Appendix C: Detailed Descriptions of Candidate Lakes for Treatment

This section describes the 21 lakes proposed for treatment over a period of approximately 10 to 12 years.

Black Lake

Black Lake is a 49.1-acre lake located in the Jewel Basin Hiking Area at 6,045 feet above sea level in the headwaters of Graves Creek. The lake has a maximum depth of 157 feet and a volume of 4,493 acre-feet (figure C-1). The outflow stream of Black Lake is a headwater tributary of Graves Creek and flows for 0.23 mile where it reaches an unnamed pond. From this pond, the stream flows for 0.93 mile where it reaches the other tributary of Graves Creek (Blackfoot Lake outflow stream). Graves Creek flows for 1.47 miles to the confluence of Cliff Lake Creek, then for 1.43 miles to Seven Acres Creek, then for 2.03 miles before entering Handkerchief Lake. After leaving Handkerchief Lake, Graves Creek flows for 0.54 mile to the confluence of Aeneas Creek, then for 0.79 mile to the barrier waterfall near its mouth. This barrier waterfall blocks all upstream fish passage. Total distance from Black Lake to the Graves Creek fish barrier, including the length of Handkerchief Lake, is 8.05 miles.

A 2.5-mile long trail network beginning at the Camp Misery trailhead accesses Black Lake.

The management objective for this lake is to remove the hybrid trout from it and from the 6.09 miles of stream between Black Lake and Handkerchief Lake. To achieve this objective, rotenone would be applied to the lake at the prescribed concentration of 1 ppm. Water leaving the lake would be allowed to flow downstream in an effort to remove the trout from downstream. MFWP would rely on on-site assays and up to date flow measurements to determine where drip stations, caged fish, and detoxification stations should be placed. Caged live fish would be placed at intervals in Graves Creek upstream and downstream of Handkerchief Lake to measure the toxicity of water. As an added safeguard measure, MFWP would rely on Handkerchief Lake to further dilute treated water. Detoxification stations and caged fish would be monitored and removed only after caged fish survive 24 hours after treatment.

In August 2002, water leaving Black Lake was gauged at the lake outlet and measured to be 1.27 cfs. Twenty days later, Graves Creek was gauged upstream of Handkerchief Lake at 3.3 cfs. Based on these measurements, the rotenone concentration in Graves Creek upstream of Handkerchief Lake would be 0.38 ppm. This represents a 62 percent reduction in concentration. Furthermore, the 811 acre-feet of water in Handkerchief Lake would dilute the stream water to sub-lethal levels. In September 2002, discharge from Jones and Aeneas Creek were measured at 8.9 cfs, and Graves Creek downstream of Handkerchief Lake was measured at 7.2 cfs. Any rotenone treated water leaving Handkerchief Lake would be further diluted by these freshwater inputs.

The removal of fish from Black Lake would require the application of 1,469 gallons (14,396 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. One thousand gallons (9,800 pounds) of rotenone would be transported to the lake in two trips by SEAT aircraft; the remaining 469 gallons (4,596 pounds) would be transported in six separate loads by helicopter. The transport of a raft and motor, and sprayers and drip stations

would require another two flights. Treatment of the lake would require, approximately, a five member team that would be transported to the lake in two separate flights. Prior to treatment, monitoring personnel would set up fish cages, drip stations, and detoxification stations at determined intervals on Graves Creek just above Handkerchief Lake. The monitors below Handkerchief Lake would set up potassium permanganate detoxification stations and caged fish. A helicopter would begin to transport personnel, equipment, and materials first thing in the morning; then prepare for application by boat. Personnel would prepare for treating freshwater inputs and seeps using sprayers and drip stations.

In August 2002, Black Lake was surveyed by air with the SEAT pilot who determined that the layout of Black Lake allows for four drops of 250 gallons of rotenone each. An application plan using SEAT was developed based on terrain features of the site. The dimensions of Black Lake are approximately 2,297 feet long by 1,286 feet wide. Before dispensing, the SEAT would conduct two flyovers to confirm communication with ground personnel at the lake, and to test weather conditions. If communication and application variables were appropriate, the SEAT would then begin administering its load. At this point the stream treatment and detoxification measures would be implemented. Mach flyovers conducted in November 2002 with a Hughes 500 helicopter revealed that the best approach to Black Lake would be from its southwest corner. The plane would make its descent toward the lake, make a slight bank to the east, dispense its load, then continue northeast down Graves Creek drainage. The SEAT would continue down Graves Creek drainage, circle back, then continue dispensing its load. The fact that rotenone appears milky white when it contacts water would allow the SEAT pilot to see precisely where the previous load was dropped; thus allowing the pilot to place subsequent loads directly adjacent to the previous load in order to provide comprehensive application coverage.

After dispensing its load, the SEAT would return to Glacier Airport for refilling. After a complete application of the first load, the personnel at the raft site would begin mixing the rotenone at the surface for application at deeper lake depths, and treatment of freshwater inputs would begin. Upon returning with a second load, the SEAT pilot would conduct flyovers to establish communication with the ground and to test weather conditions. The raft and all personnel would be removed from the lake to wait on the shoreline for the second drop. After the second drop, the treatment with the raft would resume until completed. After treatment, three people would be flown out with most of the equipment while two would remain at the site to monitor the treatment. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft, and motor) and personnel would be removed from the site. Caged fish and detoxification stations would be monitored, and removed only after caged fish survived for 24 hours following piscicide application. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days, and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate that Black Lake receives an estimated 107 angler days per year (Table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 4,900 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. There is little risk of reinvasion of Black Lake by downstream fish due to the high gradient of the stream below the lake and the fact that fish below the lake

would be removed during treatment. The stream below the lake would also be stocked to establish a population as quickly as possible.

Blackfoot Lake

Blackfoot Lake is a 16.5 acre lake located in the Jewel Basin Hiking Area at 5,520 feet above sea level and in the headwaters of Graves Creek. The lake has a maximum depth of 22 feet and a volume of 205 acre-feet (figure C-2). The outflow stream of Blackfoot Lake is a headwater tributary that forms Graves Creek. From the lake, it flows 0.83 miles until reaching another tributary that forms Graves Creek (Black Lake outflow stream). Graves Creek flows for 1.47 miles to the confluence of Cliff Lake Creek, 1.43 miles to Seven Acres Creek, then 2.03 miles before entering Handkerchief Lake. After leaving Handkerchief Lake, Graves Creek flows for 0.54 mile to the confluence of Aeneas Creek, then for 0.79 mile to the barrier waterfall near its mouth. This barrier waterfall blocks all upstream fish passage. Total distance from Blackfoot Lake to the Graves Creek fish barrier, including the length of Handkerchief Lake, is 7.72 miles.

A 5.2-mile long trail network starting at the Camp Misery trailhead accesses Blackfoot Lake.

The management objective for this lake is to remove the hybrid trout from it and from the 5.76 miles of stream that flows out of Blackfoot Lake to the inlet of Handkerchief Lake. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. The rotenone treated water leaving the lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. The downstream boundary for this treatment is Handkerchief Lake. Up-to-date flow measurements and on-site bioassays would determine where drip stations, caged fish, and detoxification stations would be placed. Caged live fish would be set in at intervals in Graves Creek upstream of Handkerchief Lake, downstream of Handkerchief Lake, and in Graves Creek Bay of Hungry Horse Reservoir as a means of measuring the toxicity of water. As an added safeguard measure, the waters of Handkerchief Lake would be used to dilute any remaining rotenone in this stream.

In September 2002, water leaving Blackfoot Lake was gauged at the lake outlet and measured to be 0.42 cfs, and Graves Creek was measured upstream of Handkerchief Lake at 3.3 cfs. Based on these measurements, the concentration of rotenone in Graves Creek above Handkerchief Lake would be 0.12 ppm. This represents an 88 percent reduction in concentration. Furthermore, the 811 acre feet of water in Handkerchief Lake would further dilute the 0.12 ppm rotenone to sub-lethal levels.

In September 2002, discharge from Jones and Aeneas Creek were measured at 8.9 cfs, and Graves Creek downstream of Handkerchief Lake was measured at 7.2 cfs. Based on these calculations, any rotenone treated water leaving Handkerchief Lake would be further diluted by these inputs of freshwater.

Removal of fish from Blackfoot Lake would require the application of 68 gallons (667 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. Rotenone would be transported to the lake by helicopter in 1 load. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Four people would be needed to treat the lake necessitating two transport flights. Prior to treatment, monitors would set up fish cages on Graves Creek above and below Handkerchief Lake to evaluate detoxification. The monitors would have potassium permanganate detoxification stations active. After treatment, two

people would be flown out with most of the equipment, while two people would stay at the site to monitor the treatment.

The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed. Detoxification stations and caged fish would be monitored, and removed only after the caged fish survived 48 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days, and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Blackfoot Lake receives an average 332 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 1,600 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. There is little risk of reinvasion by downstream fish due to the high gradient of the stream below the lake, and the fact that downstream fish would be removed during treatment.

Clayton Lake

Clayton Lake is a 62-acre lake located in the Jewel Basin Hiking Area at 6,040 feet above sea level and forms the headwaters of Clayton Creek. The lake has a maximum depth of 193 feet and a volume of 6,948 acre-feet (figure C-3). Small ephemeral streams and spring seeps provide most of the surface water inflow to Clayton Lake, mostly from the south and west shores. Clayton Creek flows out of the lake for 4.52 miles before reaching a barrier falls. The stream continues for 0.03 mile before entering Hungry Horse Reservoir. There are three unnamed tributaries that enter Clayton Creek between the lake and the mouth. The waterfall is believed to be a complete barrier to fish trying to enter Clayton Creek from the reservoir. Bull trout have never been documented in Clayton Creek above the falls. Total distance from this fish barrier to Clayton Lake is 4.52 miles.

Access to Clayton Lake is made by a 2.3 mile trail starting at Forest Road 1633 in the Clayton Creek drainage.

The management objective for this lake is to remove the hybrid trout from the lake and from the 4.52 miles of stream between the lake and the barrier waterfall. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. The rotenone treated water leaving the lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. Up to date flow measurements and on-site assays would be used to determine the number and location of drip stations, caged fish monitoring stations, and detoxification stations. Caged fish would also be placed in Clayton Creek Bay of Hungry Horse Reservoir to monitor the detoxification process. These detoxification stations and sentinel fish cages would be monitored, and removed only after the point at which sentinel fish survive 24 hours after treatment. Implementation and monitoring of the proposed stream treatment procedures, along with the detoxification and cleanup effort, is expected to take about five days, and would be conducted during most of the lake treatment.

In September 2002, the outflow stream of Clayton Lake was gauged and measured to be 0.06 cfs; Clayton Creek was gauged at road 895 crossing and measured to be 3.9 cfs.

Based on these measurements, the rotenone concentration in Clayton Creek would be 0.02 ppm. This represents a 98 percent reduction in concentration.

The removal of fish from Clayton Lake would require the application of 2,316 gallons (22,697 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. In liquid form, this amounts to 77 30-gallon drums. Because there is not adequate storage space at the lake for this amount of material, and because of the amount of time it would require a helicopter to transport full barrels in and empty barrels out, SEAT aircraft would be used to transport and apply two thousand gallons (19,600 pounds) of rotenone in four trips. The remaining 316 gallons (3,097 pounds) would be transported by helicopter in four loads. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Six people would be needed to treat the lake, requiring two transport flights. Prior to the proposed treatment, monitors would set up drip stations, fish cages, and detoxification stations on Clayton Creek at the above mentioned locations to implement and evaluate the treatment and detoxification procedures. A helicopter would transport equipment and materials to the site the day before the treatment. The following morning, personnel would be transported to the site to prepare for application by boat. Two people would prepare for treatment of freshwater inputs and seeps by sprayers and drip stations.

In August and November 2002, Clayton Lake was surveyed by air with the SEAT pilot who determined that SEAT would be able to perform this application. An application plan using SEAT was developed based on terrain features of the site. Before dispensing, the SEAT would conduct two flyovers to confirm communication with ground personnel at the lake and to test weather conditions. If communication and application variables were appropriate, the plane would begin administering the first load to the lake. The SEAT would approach the lake from the southeast, dispense its load, then exit the lake to the northwest down Clayton Creek drainage. The SEAT would continue down Clayton Creek drainage, circle back, cross over Pioneer Ridge, and then approach from the southeast to continue dispensing. After dispensing the first load, the SEAT would return to Glacier Airport for refilling. Since rotenone appears milky white when it comes in contact with water, the SEAT pilot would be able to accurately judge were to drop subsequent loads in order to provide effective application coverage, applying each load adjacent to the prior load. After the first SEAT load is administered, the raft would begin mixing the rotenone, pumping it to deeper zones of the lake; the treatment of freshwater inputs would also begin. The second SEAT load would return 30 minutes later, conduct the two flyovers to establish communication with the ground, then apply. The raft and all personnel would be removed from the lake each time to wait on the shoreline for the next drop. The third SEAT drop would occur 30 minutes later, and the fourth drop 30 minutes after that. After the fourth drop, the treatment with the raft would resume until finished. When completed, four people would be flown out with most of the equipment. Two people would stay at the site and monitor the treatment. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) and personnel would be removed from the lake. Detoxification stations would be monitored for the point at which sentinel fish survive for 48 hours after the treatment, and then removed. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days, and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Clayton Lake receives an estimated 245 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park

State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 5,800 fish, of which 1000 would be of catchable size, would be stocked in each of the first two years after the proposed treatment to restore the fishery as quickly as possible. The stream below the lake would also be stocked to establish a population as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. There is little risk of reinvasion by downstream fish due to the high gradient stream and the fact that fish in the stream below the lake would be removed down to the barrier during the treatment.

George Lake

George Lake is a 119.5-acre lake located in the Bob Marshall Wilderness at 7,115 feet above sea level. The maximum lake depth is 275 feet and lake volume is 13,475 acre-feet (figure C-4). The main surface water inputs to the lake include two perennial streams and four ephemeral streams on the north shore, and many seeps along the south shore. George Creek flows out of the lake for 0.17 mile where it flows over a waterfall. It continues for 3.75 miles to a 90-foot bedrock waterfall, which is located about 0.25 mile above the confluence with Gordon Creek. Six unnamed streams enter from the south over the lower 4 miles of George Creek. Distance from this waterfall to George Lake is 3.92 miles.

Although there is no system trail to George Lake, there is an unimproved foot trail that runs for about 3 miles up the George Creek drainage. Hikers can approach the lake by National Forest access on the west side of the Swan Mountain Range near Sunday Mountain in the East Fork of the Clearwater River.

George Creek flows out of George Lake. The management objective for this lake is to remove the hybrid trout from the lake and from the 3.92 mile of stream between the lake and the waterfall near its mouth. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between George Lake and the known bull trout population in Gordon Creek is approximately 1,875 feet. Approximately 1,300 feet of altitude drop occurs within the first 1 mile of stream that leaves the lake. Accessing this high gradient section would be difficult. Furthermore, it is unlikely that any fish reside in this section because it is so steep. For this reason, approximately two recharge stations would be installed in the remaining section of stream to remove hybrid fish. The foot trail in George Creek drainage provides access to a point approximately 1 mile below the lake. Recharge stations would begin at this point and treat down to near its mouth, which is the lower boundary of the treatment area. Up to date flow measurements and on-site bioassays would be used to determine the number and location of recharge drip stations and caged fish monitoring stations, as well as the location of detoxification stations and caged fish for detoxification monitoring.

Because there is no trail to George Lake, the 2,695 units (10,106 pounds) of antimycin necessary to treat the lake would be transported via 12 flights by a Bell OH58 helicopter. An additional 4 flights would be required to transport the equipment and personnel. Motorized rafts would be used to administer the antimycin. Five people would be needed to treat the lake, two to monitor recharge stations on the creek, and another to monitor caged fish and administer potassium permanganate if necessary. Livestock would be used to deliver the personnel and materials for the stream work, and would be staged from the Shaw Cabin. The treatment would require approximately one day for

transportation, approximately one day for set up, one day for treatment administration, and two days for clean up. Personnel and equipment would then be flown out from the lake site. Detoxification stations and caged fish would be monitored, and removed only after the caged fish survived for 24 hours after treatment. Stream treatment, detoxification, caged fish monitoring, and cleanup are expected to take approximately five days and would be conducted during most of the lake treatment.

George Lake and George Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate George Lake receives an estimated 105 (60-180) angler days per year. Its annual statewide ranking is number 923 out of 1,529 fisheries in the state (table C-1). Restocking genetically pure westslope cutthroat trout would maintain angling opportunity at George Lake, provide a source of pure fish to repopulate downstream areas, genetically dilute any possible remaining hybrids, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in George Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment, and involve 11,400 fish each year for three years. The fish population would be evaluated on year five-post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish is non-existent due to the steep waterfall immediately downstream of the lake.

Handkerchief Lake

Handkerchief Lake is a 51.3-acre lake located on the Flathead National Forest at 3,835 feet above sea level near the mouth of the Graves Creek drainage. The lake has a maximum depth of 24 feet and a total volume of 811.5 acre-feet (figure C-5). Graves Creek is the only known stream that flows into the lake. Graves Creek flows out of Handkerchief Lake for 0.54 mile before it joins with Aeneas Creek, then flows for another 0.79 mile before reaching the waterfall fish barrier just above Hungry Horse Reservoir. This barrier prevents all fish from moving upstream into Graves Creek from Hungry Horse Reservoir. Distance from this fish barrier to the lake is 1.33 miles.

Access to Handkerchief Lake is made by a road that exits off Forest Road 895.

The management objective for this lake is to remove the hybrid trout from it and from the 1.33 miles of stream between the lake and Hungry Horse Reservoir. It would be necessary to treat a small segment of Graves Creek upstream of the lake to remove any hybrid fish that may have recolonized between the treatments of Black and Blackfoot lakes. To achieve this objective, antimycin would be applied to approximately 1 mile of Graves Creek upstream of Handkerchief Lake. Antimycin would then be applied to the lake at the prescribed rate of 7-8 ppb. The elevation differential between Handkerchief Lake and Hungry Horse Reservoir is approximately 275 feet. The ability of antimycin to detoxify with every 200 feet of stream elevation drop, due to interaction with the stream bottom, oxidation, and exposure to sunlight, makes this the safest method to remove hybrid trout from the lake and stream while safeguarding the bull trout that may be residing in Graves Creek Bay of Hungry Horse Reservoir. All trout populations in the Graves Creek drainage have been identified as a threat to the genetically pure fish in Hungry Horse Reservoir.

There are three detoxification measures that would be used during the proposed treatment of Handkerchief Lake. Caged fish placed in Graves Creek near the mouth would allow the monitoring of the toxicity of water to fish. First, elevation calculations indicate that antimycin would be detoxified before it reaches Hungry Horse Reservoir. However, to

measure this, the caged fish would be placed at intervals in Graves Creek downstream of the lake: one at the lake outlet, one at the mouth of the creek, and one at an intermediate location between the two.

Second, dilution by freshwater would also be used to aid in detoxification. In September 2002, Graves Creek above Handkerchief Lake was gauged and measured at 3.3 cfs, and below the lake it was measured at 7.2 cfs. In September 2002, discharge from Jones and Aeneas creeks was measured at 8.9 cfs, and Graves Creek downstream of Handkerchief Lake was measured at 7.2 cfs. Any antimycin treated water leaving Handkerchief Lake would be diluted by these freshwater inputs by nearly 61 percent.

Finally, detoxification stations would be installed and monitored at predetermined locations downstream. This would help safeguard any bull trout in the Graves Creek Bay of Hungry Horse Reservoir. On-site bioassays and current flow measurements would be used to determine the level of natural detoxification available at the time of treatment and the location and amount of detoxification necessary.

The removal of fish from Handkerchief Lake would require the application of 159 units (596 pounds) of antimycin administered at 7-8 ppb; an additional small amount of antimycin would be needed to treat associated stream segments. The antimycin and all related equipment would be transported to the lake by truck. Approximately five people would be needed to treat the lake. Prior to the proposed treatment, monitors would set up fish cages and detoxification stations on Graves Creek upstream and downstream of the lake. After treatment, two people would stay at the lake and monitor the treatment. The following day, the dead fish would be collected from the shoreline, taken to deeper water, and then sunk. Thereafter, the remaining equipment would be removed. Detoxification stations and caged fish would be monitored, and removed only after the caged fish survived for 24 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Handkerchief Lake receives an estimated 702 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Stocking would begin in June and July following the treatment, and continue annually as needed to maintain the fishery. Multiple year classes of westslope cutthroat trout, including catchable sizes, would be stocked in the lake to restore the fishery as quickly as possible. MFWP records indicate that 711,000 grayling have been stocked over 14 separate occasions between 1954 and 1998 in Handkerchief Lake. Despite this fact, grayling rarely occur in Hungry Horse Reservoir gill net surveys, and appear to be relatively inert in the fish community. Arctic grayling do not hybridize with or appear to compete for resources with any other game fish in the South Fork Flathead drainage. Semi-annual snorkel surveys on the South Fork Flathead River have failed to observe grayling in the river. Based on this information, MFWP would continue stocking arctic grayling in Handkerchief Lake to maintain the quality fishery. The stream above and below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion of Handkerchief Lake by downstream fish would be reduced by the fact that the source fish from adjacent tributaries would be removed during the treatment of the lakes in their headwaters. Also, the large waterfall at the mouth of Graves Creek prevents any upstream movement from Hungry Horse Reservoir fish.

Koessler Lake

Koessler Lake is a 86.5-acre lake located in the Bob Marshall Wilderness at 6,010 feet above sea level. The maximum lake depth is 173 feet and lake volume is 5,731 acre-feet (figure C-6). The main surface water inputs to the lake include two streams on the southwest shore. The lake has a submerged island near the southeast corner that is visible from the air. The outlet stream from Koessler Lake is unnamed and flows for 0.93 mile before reaching the confluence with Doctor Creek. The stream gradient in this short reach is 11.5 percent. From this point, Doctor Creek flows for 1.62 miles to its confluence with Gordon Creek. Gordon Creek then continues for 1.06 mile to the confluence with George Creek. There is a suspected barrier waterfall on Gordon Creek immediately above its confluence with George Creek. This is the furthest known upstream distribution of bull trout in Gordon Creek that migrate from the South Fork Flathead River. MFWP file data document the presence of bull trout in Doctor Lake. It is believed that Doctor Creek below the lake also provides habitat for this disjunct population of bull trout. The section of Doctor Creek between the Koessler Creek confluence and the mouth of Doctor Creek was electrofished in 2000 (Rumsey and Cavigli) and again in 2002 (Grisak 2003a).

In 2000, a single juvenile bull trout was captured during electrofishing for 1.2 hours. In 2002, four sites were electrofished for a total of 1.1 hours and two juvenile bull trout were captured and a third was observed but not captured. The distance from Koessler Lake to the suspected habitat of Doctor Creek bull trout is 0.93 mile.

Access to Koessler Lake is made by traveling 15 miles on trails 35 and 291 beginning at Owl Creek trailhead.

The management objective for this lake is to remove the hybrid trout from the lake. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Koessler Lake and Doctor Creek is approximately 580 feet, which allows the antimycin to be detoxified by an elevation drop nearly three times over before it reaches Doctor Creek. Forest Service trail 291 crosses the Koessler Lake outflow stream near its mouth.

Given the proximity of bull trout in the Doctor Creek, caged fish and detoxification stations would be installed at pre-determined intervals to adequately contain the treatment. There would be no supplemental antimycin drip stations placed on this stream. Fresh water input from Doctor Creek would further dilute the antimycin. Up to date flow measurements and on-site bioassays would be used to determine the level of dilution and stream flow time.

In August 2002, discharge of Koessler Creek was measured near its mouth at 5.13 cfs. At the same time, Doctor Creek was measured just above this confluence at 3.76 cfs. Based on these measurements, water leaving Koessler Lake would be diluted by water from Doctor Creek by 64 percent in volume.

Transporting the 1,146 units (4,298 pounds) of antimycin needed to treat the lake would require approximately 25 mule loads. This could be conducted using approximately four, six animal strings in 1 week. An attended camp would be set at Koessler Lake to store the materials. The additional materials, rafts, motors, and camp would require approximately five mule loads.

Outboard motors would be required to administer the antimycin in a timely manner and to mix the compound with lake water. Pumps would be used to distribute the compound at deeper depths. The time required to pack all materials and equipment to the site would be about 10 days. Thereafter, approximately one day would be required for treatment and two for clean up, with departure on the fourth day. Monitoring, detoxification, and cleanup of the stream would require approximately five days and would overlap much of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived 24 hours after treatment.

Koessler Lake would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. Restocking genetically pure westslope cutthroat trout would maintain angling opportunity at Koessler Lake, provide a source of pure fish to repopulate areas downstream, genetically dilute any possible remaining hybrids, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in Koessler Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment and consist of 8,500 fish each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish is unlikely due to the steep gradient of the stream below the lake. During a survey of Koessler Lake in 2002, much of the outlet features were obscured by a catastrophic avalanche near the lake outlet.

Lena Lake

Lena Lake is a 74.2-acre lake located in the Bob Marshall Wilderness at 6,732 feet above sea level. The maximum lake depth is measured at 80 feet and lake volume is 2,547 acre-feet (figure C-7). The main surface water inputs to the lake include an ephemeral stream on the southern shore, which presumably receives water from an unnamed basin located 0.4 mile to the south, and a few seeps along the east and west shores. The water flowing out of Lena Lake forms Big Salmon Creek, which flows for 1.79 miles to the confluence with Feline Creek, which enters from the southwest. Big Salmon Creek continues for 1.57 miles to Pendant Creek, which enters from the west, then for 0.92 mile to a barrier waterfall. This waterfall is directly above the Smokey Creek confluence. The Smokey Creek confluence with Big Salmon Creek is 0.17 mile upstream of the Cataract Creek confluence. Big Salmon Creek flows for 1.6 miles where it meets Dart Creek from the west, then continues for 1.9 miles before meeting the confluence with Tango Creek from the northwest. It continues for 0.21 mile before meeting the confluence with Gyp Creek from the south, then for 1.1 mile before meeting the barrier falls. This barrier falls is the uppermost known distribution of bull trout in the Big Salmon drainage. Total distance from Lena Lake to the barrier falls is 9.26 miles.

Access to the Lena Lake is made by a 16.2 mile long trail that begins at the Owl Creek trailhead.

The management objective for this lake is to remove the hybrid trout from the lake and from the 4.25 miles of Big Salmon Creek between Lena Lake and the Cataract Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Lena Lake and the mouth of Cataract Creek is approximately 1,292 feet, thus requiring the installation or approximately five caged fish stations and five recharge stations to monitor the proposed treatment and to maintain

lethality of the antimycin through this reach of stream. Forest Service trails 212 and 225 parallel much of the upper Big Salmon Creek making installation of drip stations and caged fish easier.

For this project, the mouth of Cataract Creek is the lower boundary of the treatment area. This location is 4.8 miles upstream of the barrier falls on Big Salmon Creek, which is the uppermost known distribution of bull trout in the drainage. The elevation differential from the mouth of Cataract Creek to the Barrier Falls is approximately 950 feet, which is 4.75 times more than is required to detoxify the antimycin. Furthermore, fresh water input from Cataract, Dart, Tango, and Gyp creeks would further dilute the antimycin. As a safeguard measure, caged fish and detoxification stations would be placed in Big Salmon Creek near the Cataract confluence, and near the Dart Creek confluence.

In July 2002, discharge of Big Salmon Creek was measured at three locations; at the outlet of Lena Lake it was 1.36 cfs, at Pendant Cabin it was 5.48 cfs, and near the confluence with Cataract Creek it was 16.56 cfs. Cataract Creek was gauged at 22.1 cfs. Based on theses measurements, antimycin treated water leaving Lena Lake would be diluted at this point by 80 percent in volume. Up to date flow measurements and on-site bioassays would be used to determine dilution and flow time.

Transportation of materials, equipment, and personnel would be accomplished using livestock. Motorized rafts would be used to administer the antimycin. The 507 units (1,900 pounds) of antimycin needed to treat the lake and creek would require 11 mule loads. An additional small amount of antimycin would be required to treat associated stream segments. An attended camp would be set at Lena Lake to store materials. An additional four mules would be required to transport the drip stations, rafts, motors, and sprayers. Approximately five people would be needed to treat the lake, and approximately five to man drip stations, caged fish, and detoxification stations on the stream. Aside from the stock needed to transport antimycin, approximately 18 riding and pack animals would be needed to transport personnel, miscellaneous equipment, feed, and camp materials. The time required to pack materials to the site would be about six days. Thereafter, approximately one day would be needed for treatment and two days for clean up, with likely departure on the fourth day. The stream treatment, monitoring, and detoxification would require approximately five days, and would over-lap most of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

Lena Lake and upper Big Salmon Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Lena Lake receives an estimated 165 angler days per year. Its annual statewide ranking is number 712 out of 1,529 fisheries in the state (table C-2). Restocking genetically pure westslope cutthroat trout would maintain angling opportunities at Lena Lake, provide a source of pure fish to repopulate areas downstream, genetically dilute any possible remaining rainbow or rainbow westslope hybrids, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in Lena Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment with 7,400 fish each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into Lena Lake is unknown based on present information regarding fish barriers on Big Salmon Creek. Because fish would be removed from the stream between Lena Lake and the Barrier Falls near the Smokey Creek confluence during treatment, the risk of reinvasion is low.

Lick Lake

Lick Lake is a 19-acre lake located in the Bob Marshall Wilderness at 5,984 feet above sea level. The maximum lake depth is 27 feet and lake volume is 141 acre feet (figure C-8). The main surface water inputs to the lake include one high gradient stream near the outlet on the northwest shore, and three ephemeral streams on the southern shore. The water in Lick Lake is high in glacial silt and often appears milky white in color with very little apparent light penetration. Fish have been observed spawning in the outlet.

Lick Creek flows out the lake for 0.71 mile to an unnamed tributary that enters from the north, then for 2.38 miles to the confluence with Gordon Creek. Gordon Creek flows for another 0.87 mile where it reaches the Doctor Creek confluence, then for 1.06 mile to the confluence with George Creek. There is a suspected barrier waterfall on Gordon Creek immediately above its confluence with George Creek. For bull trout that migrate from the South Fork Flathead River, this is the furthest known upstream distribution in Gordon Creek. MFWP file data document the presence of bull trout and mountain whitefish in Doctor Lake. It is believed that Doctor Creek below the lake also provides habitat for this disjunct population of bull trout. In 2000, Gordon Creek was electrofished upstream of the confluence with Doctor Creek for 0.4 hour, and no bull trout were observed (Rumsey and Cavigli 2000). On August 2002, Gordon Creek was electrofished for 1.42 hours upstream of the Doctor Creek confluence, and only two juvenile bull trout were discovered in the first 0.2 miles (Grisak 2003a). Two large rock waterfalls approximately 0.2 mile upstream of the confluence are believed to limit upstream distribution beyond this point. No bull trout were observed upstream of this point. The distance from Lick Lake to the uppermost distribution of bull trout is 3.6 miles.

There is no maintained trail to Lick Lake. Access to the lake is gained by cross country hiking off of trail 35 in section 4 just south of Gordon Pass.

The management objective for this lake is to remove the hybrid trout from the lake and from the 3.7 miles of stream between the lake and rock waterfalls near the Doctor Creek confluence (approximately 0.2 miles upstream of the Doctor Creek confluence). To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Lick Lake and the known bull trout population in Gordon Creek is approximately 704 feet, which would require installing approximately two recharge stations to maintain lethality of the antimycin.

For this project, the area directly upstream of the Doctor/Gordon Creek confluence is the lower boundary of the treatment area. The stream should be sufficiently detoxified by this point. Furthermore, fresh water input from one unnamed tributary to Lick Creek and Gordon Creek would be relied upon to further dilute the antimycin. As a safeguard measure, caged fish and detoxification stations would be placed in Gordon Creek upstream of the Doctor Creek confluence. Up to date flow measurements and on-site bioassays would determine the number and locations of detoxification stations and caged fish monitoring sites.

Because there is no trail to Lick Lake, materials, equipment, and personnel would be transported via helicopter. Motorized rafts would be used to administer the antimycin. The 28 units (105 pounds) of antimycin needed to treat the lake and creek would require one helicopter load to the site. An attended camp would be set at Lick Lake where materials would be stored. Three additional helicopter loads would be required to

transport motors, sprayers, and equipment. Four people would be needed to treat the lake, and approximately three to monitor the drip stations, caged fish, and detoxification stations. Livestock would be used to deliver the materials needed for creek treatment, detoxification, and monitoring. The treatment would require one day for set up, approximately one day to administer treatment, and two days for cleanup, with departure on the fourth.

Personnel and equipment would be flown out from the site when cleanup is finished. Treatment, monitoring, detoxification, and cleanup of the stream would require approximately five days and would overlap most of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

Lick Lake and the downstream section would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Lick Lake receives an estimated 88 angler days per year, but this number seems high given the remote nature of the lake. Empirical information gathered from mountain goat hunters indicates that the lake does get fished. However, based on these figures, its annual statewide ranking is number 983 out of 1,529 fisheries in the state (table C-1). Restocking genetically pure westslope cutthroat trout would maintain angling opportunities at Lick Lake, provide a source of pure fish to repopulate downstream areas, genetically dilute any possible remaining hybrid fish, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in Lick Lake on an as needed basis. Stocking would occur the July following the treatment with 1,900 fish and continue for two years in order to establish a population. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. It is possible that Lick Lake could be managed as a wild fishery that would require little to no maintenance stocking.

In 2002, MFWP personnel hiked downstream from Lick Lake to the Gordon creek/Doctor Creek confluence. Several large rock waterfalls observed in this reach of stream suggests that risk of reinvasion by downstream fish into lick Lake is very low. Furthermore, the fact that downstream fish would be removed during the proposed treatment makes this risk low.

Lower Big Hawk Lake

Lower Big Hawk Lake is a 27.3-acre lake located in the Jewel Basin Hiking Area at 5,990 feet above sea level and is in a headwater tributary basin to Jones Creek. The lake has a maximum depth of 39 feet and has a volume of 612 acre-feet (figure C-9). The outlet stream flows from the lake for 0.5 mile then joins with the other headwater fork to Jones Creek (Pilgrim Lake effluent). Jones Creek flows for another 2.09 miles before entering Aeneas Creek. Aeneas Creek flows for 0.38 mile where it meets with Graves Creek. Graves Creek flows for an additional 0.79 mile to the barrier waterfall at its mouth. Aeneas, Jones, and Graves Creeks are all isolated from upstream movement by Hungry Horse Reservoir fish by a barrier waterfall at the mouth of Graves Creek. Distance from Lower Big Hawk Lake to the fish barrier at the mouth of Graves Creek is 3.76 miles.

Access to Big Hawk Lake is gained by a 5.6-mile long trail network that starts at Forest Road 895 in the Wheeler Creek Drainage.

The management objective for this lake is to remove the hybrid trout from the lake and from the 2.97 miles of stream between the lake and the Graves Creek confluence.

Rotenone treated water would be allowed to flow downstream to remove any fish that may have escaped the Pilgrim Lake treatment. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Up-to-date flow measurements and on-site bioassays would be used to determine the number and location of drip stations, detoxification stations, and caged fish monitoring sites.

In September 2002, surface water leaving the lake was gauged and measured to be 0.39 cfs. At the same time Aeneas Creek was gauged at 5.5 cfs, Jones Creek was gauged at 3.4 cfs, and Graves Creek was gauged at 7.2 cfs. Based on these measurements, the rotenone concentration in Graves Creek, downstream of the Aeneas Creek confluence, would be diluted by approximately 98 percent (0.02 ppm).

The removal of fish from Big Hawk Lake would require the introduction of approximately 204 gallons (1,999 pounds) of rotenone administered at 1 ppm. An additional small amount of rotenone would be needed to treat associated stream segments.

The rotenone would be transported to the lake by helicopter in three loads. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately five people would be needed to treat the lake, requiring two transport flights.

Lower Big Hawk Lake is shaped like a large figure "8." The raft used for treatment would have to be walked through the narrow channel separating the two lobes in order to apply the last half of the rotenone after the first half is applied to the upper lobe.

Prior to the proposed treatment, monitors would set up fish cages, drip stations, and detoxification stations on Aeneas, Jones, and Graves Creeks to implement and monitor stream treatment. After the treatment, three people would be flown out from the lake with most of the equipment. Two people would stay and monitor treatment at the site. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Lower Big Hawk Lake receives an estimated 60 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 2,700 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion from downstream fish is low to non-existent due to the high gradient of the outflow stream and the fact that downstream fish would be removed during treatment.

Lower Three Eagles Lake

Lower Three Eagles Lake is a 8.7-acre lake located in the Jewel Basin Hiking Area at 5,705 feet above sea level, and is in a headwater tributary basin of Aeneas Creek. The lake has a maximum depth of 84 feet and a volume of 255 acre-feet (figure C-10). The outlet stream flows from the lake for 1.12 mile before entering Aeneas Creek. Aeneas Creek then flows for 0.73 mile before meeting with Jones Creek; it then continues for

0.38 mile where it meets with Graves Creek. Graves Creek flows for an additional 0.79 mile to the barrier waterfall at its mouth. Aeneas, Jones, and Graves creeks are all isolated from upstream movement by Hungry Horse Reservoir fish by a barrier waterfall at the mouth of Graves Creek. Distance from the Three Eagles Lake complex to the fish barrier at the mouth of Graves Creek is 3.02 miles.

There is no known trail access to Lower Three Eagles Lake. The fish population has never been genetically tested. However, MFWP records indicate Lower Three Eagles Lake was stocked once in 1967 with generic cutthroat trout. Follow-up genetic surveys on other lakes stocked with generic cutthroat trout have revealed the stock was largely comprised of Yellowstone cutthroat genes. In addition, the populations upstream and downstream have been tested and found to contain hybrid trout. Based on the fact that Lower Three Eagles Lake is surrounded, both upstream and downstream, by hybrid trout, it is assumed that fish from the upper lake have entered it, or, at least, have had the opportunity to enter it. It would be difficult, if not impossible, to treat the upper lake and the lower stream without treating Lower Three Eagles Lake. For this reason, Lower Three Eagles Lake would be treated to remove any threat of hybrid trout remaining.

The management objective for this lake is to remove the hybrid trout from the lake and from the 2.23 miles of stream down to the confluence with Graves Creek. To achieve this objective, rotenone applied during the treatment of the upper lake would be allowed to enter the lower lake. Water leaving the lower lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. Drip stations, caged fish, and detoxification stations would be placed in the stream at predetermined intervals. Caged fish would be placed in Jones Creek near its mouth and in Graves Creek near the Aeneas-Graves confluence to monitor treatment. Potassium permanganate would be used to detoxify the rotenone. This would safeguard any bull trout in the Graves Creek bay of Hungry Horse Reservoir. Up-to-date flow measurements and on-site bioassays would determine the location and amount of detoxification.

In September 2002, water leaving Lower Three Eagles Lake was gauged at 0.15 cfs, Aeneas Creek was gauged at 5.5 cfs, Jones Creek 3.4 cfs, and Graves Creek was gauged at 7.2 cfs. Based on these measurements, the rotenone concentration in Aeneas Creek would be 0.02 ppm. This represents a 98 percent reduction in concentration. In addition, water from Aeneas Creek would be further diluted by water from Graves Creek by approximately 40 percent.

The removal of fish from Lower Three Eagles Lake would require the introduction of approximately 85 gallons (816 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed for use on associated stream segments.

Rotenone would be transported to the lake by helicopter in one load. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately four people would be needed to treat the lake, requiring two transport flights. This lake would be treated simultaneously with Upper Three Eagles Lake. Before beginning the proposed treatment, monitors would set up drip stations, detoxification stations, and fish cages at designated locations in Jones Creek, and also in Graves Creek just below the confluence of Aeneas Creek to evaluate detoxification. This site is located approximately 385 feet downstream of forest road 9797 crossing and would be accessed by foot. Monitors at these sites would operate potassium permanganate detoxification stations. After treatment, two people would be flown out with most of the equipment, while two stay to monitor the treatment.

The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed. Detoxification stations, and caged fish stations would be monitored, and removed only after caged fish survived for 48 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

Lower Three Eagles Lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Beginning in July following treatment, 900 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion from downstream fish into this lake is low due to the high gradient of the stream and the fact that downstream fish would be removed during treatment.

Margaret Lake

Margaret Lake is a 46.5-acre lake located on the Flathead National Forest at 5,575 feet above sea level and forms the headwaters of Forest Creek. The lake has a maximum depth of 79 feet and a total volume of 1,962 acre-feet (figure C-11). Small ephemeral streams and spring seeps provide most of the surface water inflow to Margaret Lake. Forest Creek flows out of Margaret Lake and continues for 3.9 miles before it enters Hungry Horse Reservoir. Approximately 0.9 mile up from the mouth of Forest Creek, there is a culvert located on Forest Road 895 that is believed to be a barrier that prevents fish from moving upstream. Total distance from this crossing to Margaret Lake is 3 miles. There are three unnamed tributaries that enter Forest Creek between Margaret Lake and its mouth.

Access to Margaret Lake is made by a 1.3 mile long trail that continues off Forest Road 895E in the Forest Creek drainage.

The management objective for this lake is to remove the hybrid trout from the lake and from the 3 miles of stream between the lake and the forest road 895 crossing. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Up-to-date flow measurements and on-site assays would determine the number and location of drip stations, detoxification stations, and caged fish monitoring stations necessary for successful stream treatment.

In October 2002, Forest Creek was gauged at the forest road 895 crossing and measured to be 2.9 cfs. At the same time, Margaret Lake was surveyed and outflow was estimated to be <1cfs. From the air, Forest Creek was observed to flow subsurface for approximately 100 yards at a site 1/3 mile below the lake outlet. Based on these observations and measurements, rotenone would be expected to detoxify during subterranean stream flow through natural binding processes. If the stream flowed subsurface, a drip station would be installed at the point where the stream resurfaced in order to continue stream treatment. If surface water was flowing continually, freshwater inputs from the two unnamed tributaries in Forest Creek should dilute the rotenone concentration to approximately 0.34 ppm. This represents a 66 percent reduction in concentration.

Removal of fish from Margaret Lake would require the application of 654 gallons (6,409 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. Rotenone would be transported to

the lake by SEAT in two, 250-gallon loads; a helicopter would transport the remaining 154 gallons in two loads. Two flights would be required to transport rafts, motors, sprayers, and drip stations. Six people would be needed to treat the lake. They would be transported using two flights.

Margaret Lake was surveyed by air in August and November 2002 to plan rotenone application using SEAT. The SEAT pilot indicated that the best approach to Margaret Lake would be from the southwest corner. The plane would approach and make its descent toward the lake, make a slight bank to the east, dispense its load, then continue easterly down Forest Creek. The pilot recommended that two separate loads of 250 gallons each be administered to maximize aircraft performance. After administration of the first load, the plane would return to Glacier International Airport to be loaded with the remaining 250 gallons. It would then return to the lake to apply the final load.

Prior to the proposed treatment, monitors would set up drip stations, detoxification stations, and fish cages at predetermined locations on Forest Creek to implement, monitor, and contain treatment. After treatment, four people would be flown out with most of the equipment. Two people would stay at the site to monitor treatment. The following day, the dead fish would be collected from the shoreline, taken to deeper water, and sunk. Thereafter, the remaining equipment, drip station, sprayers, raft and motor would be removed. Detoxification stations and caged fish stations would be monitored throughout the duration of the treatment and removed only after caged fish survived for 24 hours following treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

Margaret Lake and segments of Forest Creek would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Beginning in July following the treatment, 4,700 fish, of which approximately 1,000 would be of catchable size, would be stocked in each of the first two years to restore the fishery and stream populations as quickly as possible. The lake's fish population would be evaluated on year five post treatment to determine population viability and future stocking needs.

The risk of reinvasion by downstream fish into the lake is low to non-existent due to the steep gradient of the stream and the fact that downstream fish would be removed during the treatment.

Necklace Lakes

The Necklace chain of lakes is also known as the Smokey Creek Lakes. This complex consists of approximately 15 water basins; however, the majority of surface water is contained in only eleven of the water basins. The four largest lakes contain the majority of the hybrid fish population (figures C-12 – C-23). Although there are 15 lakes in the complex, the Necklace Lakes have been referred to as having 4 main basins. Prior to 2002, two of the 11 lakes, numbers 3 and 10 (identified from Figure B13), were believed to drain into the Smokey Creek drainage; however, a survey in 2002 revealed that the two lakes actually flow into the Cataract Creek drainage. The other nine lakes, and any connected basins, are targeted for this project.

The Necklace lakes are located in the Bob Marshall Wilderness at approximately 6,480 feet above sea level and form the headwaters of Smokey Creek. Total surface acreage of the nine largest lakes (numbers 1, 2, 4, 5, 6, 7, 8, 9, 11) is 42.8 acres. Total volume of these nine lakes is approximately 324 acre-feet; maximum depth of the deepest lake is 28.5 feet (Figures C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23).

Smokey Creek flows out of the Lower Necklace Lake and continues 1.94 miles down to the confluence of Big Salmon Creek. The Smokey Creek confluence with Big Salmon Creek is 0.17 mile upstream of the Cataract Creek confluence. Big Salmon Creek flows for 1.6 miles where it meets Dart Creek from the west, then continues for 1.9 miles before meeting the confluence with Tango Creek from the northwest. It continues for 0.21 mile before meeting Gyp Creek from the south, then for 1.1 mile before meeting the barrier falls. This barrier falls is the uppermost known distribution of bull trout in the Big Salmon drainage. Total distance from Necklace lakes to the barrier falls is 6.92 miles.

Access to the Necklace lakes is made by an 8.7-mile long trail that begins at the Owl Creek trailhead.

The management objective for this lake complex is to remove the hybrid trout from the lakes, from the stream segments between the lakes, and from the 2.1 miles of stream between lower Necklace Lake and the Cataract/Big Salmon Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material, making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier.

The elevation differential between Necklace lakes and the mouth of Smokey Creek is approximately 1080 feet, which would require the installation of approximately five sentinel fish cages and recharge stations to monitor treatment and maintain the antimycin lethality through this reach of streams. Forest Service trail 110 parallels much of Necklace lakes and Smokey Creek making installation of recharge drip stations easier.

For this project, the confluence of Cataract and Big Salmon creeks is the lower boundary of the treatment area. This location is 4.8 miles upstream of the barrier falls on Big Salmon Creek, which is the uppermost known distribution of bull trout in the drainage. The elevation differential from the mouth of Cataract Creek to the Barrier Falls is approximately 950 feet, which is five times greater than is required to detoxify the antimycin. Fresh water input from Big Salmon, Cataract, Dart, Tango, and Gyp creeks would further dilute the antimycin. As a safeguard measure, caged fish and detoxification stations would be placed in Smokey Creek near the mouth, and in Big Salmon Creek near the Dart Creek confluence.

Based on stream gauging measurements of Big Salmon Creek in July of 2002, empirical calculations of the input of Smokey Creek indicate the stream was flowing slightly greater than 10 cfs. Based on theses estimates, antimycin treated water leaving Smokey Creek is expected to be diluted by Big Salmon Creek ($\pm$6 cfs) and Cataract Creek (22.1 cfs) by approximately 73 percent in volume. Up to date flow measurements and on-site bioassays would be used to determine if the amount of dilution and flow time is sufficient. Potassium permanganate detoxification stations would be installed to ensure containment within the treatment boundaries.

The 64 units (240 pounds) of antimycin required to treat the Necklace lakes complex and Smokey Creek would be transported with two mule loads. An additional small amount of antimycin would be needed to treat associated stream segments. Fourteen people would be required to conduct the treatment--eight for treatment of the lakes; and six to monitor drip stations, detoxification stations, and caged fish. These fourteen people would require one horse each. Transport of the four rafts with motors, sprayers, recharge stations, and camp supplies would require approximately nine mule loads. The treatment would consist of approximately four days--one for set up, one for treatment, and two for clean up and departure. The stream treatment, detoxification, monitoring, and cleanup

would require approximately five days and would overlap much of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

All of the necklace lakes and upper Smokey Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Necklace receives an average of 118 (46-189) angler days per year (table C-1). Its annual statewide ranking is number 869 out of 1,529 fisheries in the state. Restocking genetically pure westslope cutthroat trout in the lower lakes would maintain angling opportunities at Necklace lakes, provide a source of pure fish to repopulate downstream areas, genetically dilute any possible remaining rainbow or rainbow westslope hybrids, and reduce the potential for an illegal fish introduction.

Maintenance stocking would continue in the Necklace chain of lakes to maintain population viability and angling quality. Beginning in July following the treatment, 1,400 fish would be stocked each year for three years among lakes 1, 5, 6, 8, 11, and the upper portion of Smokey Creek. Fish populations would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into the Necklace lakes is unlikely due to the high gradient of the stream below the lakes and the removal of downstream fish during the treatment.

Pilgrim Lake

Pilgrim Lake is a 29.9-acre lake located in the Jewel Basin Hiking Area at 6,365 feet above sea level and is in a headwater tributary basin to Jones Creek. The lake has a maximum depth of 154 feet and has a volume of 2,528 acre-feet (figure C-24). The outlet stream flows from the lake for 0.8 mile before joining with the other headwater fork to Jones Creek (Big Hawk Lake effluent). Jones Creek flows for another 2.09 miles before entering Aeneas Creek. Aeneas Creek flows for 0.38 mile where it meets with Graves Creek. Graves Creek flows for an additional 0.79 mile to the barrier waterfall at its mouth. Aeneas, Jones, and Graves Creeks are all isolated from upstream movement by Hungry Horse Reservoir fish by a barrier waterfall at the mouth of Graves Creek. Distance from Pilgrim Lake to the fish barrier at the mouth of Graves Creek is 4.06 miles. Upper Pilgrim Lake was surveyed in 2001 and found to be fishless.

There is no known trail access to Pilgrim Lake.

The management objective for this lake is to remove the hybrid trout from the lake and from the 3.27 miles of stream between the lake and the Aeneas-Graves confluence. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Rotenone-treated water leaving the lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. Up to date flow measurements and on-site assays would determine the number and location of sentinel fish cages, drip stations, and detoxification stations.

In September 2002, Pilgrim Lake was surveyed and found to have no surface water flowing out of it. The outflow channel from Pilgrim Lake was dry to the point of the confluence with the Big Hawk Lake outflow stream. Under these circumstances, rotenone treated water flowing subterranean would likely be detoxified through natural binding processes. A rotenone drip station would be installed at the point where the stream resurfaced to remove fish from that point down to the Aeneas-Graves confluence.

Removal of fish from Pilgrim Lake would require the application of 842 gallons (8,252 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat the associated stream segments. Five hundred gallons (4,900 pounds) would be transported to the lake in one trip by SEAT aircraft; the remaining 342 gallons (3,352 pounds) would be transported by helicopter in four loads. Two helicopter flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately five people would be needed to treat the lake, requiring two transport flights by helicopter.

Prior to treatment, monitors would set up fish cages, drip stations, and detoxification stations at predetermined locations on Aeneas Creek downstream of Jones Creek, and on Graves Creek just below the confluence of Aeneas Creek. All personnel, equipment, and materials would be transported to the site prior to treatment to prepare for application by boat. Two people would prepare for treatment of freshwater inputs and seeps using sprayers and drip stations.

In August and November 2002, Pilgrim Lake was surveyed by air with a SEAT pilot who determined that the layout of Pilgrim Lake allows for four, 125 gallon drops of rotenone. An application plan using SEAT was developed based on terrain features of the site. Before dispensing rotenone, the SEAT would conduct two flyovers to confirm communication with ground personnel at the lake and to test weather conditions. Mach flyovers conducted in November 2002 with a Hughes 500 helicopter revealed that the best approach to Pilgrim Lake would be from the southwest corner. The plane would make its descent toward the lake, make a slight bank to the east, dispense its load, then continue easterly down Jones Creek drainage. The SEAT would circle back to the south of Big Hawk Lake, and approach from the southwest to continue dispensing. After the final drop, the SEAT would return to Glacier Airport.

Since rotenone appears milky white when it comes in contact with water, the SEAT pilot would be able to accurately judge where to drop subsequent loads in order to provide effective application coverage, applying each load adjacent to the prior load. After the first SEAT load is administered, the raft would begin mixing the rotenone, pumping it to deeper zones of the lake; the treatment of freshwater inputs would also begin.

After the SEAT made its initial application, treatment, and detoxification of stream segments would begin. When treatment was completed, three people would be flown out with most of the equipment. Two people would stay at the site and monitor the treatment. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) and personnel would be removed. Caged fish stations, drip stations and detoxification stations would be monitored continually until treatment is completed, and removed only after caged fish survived 24 hours after treatment. It is expected that stream treatment, monitoring, detoxification, and cleanup would take about five days. These procedures would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Pilgrim Lake receives an estimated 34 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the proposed treatment, 3,000 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion by fish from downstream is

nonexistent due to an approximately 300 feet long steep rock slab fish barrier located, at the outlet of the lake.

Pyramid Lake

Pyramid Lake is an 8.9-acre lake located in the Bob Marshall Wilderness at 6,927 feet above sea level. The maximum lake depth is 37 feet and lake volume is 191 acre-feet (figure C-25). The main surface water input to the lake is located on the southwest shore. Pyramid Creek flows out of the lake for 1.84 miles until it reaches the confluence with Young Creek. This section of stream is at 11 percent gradient and is reported to frequently go dry. Youngs Creek flows for 1.43 miles where it meets with Devine Creek, then 1.08 miles until it reaches Ross Creek, and another 1.69 miles until it reaches Jenny Creek. The area between Spruce and Jenny Creeks is the uppermost distribution of bull trout in the Young Creek drainage. The distance from this point to Pyramid Lake is approximately 5.2 miles.

Pyramid Lake can be accessed by a 2.7-mile long trail beginning at the Pyramid Pass trailhead.

The management objective for this lake is to remove the hybrid trout from the lake, from the small pond downstream of the lake, and from the 3.3 miles of stream between the lake and the Youngs/Devine Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier.

The stream that flows out of Pyramid Lake often runs dry in the fall of the year. If it is flowing, the stream down to Devine Creek would be treated; otherwise, the lower boundary of the project would be where the stream goes dry. The elevation differential between Pyramid Lake and Devine Creek confluence is approximately 1,242 feet, which, if the stream is flowing, would require the installation of approximately five recharge stations to maintain antimycin lethality in this section of stream. Forest Service trail 283 parallels upper Youngs Creek making access to the creek possible. Up to date flow measurements and on-site bioassays would be used to determine the number and location of drip stations, detoxification stations, and caged fish monitoring stations.

Bull trout occur in the Young's Creek drainage and their uppermost known distribution is between the Spruce Creek and Jenny Creek tributaries. The lower treatment boundary for Young's Creek is at the Devine Creek confluence, which is approximately 1.5 miles upstream of the uppermost know bull trout distribution. If Pyramid Creek is flowing and connected to Young's Creek, up-to-date flow measurements and on-site bioassays would be used to determine the number and location of drip stations, detoxification stations, and caged fish monitoring stations. Detoxification and caged fish monitoring stations would be used to safeguard downstream bull trout.

Transporting the estimated 38 units (143 pounds) of antimycin needed to treat the lake would require one mule load. An additional small amount of antimycin may be needed to treat associated stream segments. A camp would be set at Pyramid Lake to conduct the treatment. Approximately five people would be needed to treat the lake; and approximately six to proved stream treatment, detoxification, and caged fish monitoring. Transport of materials, rafts, motors, and camp would require approximately six mule loads. Outboard motors would be required to administer the antimycin in a timely manner and to mix the compound with lake water. Pumps would be used to distribute the

compound at deeper depths. All personnel, equipment, and materials would be transported to the site prior to treatment. Thereafter, treatment would require approximately one day and cleanup two, with departure on the fourth. Stream treatment, detoxification, caged fish monitoring, and cleanup would require approximately five days, and would be conducted during the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after cage fish survived 24 hours after treatment.

Pyramid Lake and sections of the stream would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate that Pyramid Lake receives an estimated 57 (25-83) angler days per year. Its annual statewide ranking is number 1,175 out of 1,529 fisheries in the state. Restocking genetically pure westslope cutthroat would maintain angling opportunities at Pyramid Lake, provide a source of pure fish to repopulate downstream, genetically dilute any possible westslope x Yellowstone cutthroat and/or rainbow hybrids, and reduce the potential for an illegal fish introduction.

Maintenance stocking would continue at Pyramid Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment, and would involve 1,000 fish each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into Pyramid Lake is low due to the high gradient of the stream below the lake and the fact that the stream frequently flows underground.

Sunburst Lake

Sunburst Lake is a 148.5-acre lake located in the Bob Marshall Wilderness at 5,322 feet above sea level. The maximum depth of the lake is 221 feet and the lake volume is 12,687 acre feet (figure C-26). There are at least 10 surface water inputs to the lake including perennial streams, ephemeral streams, and freshwater seeps. These occur around the entire shoreline of the lake, but are more abundant on the south and west shores. Gorge Creek flows out of the lake for 1.53 miles where it meets the confluence with Inspiration Creek. The stream continues for 3.64 miles where it meets Stadium Creek, then it continues for 1.61 miles where it reaches Feather Creek, and, finally, another 0.76 mile where it reaches a barrier waterfall. Gorge Creek continues for 1.36 miles where it reaches the confluence of Bunker Creek. Bull trout use Bunker Creek as a spawning and rearing stream, but at very low levels. Total distance from Sunburst Lake to the barrier falls is 7.54 miles.

Sunburst Lake can be accessed by a 10.7-mile long trail beginning at the Napa Point trailhead. Although this is the closest access, poor trail conditions experienced during an inspection in 2002 indicate that the Inspiration Creek trail precludes use by large numbers of stock. Rather, access to the lake would best be gained by trail 218 starting at the Gorge Creek trailhead and traveling 10.9 miles up Gorge Creek drainage to the lake.

The management objective for this lake is to remove the hybrid trout from the lake and from the 6.1 miles of stream between the lake and the waterfall near Feather Creek. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material, making transport to a remote location easier; and it naturally detoxifies with every 200 feet of downstream elevation drop, which also makes containment easier. The elevation differential between Sunburst Lake and the waterfall near Feather Creek is approximately 1,875 feet, which would require the installation of approximately seven recharge stations to maintain lethality of the

antimycin through this reach of stream. Forest Service trails 693 and 218 parallel Gorge Creek, which makes access easier.

For this project, the barrier waterfall near the mouth of Feather Creek is the lower boundary of the proposed treatment area. Up to date flow measurements and on-site bioassays would be used to determine the level of natural detoxification. As a safeguard measure, caged fish would be placed in Gorge Creek upstream of the waterfall near Feather Creek and, if natural detoxification were not effective, potassium permanganate would be administered at the rate of 1ppm to detoxify the antimycin.

The 2,537 units (9,513 pounds) of antimycin needed to treat Sunburst Lake and Gorge Creek would require 55 mule loads. This could be conducted using six pack strings over a two week period. An attended camp would be set at Sunburst Lake for storage of materials. There would be an additional small amount of antimycin needed to treat associated stream segments. Eight personnel would be required to treat the lake, another eight to treat the stream, and one to monitor the caged fish and set up a detoxification station if needed. All personnel would access the project site by horse. Eight additional mule loads would transport supplies, materials, four rafts, and motors. Boat motors would be used to distribute the compound near the surface, and pumps would be used to distribute the compound at deeper depths. The treatment of Sunburst Lake and Gorge Creek would be conducted in mid to late September to take advantage of warmer water temperature, thus facilitating an effective treatment. The proposed treatment of the lake and stream would be expected to take two days for set up, one day for application, and two days for cleanup and site departure. Stream treatment, detoxification, and cleanup is expected to take approximately five days and would overlap much of the lake project. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

Sunburst Lake and Gorge Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Sunburst Lake receives an average of 96 (39-175) angler days per year. Its annual statewide ranking is number 965 out of 1,529 fisheries in the state (table C-1). Maintenance stocking would continue on Sunburst Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment and continue for two more years. Approximately 14,800 fish, of which 1,000 would be of catchable size, would be stocked in each of the first two years to restore the fishery as quickly as possible. The stream below the lake would also be stocked to establish a population as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and stocking needs. Reinvasion by downstream fish into Sunburst Lake is possible, but to what extent is unknown. Gorge Creek has several likely waterfall barriers that may prevent upstream movement of fish. The risk of reinvasion by downstream fish into Sunburst Lake is unlikely since fish in Gorge Creek would be removed during treatment down to the barrier near its mouth.

Upper Three Eagles Lake

Upper Three Eagles Lake is a 10.8-acre lake located in the Jewel Basin Hiking Area at 6,340 feet above sea level and is in a headwater tributary basin of Aeneas Creek. The lake has a maximum depth of 72 feet and has a volume of 487 acre-feet (figure C-27). The outlet stream flows from the lake for 0.28 mile before entering Lower Three Eagles Lake.

There is no known trail access to Upper Three Eagles Lake.

The management objective for this lake is to remove the hybrid trout population from it and its effluent stream. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Water leaving the lake would be allowed to flow downstream in an effort to remove hybrid trout from the intermediate section of stream between the upper and lower lakes. Given the proximity of the two lakes, treating the lower lake would be mandatory during the treatment of the upper lake.

Removal of fish from Upper Three Eagles Lake would require the application of 162 gallons (1,588 pounds) of rotenone administered at 1 ppm. The rotenone would be transported to the lake by helicopter in two loads. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately four people would be needed to treat the lake, requiring two additional transport flights. This lake would be treated simultaneously with Lower Three Eagles Lake.

The lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Beginning in July following the treatment, 900 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. Due to the steep gradient and removal of fish from this section of the stream, there is little risk of reinvasion by downstream fish into the lake.

Wildcat Lake

Wildcat Lake is a 40-acre lake located in the Jewel Basin Hiking Area at 5,810 feet above sea level that forms the headwaters of Wildcat Creek. The lake has a maximum depth of 112 feet and a total volume of 2,066 acre-feet (figure C-28). The two main surface water inputs to the lake include one perennial stream in the southeast corner and another ephemeral stream in the southwest corner of the lake. The steep gradient of both streams precludes them from harboring a viable population of fish. Fish have been observed spawning at the outlet of the lake on small angular rock.

Wildcat Creek flows out of the lake for approximately 35 feet where it flows over a 25-foot waterfall. The stream flows for another 0.09 mile where it enters a small in-stream pond located on a bench below Wildcat Lake. The stream flows for another 3.37 miles where it encounters another barrier waterfall. Total distance from this waterfall to Wildcat Lake is 3.46 miles. Wildcat Creek continues for 0.02 mile to its confluence with Wounded Buck Creek.

Access to Wildcat Creek is made by a 4.3-mile long trail network that starts at the Camp Misery trailhead.

The management objective for Wildcat Lake is to remove the hybrid trout population from the lake, from the unnamed pond directly downstream, and from about 1 mile of stream below the unnamed lake. To achieve this objective, antimycin would be used because it naturally detoxifies in a stream with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. In addition, since the elevation differential between Wildcat Lake and the waterfall near the mouth of Wildcat Creek is approximately 1,770 feet, the detoxification of the stream would be approximately seven times greater than necessary.

Some fish in the stream below the lakes would be killed during the treatment and natural detoxification process. Drip stations, sentinel fish cages, and detoxification stations would be placed in the stream to treat, monitor, and detoxify the stream at designated

locations. Up to date flow measurements and on-site assays would be used to determine the location of these stations.

Detoxification stations and sentinel fish cages would be used to monitor Wounded Buck Creek near the Wildcat Creek confluence as a safeguard measure for any bull trout that may be residing in Wounded Buck Creek.

Removal of fish from Wildcat Lake would require the application of 404 units (1,515 pounds) of antimycin administered at 7-8 ppb; an additional small amount of antimycin would be needed to treat associated stream segments. This would be transported to the lake by helicopter in two loads. Two flights would be required to transport rafts, motors, sprayers, and drip stations. Six people would be needed to treat the lake, and two additional personnel for treatment of the small pond downstream. The transport of personnel would require three flights.

Prior to the proposed treatment, monitors would set up drip stations, sentinel fish cages, and detoxification stations on Wildcat Creek and Wounded Buck Creek downstream from the Wildcat/Wounded Buck confluence in order to evaluate treatment and detoxification measures. After treatment, six people would be flown out with most of the equipment. Two people would remain at the lakes to monitor the treatment. The following day, dead fish would be collected from the shoreline of the lake and the small pond downstream, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed from the lake. Detoxification stations and caged fish would be monitored, and removed only after sentinel fish survived for 48 hours after treatment. It can be expected that the proposed stream treatment, monitoring, detoxification, and cleanup would take about five days, and would be conducted during most of the lake treatment.

In August 2002, the outflow stream of Wildcat Lake was gauged and measured to be 2.12 cfs. In September 2002, Wildcat Creek was gauged at its mouth and measured to be 8.2 cfs. At the same time, Wounded Buck Creek was gauged above its confluence with Wildcat Creek and found to be 14.4 cfs. Based on these measurements, antimycin treated water leaving Wildcat Lake would be diluted to a concentration of 0.75 ppb shortly after entering Wounded Buck Creek. This represents a reduction in concentration by approximately 87 percent.

MFWP angler use statistics from 1989 through 2001 indicate Wildcat Lake receives and estimated 112 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Stocking would occur the July following the treatment and continue for two more years. Beginning in July following the treatment, 3,900 fish, of which 700 would be of catchable size, would be stocked in each of the first two years to restore the fishery as quickly as possible. The stream below the lake would also be stocked to establish a population as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. There is no risk of reinvasion of downstream fish in Wildcat Lake and the pond due to the high gradient stream and numerous waterfalls that prevent fish from moving upstream.

Woodward Lake

Woodward Lake is a 65-acre lake located in the Bob Marshall Wilderness at 6,433 feet above sea level. The lake is located 0.9 mile downstream of Rubble Lake (fishless) and forms the headwaters of Cataract Creek. The maximum lake depth is 119 feet and total

volume is 2,255 acre feet (figure C-29). The main surface water inputs to the lake include seeps along the northwest shore from upland snowfields, ephemeral streams on the west and north shores, and several seeps on the south shore. Four of the water basins in the Necklace Lakes chain drain into Woodward Lake. Surveys in July 2002 revealed that these basins are fishless and their outlet streams flowed subsurface shortly after leaving the Necklace plateau. Cataract Creek flows out of the lake, then for 0.7 mile where Terrace Creek joins it from the north. It flows for another 2.26 miles before meeting the confluence with Big Salmon Creek. Big Salmon Creek flows for 1.6 miles where it meets Dart Creek from the west, then continues for 1.9 miles before meeting the confluence with Tango Creek from the northwest. It continues for 0.21 mile before meeting Gyp Creek from the south, then for 1.1 mile before meeting the barrier falls. This barrier falls is the uppermost known distribution of bull trout in the Big Salmon drainage. Total distance from Woodward Lake to the barrier falls is 7.73 miles. Big Salmon Creek continues for 4.84 miles until it reaches Big Salmon Lake.

Access to Woodward Lake is made by a 9.5-mile long trail that begins at the Owl Creek trailhead. Cataract Creek is the outflow stream from Woodward Lake. The management objective for this lake is to remove the hybrid trout from the lake and from the 2.96 miles of stream between Woodward Lake and the Cataract/Big Salmon Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for fish removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Woodward Lake and the mouth of Cataract Creek is approximately 993 feet; in order to maintain antimycin lethality would require the installation of approximately four recharge stations and a number of sentinel fish cages to monitor treatment through this reach of stream.

For this project, the mouth of Cataract Creek is the lower boundary of the treatment area. This is 4.81 miles upstream of the barrier falls on Big Salmon Creek, which is the uppermost known distribution of bull trout in the drainage. The elevation differential from the mouth of Cataract Creek to the Barrier Falls is approximately 950 feet which is 4.75 times greater than is required to detoxify antimycin at the proposed treatment levels. In addition, fresh water input from Big Salmon, Dart, Tango, and Gyp creeks would be relied upon to dilute the antimycin. As a safeguard measure, detoxification stations and caged fish would be placed in Cataract Creek near the mouth and in Big Salmon Creek near the confluence of Dart Creek. If natural detoxification were not effective, potassium permanganate would be administered at the rate of 1ppm to detoxify the antimycin.

Cataract Creek was gauged in July 2002 near its mouth and discharge was measured to be 22.1 cfs. Big Salmon Creek was gauged near this confluence and found to be 16.6 cfs. Based on these measurements, dilution of Cataract Creek by Big Salmon Creek is expected to be at least 43 percent in volume. Up to date flow measurements and on-site bioassays would be used to determine the number and spacing of drip stations, detoxification stations, and caged sentinel fish.

The 451 units of antimycin (1,691 pounds) needed to treat Woodward Lake and Cataract Creek would require approximately 10 mule loads. An additional small amount of antimycin would be needed to treat associated stream segments. This could be conducted using two, five-animal strings prior to the day of treatment. An attended camp would be set at Woodward Lake to store materials. Six personnel would be required to treat the lake, another four to treat the stream, and one to monitor the caged fish and set up a precautionary detoxification station. These eleven people would each need one riding

horse and six mules for supplies, materials, rafts, motors, and feed. Two outboard motors would be required to administer the antimycin in a timely manner and to mix the compound with lake water. Pumps would be used to distribute the compound at deeper depths.

The proposed treatment of Woodward Lake and Cataract Creek would be conducted between mid September and early October. The treatment of the lake and stream is expected to take two days for set up, one day for application, and two days for cleanup and site departure.

Treating and cleanup of the stream would require approximately five days for set-up, treatment, and cleanup, and would overlap much of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged sentinel fish survived for 24 hours after treatment.

Woodward Lake and upper Cataract Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Woodward Lake receives an average of 156 (34-572) angler days per year (table C-1). Its annual statewide ranking is number 732 out of 1,529 fisheries in the state. Restocking genetically pure westslope cutthroat would maintain angling opportunities at Woodward Lake, provide a source of pure fish to repopulate downstream, genetically dilute any possible remaining rainbow or rainbow westslope hybrids downstream, and reduce the potential for an illegal fish introduction.

Maintenance stocking would continue on Woodward Lake to maintain population viability and angling quality. Beginning in July following the treatment, 6,500 fish, of which 1,000 would be of catchable size, would be stocked in each of the first three years to restore the fishery as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into Woodward Lake is low since the high gradient stream below the lake makes upstream passage by fish difficult if not impossible. The risk would also be diminished since downstream fish would be removed during treatment.

Figure C-1. Bathymetric map of Black Lake.

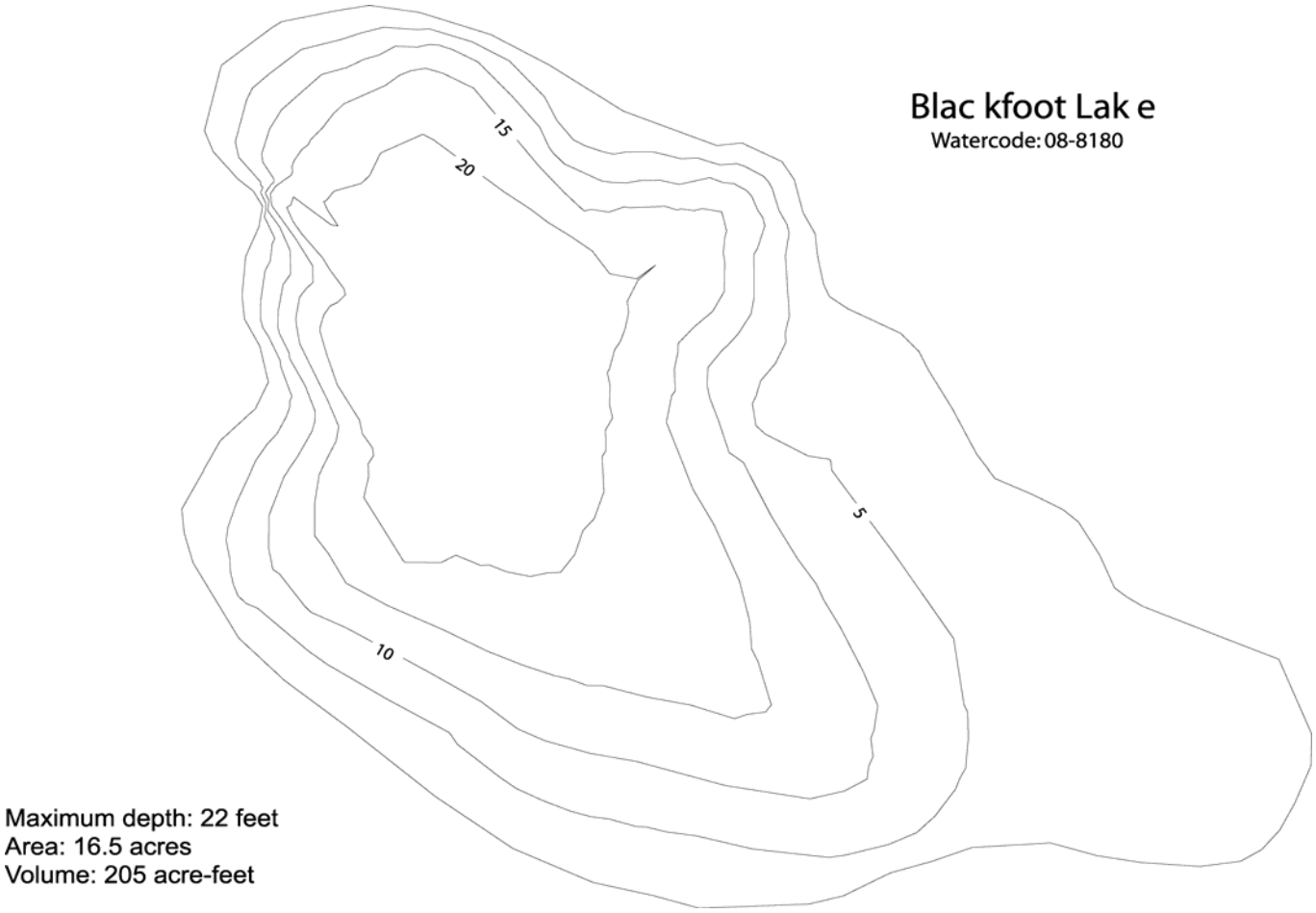
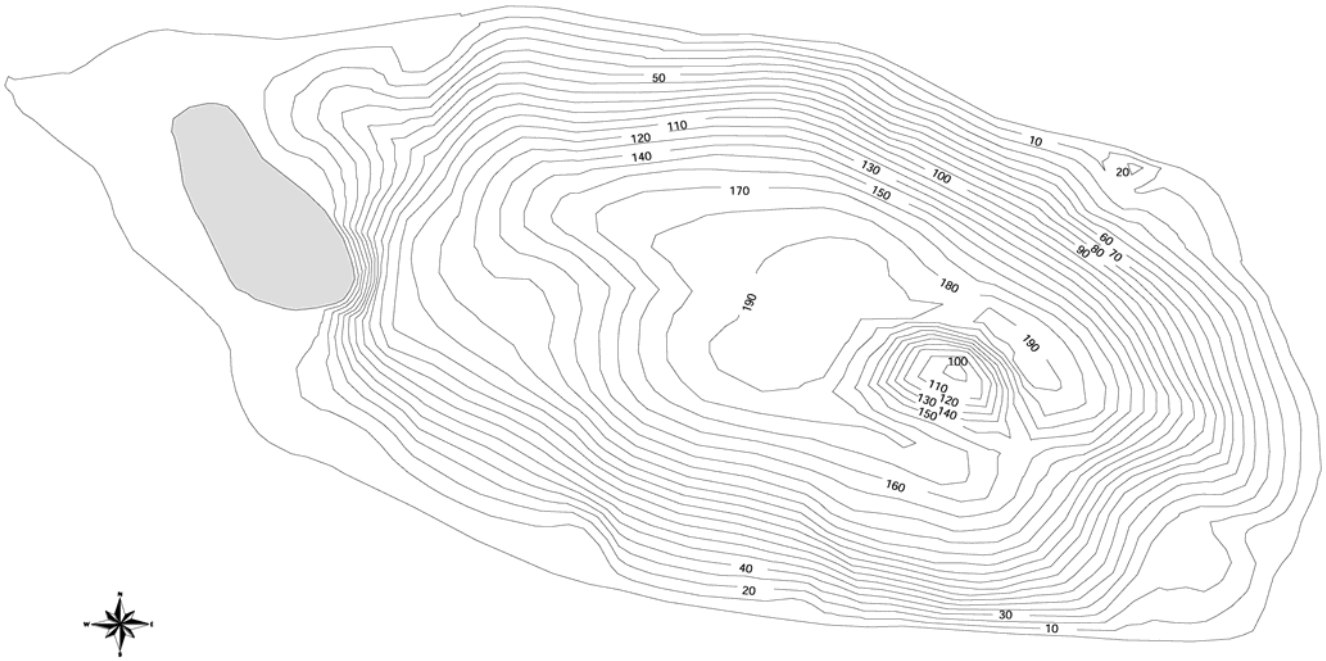


Figure C-2. Bathymetric map of Blackfoot Lake.

Clayton Lake
Watercode: 08 - 8340



Maximum depth: 193 feet
Area: 62 acres
Volume: 6948 acre-feet

Figure C-3. Bathymetric map of Clayton Lake.

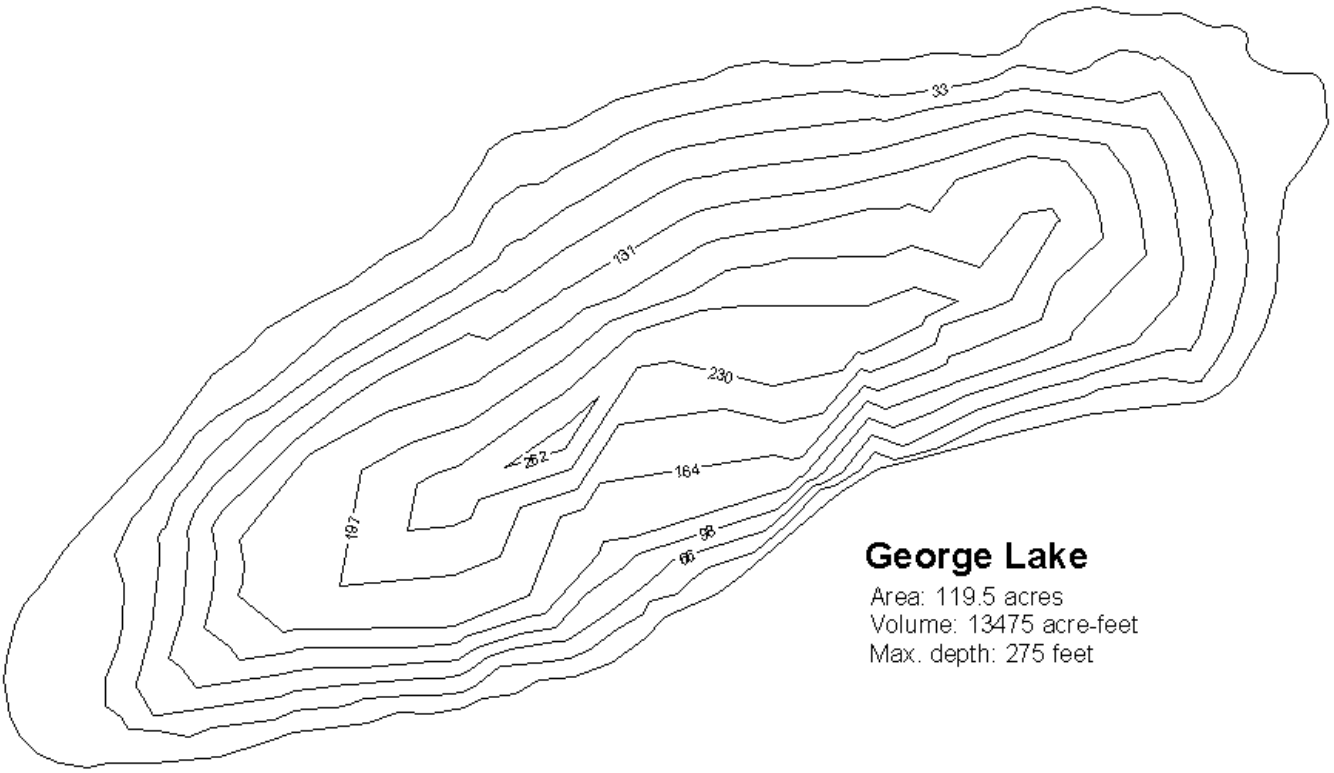


Figure C-4. Bathymetric map of George Lake.

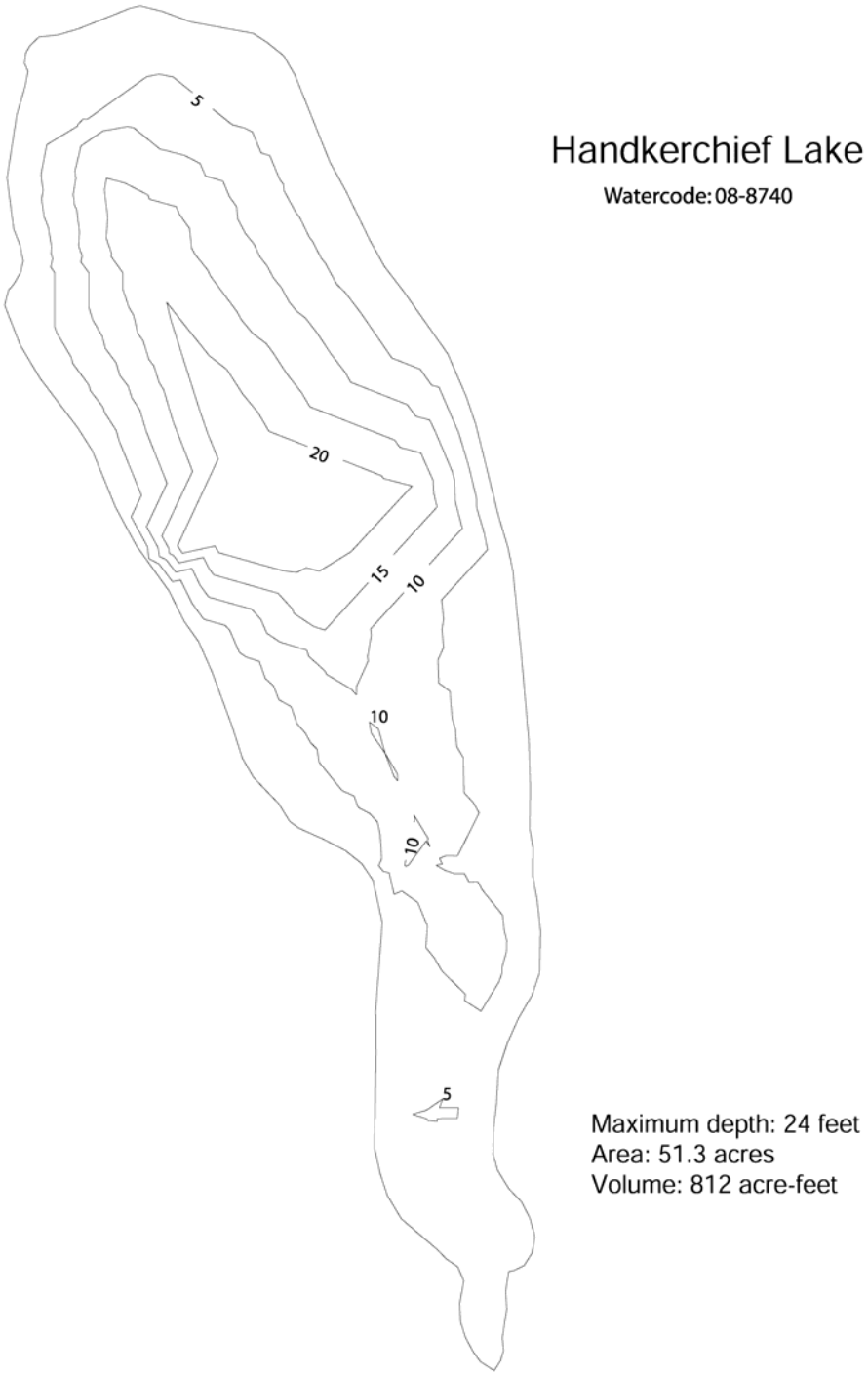


Figure C-5. Bathymetric map of Handkerchief Lake.

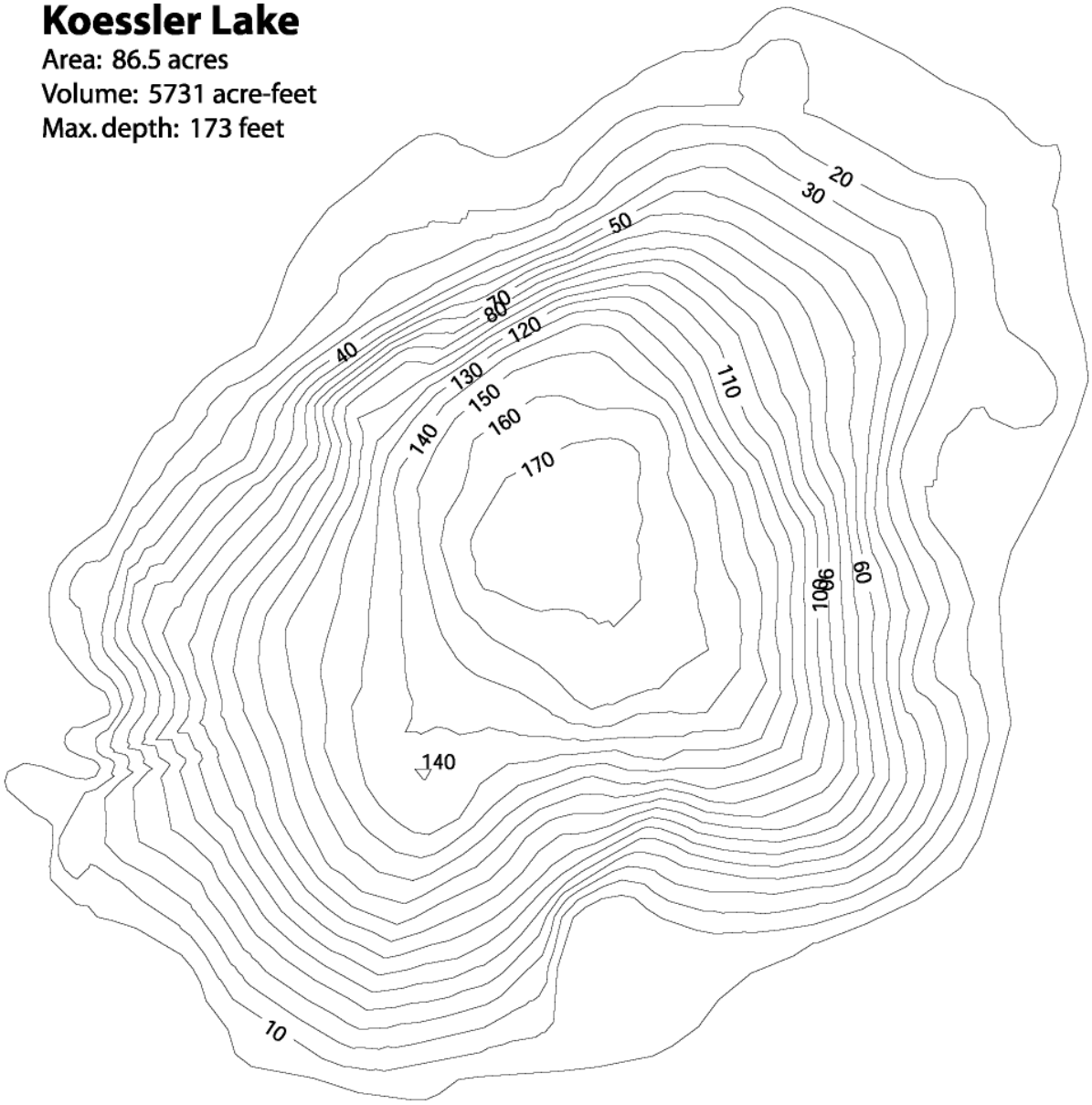


Figure C-6. Bathymetric map of Koessler Lake.

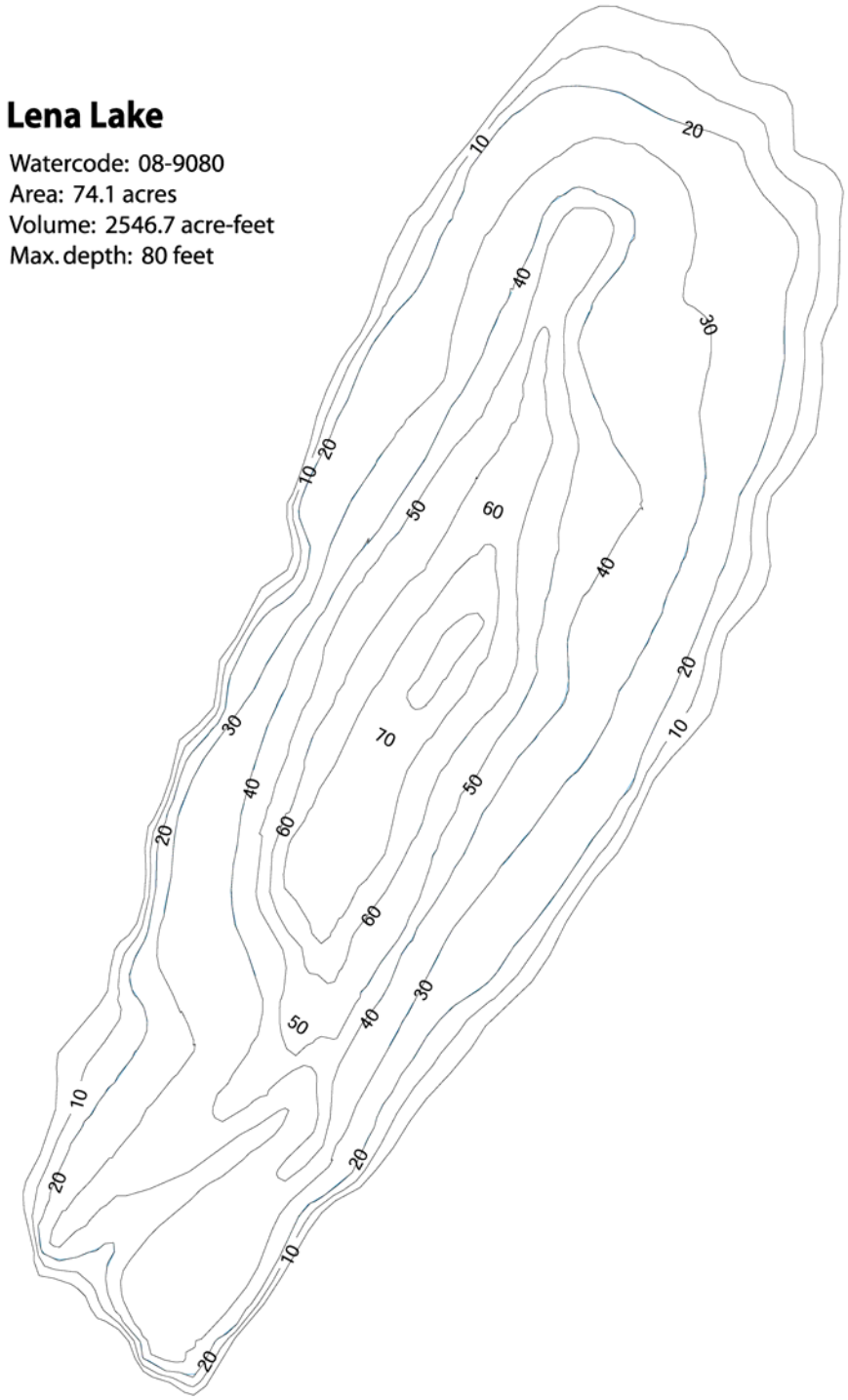


Figure C-7. Bathymetric map of Lena Lake.

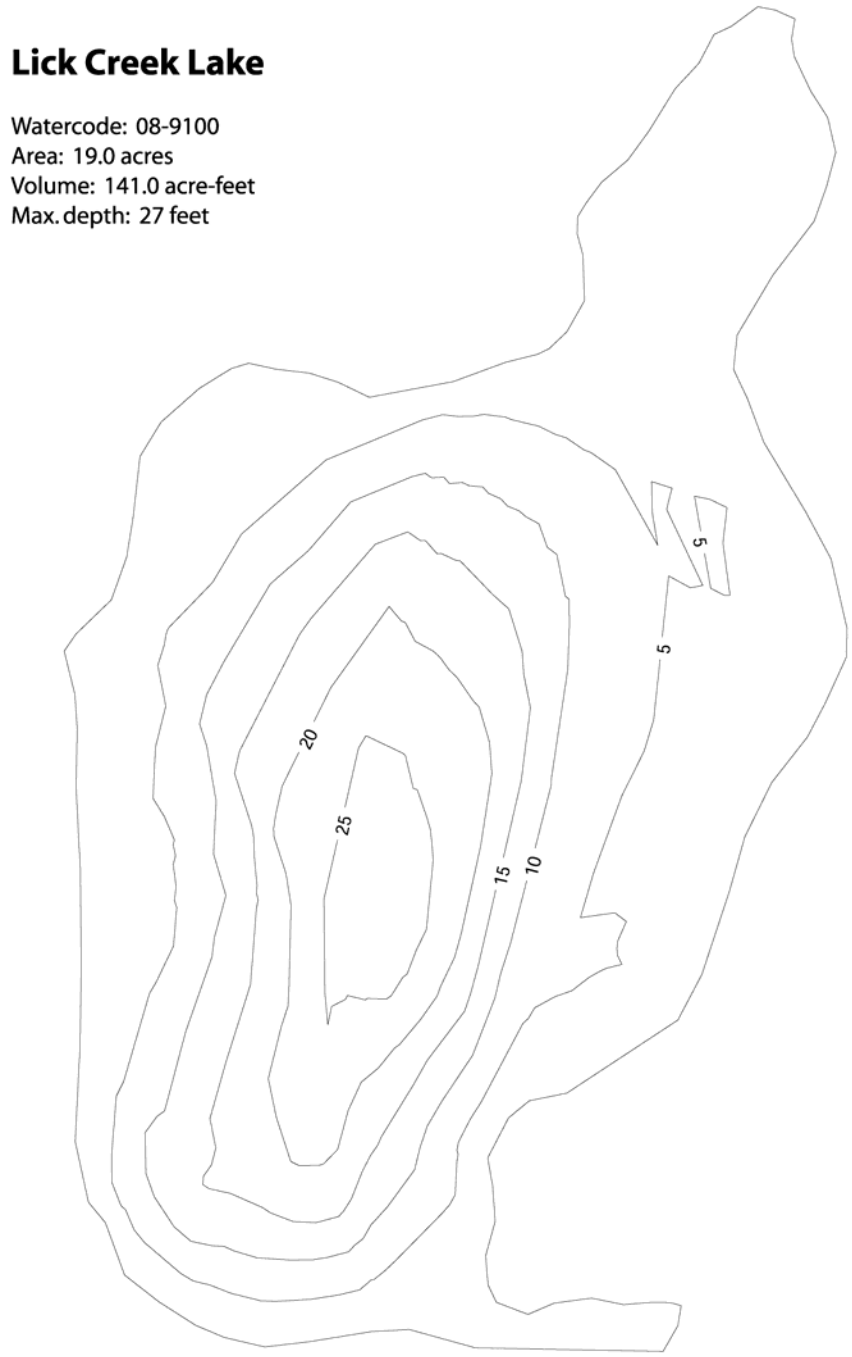


Figure C-8. Bathymetric map of Lick Lake.

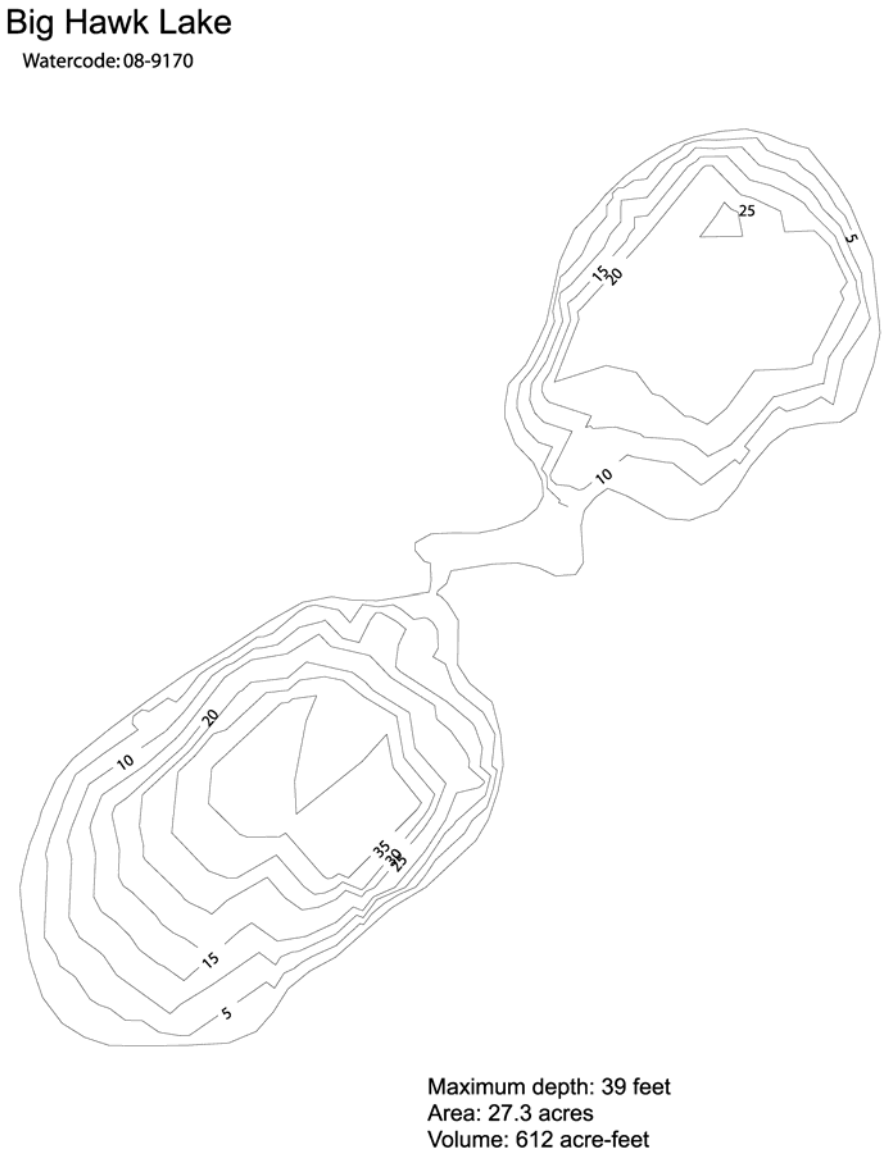


Figure C-9. Bathymetric map of Lower Big Hawk Lake.

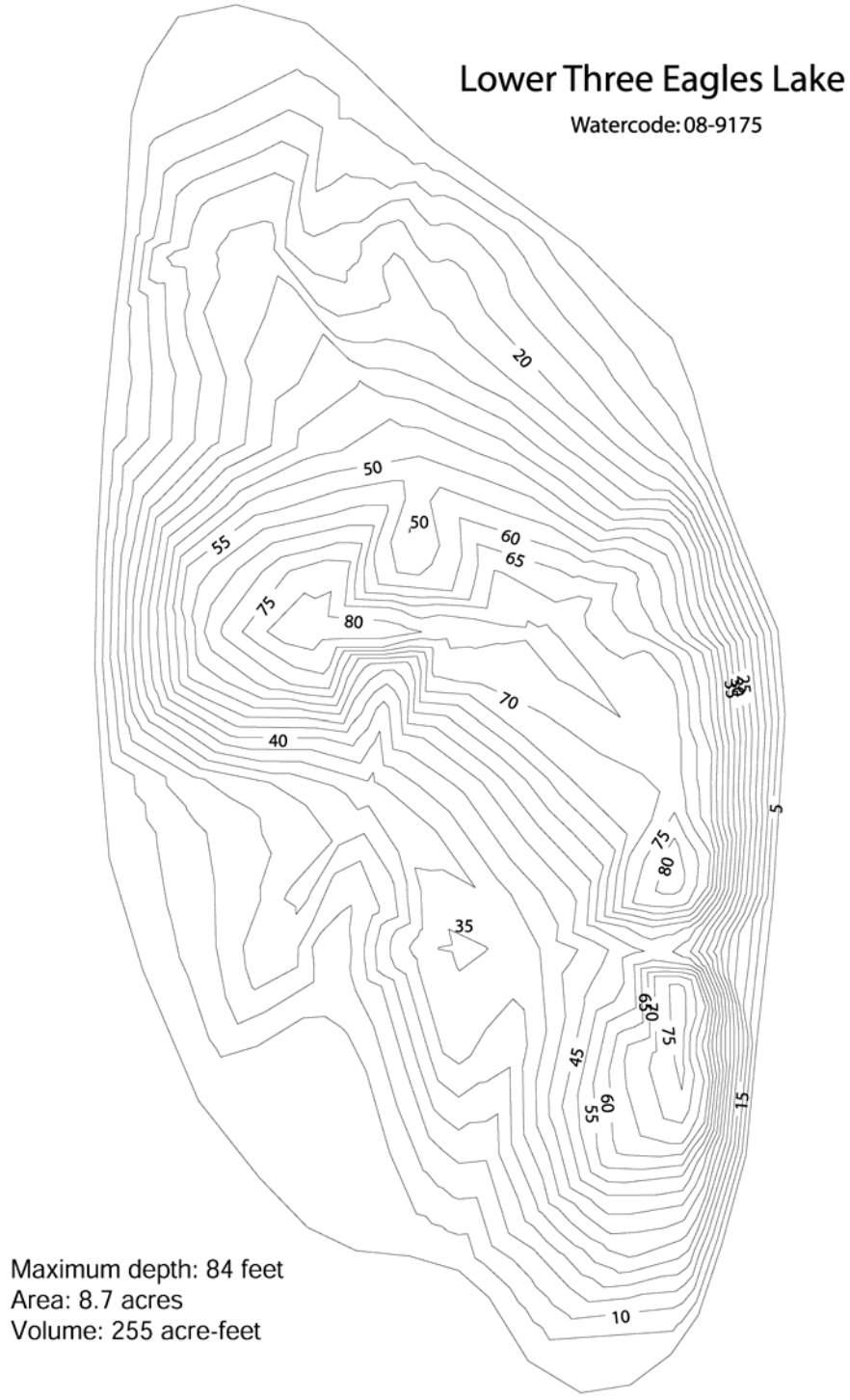


Figure C-10. Bathymetric map of Lower Three Eagles Lake.

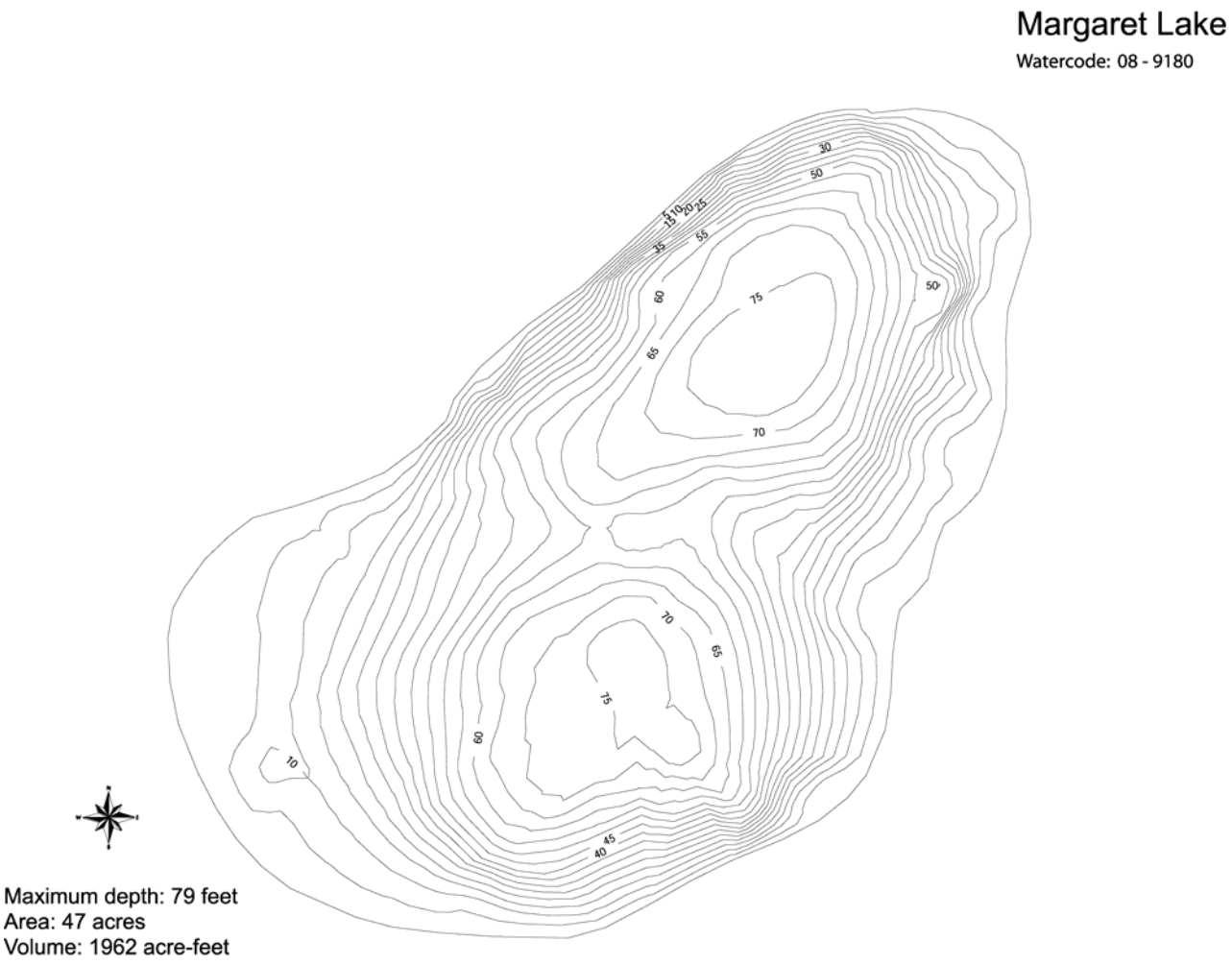


Figure C-11. Bathymetric map of Margaret Lake.

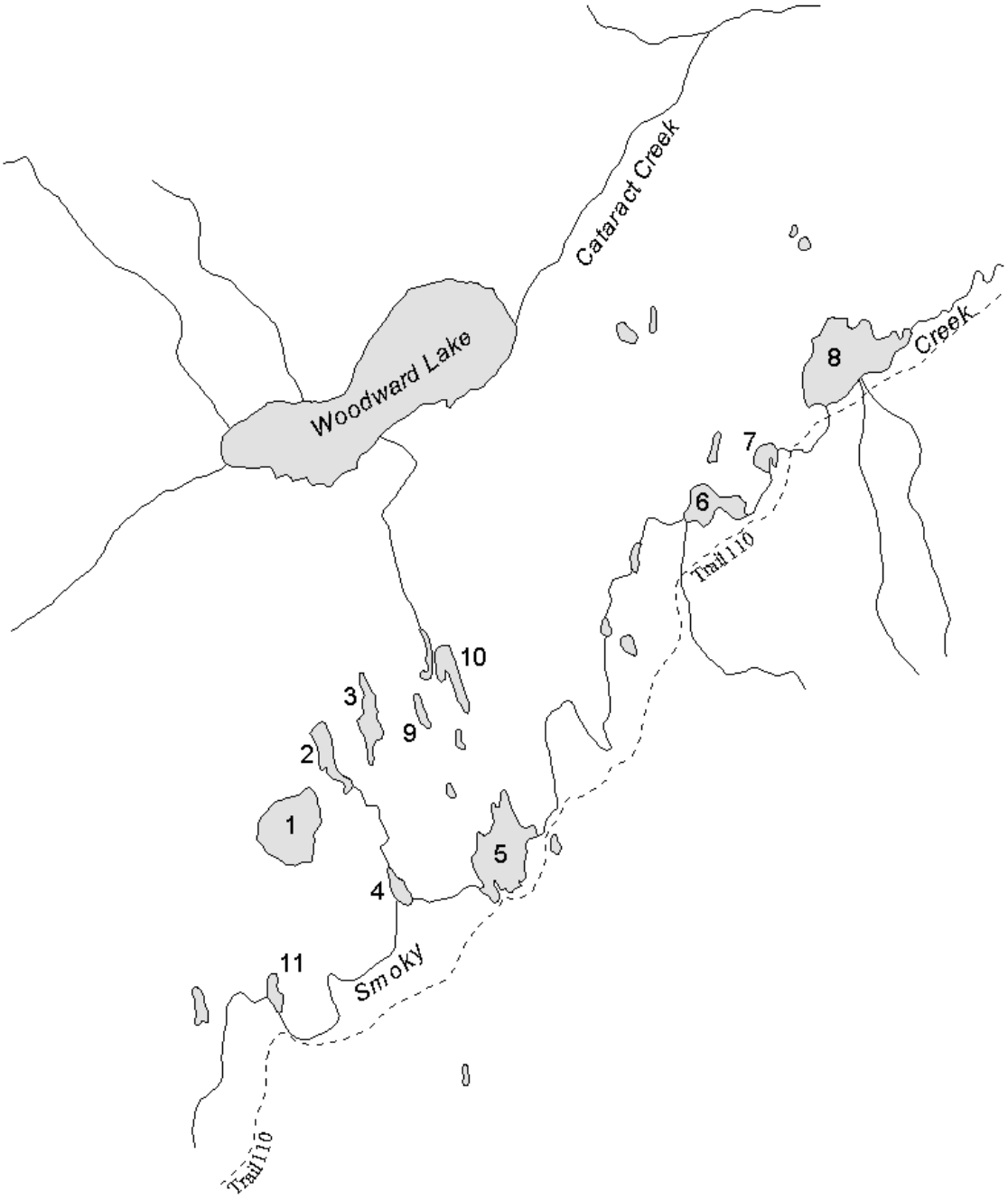


Figure C-12. Location map for the Necklace Lakes.

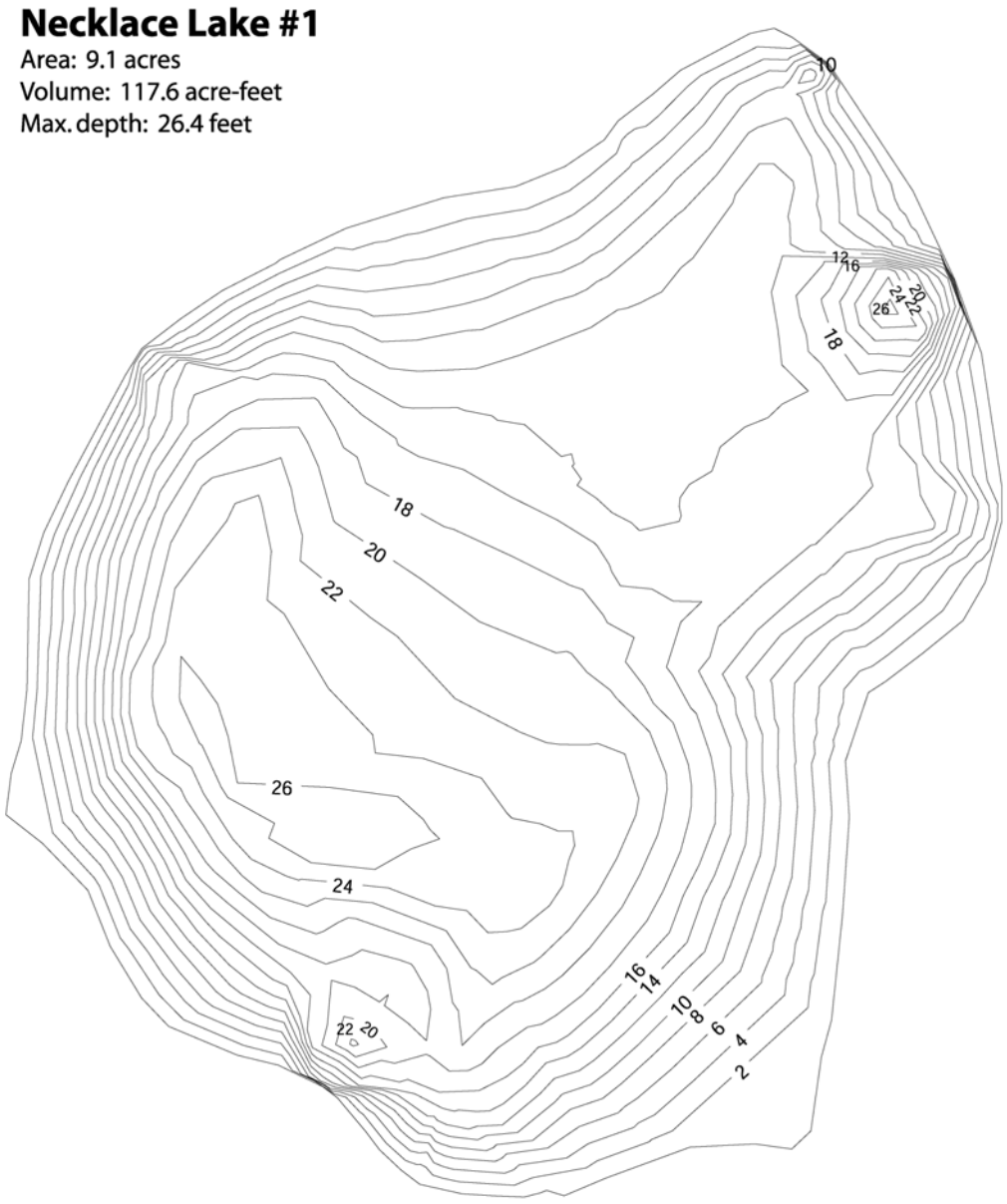


Figure C-13. Bathymetric map of Necklace Lake #1.

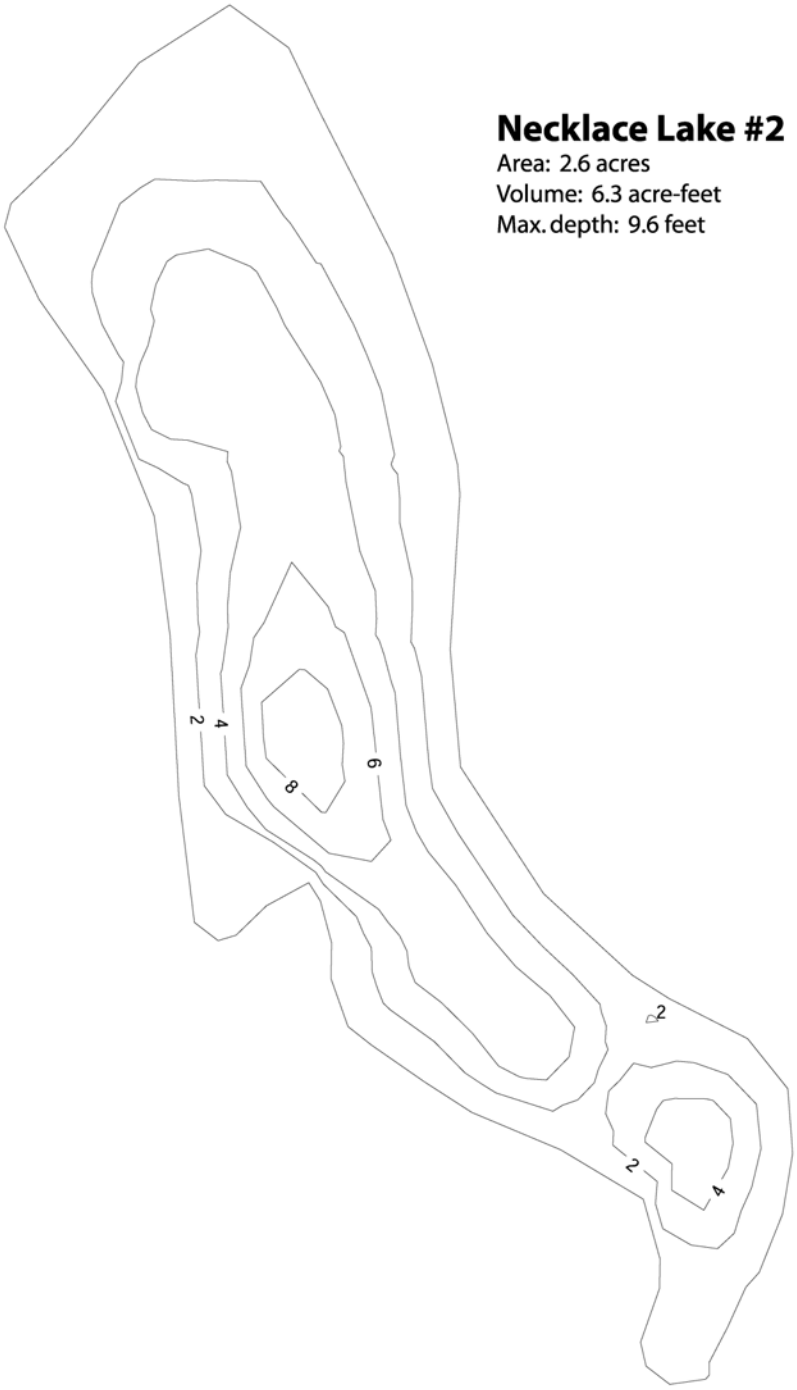


Figure C-14. Bathymetric map of Necklace Lake #2.

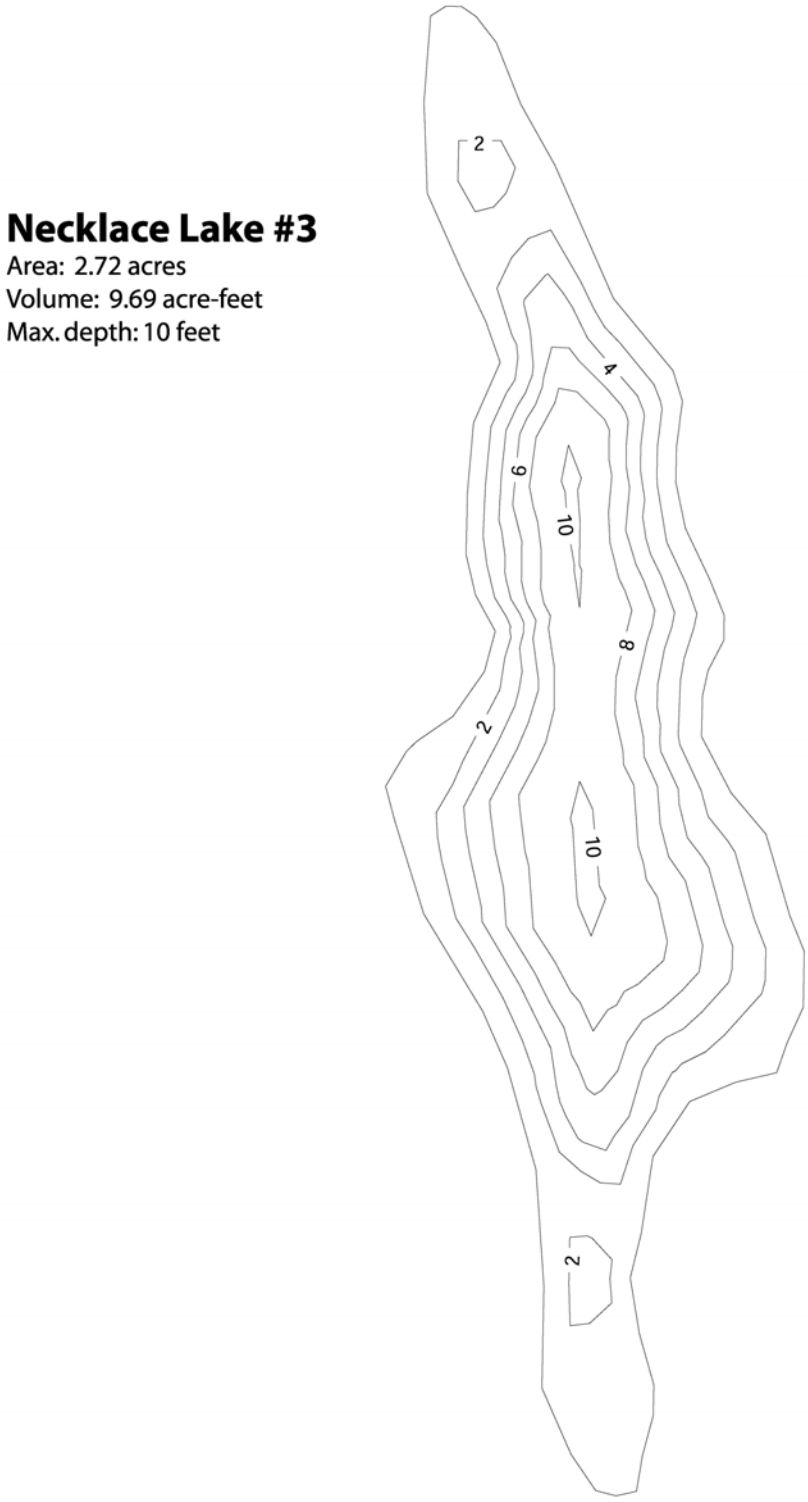


Figure C-15. Bathymetric map of Necklace Lake #3.

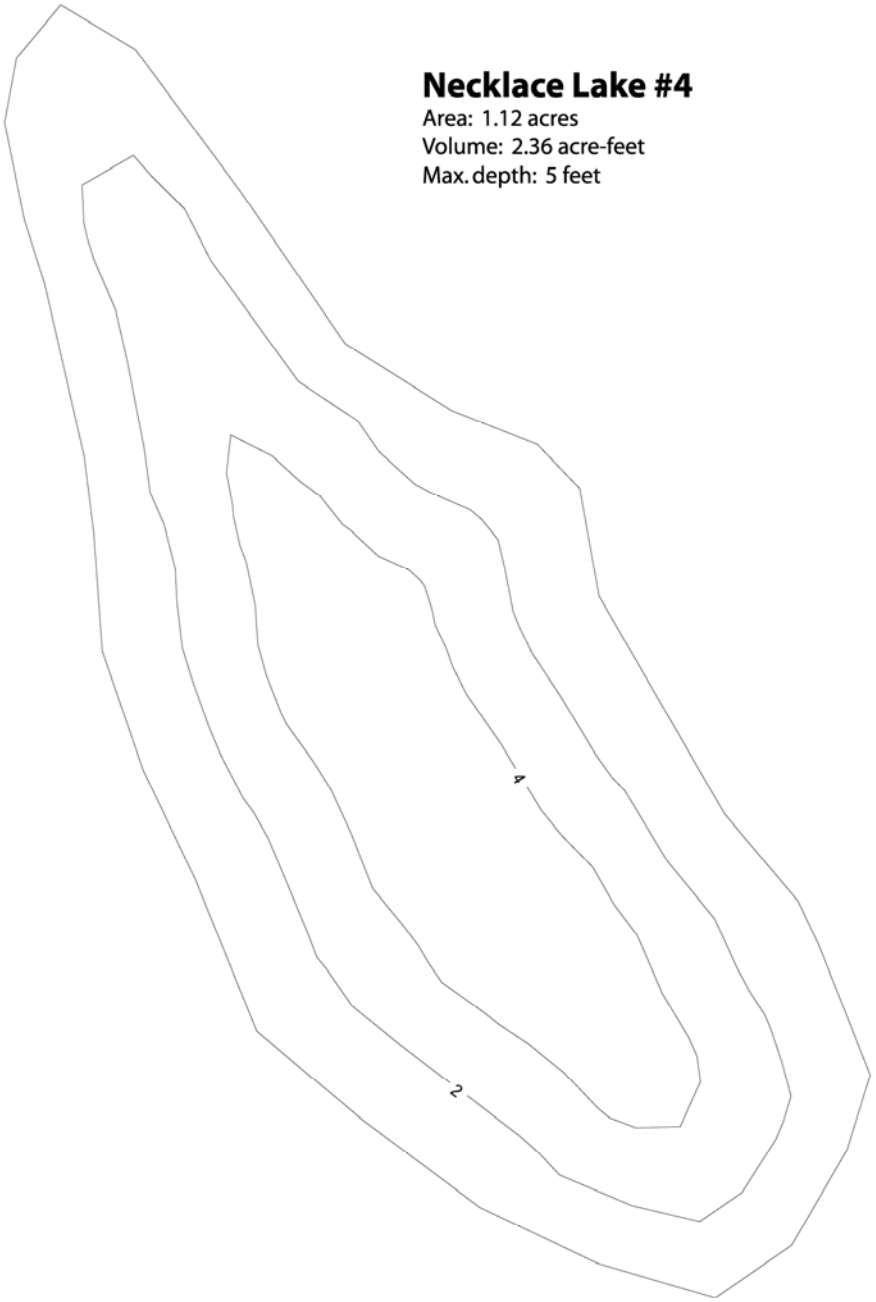


Figure C-16. Bathymetric map of Necklace Lake #4.

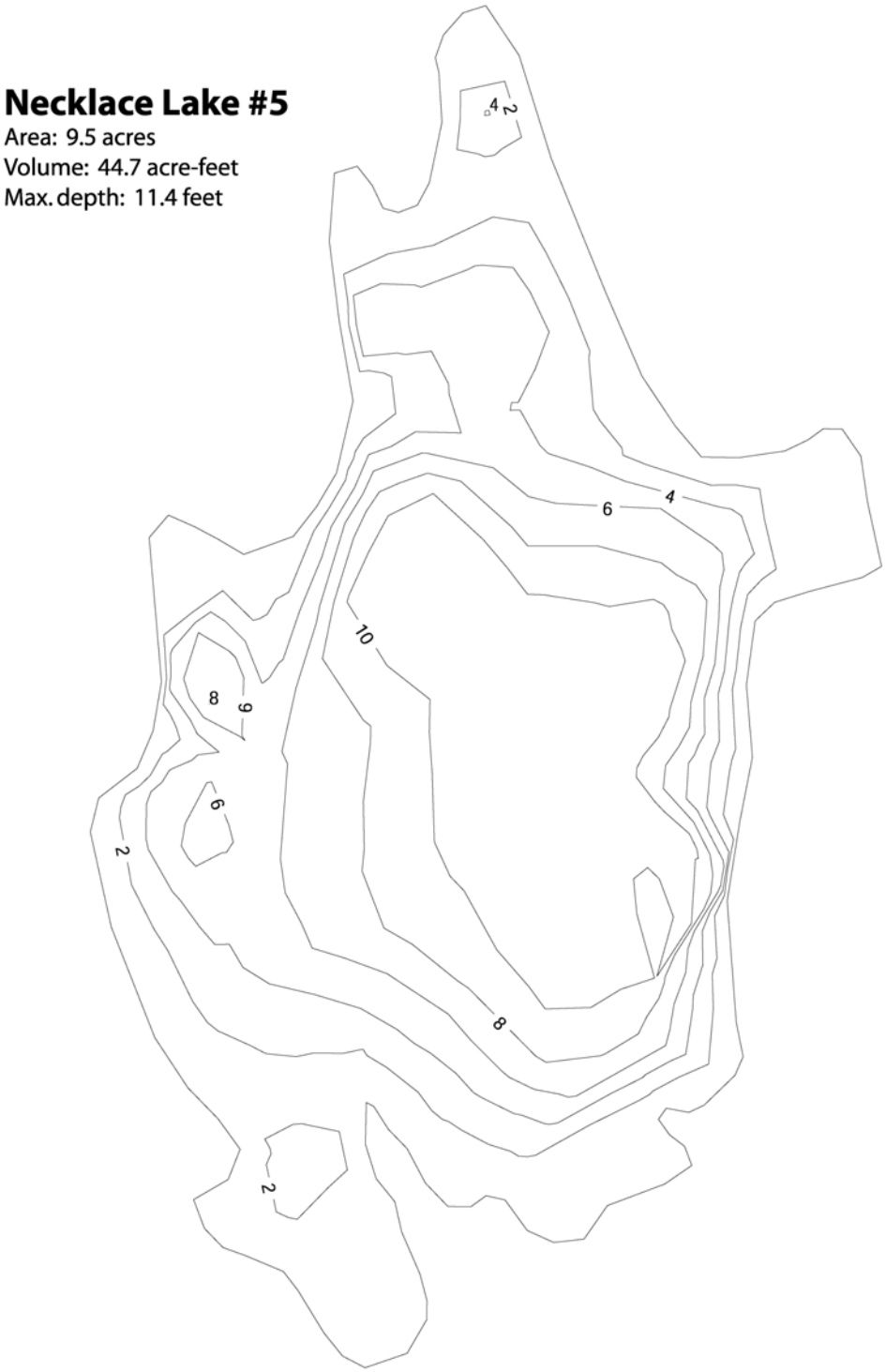


Figure C-17. Bathymetric map of Necklace Lake #5.

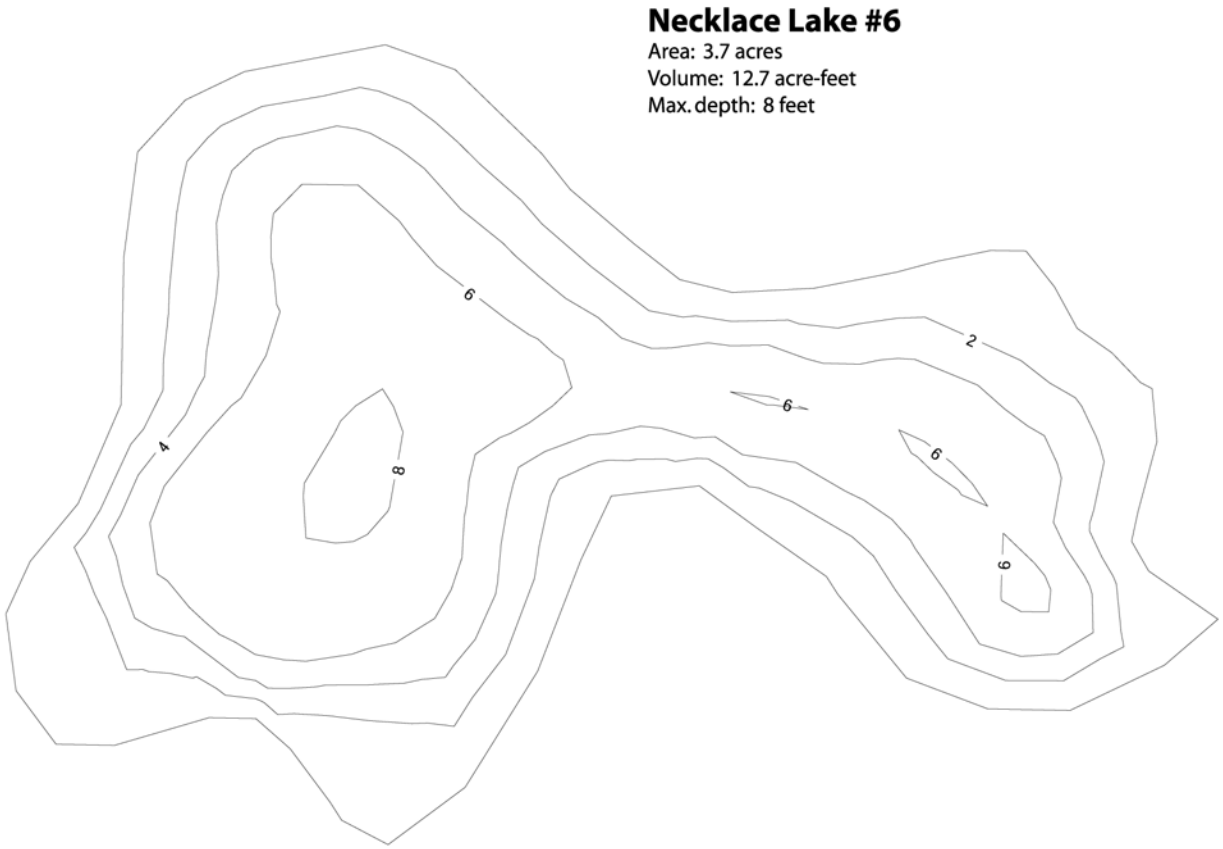


Figure C-18. Bathymetric map of Necklace Lake #6.

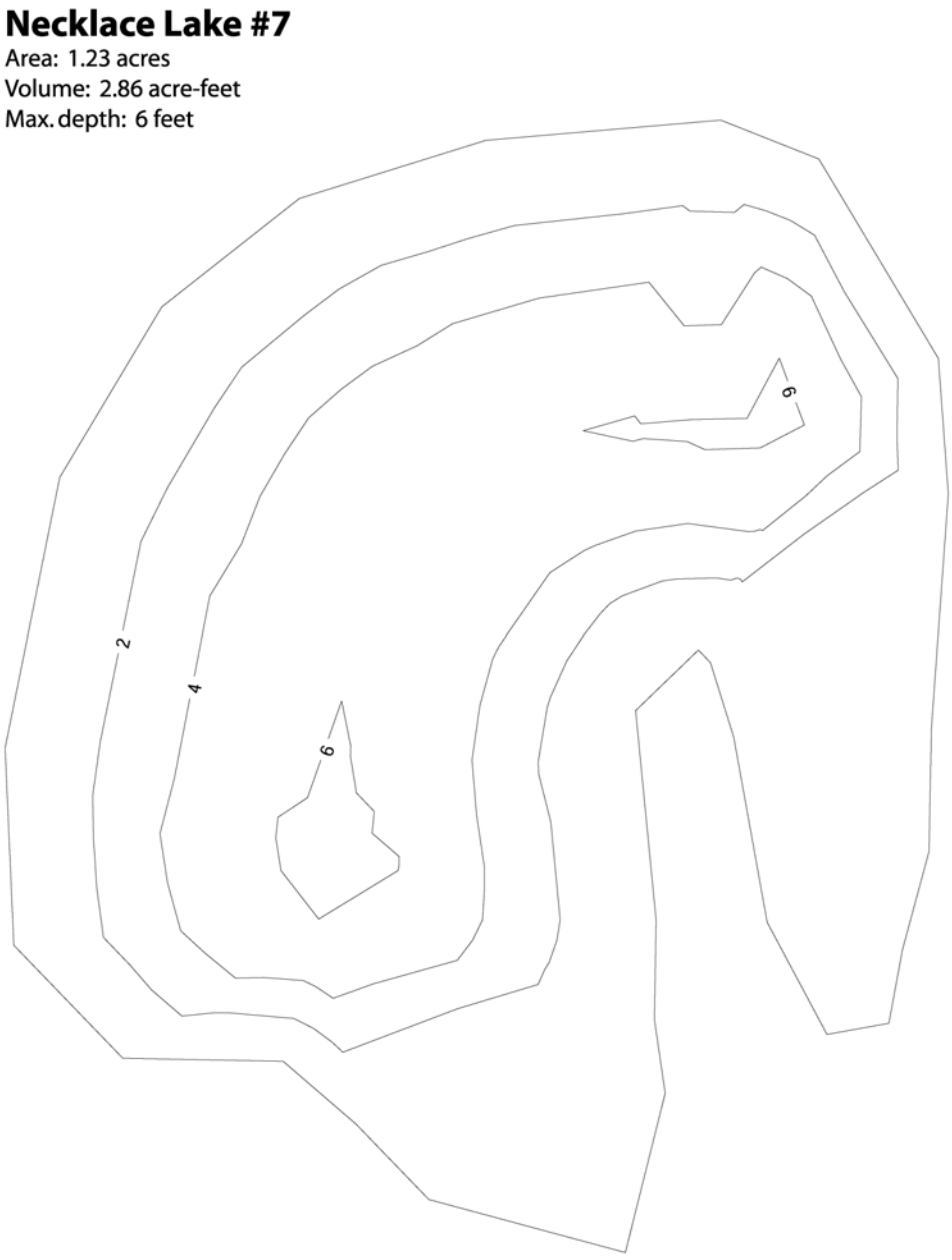


Figure C-19. Bathymetric map of Necklace Lake #7.

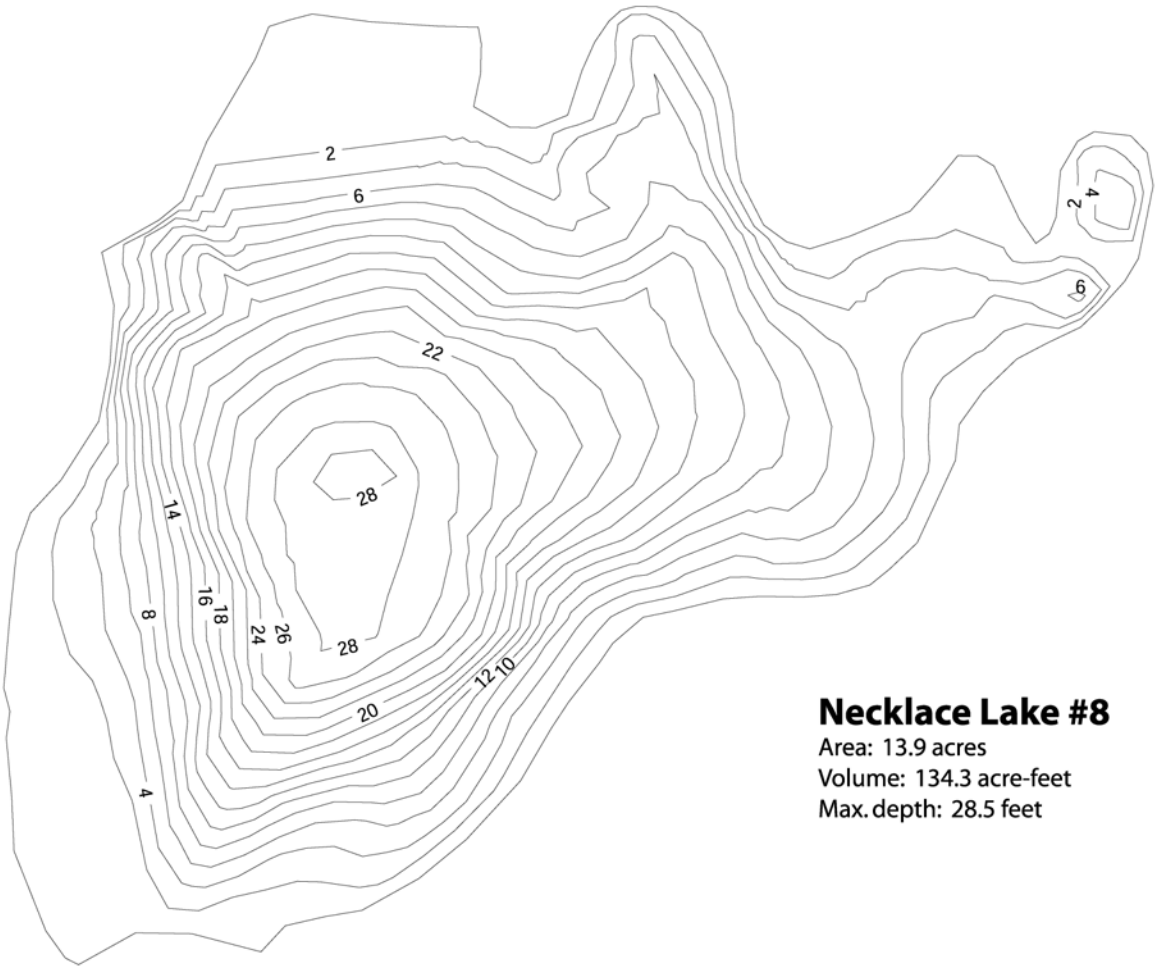


Figure C-20. Bathymetric map of Necklace Lake #8.

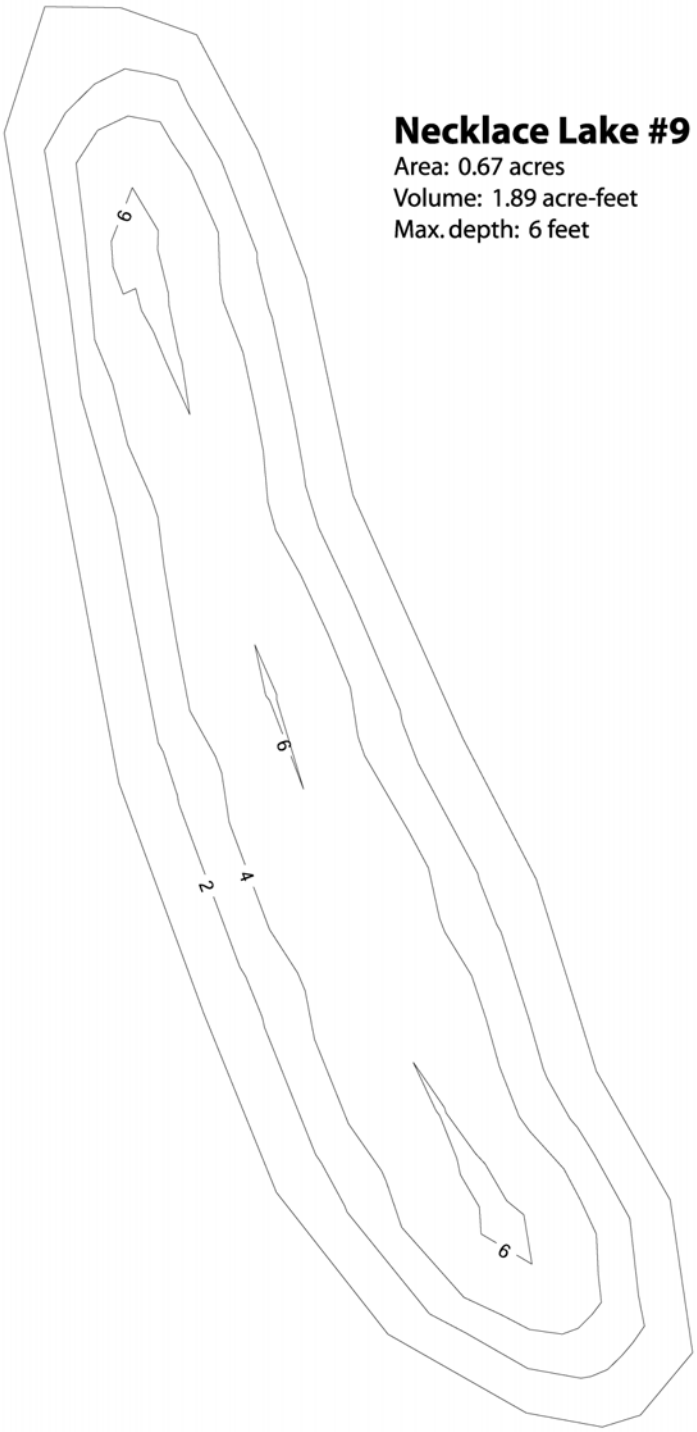
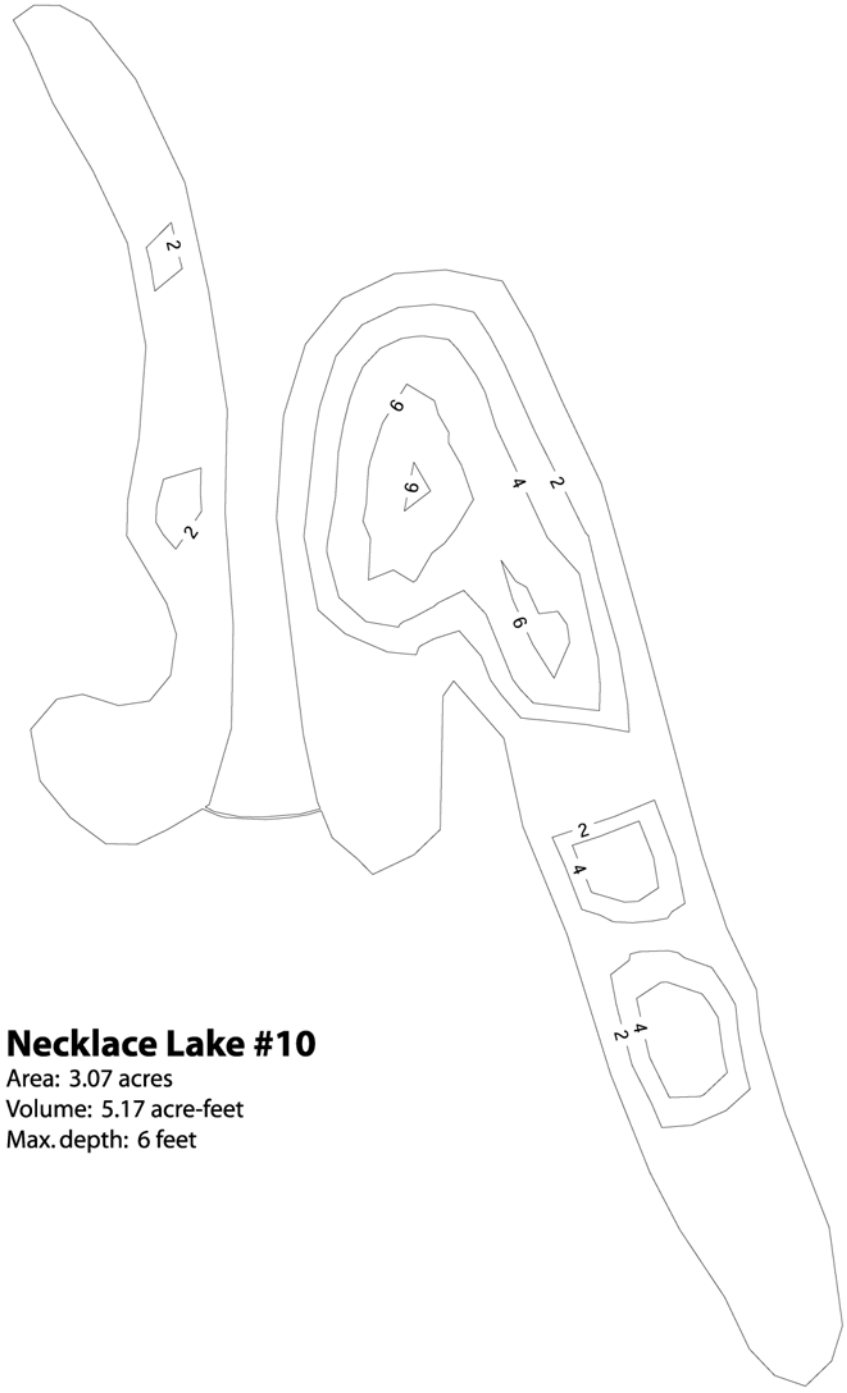


Figure C-21. Bathymetric map of Necklace Lake #9.



Necklace Lake #10
Area: 3.07 acres
Volume: 5.17 acre-feet
Max. depth: 6 feet

Figure C-22. Bathymetric map of Necklace Lake #10.

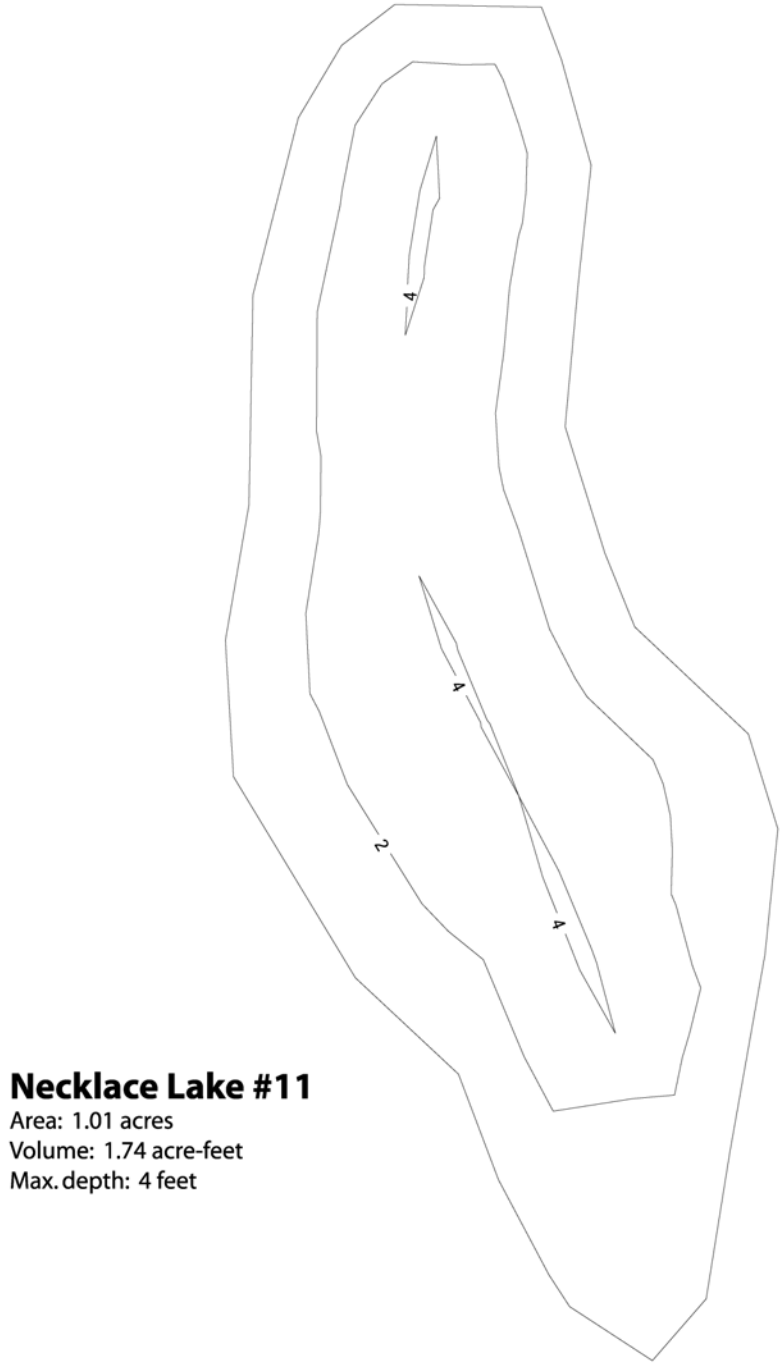


Figure C-23. Bathymetric map of Necklace Lake #11.

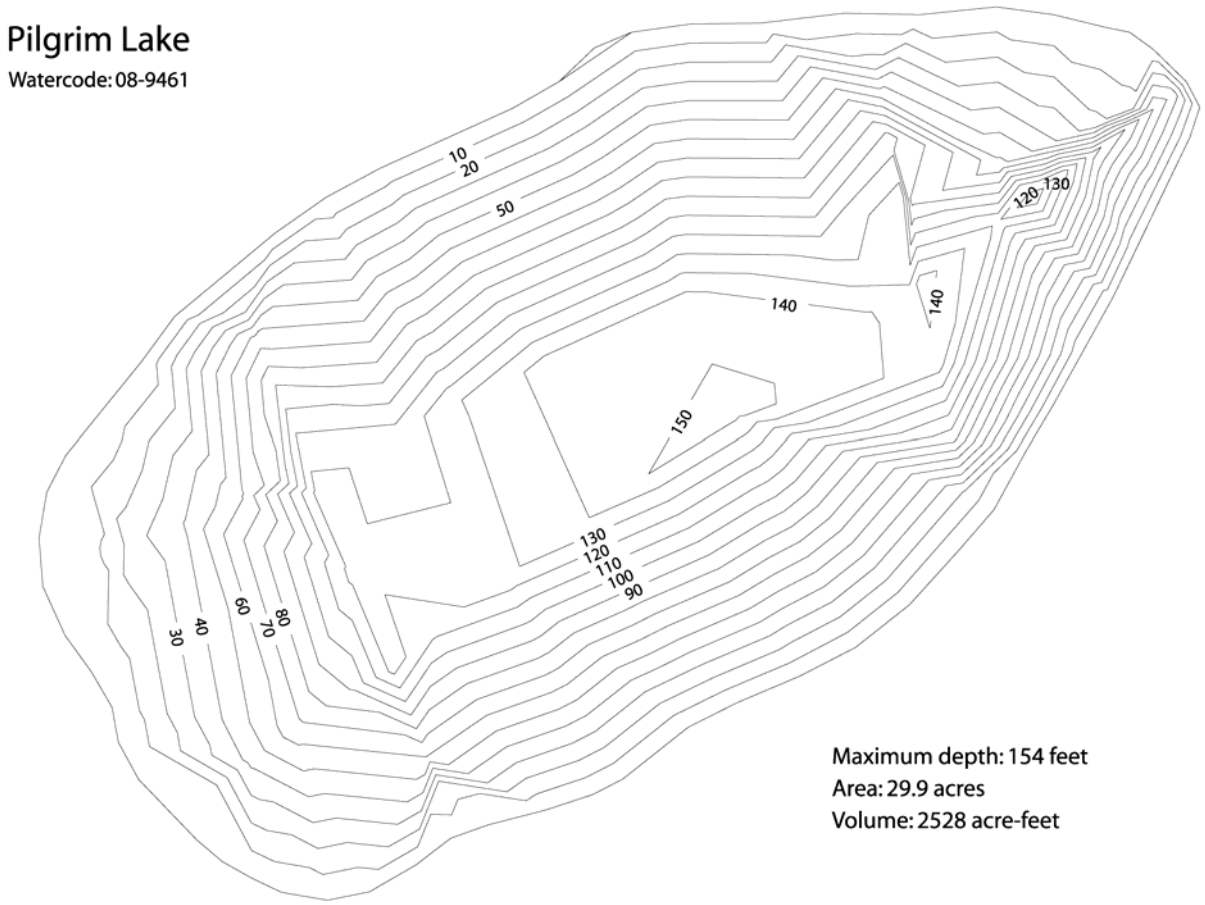


Figure C-24. Bathymetric map of Pilgrim Lake.

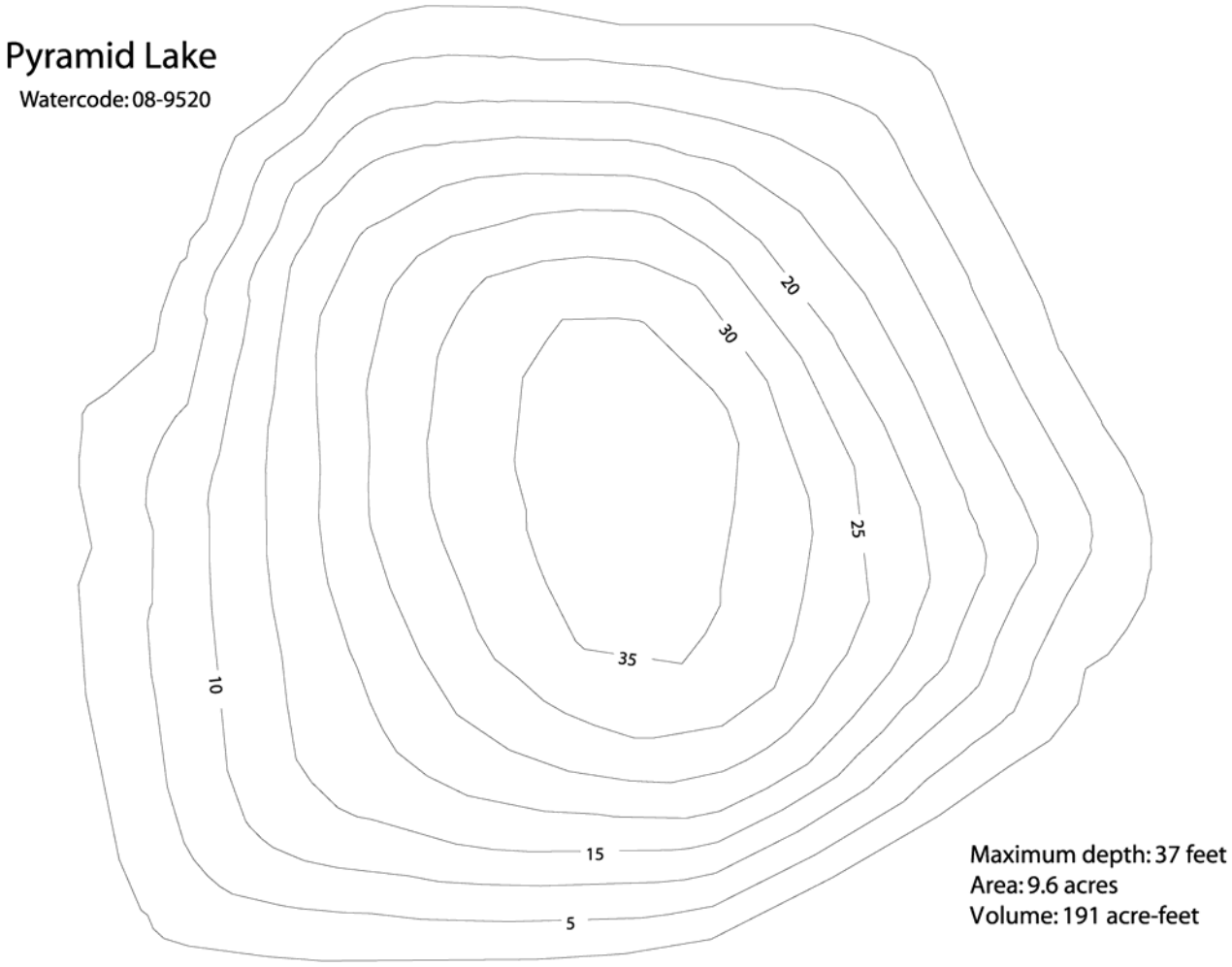


Figure C-25. Bathymetric map of Pyramid Lake.

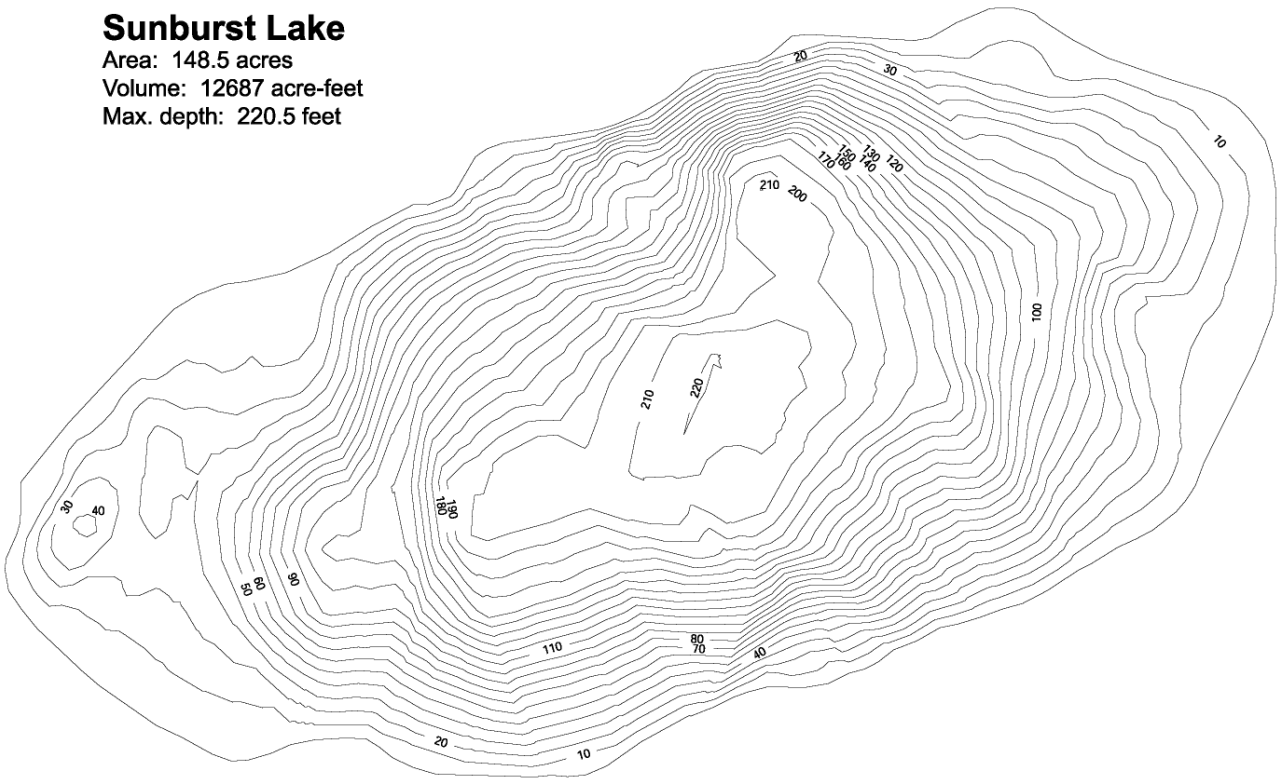


Figure C-26. Bathymetric map of Sunburst Lake.

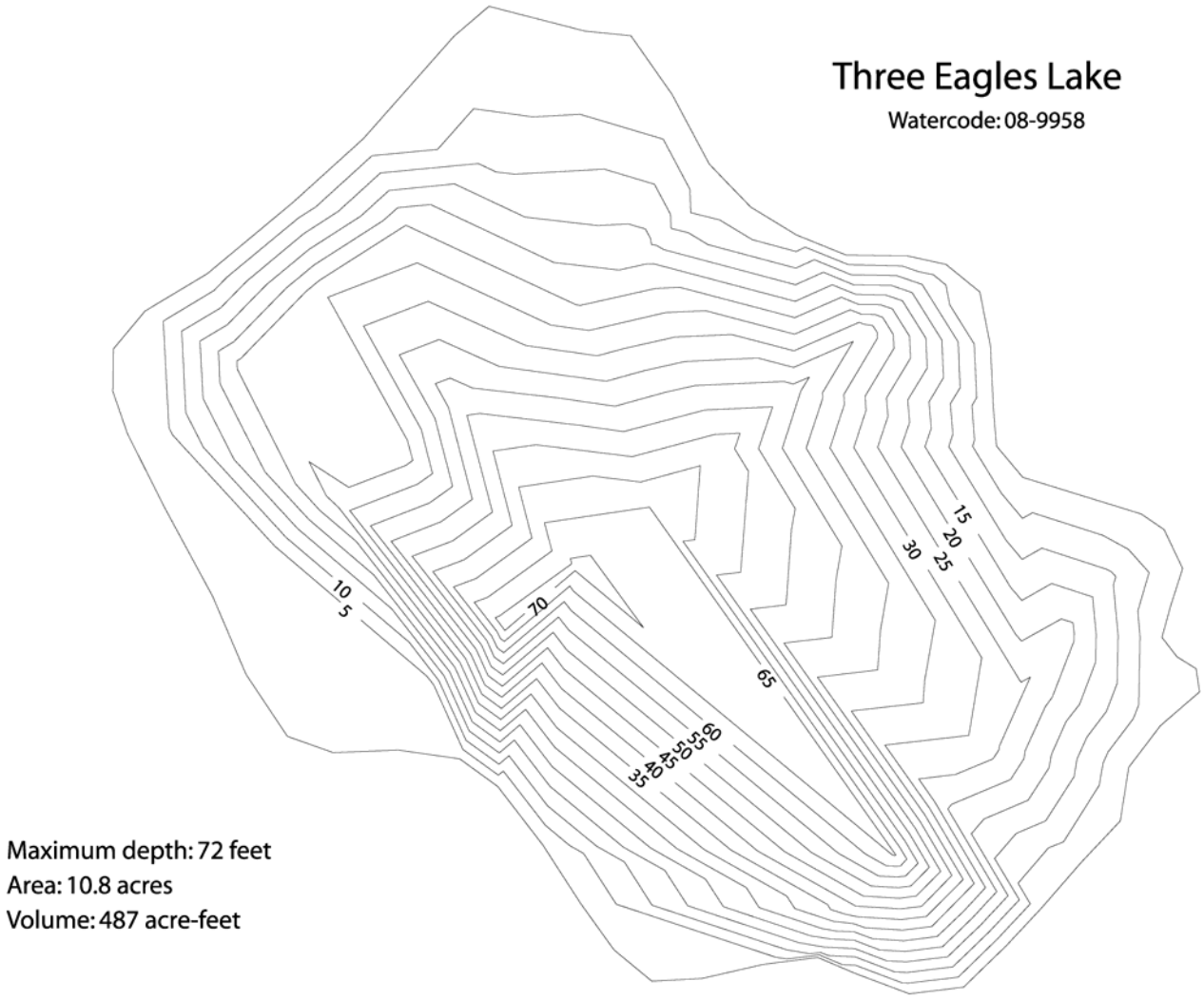


Figure C-27. Bathymetric map for Upper Three Eagles Lake.

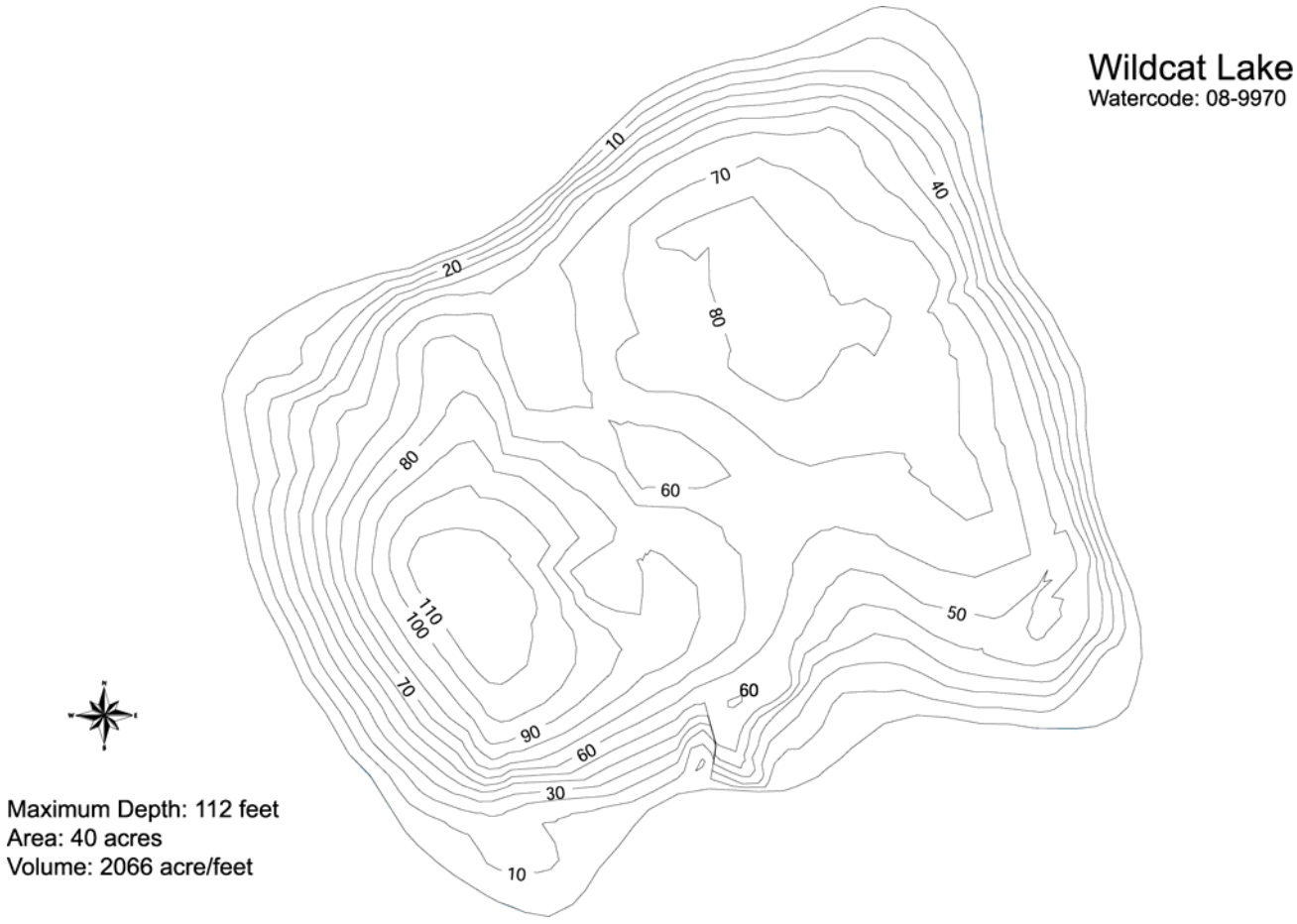


Figure C-28. Bathymetric map for Wildcat Lake.

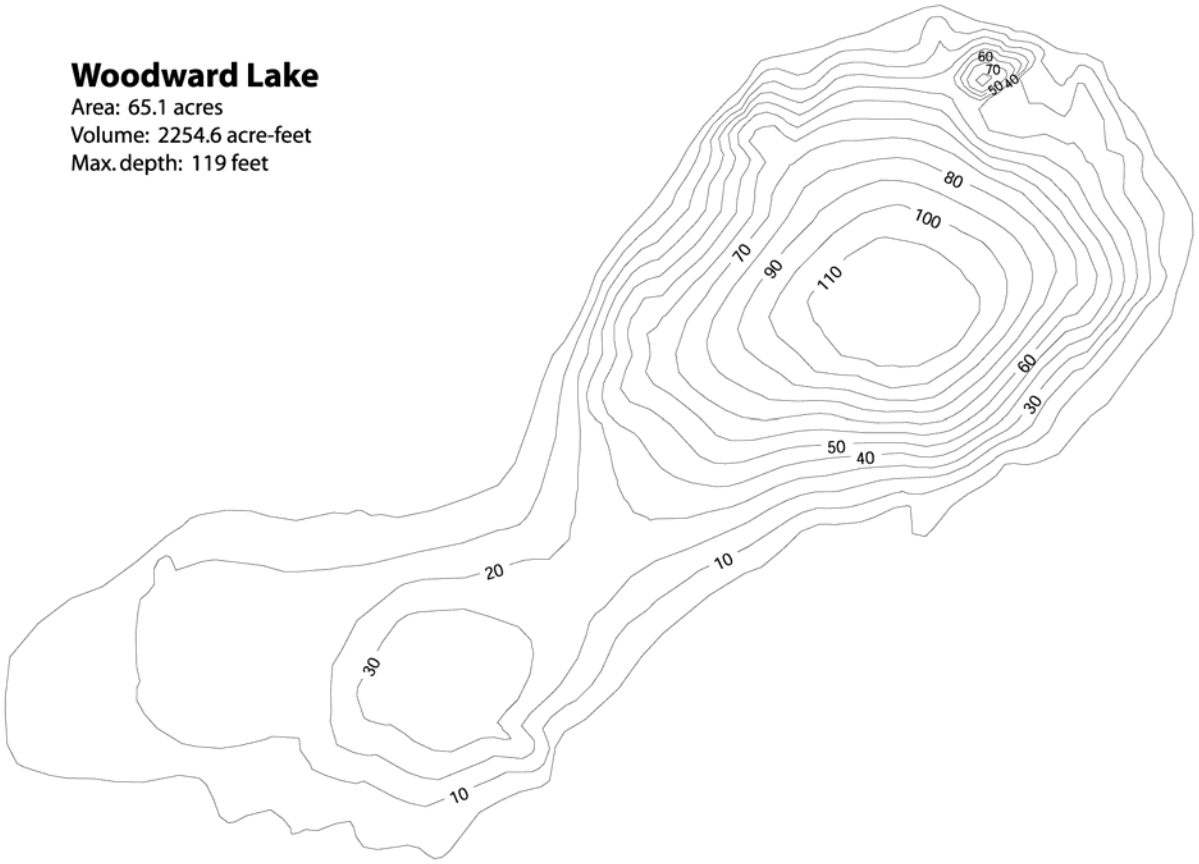


Figure C-29. Bathymetric map for Woodward Lake.

Table C-1. Angler use estimates for select lakes in the South Fork Flathead River drainage from 1989 to 2001, and statewide rank based on 1,529 fisheries in the state.

Lake	*1989*	*1991*	*1993*	*1995*	*1997*	*1999*	*2001*	*Mean*	*State ranking*
Big Hawk	---	99	---	44	38	---	---	60	1173
Black	48	89	199	196	135	38	41	107	912
Blackfoot	1282	75	25	311	34	123	478	332	479
Clayton	164	304	289	116	396	83	368	245	579
George	60	76	---	180	---	---	---	105	923
Handkerchief	1096	327	632	703	573	660	924	702	320
Koessler	---	---	---	---	---	---	---	---	---
Lena	---	---	---	165	---	---	---	165	712
Lick	---	---	---	88	---	---	---	88	983
Margaret	288	56	105	250	108	42	36	127	846
Necklace (4)	---	---	189	---	46	---	---	118	869
Pilgrim	---	---	---	---	---	34	---	34	1404
Pyramid	72	37	25	---	---	83	69	57	1175
Sunburst	103	49	115	175	39	45	149	96	965
Three Eagles (2)	---	---	---	---	---	---	---	---	---
Wildcat	181	74	40	148	39	90	214	112	886
Woodward	60	572	---	34	67	45	---	156	732
Total								**2493**	**157**

Source: Montana statewide angler pressure (MWFP 1989, 1991, 1993, 1995, 1997, 1999, 2001), Bozeman.

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Table C-2. Proposed lake treatments under Alternative B.

Lake	Land Use*	Size (acres)	Antimycin (units)	Antimycin (pounds)	Rotenone (gallons)	Rotenone (pounds)	$KMnO_4$ (pounds)	Transport method	Estimated number of loads for material	Stream miles treated	# of fish to restock	Amphibian status
Black	JBHA	49.1	---	---	1,469	14,396	To be determined after on-site assays	SEAT/heli	2/6	6.09	4,900 x 3	Spotted frog, salamander w/in 0.6 mile
Blackfoot	JBHA	16.5	---	---	68	667	To be determined after on-site assays	helicopter	1	5.76	1,600 x 3	Spotted frog, salamander
Clayton	JBHA	62	---	---	2,316	22,697	To be determined after on-site assays	SEAT/heli	4/4	4.52	5,800 x 3	Spotted frog, salamander
George	BMW	119.5	2,695	10,106	---	---	To be determined after on-site assays	helicopter	12	3.92	11,400 x 3	Spotted frog
Handkerchief	FNF	51.3	159	596	---	---	To be determined after on-site assays	truck	1	1.33	As needed	Spotted frog
Koessler	BMW	86.5	1,146	4,298	---	---	To be determined after on-site assays	livestock	25	0.10	8,500 x 3	Spotted frog, salamander, garter snake
Lena	BMW	74.2	507	1,900	---	---	To be determined after on-site assays	livestock	11	4.25	7,400 x 3	Spotted frog
Lick	BMW	19	28	105	---	---	To be determined after on-site assays	helicopter	1	3.70	1,900 x 3	Spotted frog, garter snake
Lower Big Hawk	JBHA	27.3	---	---	204	1,999	To be determined after on-site assays	helicopter	3	2.97	2,700 x 3	Spotted frog, salamander w/in 1.37 miles
Lower Three Eagles	JBHA	8.7	---	---	85	816	To be determined after on-site assays	helicopter	1	2.23	900 x 3	Spotted frog, salamander w/in 0.83 mile
Margaret	FNF	46.5	---	---	654	6,409	To be determined after on-site assays	SEAT/heli	2/2	3.00	4,700 x 3	N/A

Lake	Land Use*	Size (acres)	Antimycin (units)	Antimycin (pounds)	Rotenone (gallons)	Rotenone (pounds)	$KMnO_4$ (pounds)	Transport method	Estimated number of loads for material	Stream miles treated	# of fish to restock	Amphibian status
Necklace (4)	BMW	42.8	64	240	---	---	To be determined after on-site assays	livestock	2	2.10	1,400 x 3	Spotted frog, salamander
Pilgrim	JBHA	29.9	---	---	842	8,252	To be determined after on-site assays	SEAT/heli	1/4	3.27	3,000 x 3	Salamander w/in 0.69 mile
Pyramid	BMW	8.9	38	143	---	---	To be determined after on-site assays	livestock	1	3.30	1,000 x 3	N/A
Sunburst	BMW	148.5	2,537	9,513	---	---	To be determined after on-site assays	livestock	55	6.10	14,800 x 3	Garter snake
Upper Three Eagles	JBHA	10.8	---	---	162	1,588	To be determined after on-site assays	helicopter	2	0.28	900 x 3	Spotted frog, salamander w/in 0.58 mile
Wildcat	JBHA	40	404	1,515	---	---	To be determined after on-site assays	helicopter	2	0.90	3,900 x 3	N/A
Woodward	BMW	65	451	1,691	---	---	To be determined after on-site assays	livestock	10	2.96	6,500 x 3	Spotted frog

**JBHA= Lakes in the Jewel Basin Hiking Area, which is designated for hiking only (pack animals not permitted); FNF=Flathead National Forest, outside of Wilderness and other special land use areas; BMW=Bob Marshall Wilderness.*