Appendix G: Statement of Findings for Wetland Protection

G.1 Introduction

Yellowstone National Park (YELL) has prepared and made available an Environmental Assessment (EA) analyzing a park wide Native Fish Conservation Plan under an adaptive management framework for conserving native fish from threats of non-native species, disease, and climate-induced environmental change.

Executive Order (EO) 11990 requires the National Park Service (NPS) and other agencies to evaluate the likely impacts of actions in wetlands and waters of the U.S. and their associated values. National Park Service Director's Order #77-1: Procedural Manual 77-1: Wetland Protection provides NPS policies and procedures for complying with EO 11990. This Statement of Findings (SOF) has been prepared in accordance with these NPS wetland protection procedures.

This draft SOF is a programmatic document that will address potential native fish restoration activities involving the application of piscicides, construction of a barrier on Specimen Creek, alteration of waterfalls on Grayling and Soda Butte Creeks, modification of sandbars on tributaries to Yellowstone Lake (YSL), and reconstruction of the Clear Creek Weir. All of these actions are discussed programmatically only. This SOF was prepared to focus on activities that have the potential to have adverse impact on wetlands and waters of the U.S. and their associated values. Further SOFs may be required after additional assessments are completed and it is determined that actions of specific projects do not qualify as excepted actions under DO-77-1.

This draft SOF has been prepared as a companion document to the Native Fish Conservation Plan / Environmental Assessment (EA) for Yellowstone National Park. The EA incorporates a comprehensive adaptive management strategy for conserving native fish across YNP for the coming decades. The projects discussed here are not a comprehensive list of all potential future projects with a nexus to DO-77-1. In the event that projects utilizing additional application of piscicide, construction or modification of fish barriers, or other activities that disturb wetlands, or cause other non-exempt wetland impacts (as defined in National Park Service 2008, National Park Service Procedural Manual #77-1: Wetland Protection) are proposed we would prepare additional WSOF's. Additional WSOF's would be released for public review and would be considered additional companion documents to the current (2010) Native Fish Conservation Plan for Yellowstone National Park / Environmental Assessment.

G.2 Proposed Action

This draft SOF is programmatic in nature. It introduces the potential actions of the Native Fish Conservation Plan and provides details on these actions to the extent possible at the time of public review. The level of detail provided varies by category of action, including:

- Information on projects related to the use of piscicides and to the removal of sandbars blocking Yellowstone Lake tributaries provide necessary site-specific detail to make an accurate determination on the amount of adverse impact;
- Information on reconstruction of the Clear Creek weir, fish barrier construction on Specimen Creek, and modification of existing waterfalls (on Grayling Creek and Soda Butte Creek) are preliminary. Additional hydrologic assessments are planned prior to initiation of these projects.

Although the Native Fish Conservation Plan addresses projects parkwide, only those representative projects proposed for piscicide treatment in this WSOF are covered under this WSOF. The same applies to construction, reconstruction, or modification of structures. For each specific project, an additional site-specific SOF will be developed if an assessment determines that it does not qualify as an excepted action under DO-77-1. Some projects may be excepted if they are designed for the purpose of restoring degraded (or completely lost) natural wetland, stream, riparian, or other aquatic habitats or ecological processes (NPS Procedure Manual #77-1; 4.2.1); temporary wetland disturbances directly associated with such restoration as well as actions causing a cumulative total of up to 0.25 acres of new long-term adverse impacts on natural wetlands may be considered excepted actions. Proposed projects must also satisfy the BMP's/Conditions found in Appendix 2 of NPS Procedural Manual #77-1 to qualify as excepted actions. Because a primary goal of the Native Fish Conservation Plan is to restore and maintain the important ecological role of native fishes and if hydrologic assessments can show these other parameters to be met, it is anticipated that at least some of the proposed actions will be exempt. Others that do not meet these parameters or do not meet the "Conditions" for excepted actions will require separate project-specific SOFs.

Four alternatives are evaluated in this Environmental Assessment, They are briefly summarized below. Please note that only activities involving piscicide application, construction or alteration of barriers, modification of sandbars on tributaries to YSL and reconstruction of the Clear Creek weir are addressed in this WSOF. Other activities pertinent to DO-77-1 would be addressed in separate WSOF's.

G.2.1. Alternative 1: No Action – Continuation of Current Management Practices

The no-action alternative would result in a continuation of efforts at existing levels to conserve native fish.

G.2.2. Alternative 2: (Preferred Alternative) Full Use of Native Fish Conservation Techniques and Lake Trout Carcasses Returned to Yellowstone Lake

The second alternative would conserve Yellowstone Lake YCT by an increase in removal of lake trout by private sector, contract netters; and would conserve Arctic Grayling (GRY), westslope cutthroat trout (WCT), and Yellowstone cutthroat trout (YCT) elsewhere by the construction of fish barriers to exclude non-native fish, removal of nonnative fish using EPA approved piscicides (fish pesticides) followed by restocking of native species from genetically-unaltered brood sources in the Greater Yellowstone Ecosystem (GYE). Native non-game species (i.e. sculpin) would also be restocked from downstream sources after treatments are completed.

Non-native species targeted for removal include brook trout (BKT), brown trout (BNT), rainbow trout (RBT), and cutthroat –rainbow trout hybrids (CTX). Under the preferred action the following are examples of potential projects under consideration (a – e are piscicide projects only; f – j include barrier or weir construction, waterfall modification, or sand bar removal):

G.2.2.1. De Lacy Creek
Brook trout are proposed to be removed from De Lacy Creek with the use of piscicides, followed by a YCT restocking effort.

G.2.2.2. Elk Creek Complex
This project would remove BKT using piscicides with subsequent restocking of YCT.

G.2.2.3. Gibbon River (upper)
Non-natives such as BKT, BNT, and RBT are proposed to be removed in this section of river upstream of Gibbon Falls by piscicides followed by the restocking of AGY &WCT.

G.2.2.4. Goose Lake Chain
This project would remove RBT that were previously stocked in this historically fishless lake. The proposed project would utilize piscicide to remove the RBT from the Goose Lake chain, including all streams between the lakes, and replace them with a self-sustaining population of WCT.

G.2.2.5. Pocket Lake
Pocket Lake is proposed for removal of BKT by use of piscicide followed by a restocking of YCT. Not only would the entire area of the lake be treated, but the upstream tributary and downstream to the lower waterfall would be treated as well.

G.2.2.6. Clear Creek
For more than 50 years information concerning spawning YCT from YSL was collected at a weir on Clear Creek. The weir was located approximately 250 meters upstream of the confluence with YSL (Figure G-1). In 2008, high water damaged the existing weir, rendering it inoperable. The NPS is proposing to reconstruct the weir in a fashion that would allow the weir to again monitor spawning YCT and would minimize impacts to hydrology and wetlands or waters of the U.S. and their associated values.

Figure 10. The original weir on Clear Creek before it was washed out by a high water event in 2008, rendering it inoperable for collecting spawning information on YCT from YSL.

Construction Required
The proposal would include utilization of some elements of the structure that remained undamaged in 2008 and removal, redesign, and reconstruction of other elements. Also included in the proposal is restoration of stream bank erosion

caused by the old structure. At present, students from Montana State University's Engineer Department, with guidance from NPS staff, are developing conceptual designs (Figure G-2). Construction would utilize non-native materials like concrete and rebar to create permanent bulkheads along the stream bank with a removable weir that transects the stream channel. The weir would only be operated on a temporary basis during YCT spawning. The remainder of the year water would pass uninhibited, thus reducing impacts to hydrology. While repair or even reconstruction on instream diversions can be considered excepted actions, impacts to wetlands or waters of the U.S. and their associated values may not exceed the minor deviations allowed (totaling up to 0.1 acres). Current designs anticipate total activities would occur in an area approximately 60 feet wide by 150 feet wide, or 9,000 square feet (or 0.2 acres).

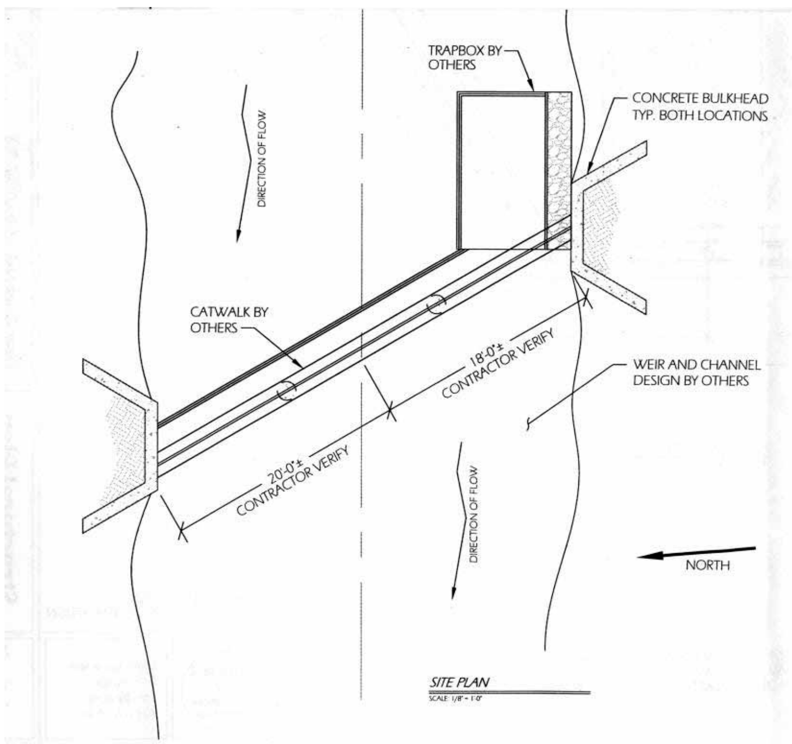

Figure G-2. Potential design for Clear Creek reconstruction.

G.2.2.7. Grayling Creek

This project would remove non-natives such as BNT, RBT, and CTX by use of piscicide followed by a restocking of AGY and WCT. A small existing bedrock waterfall would be modified to ensure it is a complete barrier to passage by nonnative fish (rainbow and brown trout) as they attempt to move upstream. The waterfall is located out of public view in a steep canyon near Montana HWY 191, 15 miles north of West Yellowstone, MT. The waterfall is approximately 2 meters in height (Figure G-3). A deep (1 m depth) pool ("plunge pool") exists immediately downstream at the base of the falls. The falls is bounded by bedrock and boulders on both sides.

Cracks in the bedrock and large boulders on both sides of the falls have resulted in short cascades that are passable by nonnative trout moving upstream under some flow conditions. Additionally, the presence of the plunge pool at the base of the falls currently allows for larger nonnative trout to aggressively swim up through the pool and leap over the center of the falls,

Figure G-3. Existing bedrock waterfall on Grayling Creek, a tributary to the Madison River (now Hebgen reservoir) in Yellowstone National Park.

by-passing the feature and allowing for their continued movement into upper reaches of the watershed.

Modification Required

Design criteria for an effective fish barrier are that they are capable of physically withstanding a 100-year flood event, and that they must prevent the upstream passage of nonnative trout at all flows up to and including a 100-year flood event. For nonnative brown, brook, and rainbow trout, this typically would be a natural waterfall or man-made barrier that is at least 6 ft in height. This is only general guidance, however, as conditions at each site vary. The presence of a splashpad (or other velocity barrier) downstream of the barrier would greatly influence fish jumping ability and dictate what barrier height would be required to preclude passage by trout. For additional guidance on fish barrier design criteria, see an Evaluation of the Efficiency and Efficacy of Non-Native Fish Eradication and Exclusion Techniques for Native Fish Restoration at http://wildfish.montana.edu/projects/ee_summary.asp.

On Grayling Creek, to direct all water flow over the center of the falls, short walls ("wing walls") would be constructed of native rock and mortar/concrete (that is dyed a natural bedrock color). The walls would be built extending from the bedrock on both sides of the stream, and during normal flow conditions, water would no longer flow over the short cascades along each side of the falls. Each wall would be approximately 1.3 meters height, 0.6 meter thick, and extend approximately 2.5 meters into the channel (Figure G-3).

The existing plunge pool below the Grayling Creek falls would be filled with native rock and would be covered with a pad ("splash pad") to prevent scour and reformation of the pool. The fill would be native rock, logs, or other material found on site and the splash pad would be constructed of logs, concrete and/or steel.

A steel mesh grate ("drop through grate") may be placed between the wing walls and extend outward (downstream; Figure G-3) along the upper front margin of the falls. Stream flows would pass over the center of the falls and through the drop through grate, prior to landing on the splash pad below. The steel mesh grate would fully ensure that no nonnative trout are able to bypass the feature.

G.2.2.8. Soda Butte Creek

This project would protect remaining YCT in Soda Butte Creek upstream of Ice Box Canyon. In order to preserve native Yellowstone cutthroat trout in the upper reaches of Soda Butte Creek we would modify an existing bedrock waterfall to ensure it is a complete barrier to passage by nonnative fish (rainbow and brook trout) as they attempt to move upstream. The waterfall is located out of public view in a steep canyon (Ice Box Canyon) along the East Entrance Road, east of Tower Junction.

Ice Box Canyon contains a series of small falls and cascades (each approximately 2 meters height) which are bounded by steep bedrock on both sides. There is one feature within this series of falls and cascades that represents a significant barrier to upstream movement of trout (Figure G-4). However, a large crack in the bedrock has formed a chute that may be passable by fish under some flow conditions. Of particular concern is the west bank of the falls where a large crack in the bedrock ascends the falls creating a single steep (but potentially passable) cascade.

Figure G-4. Existing bedrock waterfall on Soda Butte Creek in Ice Box Canyon, Yellowstone National Park. A large crack extends along the east side (left and out of view in photo) creating a chute that nonnative trout are able to swim up and bypass the feature.

Modification Required

Flows would be diverted away from the bedrock chute along the eastern margin of the falls using portable canvas and rocks. A concrete form would be constructed within the chute using common framing lumber. The form would be placed near the downstream end of the chute to create the largest possible water drop upon completion of the project. Concrete would be used to fill approximately 8 meters of the chute, upstream of the form, to an elevation equal to the bedrock surface. By filling the chute in this way, flows would be carried farther downstream (and over the filled chute) and drop from a much greater height.

The modification to Ice Box Falls may also require construction of a wing wall to direct all flows over its center. This wall would be approximately 1.3 meters height, 0.6 meter thick, and extend approximately 1.5 meters into the channel. The wall would be constructed of native rock and mortar/concrete (that is dyed a natural bedrock color). The wall would be built extending from the bedrock on the western side of the stream.

G.2.2.9. Specimen Creek

During 2006 – 2010 native westslope cutthroat trout were restored to the East Fork of Specimen Creek (EFSC) temporarily isolated from the remainder of the Specimen Creek watershed by a man-made barrier to upstream movement of nonnative trout (rainbow and brown trout). The EFSC fish barrier is a log structure placed in a remote canyon, 5 km from the trailhead at HWY 191 (Figure G-5). Although this work represents a significant advancement in the conservation of westslope cutthroat trout, the overall goal remains to restore the entire watershed (including the North Fork of Specimen Creek and the mainstem) extending downstream to near the HWY 191 road bridge. Upon completion of the watershed restoration, the EFSC barrier would be removed and the area rehabilitated to its natural condition.

To restore native westslope cutthroat trout to the entire Specimen Creek watershed, it would first be protected from invasion by downstream sources of nonnative trout (in the Gallatin River) via a permanent fish barrier constructed largely of concrete and steel. The barrier site is well within public view near the Specimen Trailhead parking area, 26 miles north of West Yellowstone, MT. The site consists of an abandoned road bed (old HWY 191) that intersects Specimen Creek approximately 75 meters upstream of the existing highway bridge and forms an existing low “dam” across the floodplain (Figure G-6). Specimen Creek flows through a narrow

Figure G-5. Fish barrier constructed mostly of logs and rocks in 2008 to temporarily isolate East Fork Specimen Creek for restoration of native westslope cutthroat trout. Vegetation is recovering following the Owl Fire, which burned the watershed (including the barrier site) in 2007.

Figure G-6. Location for construction of a permanent fish barrier on Specimen Creek in Yellowstone National Park. Tape extending across the stream is along the old HWY 191 road embankment. Concrete remaining from the pre-existing bridge can be seen along the right descending stream bank (left margin of the photo).

notch in the embankment, where a bridge once stood. Analysis of this site using Hec-Ras hydrological modeling (White 2008) indicates that it is a feasible site for barrier construction. Bankfull widths of the creek average 9 meters at undisturbed cross-sections (Figure G-7).

Construction Required

A confined, flat weir with concrete splash apron would be constructed (Figure G-8). The weir would concentrate streamflow within a confined cross-section and direct it over a flat crest. The apron would prevent scouring and development of a plunge pool downstream of the weir. The lateral constriction and elevation drop at the weir, coupled with the smooth flat splash apron, would concentrate the energy of the streamflow and cause a supercritical flow zone immediately downstream of the weir base. Water velocity within this supercritical flow zone would be extremely high and depth is relatively shallow, making leaping (or even entering the zone) extremely difficult for fish.

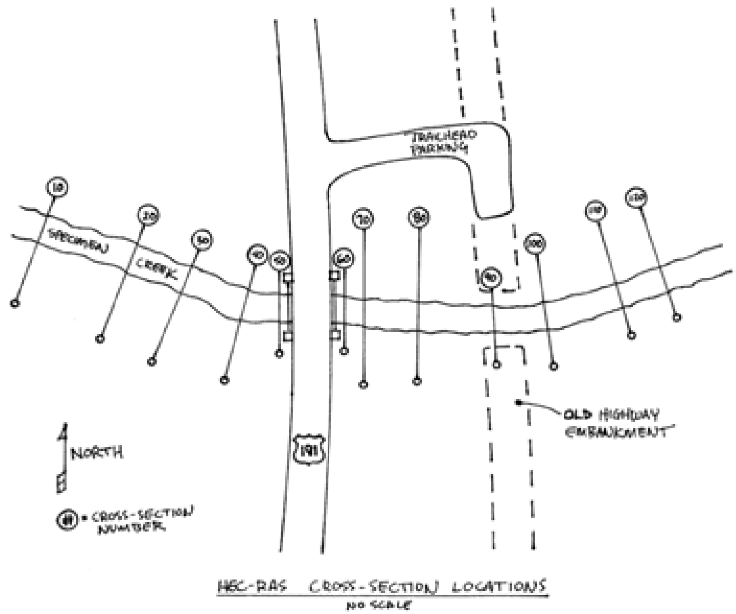

Figure G-7. Location for construction of a permanent fish barrier on Specimen Creek in Yellowstone National Park. The barrier would be placed at cross-section #90 and between the abandoned HWY 191 road embankment, just upstream of the existing HWY 191 road bridge.

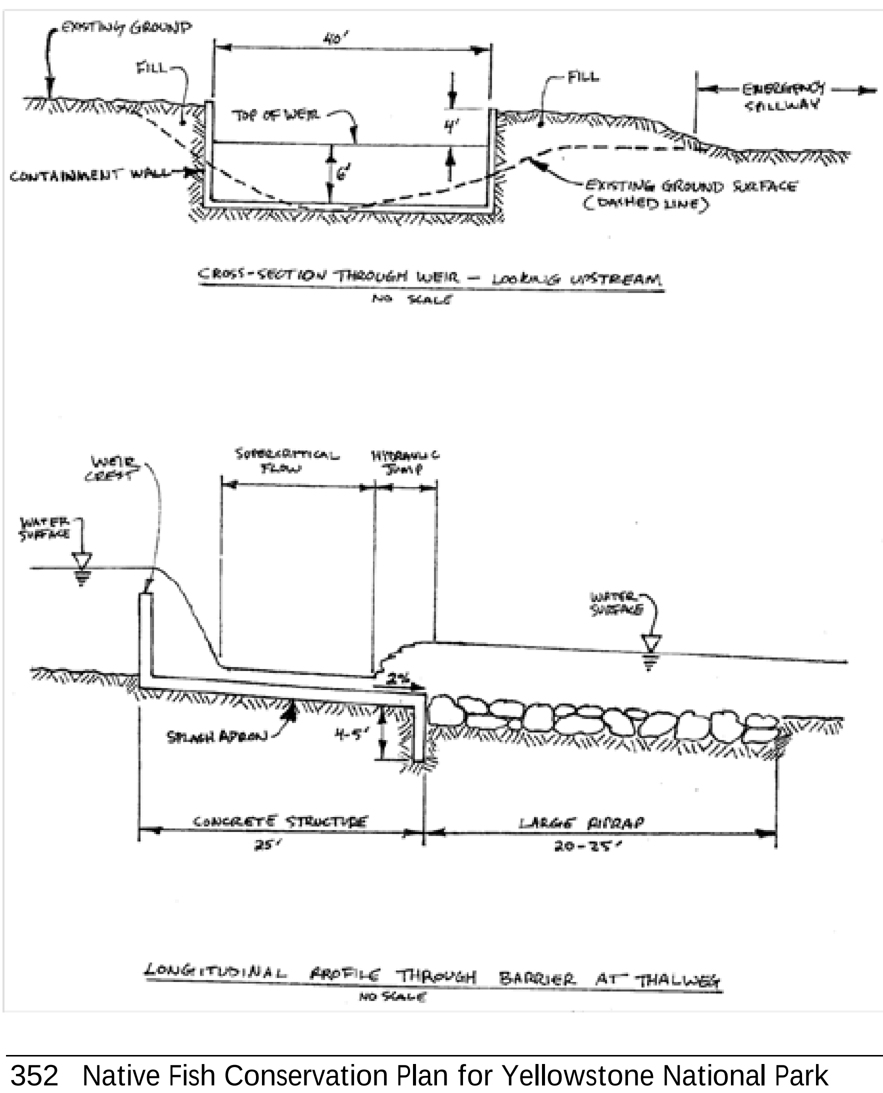

Figure G-8. Cross-section through weir (upper diagram) showing elevation of existing abandoned roadbed (existing ground) and longitudinal profile (lower diagram) showing location of splash apron extending 25 ft along stream bottom from the base of the weir.

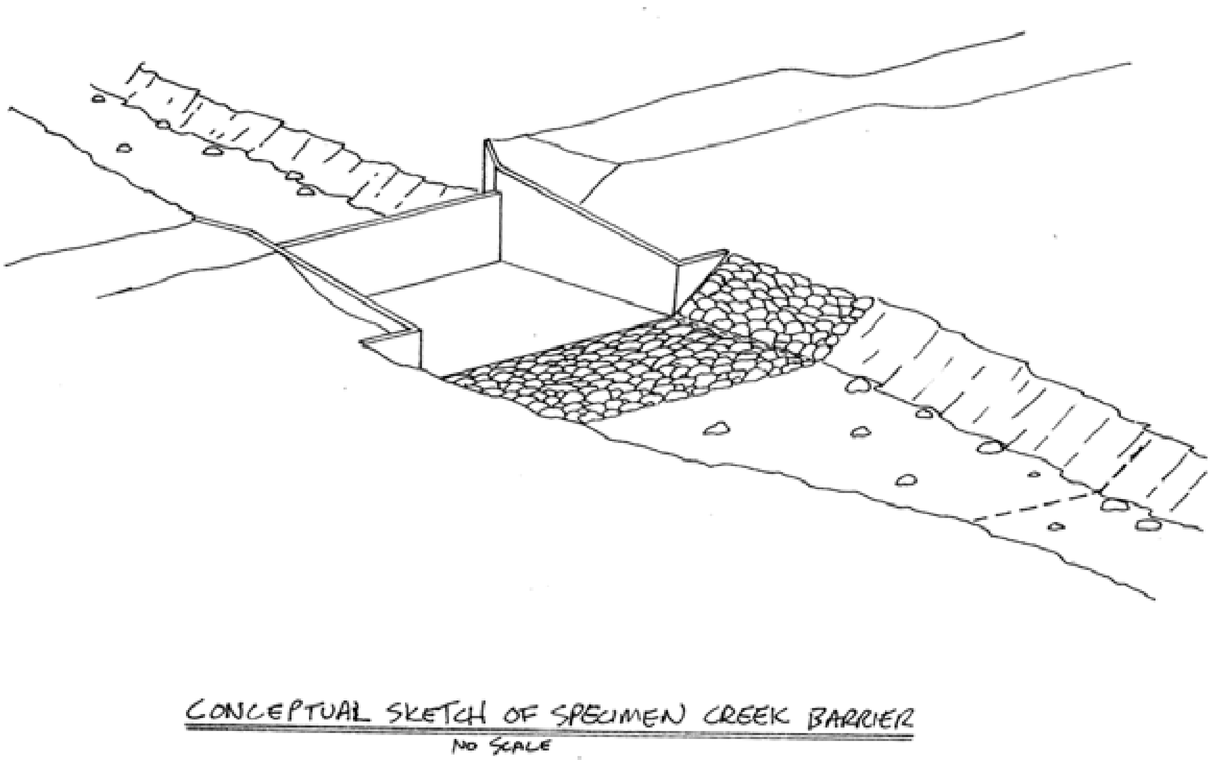

Figure G-9. Conceptual sketch of the fish barrier to be constructed on Specimen Creek, a tributary of the Gallatin River, in Yellowstone National Park. View is from below (downstream of) the barrier looking upstream to show the concrete splash pad at the base of the barrier.

G.2.2.10. Yellowstone Lake

Proposed actions for YSL include the modification of sandbars that have blocked the mouths of YCT spawning tributaries through natural wave action to re-establish surface flow to YSL. This reconnection with the Lake would allow YCT to move upstream to spawn in the spring and juveniles would be able to descend the tributaries in the fall. This proposal would include the movement of sand and gravel by shovel to adjacent non-vegetated shoreline areas that would not impact other resources. If a species of special concern is found and could not be mitigated for, the tributary would be removed from further consideration for enhancement of YCT spawning areas. In particular, the Yellowstone sand verbena (*Abronia ammophila*) is a species endemic to Yellowstone which is being evaluated for listing as a federal threatened or endangered species that inhabits the sand along YSL shores, and would be highly protected in restoration activities.

G.2.3. Alternative 3: Full Use of Native Fish Conservation Techniques and Lake Trout Marketed and/or Donated

The third alternative would implement the same actions as Alternative 2, except that lake trout would be removed from Yellowstone Lake and marketed or donated by the contract netters.

G.2.4. Alternative 4: Limited Use of Native Fish Conservation Techniques

The fourth alternative would attempt to conserve native fish using a limited toolbox of methods; contract netters and piscicides would not be used. Modification of sandbars at YSL tributary mouths would occur under Alternative 4.

Of the four alternatives, only alternatives 2 and 3 would fully meet plan objectives to preserve, protect, and restore the full range of native fish species and natural ecosystem processes of YELL over the long term. Aquatic resources would be adaptively managed using a hierarchical series of desired outcomes (primary – tertiary), each chosen based on conservation value, technical feasibility, environmental impact analysis, and resource availability. Long-term monitoring of performance metrics would be used to track responses to conservation actions, guide the adjustment of these actions, and determine success or failure (quaternary outcome) of individual projects.

None of the alternatives would have more than moderate impacts to the environmental setting, including geologic, water quality and quantity, wetlands, and vegetation; to fish and wildlife resources, including special status species; or to social and economic resources, including health and human safety, visitor use and experience, park operations, and wilderness. Alternative 2, the preferred alternative, would result in both short-term adverse and long-term beneficial impacts to these resources. None of the alternatives would result in impairment of park resources.

G.3 Site Descriptions

G.3.1. Affected Wetlands or Waters of the U.S. and Their Associated Values in Potential Project Areas

The Native Fish Conservation Plan/EA was designed to address a range of potential projects in streams, rivers, and lakes across the historic ranges of native fish in YELL. However, this is not intended to be a complete list of all projects to be completed under the plan. Additional projects may be developed based on emerging information and changing environmental conditions. This WSOF covers piscicide treatments only in those stream segments identified in this WSOF. This WSOF covers only those structures identified in this WSOF (though even so, additional WSOFs may be needed for these structures if they do not fully qualify as excepted actions). Any other piscicide treatments or construction, reconstruction, or modification of structures not covered in this WSOF would need to be addressed in a new WSOF(s) (unless they fully qualify as excepted actions). Similarly, projects included in the list below may be removed from consideration or considered for less-desirable conditions if they are found to be technically unfeasible, resources for completion are not available, or impacts are determined to be unacceptable.

There are 24 wetland types that would potentially be impacted (Table G-1). The types of wetlands present have been interpreted from the NWI classification system (Table G-3). The majority of potentially impacted wetlands from restoration activities in Yellowstone were identified as “PEMC” interpreted as palustrine habitat that is seasonally flooded and characterized by emergent plant growth. For several reasons only a very small percentage (<5%) of the wetlands identified in Table 1 would actually be affected by piscicide application. Only wetlands that featured a surface water connection to the project stream or were found to bear fish at the time of the treatment would be impacted. Since many wetlands are seasonal, not connected to the stream channel by surface flow, and/or are not inhabitable by fish, a large percentage of wetlands would not require piscicide treatment. In order to minimize the impacts to wetland areas, treatments would be scheduled for the late summer period when seasonal wetlands are dewatered and seasonal overland connections between stream channels and wetlands are minimal.

G.4 Potential Impacts to Wetlands, Other Waters of the US and Associated Values

Potential impacts to wetland areas during or after restoration activities would be small relative to the treatment area and would only impact wetlands for the short-term. It is important to note that many of the values associated with these wetlands would be impacted, even if these impacts would be negligible in the long-term. These wetland values include the biology, both floral and faunal, as well as hydrology and nutrient cycling.

G.4.1. Potentially Impacted Wetland Areas

The primary areas to be impacted are the lakes and streams (as opposed to the adjacent vegetated wetlands). The lower reaches of the target streams are classified in the National Wetland Inventory classification system as upper perennial riverine, unconsolidated bottom or unconsolidated shore, portions of the higher reaches of the target streams are variously classified as intermittent streambeds that are seasonally or temporarily flooded. The majority of potentially impacted habitats within the Goose and Pocket lake treatment areas are classified as lacustrine deepwater habitats. Approximately two-thirds of both projects would occur in this habitat type, which are not designated wetlands under the Cowardin System. All of the streams to be treated with piscicides are free-flowing and unimpacted with the exception that non-native fish are displacing native fish populations, and disturbing the natural species composition of other organisms such as aquatic macroinvertebrates and amphibians. The lakes are similarly unimpacted and both the streams and lakes support popular sport fisheries.

To quantify the area impacted by potential future piscicide treatments, total stream length was calculated by including all stream reaches between upper barriers to fish movement or the furthest extent of water and large bodies of water or current or potential lower barriers. To quantify the area impacted by barrier/weir construction or modification we estimated the area impacted by construction activities as well as areas impacted by pooling of water. All potential restoration projects that would impact wetlands through piscicide application, barrier construction or sandbar modification are summarized below. In order to clarify the types of activities being considered and range of waters where projects occur, specific examples are described below (Table G-1 summarizes):

G.4.1.1. De Lacy Creek

De Lacy Creek treatment would begin in headwater areas except for the case of two west branches where treatment would begin below waterfalls. The project would cover 44.7km of stream and total less than 5 acres of river area. De Lacy Creek treatment would end where the system enters Shoshone Lake, encompassing the entire delta area.

G.4.1.2. Elk Creek

The Elk Creek Complex project would include the upstream portions of Elk, Lost and Yancy Creek below natural waterfall barriers. These three forks form the main stem of Elk creek which would also be part of the treatment and would reach below the lower falls on Elk Creek, just upstream from the Yellowstone River. The total stream length potentially impacted is 11.5km and river area would be approximately 1 acre.

G.4.1.3. Gibbon River

The Gibbon River potential treatment area would be as large as 63 acres, the total stream length would be 179.4 km. The treatment area would include the whole watershed above Gibbon Falls and areas above and below all other natural falls would be treated.

G.4.1.4. Goose Lake Chain

The Goose Lake treatment would encompass Goose Lake and with two other small lakes upstream of Goose Lake (Goose Neck Lake and other unnamed) with a surface area of 42 acres. The total stream length treated would be 4.6km with an area of treatment less than half an acre.

G.4.1.5. Pocket Lake

Treatment of Pocket Lake (less than 14.5 acres) would include a small section of stream above Pocket Lake as well as the section of stream below the lake, to a naturally existing waterfall. In total 2.8km of stream would potentially be affected and in total less than half of an acre of stream area would be treated.

G.4.1.6. Clear Creek

The construction of a replacement weir on Clear Creek would not utilize piscicide and thus stream wetland area impacted is not quantifiable in this manner. Total area impacted by the construction and structure would be less than 0.25 acres.

G.4.1.7. Grayling Creek

The Grayling Creek project would impact 72.3 kilometers of stream, treating from the uppermost extent of water in the drainage to a natural waterfall located near Highway 191. This project would include a modification of the Grayling waterfall. Pooling of water behind the altered structure would be less than 0.25 acres. The total acreage of stream treated with piscicide would be less than 19 acres.

G.4.1.8. Soda Butte Creek

Although alterations to the current falls on Soda Butte would require construction the area affected during construction and as a result of pooling would be less than .25 acres. This project would not utilize piscicide and thus area impacted is not quantifiable in this manner.

G.4.1.9. Specimen Creek

The treatment of the Main Stem and North Fork Specimen Creek would complete the project that began in 2006 with High Lake and the East Fork Specimen Creek in 2008. For this treatment, a barrier would be constructed where Highway 191 crosses the creek. Initial calculations for the Main Stem Specimen Creek barrier (White 2008) suggest that approximately 8 acre-ft of water could pool behind the barrier during a 100 year flood event. Surface area of impounded water could be up to a maximum of 2 acres during normal, base flow conditions. Less than 0.5 Km of wetland (stream) would be impacted by water pooled behind the barrier; most of the impounded water would be impacting upland areas adjacent to the stream. Treating the creek with piscicide would impact 51.2 km of stream and potentially impact 11.5 acres of river area.

G.4.1.10. Yellowstone Lake

There are 54 spawning tributaries to Yellowstone Lake that would be considered for sandbar modification. However, it is not probable that in any season all of these tributaries would be disconnected from the lake and require treatment. The number of tributaries requiring treatment would vary based on water conditions in a given year with drought years requiring more treatments and flood years potentially requiring no treatments. When bars are modified an area of gravel estimated to be 8 meters long by 3 meters wide would need to be moved. Even in the event that all 54 spawning tributaries required treatment in a year the total area impacted would be 0.13 hectares (0.32 acres). There would be no piscicide treatment associated with this project.

G.4.2. Potentially Impacted Wetland Organisms

Riparian wetlands provide essential habitat for Yellowstone's rare plants, reptiles, amphibians, and numerous insects, birds, mammals, and fish. Their ecological function goes well beyond vegetation. These habitats provide shade and temperature regulation for fish, amphibians, aquatic macroinvertebrates and plankton communities. These wetlands also supply coarse woody debris from the riparian canopy which can add structure and shelter for aquatic organisms below the surface of a stream.

Common riparian forest trees are primarily Engelmann spruce, subalpine fir, and lodgepole pine. Understory shrubs include grouse whortleberry, huckleberry, snowberry, Utah honeysuckle, ninebark, thimbleberry, alder, and willows. The herbaceous understory is composed of bluejoint reedgrass, pinegrass, sedges, silvery lupine, false Solomon-seal, violets, and goldenrods. Open creek-side meadows are dominated by numerous sedge and grass species along with asters, fleabanes, biscuitroot, wild mint, yampah, pussytoes, buttercups, goldenrods, and lupines.

The ecological function provided by wetland resources is exemplified in the dynamics of the food chain prevalent in aquatic systems. The biotic tiers of life supported in aquatic environments are explained below.

Phytoplankton are tiny photosynthetic plants that float within the water column. The phytoplankton community includes diatoms, blue-green algae, green algae, and photosynthetic flagellates. Like other algae or vascular plants, phytoplankton transform sunlight and carbon dioxide into organic tissue through photosynthesis and are therefore considered "primary producers." When phytoplankton die, they become organic matter or food that is available for organisms at higher levels in a lake's food web. Because they are the first link in the aquatic food web, phytoplankton are vital components of lake ecosystems in Yellowstone.

Phytoplankton can play a major role in affecting water chemistry and the physical and biological properties of water. During daylight hours, photosynthesis transforms sunlight and carbon dioxide into organic tissue and produces dissolved oxygen. Adequate levels of dissolved oxygen are needed for all aquatic, gill-breathing animals to survive. At night, plants and animals use oxygen and give off carbon dioxide. Carbon dioxide can interact with water-producing carbonic acid and thus lower pH, which is generally highest during late evening and lowest during early morning.

Zooplankton are microscopic animals that are free-floating in the water column, including protozoans, copepods, cladocerans, and rotifers. They are the first consumer level in the food web, with most zooplankton feeding on algae and suspended detritus. *Daphinia* spp., the most commonly known genus of cladocerans, are small plant-eating zooplankton that graze primarily on phytoplankton. Most zooplankton are preyed upon by larger macroinvertebrates and larval fish. The 49 zooplankton taxa that have been identified in Yellowstone include 11 copepods, 22 cladocera, and 16 rotifer species. Zooplankton are directly affected by fish predation and indirectly affected by changes in the food web caused by the introduction of fish species.

*Aquatic macroinvertebrate***s** include a large array of organisms that can be seen with the naked eye and are found in a wide range of rivers, streams, ponds, lakes and wetlands. They are an important food source for fish, amphibians, and some bird and mammal species. Study of aquatic macroinvertebrates in Yellowstone during the last several decades has identified 818 aquatic macroinvertebrate taxa representing 21 distinct taxonomic groups, including aquatic insects, gastropods (snails), bivalves (mussels and clams), hydracarina (water mites), annelids (segmented worms and leeches), amphipods (scuds), isopods (pillbugs), decapods (crayfish), hydroid (hydra), turbellaria (flatworms), porifera (freshwater sponge), and nematodes (unsegmented worms).

Macroinvertebrates are important indicators of the impacts of potential stressors to water quality, such as road construction, sewage spills, and mining activities. Mayflies, stoneflies and caddisflies are indicators of good water quality because they are typically sensitive to environmental change and most abundant in riffle habitats of streams where water quality is very good. Beetles, flies and midges, which are typically less sensitive to environmental change and have the highest densities where water quality has been compromised by natural or human-caused disturbances are indicators of poor water quality.

G.4.3. Potentially Impacted Wetland Functional Values

To address the impacts to the functional value of wetlands, effects are considered by the main restoration activities addressed in this WSOF: Construction, removal and recovery.

Construction relative to native fish restoration activities includes the construction of barriers or weirs, the modification of natural falls or cascades to create barriers and removal of sandbars to re-open spawning streams on Yellowstone Lake. These activities may have impacts on aquatic life, including fish, amphibians and aquatic macroinvertebrates, along with terrestrial wildlife, aquatic and terrestrial vegetation and localized impacts to hydrology.

Barrier and weir construction would take place within the stream channel and surrounding riparian areas. Although there is reason to assume that there would be localized trampling of vegetation, minimal amounts of vegetation would be disturbed or removed for construction purposes. During construction the addition of pack stock for transporting equipment increases potential for trampling vegetation and introducing non-native species into disturbed areas. Plankton, aquatic invertebrate, and amphibians would be directly affected by the rebuilding of a weir or barrier. The streambed and riparian areas would be disturbed, displacing plankton, aquatic invertebrate, and amphibian populations causing these organisms to become dislocated making them more susceptible to predation. Adverse impacts to wildlife that use riparian area such as otter, black bear, beaver, muskrat, American dipper, and other migratory bird species would include temporary displacement. Wildlife that use riparian areas would most likely be affected by weir and barrier construction, maintenance and monitoring activities, as human activities could interrupt their habitat and temporarily displace these animals.

Construction of the Specimen Creek fish barrier could initially alter patterns of sediment transport and debris flow. The barrier will act as a sediment trap until the upstream pool formed by the barrier fills in completely with stream substrate. During the in-filling period there could be an increase in erosion levels in the stream channel downstream of the structure, as sediment recruited from that area may not be replaced by sediment carried in from above. Once the area upstream of the barrier has filled completely, sediment transport continuity through the barrier reach should return to existing levels. The proposed design of the Specimen Creek barrier, which contains a shallow notch-shaped depression at its crest, would facilitate the movement of sediment and debris. As a part of routine maintenance of the structure by NPS crews, large (woody) debris blocked would be removed and allowed to progress downstream.

Modifications of natural waterfalls (Grayling Creek and Soda Butte Creek) by addition of concrete wingwalls and splashpads would not significantly alter patterns of sediment transport during periods of operation. Flow rates and the transport of nutrients/energy in these systems would not change due to the proposed projects. Completion of the modifications would negligibly alter local hydrology, causing a minor amount of water to pool as eddies upstream of the wingwall structures. Fish (WCT or YCT) would possibly congregate in these eddies, increasing their vulnerability to predation. Alternatively these eddies could create additional habitat for certain wildlife species. Redirected water velocities may cause an change in the community structure of local plankton, aquatic invertebrate communities, and amphibians.

Clear Creek is one of the major spawning streams for YCT in the Yellowstone Lake watershed. Construction of the weir would require work within the stream and adjacent riparian areas. Weir maintenance and operation could seasonally inundate wetland, riparian, and upland vegetation upstream of the weir. Small numbers of fish and fish eggs could be disturbed or crushed from construction activities. Completion and use of the weir would affect the migration pattern of spawning YCT because weir impingement may cause some fish deaths and handling of fish by NPS crews would cause additional stress to spawning fish. The presence of the weir may concentrate fish and allow them to be more susceptible to predation by birds and mammals. Completion of the Clear Creek weir would seasonally alter local hydrology, causing water to pool behind the weir. Change in water velocities may cause an adverse change in community structure of the local plankton and aquatic invertebrate population and create more suitable habitat for amphibians.

Construction of fish barriers similar to the one on Specimen Creek would affect native fish resources in the immediate vicinity upstream of the barrier because construction activities may temporarily displace some fish. Barriers would permanently affect the migration pattern of local fish; however, barriers would not be placed where native fish with migratory life history strategies currently exist. Native fish populations are expected to benefit through reduced predation, competition, and hybridization with non-native fish because barrier construction would create isolated habitats where native fish could thrive. Examples of modifying existing water features that serve as partial barriers include: redirecting stream flow using wing walls, filling plunge pools with material to eliminate jumping areas, using explosives to increase the height or angle of a feature, or some combination of the above. Completion of natural structure modification would have the same impact on native species as a constructed barrier, such as temporary displacement of native species and temporal impacts to hydrology.

Modification of sandbars would move small amounts of unvegetated sand and gravel from the mouths of YSL tributaries to adjacent shoreline areas of comparable unvegetated sand and gravel. This activity would have a minor impact on hydrology as tributary streams would be allowed to flow directly into YSL instead of percolating through a sandbar before entering the lake. The activity would not disturb vegetation, alter water quality or quantity, or affect the formation of sandbars in the long-term. Effects from treatments, moving sand and gravel, would likely last one season or less, as natural wave action and sediment transport/deposition would be unaffected. Although the adverse effects on wetland biotic communities would be negligible, there is potential that moving and placing sandbar material would displace aquatic invertebrates that live within the substrate. It is also important to note that if plant species of special concern (especially Yellowstone sand verbena (Abronia ammophila) an endemic to Yellowstone which is being evaluated for listing as a federal threatened or endangered species) are found and could not be mitigated for, the tributary would be removed from further consideration for enhancement of YCT spawning areas.

Removal of non-native fish species would occur in two forms: mechanical and chemical. Mechanical removal would utilize techniques like electro-fishing and gill-netting while chemical removal would entail the use of piscicides like rotenone or antimycin and neutralizing agents such as potassium permanganate ($KMnO_4$). Applied chemicals would affect waters being treated and may affect downstream portions of the treatment area; mechanical removal would only affect waters in the immediate work area. Chemical and mechanical methods to remove non-native fish would affect native fish resources within the project watershed, particularly in areas where native fish populations coexist with non-native fish. Both methods would have adverse affects on native fish populations found within restoration areas because some native fish could be killed or injured. The intent of these projects is to restore YCT, WCT and GRY but in project areas where native non-salmonid species (i.e. sculpin) were present before treatment they would also be restocked from downstream sources after treatments are completed. Whether removal is chemical or mechanical, short-term indirect effects may occur when localized fish populations are removed and aquatic invertebrate or larval amphibian communities are reduced because the food source for some species would be reduced. Wildlife that depends on fish and aquatic invertebrate communities may be displaced until the stream has recovered. Picivorous species such as river otter, bald eagles, and osprey would most likely be affected on larger streams; American dipper, a small, aquatic, insect-eating bird, may also be affected by chemical removal of fish and aquatic insects.

Mechanical removal would be used for selective removal projects, when the intent is to avoid complete removal of all species; however both electrofishing and gill-netting can injure or kill non-target organisms. Gill-net by catch can lead to the death of non-target fish species. Electrofishing can cause permanent injury to fish from the shock itself or from handling stress which may lead to death. Electrofishing and netting may affect plankton, aquatic invertebrates, and amphibians to a small degree by dislodging individuals, shocking individuals or from trampling. Electrofishing and netting may also affect some wildlife to a small degree by temporarily displacing them from the project area because these removal efforts would require walking in stream channels and along lake shorelines.

Piscicide treatments would have short-term impacts on the aquatic biota of wetlands. The intent of chemical treatments is a complete kill of all fish present in a habitat, thus all fish species present in treated wetland areas would be killed. As with the native species that these projects intend to restore (YCT, WCT and GRY) other native non-game species would be restored after treatment. Adult amphibians, mammals, birds, and reptiles would not be directly affected by piscicide application. Amphibians and AMI that are affected by piscicide treatment would be expected to recover completely within 3 years, and would likely recover more quickly. Chemical treatments would have adverse affects to plankton, aquatic invertebrates, and amphibians. Susceptibility and degree of impact would vary among species and life history stage. Studies have shown though, that reestablishment of native fish would in the long term improve diversity of these species and ecological function. It is very important to note that piscicide application would likely cause direct mortality to juvenile Alexander's Rhyacophilan caddisfly, a rare species.

In general, adult and juvenile zooplankton tend to be sensitive to chemical treatments, resulting in a marked decline in their population immediately after treatment, which would recover over time. Some Aquatic Macroinvertebrates (AMI) would be killed in treated wetland areas, other AMI species would be displaced, and other species would not be affected. Response by aquatic invertebrates would depend on a variety of factors including species, exposure, and method of respiration. Typically, invertebrates that are affected by chemical treatment would be dislodged and drift downstream to avoid chemical exposure. Overall affects of chemicals on individual invertebrates can range from negligible (no effect) to death. Some invertebrate taxa may be entirely removed from the population. Aquatic invertebrate populations are dynamic and highly variable, thus total recovery of some invertebrate taxa would be impossible to document. All larval amphibians in treated wetland areas would be killed. Larval amphibians are very susceptible to rotenone which can cause 100 percent mortality; adult amphibians do not seem to exhibit adverse affect from its application. Therefore, mitigation measures (e.g., timing, relocating, and rearing individuals) would be taken to avoid these sensitive periods in life histories of aquatic organisms (see Appendix B of the EA for an in-depth discussion on impacts to non-target species).

Chemical application associated with fisheries restoration activities are not lethal to aquatic or riparian vegetation. It is the case that reduced light penetration from $KMnO_4$ applications could reduce photosynthesis in aquatic vegetation; however, impacts would be negligible since application takes place over a relatively short period of time (and 2-3 days for streams). During fish removal efforts, vegetation would be trampled or disturbed from motorized boats, walking/wading along shorelines and riparian areas, accessing application stations, angling, electrofishing, and net deployment and retrieval.

Recovery refers to active restoration of native fish populations by fisheries managers. In YELL these activities would include restocking fish from native, genetically pure brood stocks along with implementing remote site incubators (RSIs). RSIs promote natural reproduction through the placement of eggs in spawning streams for successful future recruitment, fundamental to the success of population recovery.

In restoring native populations the use of incubators would entail walking in streams and adjacent riparian areas. This could cause aquatic organisms to become trampled or dislodged making them more susceptible to predators. After restoration, all native fish species (native trout along with non-game species) would be restocked and native fish populations would benefit from returning to their historic range within the park and reducing extirpation risk within the Yellowstone ecosystem. Specifically, the recovery of YCT to the tributary streams of Yellowstone Lake would provide a long-term moderately beneficial impact on grizzly bears as YCT would again become an available food source. However, in and near developed areas, the return of YCT could increase the incidence of human/bear conflicts and could precipitate a long-term, negligible to minor adverse impact on grizzly bears in these areas.

G.4.4. Proposed CompensAtion

Six streams and 3 lakes are listed as representative projects where the proposed activities would cause adverse impacts to wetlands and waters of the U.S. and associated values. Specifically, the application of piscicide to water would kill some aquatic macroinvertebrates (AMI) and larval amphibians along with all native non-game species of fish. These species of fish would be restocked in treated rivers and streams from downstream sources after treatments are completed. The physical nature of the wetlands, other wetland fauna, and wetland plants would not be adversely impacted by piscicide application. Following treatments with piscicide AMI and amphibian communities would be expected to recover naturally within 3 years and likely less. Also following treatment, native fish assemblages would be restored in wetland areas, including target restoration species (YCT, WCT and GRY) and native non-game species such as the mottled sculpin. Because the nature of impacts to wetlands or waters of the U.S. and their associated values from piscicide application is temporary, and because these treatments will in the long term provide for restoration of native fish which in turn would support a more naturally functioning system, the proposed activities would be self-compensating. The same is true for the proposed activity of movement of shoreline gravel to reconnect YCT spawning tributaries to YS.

Currently the status of native YCT, WCT and GRY across the Yellowstone region is threatened. Protecting and reestablishing these populations within the streams and lakes of YELL would benefit preservation of these threatened species throughout their natural ranges. Native species benefit their natural habitats as they have evolved as an integral part of the ecosystem. Native species have important ecological roles within their native systems and when the species assemblage of an ecosystem is altered the basic functioning of that ecosystem is often deteriorated. As an example the LKT in Yellowstone Lake (YSL) have significantly reduced the population of YCT which has resulted in impacts to multiple trophic levels within the ecosystem. Declines in several important consumer species near the lake and/or its tributaries have been documented, including grizzly bears, bald eagles, ospreys, and river otters (McEneaney 2002; Koel et al. 2005; Haroldson et al. 2005; Crait and Ben-David 2006; McEneaney 2007). The expanded LKT population and YCT loss have resulted in significant shifts in energy (nutrient) flow both within the lake and between the lake and its spawning tributaries (Tronstad 2008).

Although LKT are only issues in YELL's larger lakes (Yellowstone, Lewis and Shoshone) there are many studies that show the negative impacts of non-native trout to smaller, stream ecosystems. Non-native trout have negative impacts on wetland values, including native fish species (Peterson et al. 2004, Baker et al. 2008, Shepard 2010), amphibians (Vredenburg 2004, Knapp 2005, Knapp et al. 2007), reptiles (Matthews et al. 2002, Knapp 2005), other lake fauna and nutrient cycling (Knapp et al. 2001, Sarnelle and Knapp 2005, Schilling et al. 2009). Therefore, although it is the case that restoration activities would have short-term adverse impacts to wetlands and their flora and fauna, these activities would directly lead to long-term benefits of wetland character by restoring native species.

This may also be true for construction of fish barriers but other compensations may be necessary depending on hydrologic assessments. These compensations would be developed during the project-specific SOF process. For example, upon completion of the watershed restoration on Specimen Creek, the existing EFSC barrier would be removed and the area rehabilitated to its natural condition. This would result in 0.125 acre of aquatic habitat (stream/wetland) restored to a natural condition. Reconstruction of the Clear Creek weir would result in impacts to 0.2 acre of wetland. However, the pre-existing structure was built and operated in a way that pooled water extensively and greatly altered sediment transport. As a result, large sediment deposits (sand and gravel bars) were created both upstream and downstream of the previous structure, diverting streamflows and causing extensive streambank erosion and undercut banks. The new weir is intended to be operated in a manner that will allow open (natural) flows, to prevent further sediment deposition and bank erosion. Compensation for impacts to 0.2 acre wetland by reconstruction of the Clear Creek weir would be rehabilitation of the existing severely degraded wetland habitat upstream and downstream of the site. Approximately 0.4 acre aquatic habitat (stream/wetland) would be rehabilitated to a natural condition. As such, all activities proposed in this WSOF have the potential to be self-compensating, either through the restoration of native aquatic communities, restoration of natural aquatic habitats, or both.

G.5 Justification for Use of Wetland Areas

The purpose of this project is to restore native fish to streams, rivers, and lakes park wide in order to conserve those species and their associated communities from threats of non-native species, disease, and climate-induced environmental change. Restoring aquatic communities by removal of non-natives and restocking with native species restores aquatic habitats and ecological processes to a more natural state and function.

G.6 Investigation of Alternative Sites

Sites selected for piscicide application in the current EA and WSOF were selected from many sites by assessing their technical feasibility, conservation value, and likelihood for success. Additionally, because of the nature of the actions, comparable impacts would occur at any site where native fish restoration occurred. Alternative sites have been investigated, considered, and dismissed.

G.7 Mitigative Measures

The following are mitigations or compensatory actions that would be implemented with each project in order to reduce impacts and to maintain consistency with the NPS “no net loss of wetlands’ goal found in DO #77-1.

- Each project that requires piscicide use would be managed by a certified piscicide applicator.

- Methods to mitigate piscicide use include: lowering piscicide concentration while still achieving complete eradication and adjusting treatment timing to avoid harming juvenile amphibians and AMI.
- Survey work would be completed prior to piscicide application to establish the distribution of target and non-target fish and presence of fishless water so that waters can be left untreated if treatment is not required.
- Mitigating the impacts to non-target organisms would also be accomplished by collecting and disposing of as many fish carcasses as possible immediately following treatment to avoid attraction of bears and other animals to the project area.
- Impacts to wetland areas from piscicide application would be minimized by timing treatments to coincide with the low-water period of late-summer and early-autumn to the greatest extent possible.
- In streams proposed for a project, any man-made fish barriers (culverts and other water diversion structures) would be re-engineered and replaced with structures that would allow more natural fish movement.
- For each fish barrier constructed, interdisciplinary collaboration would take place to minimize the change to the stream's natural hydrologic conditions.
- The proposed design of the Specimen Creek barrier, which contains a shallow notch-shaped depression at its crest, would facilitate the movement of sediment and debris. As a part of routine maintenance of the structure by NPS crews, large (woody) debris blocked would be removed and allowed to progress downstream.
- For each fish barrier constructed, regular monitoring of structural integrity and regular maintenance would be conducted to help assure that the restoration gains would be essentially permanent.
- Spawning stream work would not take place during the YCT spawning run when these areas are closed during the Bear Management Area restriction (until July 15th for most tributaries and August 11th for Clear Creek and the east shore of Yellowstone Lake) without consultation and approval from the Yellowstone Bear Management Office.
- Consultation from park experts concerning rare plant species, cultural resources, and wetlands before implementation of projects where sand and gravel would be disturbed.
- All disturbed areas would be restored as nearly as possible to pre-treatment conditions shortly after activities are completed.

G.8 Compliance

Current plans and policy that pertain to this proposal include the Yellowstone's Resource Management Plan (NPS 1998), the 2006 National Park Service Management Policies (NPS 2006), and other legislation. Outlined below is more information pertaining to how this proposal meets the goals and objectives of these plans and policies:

- This plan is consistent with the goals and objectives of the 2006 Management Policies (4.4.4 Management of Exotic Species) which requires national parks to prevent the displacement of native species by exotic [non-native] species (NPS 2006).
- Restoration practices including the removal of exotic species are consistent with the 2006 NPS Management Policies (NPS 2006). Section 1.4.7.2 of NPS Management Policies (Improving Resource Conditions within Parks) states,

- This plan is consistent with Executive Order 13112 which states, a federal agency is not authorized to fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions." The Executive Order requires federal agencies to develop management plans to identify invasive species and develop a plan that would prevent the introduction and reduce the risk of spread of identified species.
- This plan is consistent with Yellowstone's Resource Management Plan (NPS 1998) which identified conservation of stream communities and native cutthroat trout and controlling non-native aquatic species as a high-priority need.
- Restoration activities would be guided by the natural and cultural resource-specific policies identified in chapters 4 and 5 of these Management Policies" (National Park Service, 2006).
- Section 4.4.4.2 (Management of Exotic Species) includes the following direction:
- High priority would be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controlled. Lower priority would be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled. Where an exotic species cannot be successfully eliminated, managers would seek to contain the exotic species to prevent further spread or resource damage.

G.9 Summary

The preferred alternative was designed to avoid and minimize impacts to wetlands park wide to the greatest extent possible.

Actions proposed under the Native Fish Conservation Plan would result in substantial short-term adverse impacts to wetland ecological function through the use of piscicides and resulting loss of some macroinvertebrates. Removal of sand bars blocking some Yellowstone Lake spawning tributaries would result in short-term adverse impacts to wetland vegetation if it exists. However, long term adverse impacts would be negligible as macroinvertebrate species recover within 1-3 following treatment and vegetation would be restored.

Reconstruction of the Clear Creek weir would result in impacts to 0.2 acre of aquatic habitat (stream/wetland). However, the new weir is intended to be operated in a manner that will allow open (natural) flows, to prevent further sediment deposition and bank erosion. Compensation for impacts to 0.2 acre wetland by reconstruction of the Clear Creek weir would be rehabilitation of the existing severely degraded wetland habitat upstream and downstream of the site. Approximately 0.4 acre aquatic habitat (stream/wetland) would be rehabilitated to a natural condition.

Construction of the Specimen Creek fish barrier would result in an upstream pool that will fill with sediment. As this occurs, sediment-poor water may scour and erode the stream immediately downstream of the barrier. However, once the pool is filled, sediment movement will return to existing levels. The Specimen Creek barrier will impound water and inundate existing (stream) wetland, resulting in long-term adverse impacts to <0.5 Km. However, upon completion of the watershed restoration on Specimen Creek, the existing EFSC barrier would be removed and the area rehabilitated to its natural condition. This would result in partial compensation for the new Specimen Creek fish barrier, as 0.125 acre of aquatic habitat (stream/wetland) would be restored to a natural condition.

Modifications to existing waterfalls on Grayling Creek and Soda Butte Creek would not significantly pool water or otherwise adversely impact wetlands, and would allow recovery of watersheds to support native species and natural, ecological processes.

Restoration of native fish and the aquatic/terrestrial species they support across up to 367 Km of stream would compensate for short term adverse impacts to wetlands and a long-term permanent loss of <0.5 Km of wetland on Specimen Creek. Overall, no significant loss of wetland area or impacts to wetland ecological function are anticipated upon implementation of the proposed actions. If project-specific compensations are determined necessary for fish barrier modification actions, these will be disclosed in separate SOFs. Therefore the NPS finds this programmatic analysis is consistent with the policies and procedures of NPS Director's Order #77-1: Procedural Manual 77-1: Wetland Protection which provides NPS policies and procedures for complying with Executive Order 11990.

Literature Cited

Baker, G., N. Darby, T. Williams, and J. Wullschleger. 2008. Bonneville cutthroat trout restoration project—Great Basin National Park. Natural Resource Report NPS/NRPC/NRR—2008/055. National Park Service, Fort Collins, Colorado.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoc. 1979 Classification of Wetlands and Deepwater Habitats of the United States. Fish and Wildlife Service, USDI, Report FWS/OBS-79-31. Washington, D.C.

Crait, J.R. and M. Ben-David. 2006. River otters in Yellowstone Lake depend on a declining cutthroat trout population. Journal of mammology 87:485-494.

Haroldson, M.A., K.A. Gunther, D.P. Reinhart, S.P. Rodruzny, C. Cegelski, L. Waits, T. Wyman, and J. Smith. 2005. Changing numbers of spawning cutthroat trout in tributary streams of Yellowstone Lake and estimates of grizzly bears visiting streams from DNA. Ursus 16:167-180.

Knapp. R.A. 2005. Effects of nonnative fish and habitat characteristics on lentic herpetofauna in Yosemite National Park, USA. Biological Conservation 121:265-279.

Knapp, R.A., D.M. Boiano and V.T. Vredenburg. 2007. Removal of nonnative fish results in population expansion of a declining amphibian (mountain yellow-legged frog, *Rana muscosa*). Biological Conservation 135:11-20.

Knapp, R.A., K.R. Matthews and O. Sarnelle. 2001. Resistance and resilience of alpine fauna to fish introductions. Ecological Monographs 73:401-421.

Koel, T. M., P. E. Bigelow, P. D. Doepke, B. D. Ertel, and D. L. Mahony. 2005. Nonnative lake trout result in Yellowstone cutthroat trout decline and impacts to bears and anglers. Fisheries 30:11 10-19.

Matthews, K.R., R.A. Knapp and K.L. Pope. 2002. Garter snake distributions in high-elevation aquatic ecosystems: Is there a link with declining amphibian populations and nonnative trout introductions. Journal of Herpetology 36:16-22.

McEneaney, T. 2002. Piscivorous birds of Yellowstone Lake: their ecology, history, and status. Pages 121 – 134 *in* R.J. Anderson and J. Harmon, editors. Yellowstone Lake: hotbed of chaos or reservoir of resilience? 6th Biennial scientific conference on the Greater Yellowstone Ecosystem. Yellowstone Center for Resources, Yellowstone National Park, Wyoming.

McEneaney, T. 2007. Yellowstone bird report. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-NR-2007-01.

National Park Service (NPS). United States Department of Interior. 2008. Director's Order #77-1, Procedural Manual #77-1: Wetland Protection. Fort Collins, Colorado.

Peterson, D.P., K.D. Fausch and G.C. White. 2004. Population ecology of an invasion: Effects of brook trout on native cutthroat trout. Ecological Applications 14: 754-772.

Schilling, E.G., C.S. Loftin and A.D. Huryn. 2009. Effects of introduced fish on macroinvertebrate communities in historically fishless headwater and kettle lakes. Biological Conservation 142:3030-3038.

Schindler, D.E., R.A. Knapp and P.R. Leavitt. 2001. Alteration of nutrient cycles and algal production resulting from fish introductions into mountain lakes. Ecosystems 4:308-321.

Sarnelle, O. and R.A. Knapp. 2004. Zooplankton recovery after fish removal: Limitations of the egg bank. Limnology and Oceanography 49:1382-1392.

Sarnelle, O. and R.A. Knapp. 2005. Nutrient recycling by fish versus zooplankton grazing as drivers of the trophic cascade in alpine lakes. Limnology and Oceanography 506:2032-2042.

Shepard, B.B. 2010. Evidence of niche similarity between cutthroat trout (*Oncorhynchus clarkii*) and brook trout (*Salvelinus fontinalis*): Implications for displacement of native cutthroat trout by nonnative brook trout. PhD dissertation. Montana State University, Bozeman.

Tronstad, L. M. 2008. Ecosystem consequences of declining Yellowstone cutthroat trout in Yellowstone Lake and spawning streams. Doctoral dissertation. University of Wyoming, Laramie, Wyoming.

Vredenburg, V. T. 2004. Reversing introduced species effects: experimental removal of introduced fish leads to rapid recovery of a declining frog. Proceedings of the National Academy of Sciences (USA) 101:7646–7650.

White, D. 2008. Hydrolic (Hec-Ras) analysis and conceptual design report for Specimen Creek fish barrier. Interim project report for Yellowstone National Park. Gallatin National Forest, Bozeman, MT.

Tables

Table G.1. Anticipated Stream Length (km) and Acreage Treated

	length (km)	total acreage
De Lacy Creek	45	5
Elk Creek	12	1
Gibbon River	179	64
Goose Lake	5	<1
Grayling Creek	72	19
Pocket Lake	3	<1
Specimen Creek	51	11

Table G-1. Anticipated stream length (km) and acreage treated with piscicide in potential restoration activities. The total stream length potentially treated here is 3.2% of all the known streams in YELL.

Table G.2. Wetland Types Potentially Impacted by Restoration Activities

Lacustrine	**Palustrine**	**Riverine**
L2ABG	PABF	R3UBF
L2UBG	PABG	R3UBG
L2USC	PEMA	R3UBH
	PEMB	R3USA
	PEMC	R4SBA
	PEMJ	R4SBC
	PFOA	
	PFOB	
	PFOJ	
	PSSA	
	PSSB	
	PSSC	
	PUSC	
	PUSJ	

Table G-2. Complete list of wetland types potentially impacted by restoration activities. Use Table 3 to key out the four or five letter terms (i.e. PFOB) identifying specific wetland types.

Table G.3. National Wetland Inventory classification table

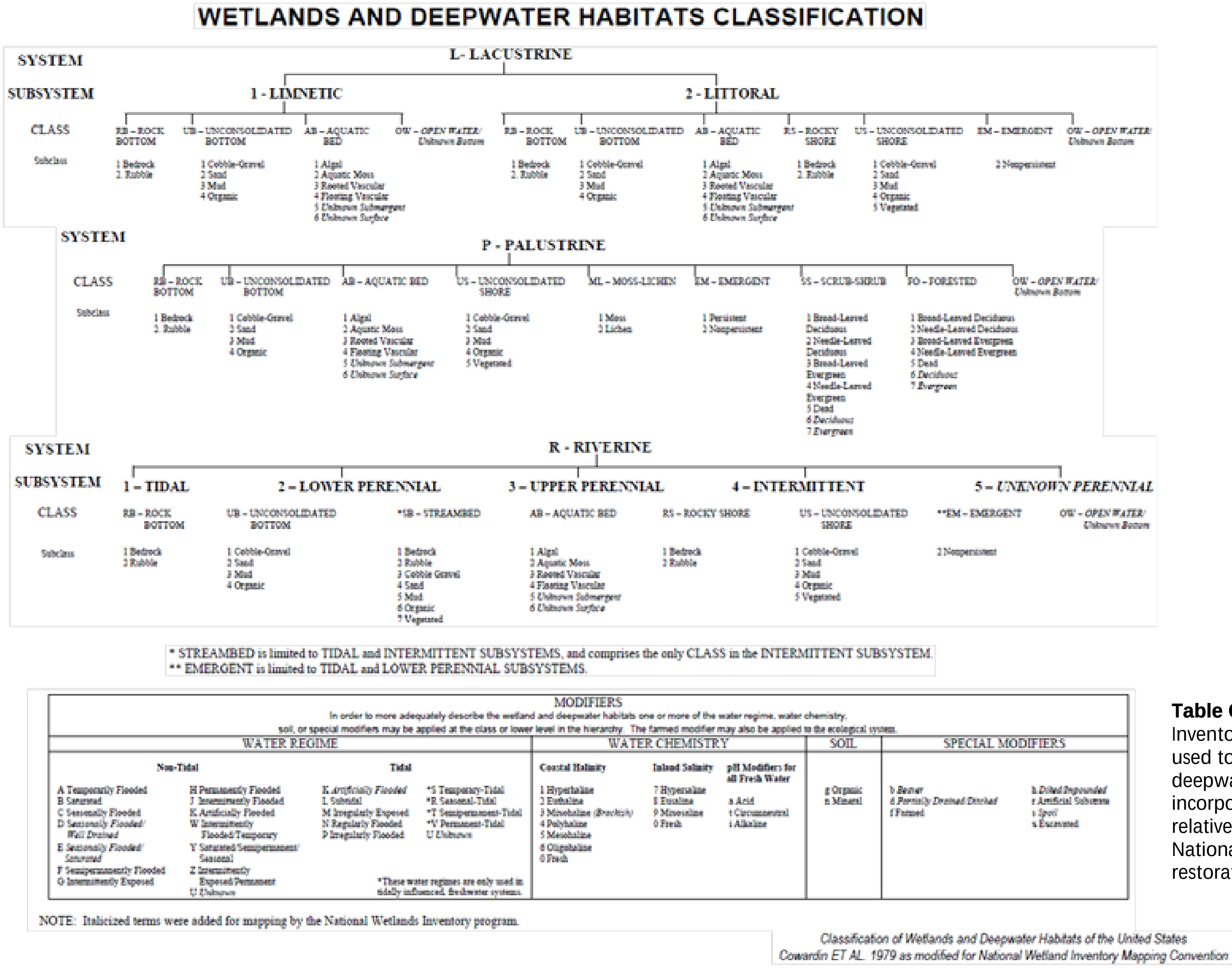

Table G-3. National Wetland Inventory classification table used to identify wetlands and deepwater habitats. Altered to incorporate those ecosystems relative to Yellowstone National Park and potential restoration activities.

Figures

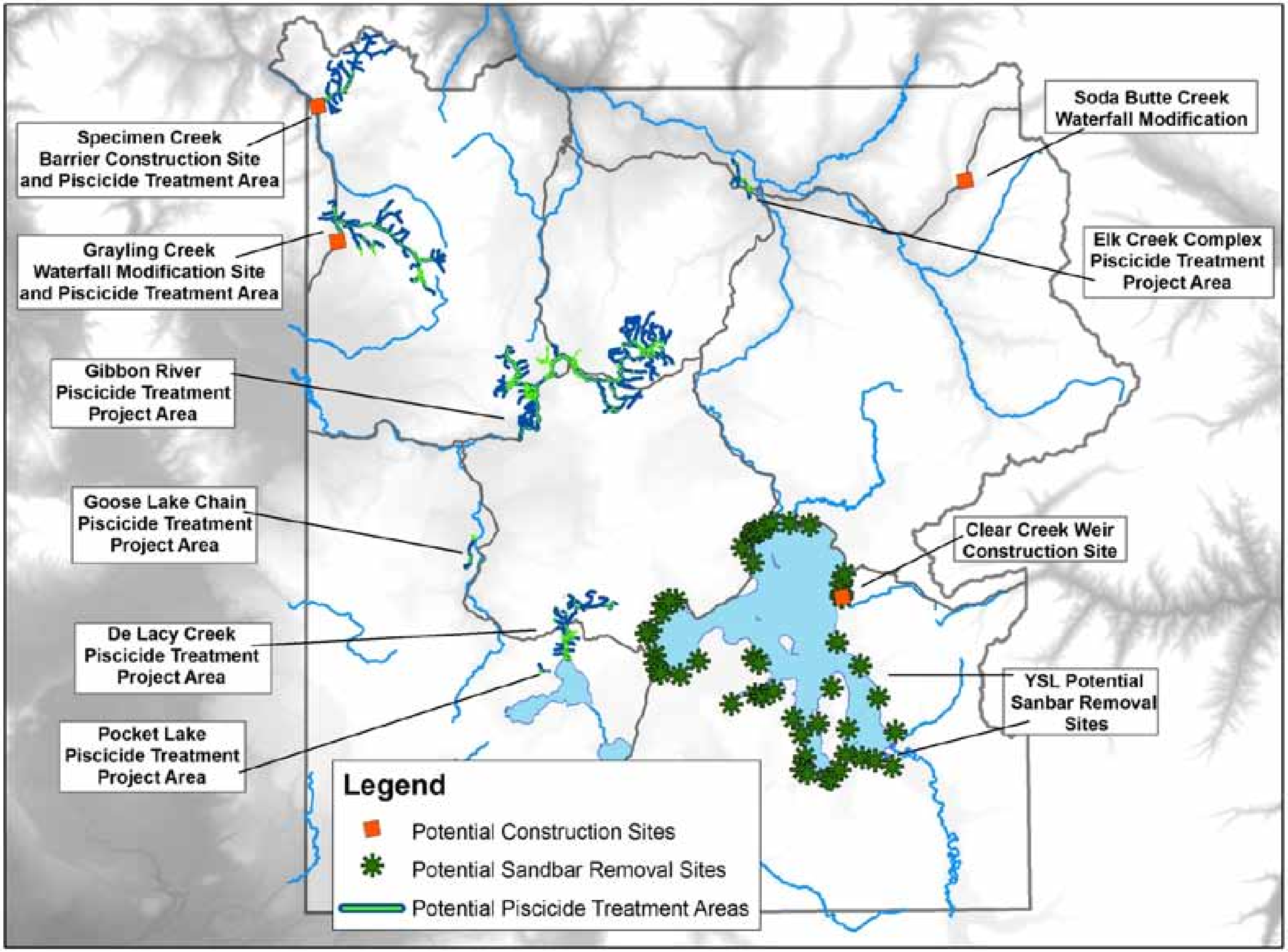

Figure G-10. All potential restoration activities included in the 2010 Yellowstone Native Fish Conservation Plan EA.

Maps of all potential restoration project areas that would include the use of piscicide or barrier construction. Maps created with National Wetland Inventory (NWI) data highlighting the wetland areas identified by 1998 NWI data (highlighted in green) along with stream wetland areas (in blue) potentially impacted by restoration activities. NWI wetlands were identified as potentially impacted due to their proximity (within 30m) to the stream, but the entire stream channel would be impacted as well.

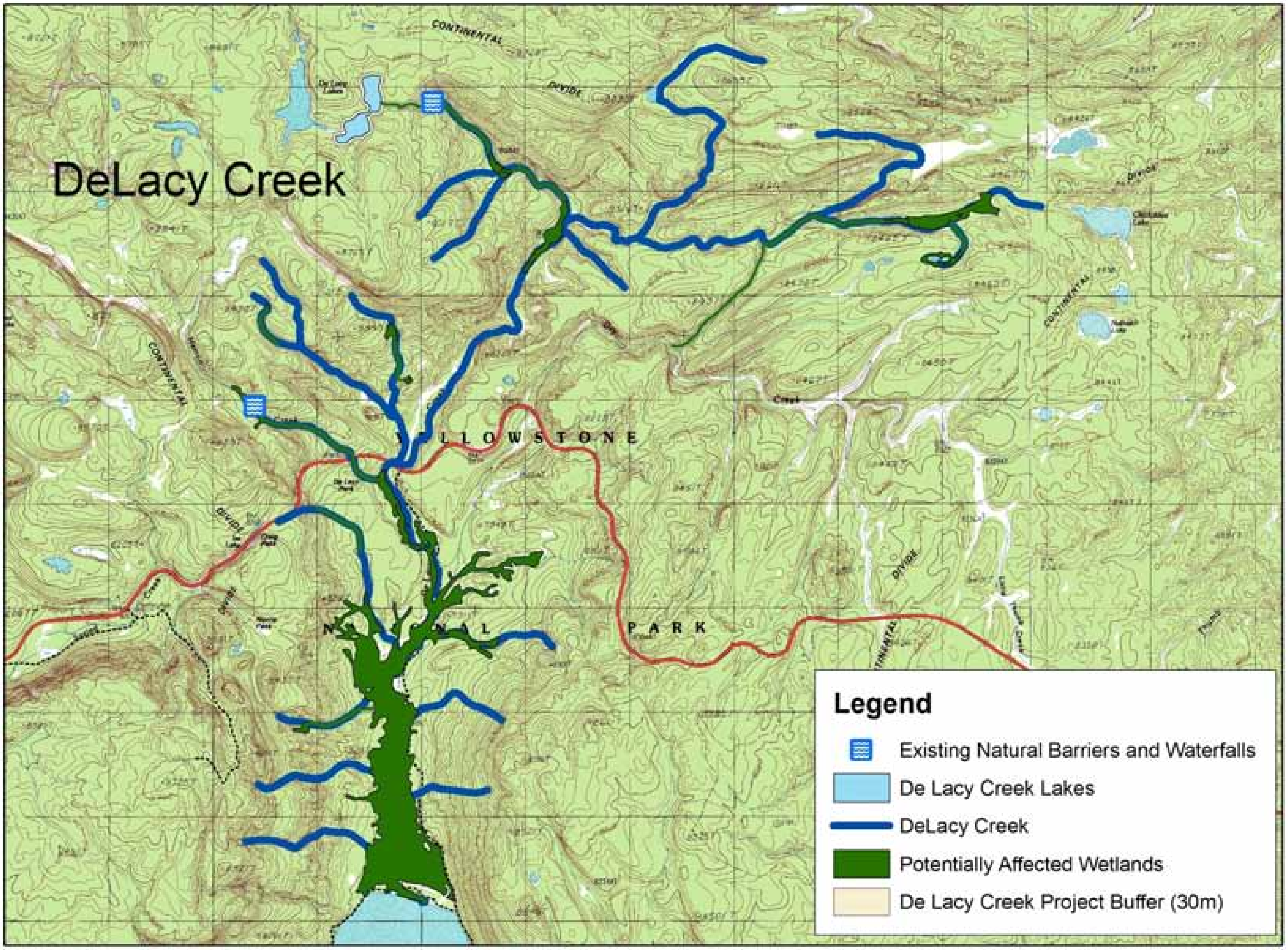

Figure G-11. De Lacy Creek potential project wetlands From USFWS NWI map data, 1998.

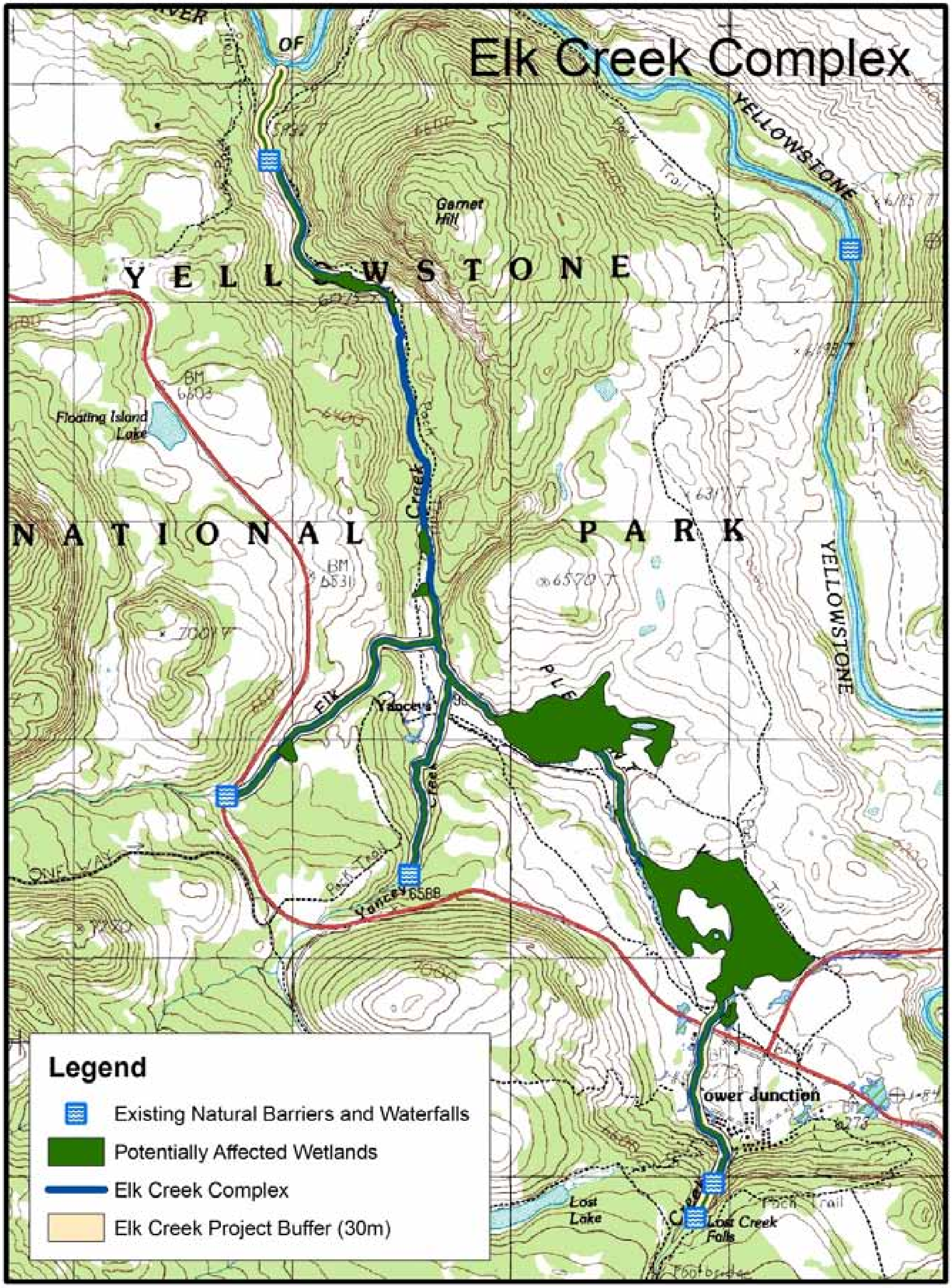

Figure G-12 Elk Creek Complex potential project wetlands. From USFWS NWI map data, 1998.

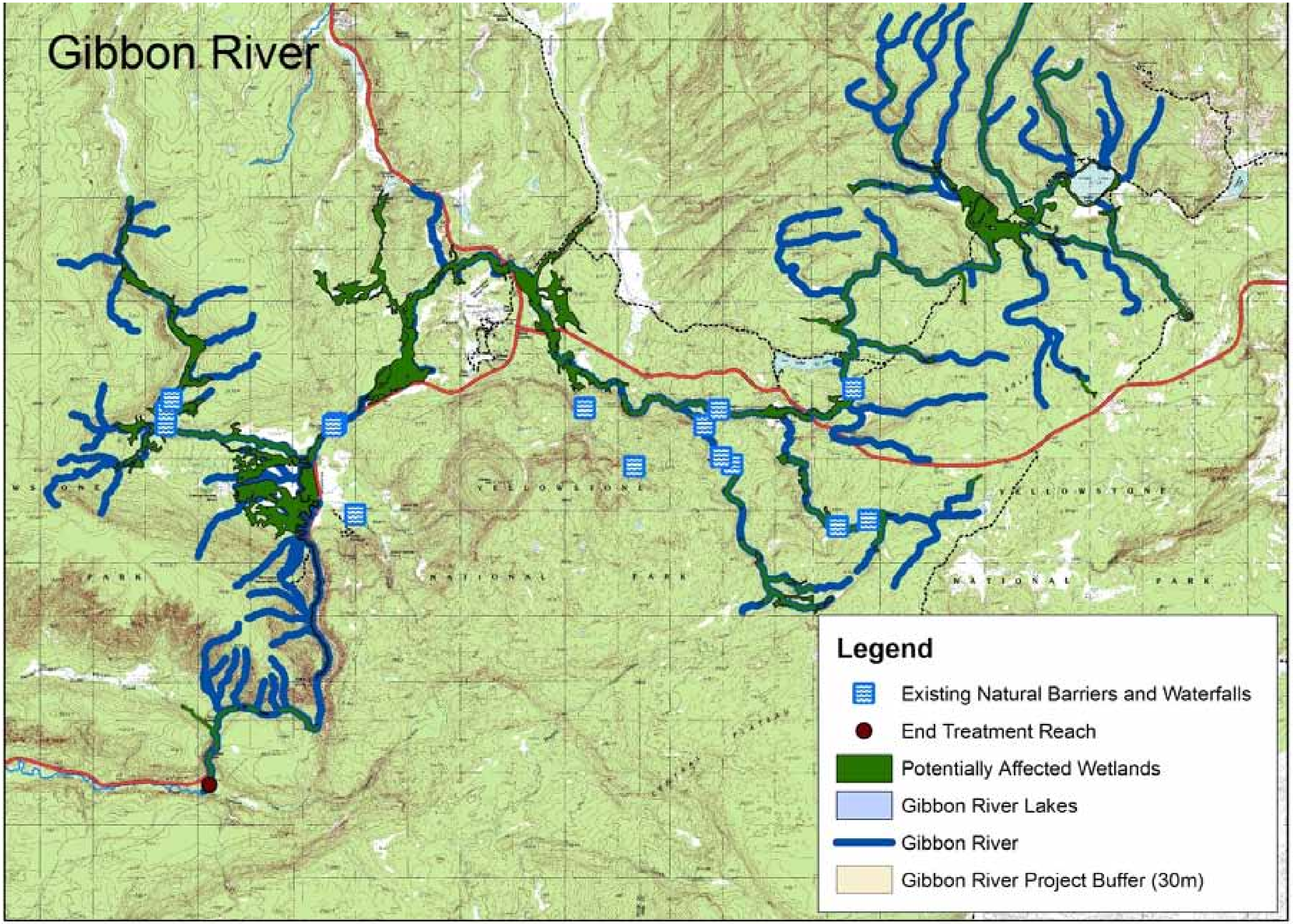

Figure 11. Gibbon River potential project wetlands.

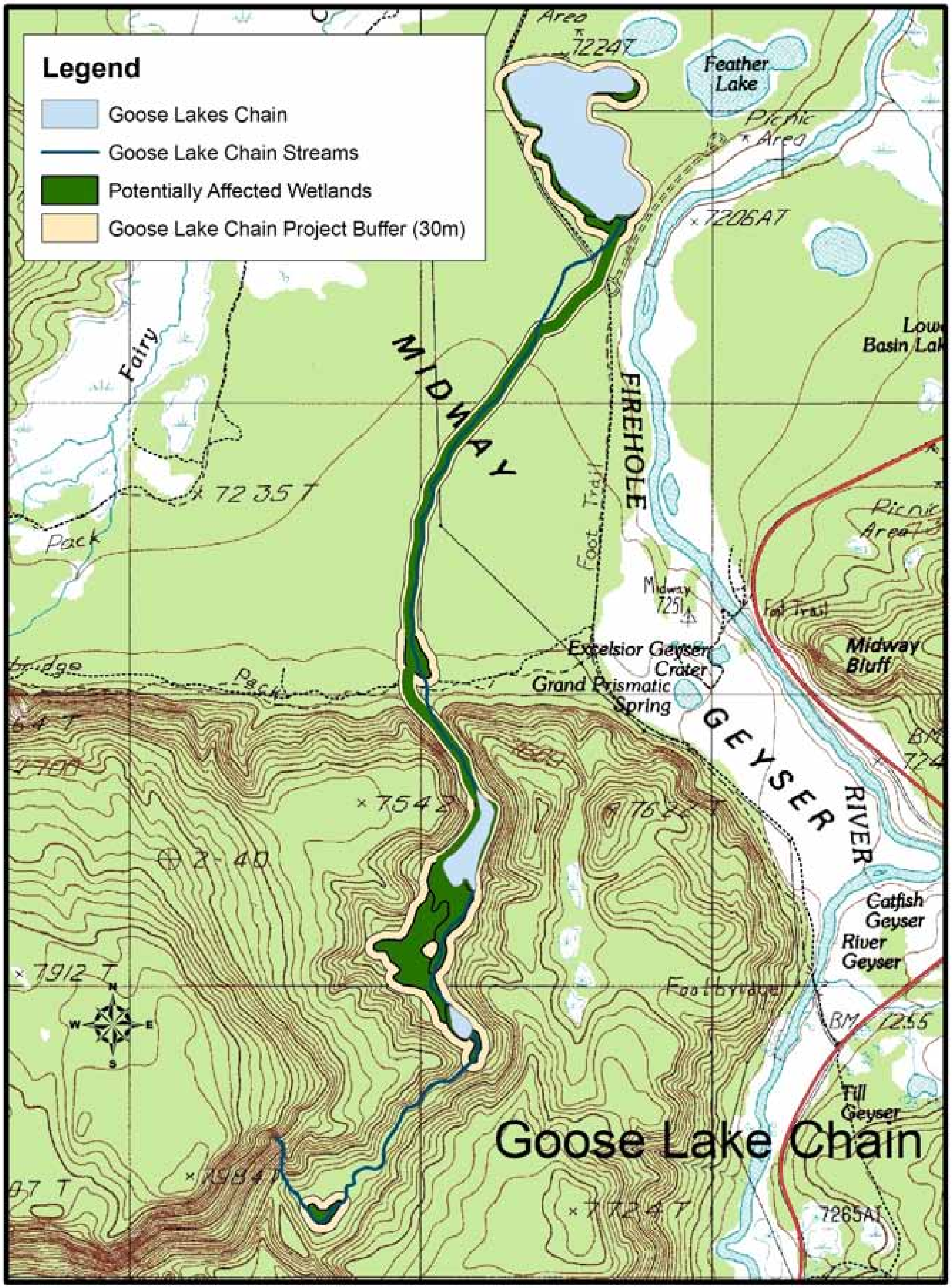

Figure G-14. Goose Lake Chain potential project wetlands. From USFWS NWI map data, 1998.

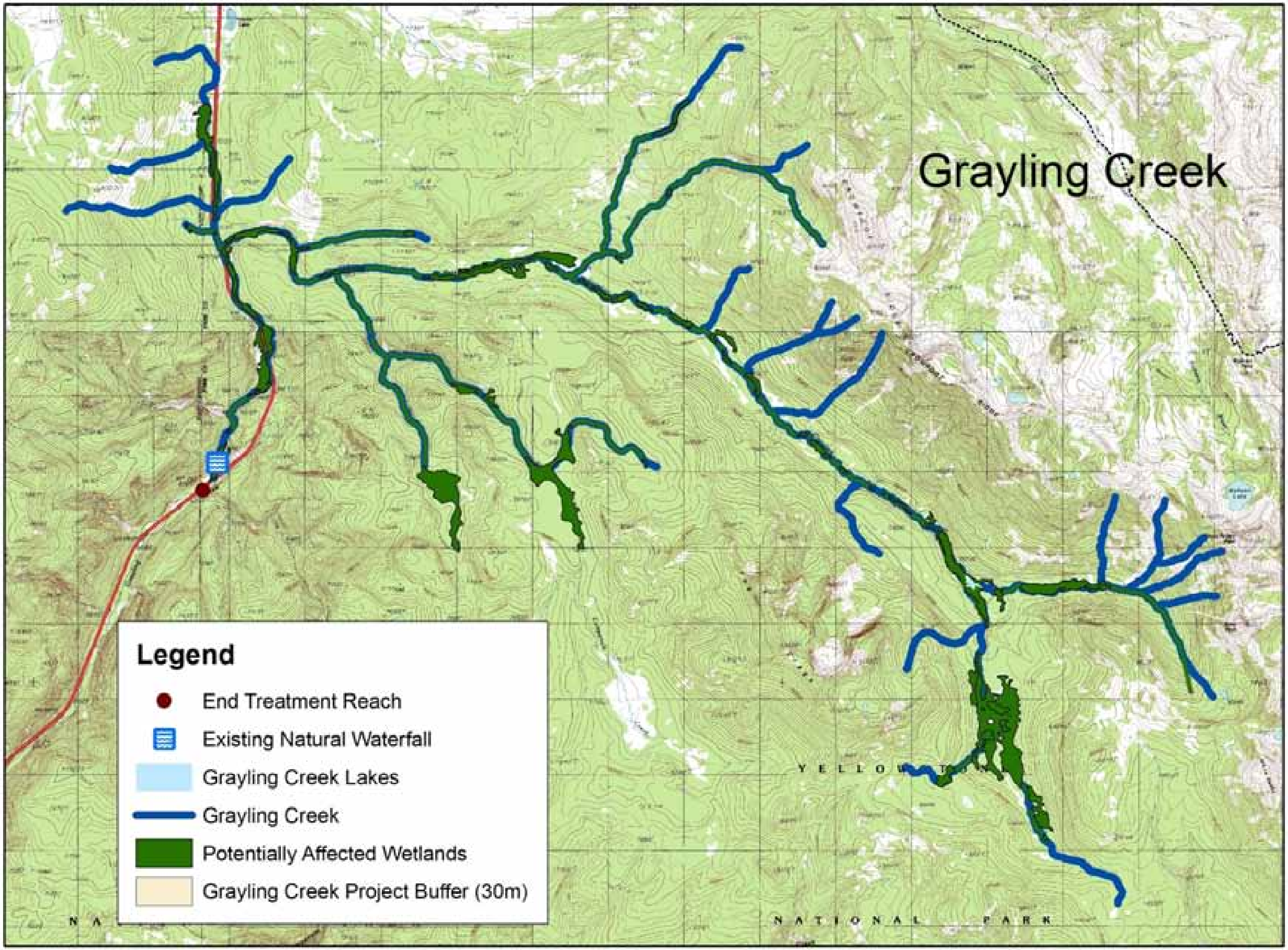

Figure G-15. Grayling Creek potential project wetlands. From USFWS NWI map data, 1998.

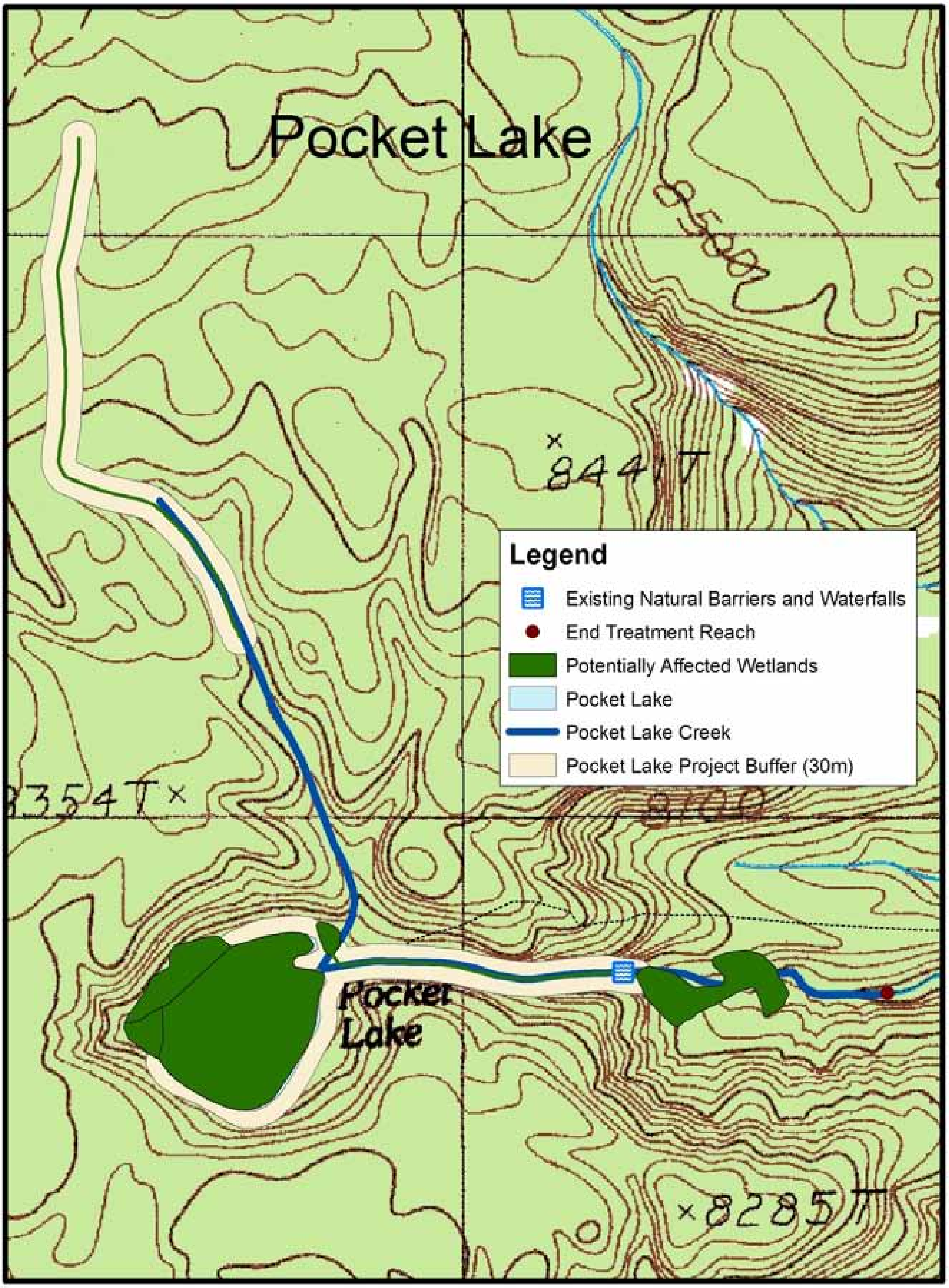

Figure G-16. Pocket Lake potential project wetlands.From USFWS NWI map data, 1998.

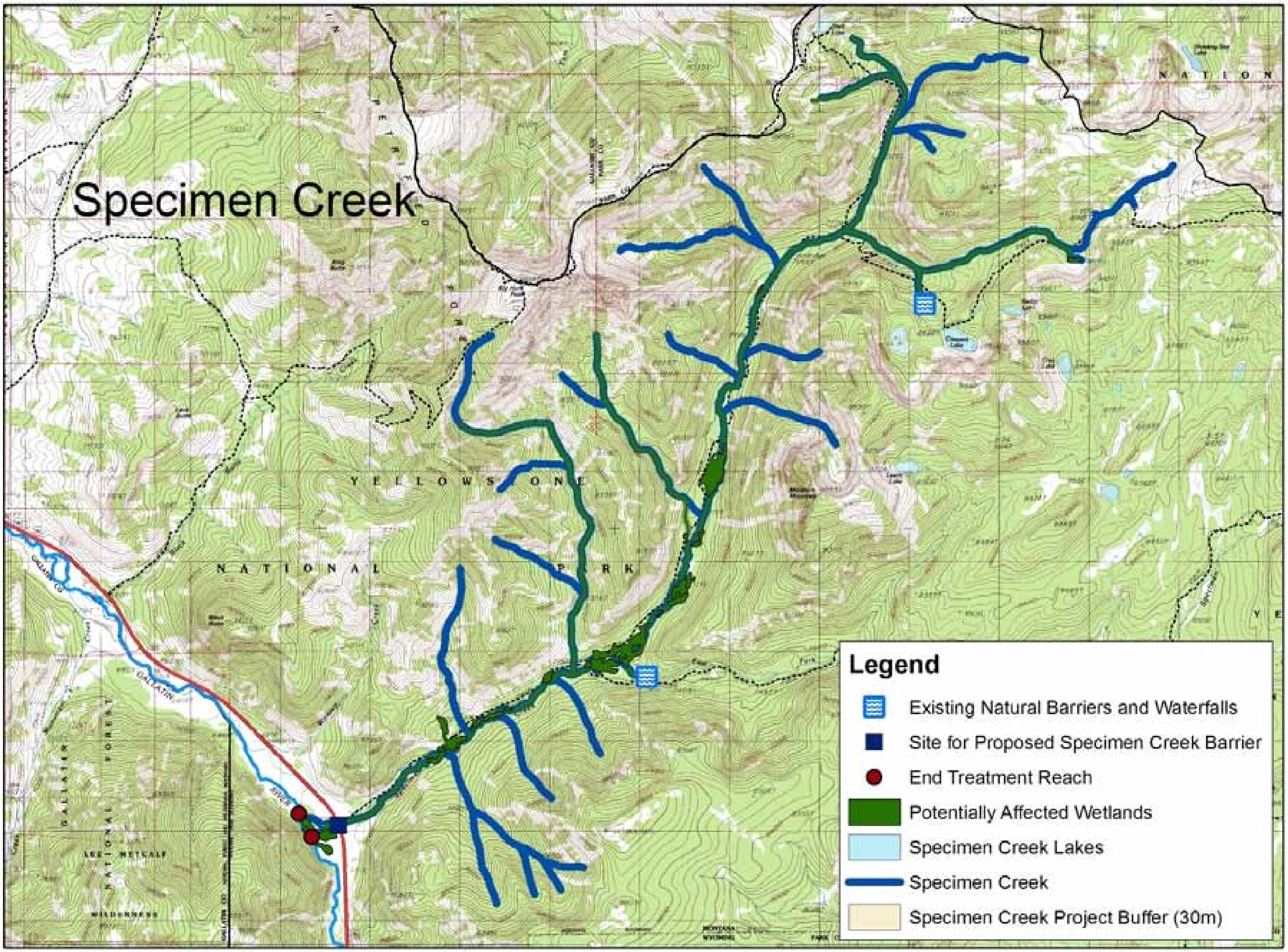

Figure G-17. Specimen Creek potential project wetlands. From USFWS NWI map data, 1998.

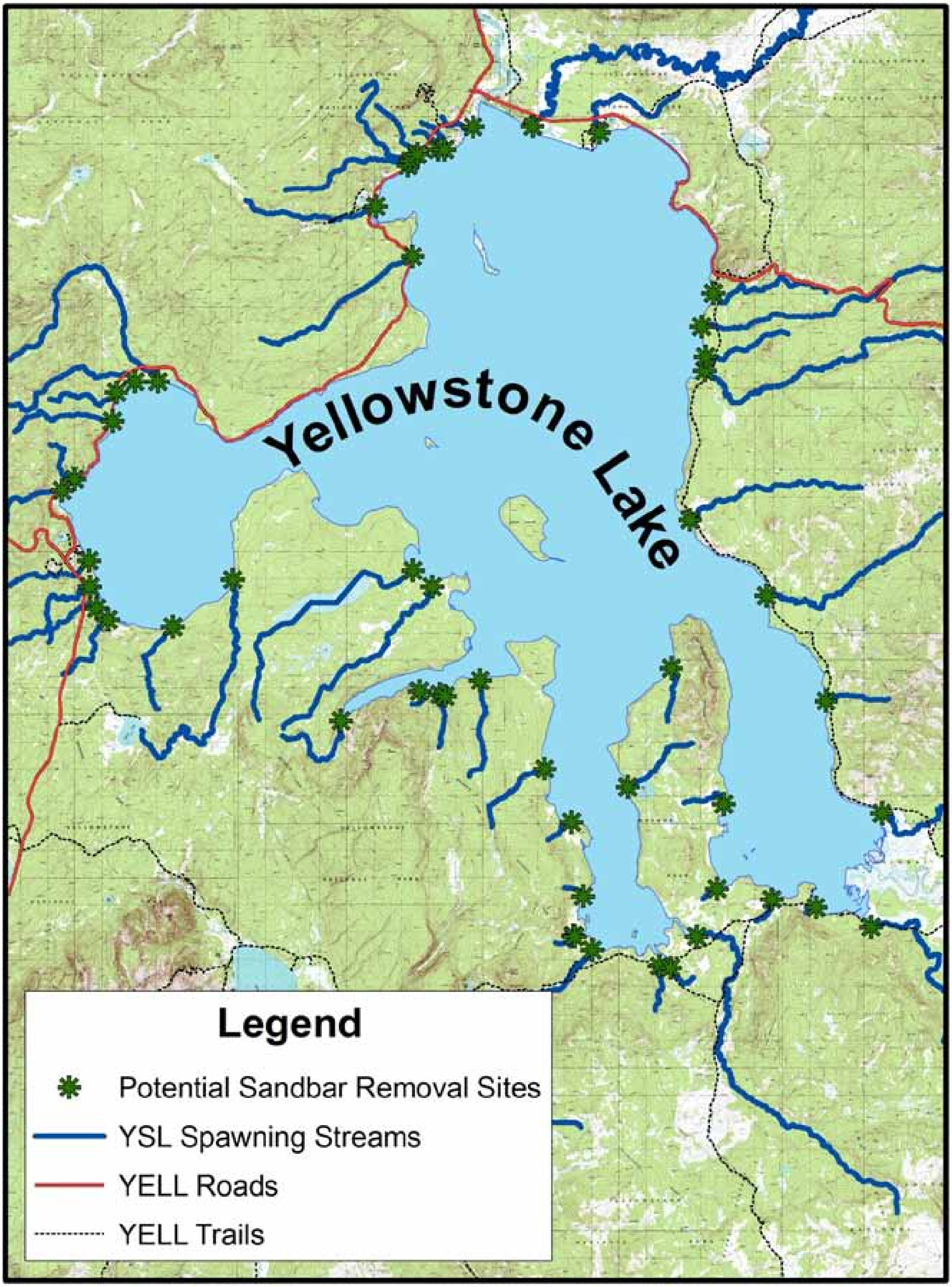

Figure G-18 Yellowstone Lake potential project areas (sandbar removal) highlighted by asterisks. From USFWS NWI map data, 1998.

THIS PAGE INTENTIONALLY LEFT BLANK