 11 culverts identified in the 2005 aquatic organism passage survey remain barriers to fish migration (see figure 6). Increased integration among forest engineers, biologists, hydrologists, as well as other agencies are becoming more common during the planning and implementation of new and existing stream crossings.

Description of Natural Range of Variation

Barriers to fish passage can be naturally occurring (bedrock nicks, waterfalls, steep cascade streams) and human caused (dams, culverts, diversion structures, weirs, artificially dewatered streams). In most cases, connectivity is a function more of man-made features than of natural variation, with the exception of areas like the South Unit. The South Unit has a combination of steep slopes, highly erosive soils, and narrow canyons. Stream gradients too steep for aquatic organisms to pass through a certain area are typically associated with marginal or unsuitable fisheries habitat above the restriction. Natural processes, such as debris jams and beaver dam complexes, typically do not restrict connectivity for aquatic species.

For the key ecosystem characteristic of aquatic habitat connectivity, 73 percent of Ashley National Forest sub-watersheds were designated **within** the natural range of variation. Twenty-seven percent were designated as **trending towards** the natural range of variation, due to the presence of anthropogenic features acting as barriers to salmonid passage. See figure 6 for a forest wide, subwatershed scale depiction of aquatic habitat connectivity.

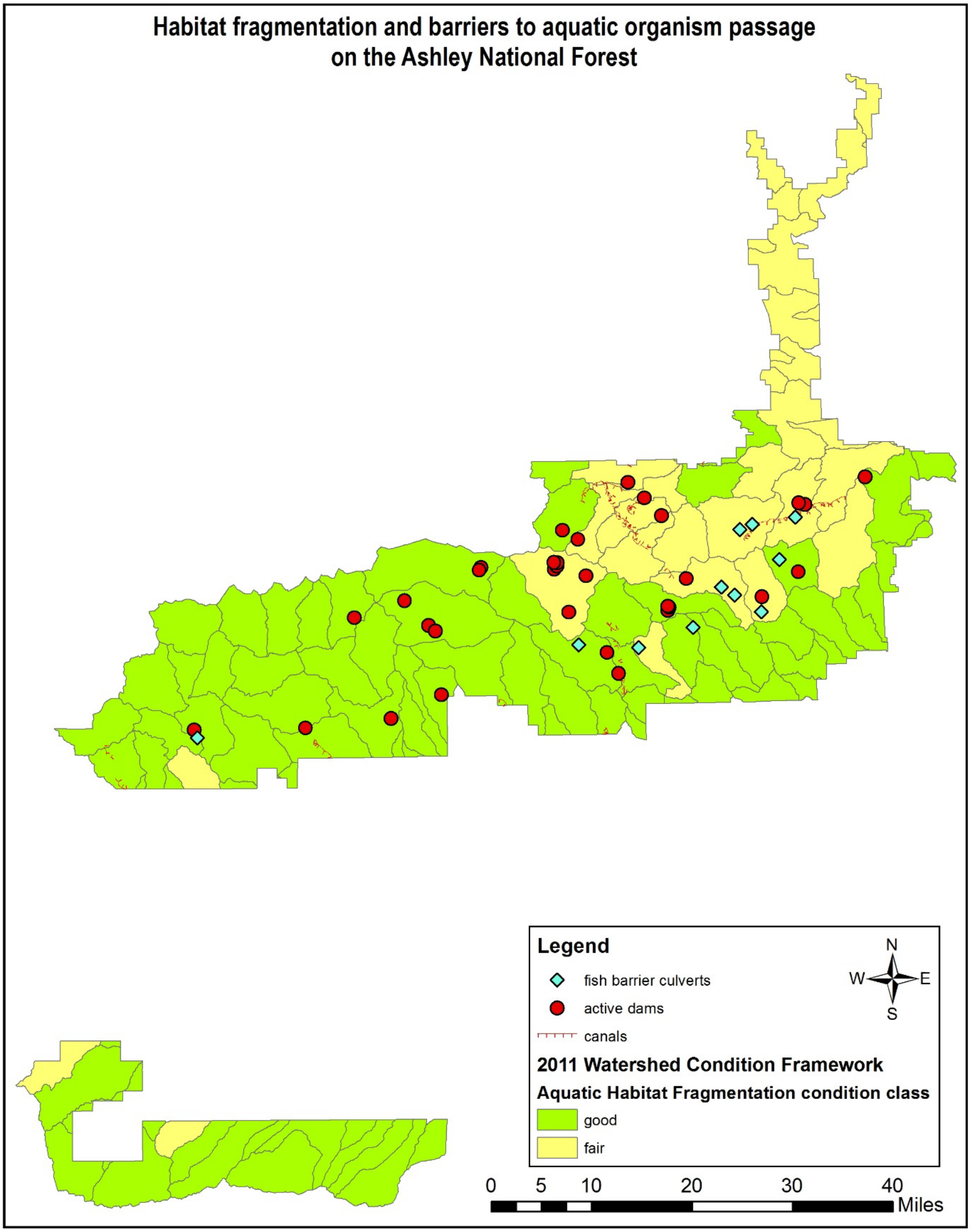

Figure 6. Subwatershed depiction of habitat fragmentation and barriers to aquatic organism passage (dams, culverts, and canals) as assessed in the 2011 watershed condition framework

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